Mom-O-Meter: A self-help pregnancy Android app

A Major Qualifying Project
Submitted to the Faculty
of the

WORCESTER POLYTECHNIC INSTITUTE

In partial fulfillment of the requirements for the
Degree of Bachelor of Science

by

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3/14/2011
Sponsored by:

I. Abstract

The goal of this project was to develop a self-help Android application to aid pregnant women in achieving healthy weight gain during pregnancy. Using Scrum, an agile software development approach, the team gathered requirements, designed, and implemented a smartphone application utilizing the Android and Google Health platforms. This application empowers women to take their health into their own hands, and has the potential of reducing short-term and long-term health risks associated with gestational weight gain for both mother and child. This application is an example of continued advancement of mobile technologies in healthcare, which drives the shift from a reactionary to preventative treatment paradigm.

II. Executive Summary

Healthcare has been, and continues to be one of the most pressing concerns facing the United States and the rest of the world in the 21st century. Healthcare providers and experts in the field have been looking for ways to provide quality healthcare at affordable rates. One such way has been through the use of technology, which has been rapidly evolving over the past years. Mobile technologies, in particular, have been gaining traction in recent years and making their way into a great number of industries, revolutionizing the way business is done in these industries. The use of mobile technologies in the healthcare field, also known as Mobile Healthcare, is relatively new and unexplored. Hence our goal with this project was to design and develop a smartphone application to empower patients with the ability to self-manage their health.

Based on academic literature on gestational weigh gain (GWG), our team focused on developing an application that would allow pregnant women to keep track of and optimize their weight gain during pregnancy, which is a factor that can significantly affect the immediate and long-term health of both the mother and child. There is currently no Android application in the marketplace that serves as a tool for pregnant women to optimize their GWG. Drs. Rosal and Moore developed a set of guidelines regarding GWG. Depending on a patient's body mass index (BMI), that patient must gain a certain amount of weight, also known as the GWG trajectory, each week throughout their pregnancy. Using this research we set forth to build an Android application that would allow pregnant women to keep track of their GWG and some other factors that might affect their GWG.

In our efforts to design and implement the Android application we adopted the Scrum Agile methodology due to the short time frame of the project, and we modified it to suit our project need. This approach provided us with the flexibility to adapt to potential problems or changes in the

requirements of the project and to separate the project into smaller tasks in order to optimize the development process. We maintained a product backlog with the application's requirements and functionalities and divided the development process into 6 two-week sprints. We came up with a fully-functionally application at the end of the 6th sprint.

Over the course of the project we met with our sponsors, Drs. Rosal and Moore to determine the required functionality of the application since they were currently performing these pregnancy interventions to optimize GWG via a paper book solution. Additionally we organized focus groups and interview sessions to allow the participants to try out our application and provide us with feedback regarding the usability, intuitiveness, user-friendliness, and additional functionality they would like to see in the application.

After gathering the requirements for the project, we designed the application using a modular approach by splitting up the system into a number of smaller components. This allowed us to divide up the different components of the application among the various developers in order to optimize the development process. We documented the system architecture and the implementation process so that any other group would be able to pick up our project and recreate it or expand upon our final product without having to spend too much time looking through our source code and trying to understand it.

The final product we developed, which we named Mom-O-Meter, consisted of the following features: motivational notifications to remind the users to record their wellness data, a feedback engine to review this wellness data and compare it to a set of rules or guidelines to provide feedback to the user as to how well she is doing, a library component with general information about nutrition and gestational weight gain, and a user-friendly and intuitive user interface to allow the users to experience a seamless interaction with the application.

Towards the end of the project we conducted a final usability test using interviews to validate the design of our application in order to make sure that the user experience is as smooth as it can be. From the focus groups and interview sessions that we conducted we learned that most participants were very receptive to the idea of managing their GWG through our smartphone application and most of the feedback was positive. There were also a number of requests for enhanced functionality and adding new features to the application. This tells us that the women would be willing to use our application and that they would like to see it evolve into a full-fledged pregnancy application that they can carry around as their "my pregnancy" book.

The application will act as an intervention mechanism that will help guide the patient to gain the right amount of weight throughout her pregnancy through tracking tools, feedback and suggestions. Therefore patients will be able to take matters into their own hands, which could reduce the number of visits to their physicians, thus saving the patients time and money and reducing the strain on the hospitals' and clinics' resources. This said, our application is the first Android application that helps pregnant women to optimize their gestational weight gain and it represents a small step towards the advancement of mobile healthcare. Our recommendations include further extending the application and converting it into a more comprehensive pregnancy tool and conducting long-term testing to evaluate the effectiveness of the application. There is yet much to accomplish and we hope that future groups will be able to pick up where we left off.

III. Acknowledgements

IV. Authorship and Contributions

This project represents the works of all the project team members. The team worked together on the Abstract, Planning, Design, Implementation, Conclusion, Focus Groups, and Interviews.

The following are the tasks that each team member worked on individually:

Evan Duderewicz was part of the research team and wrote on most of the background chapter, as well as the content information for the application. Evan and Thomas designed the focus group and interview protocols. Evan also evaluated and wrote up the analysis of the focus groups.

Brendan Harris was part of the research team and development team. Brendan wrote part of the background and results chapters, as well as the user manual, and worked on the application's user interface design.

Thomas Jenkins was part of the research team and wrote part of the background chapter, methodology chapter, and results chapter. Thomas also led the focus group discussions and interviews to gather qualitative feedback on the usability of the application.

Ken Miyauchi was part of the development team and worked on most of the user interface aspects of the application to make sure that the application's look and feel is well-designed.

Michael Ng was part of the development team. He designed the system architecture and coded all of the application's back-end components. Michael also wrote the executive summary, introduction, system architecture chapters, and much of the methodology chapter.

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1. Introduction

Healthcare is one of the most pressing concerns facing the United States and the rest of the world in the 21st century. As healthcare costs soar ever higher (Dick, et al, 1997), industry professionals have been looking for ways to keep these costs at bay. One such method has been the use of technology. Technology has been a core player in helping improve healthcare, by reducing costs, improving patient safety and satisfaction, saving time and effort for both patients and clinics alike, and reducing potential errors (Leyva, 2009). This shift in paradigm is, in part, due to the fact that technology can help automate a lot of manual processes and procedures involved in healthcare practices. In recent years, mobile technology, in particular, has greatly evolved and become a mature platform, and according to CBS News (2010), there are around 4.6 billion mobile phones worldwide. Because of this, many health organizations such as the World Health Organization and experts from across the healthcare industry are looking to tap into the potential of mobile technology to revolutionize healthcare management and delivery (Carucci, 2009).

It is in this regard, that we look to employ mobile technology to help pregnant women more effectively manage and keep track of their weight gain during their pregnancy. Weight gain during prenatal stages, also known as Gestational Weight Gain (GWG), is a factor that can significantly affect the immediate and long-term health of both the mother and child (Moore, Rosal, et al, 2010). Studies have shown that women should gain a recommended amount of weight, determined by their body mass index (BMI) during prenatal stages. However, many women in their prenatal stages still gain weight outside of specific recommended ranges. According to Stotland et al (2005), 24.1% of overweight women gain weight above the Institute of Medicine (IOM) recommended guidelines, compared to 4.3% of normal weight women, and 51.2% of underweight women gain weight below the recommended guidelines, compared to 10.4% of normal weight women.

Endeavors to control GWG thus far have been resource- and time-intensive for both physicians and pregnant women. These women have to visit their physicians regularly for a checkup, as most of them do not keep track of their GWG on their own, and their physicians might not be able to give them immediate feedback; sometimes it can take up to a week or two for women to get feedback on their GWG.

According to Moore et al (2010), no publication to date has utilized mobile technology to assist in the optimization and management of GWG. However, there have been developments in web-based interventions for general weight management. These web-based solutions help adults to effectively manage their weight and weight loss. Likewise, many weight loss and weigh control applications have been developed for the various smartphone platforms (see section 2.5). Yet none of these solutions, as of this publication, specifically address the optimization of weight gain/loss during prenatal stages (Moore et al, 2010). A large percentage of women of child-bearing age are internet-connected, either through their computers and/or handheld devices, and welcome the idea of utilizing tools such as the Internet for optimizing GWG. People carry their smartphones wherever they go, which allows them to be connected to the Internet at all times.

Hence the goal of our project is to design and develop a smartphone application that will help pregnant women during their prenatal stages to optimize their Gestational Weight Gain in order to promote improved health for both mother and child. More specifically, this application will help women keep track of their weight gain/loss, their level of physical activity, and their nutrition, all of which are factors that might influence their GWG. The application will also provide them with feedback on whether they are gaining/losing too much weight so that they can adjust their diet, physical activity, etc. to get back on track. In addition, the application will be storing this information in an online repository,

Google Health, so that the users will always have this information readily available to them for personal use or to share with their physicians.

These features can significantly simplify the efforts of pregnant women to optimize their GWG as they will empower the users with the ability to better manage their own health. Healthcare providers would be able to drastically reduce their costs and hospitals and clinics would be able to better allocate their time and other resources because part of the healthcare process would be delegated to the patient's self-care through the use of mobile technology.

As mobile technology, specifically smartphones, becomes more widespread, we believe that many of our daily activities will be performed through interactions with our smartphones. This is also true of self-care. Many healthcare providers will jump onto the mobile bandwagon to realize the potential savings and efficiencies by having users take matters into their own hands, through the use of their smartphones. As we move forward into the next decade, mobile technology will play an essential role in revolutionizing the healthcare industry.

The next chapter will provide background information on various topics of importance to our project. Chapter three will explain how we approached both the research and software development aspects of the project by flushing out the details about the methodologies we employed. Chapter four will go over the details of the system architecture and the implementation of the application. Chapter five will present our findings and results regarding how the system can help women optimize their GWG, and explain in detail the features and functionalities of the software system we developed. Finally, Chapter six will provide our conclusions and recommendations.

2. Literature Review

2.1.1 Mobile Technologies in Healthcare

Mobile devices have become ubiquitous in today's society. Projections in 2002 speculated that more people were expected to access the internet from a mobile device more than from traditional desktop computers (Beaulieu, 2002). According to more recent studies in 2009, 32% of the American population has used a cell phone for communication or information gathering with 19% of Americans are using mobile devices to access the internet every day (Horrigan, 2009). Another study done between April 2009 and May 2010 has shown that 54% of American adults have sent someone a photo or video from a cell phone (Hemmenginger, 2010). The progression of technology has facilitated this increased use of mobile devices. Many improvements, namely faster processors and better battery life, have enabled notebooks and smartphones to become powerful devices, giving us the ability to completely change the way we work. The evolution of the smartphone, especially, has changed the face of business. It is now possible with our data infrastructure, and powerful mobile devices, for many people to do most of their work outside the office (Livingston, 2004). With the emergence of the smartphones of today, namely Apple iPhone, Android, and Blackberry products, people can work almost anywhere. Operating systems on many of these smartphones have the ability to run many business applications, such as the ever popular Microsoft Office. The explosion of software that has been developed, especially on the major smartphone platforms, covers a variety of categories. Figure 2-1, Figure 2-2, and Figure 2-3 illustrate the distribution of applications available by category on the main three platforms. Health applications account for a relatively small percentage of the overall applications available. They also fall under overlapping categories. For example, there are "Healthcare & Fitness" and "Medical" categories under the Apple App Store. This is because of the wide variety of uses for mobile devices in these particular areas. As a result, there is a lot of room for development in this sector of mobile software.

There is also potential for applications that are extremely full featured and can transcend individual categories.
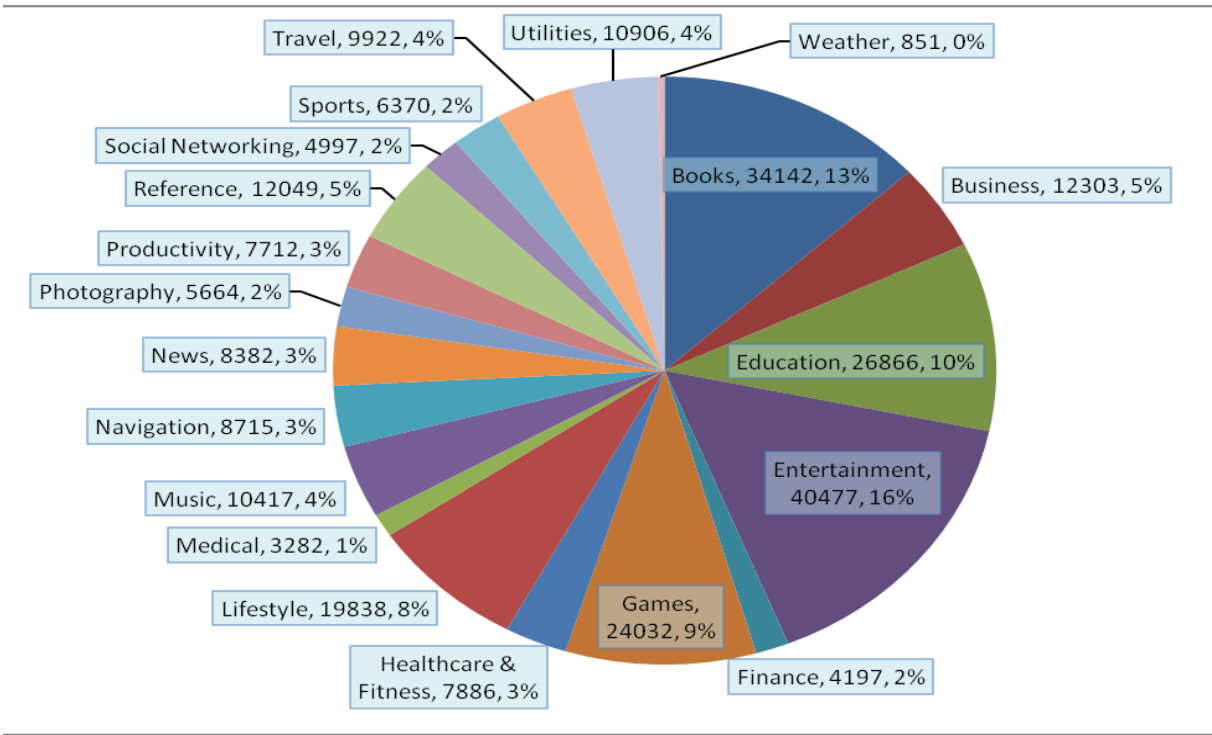
Figure 2-1: Distribution of Available Applications on the Apple AppStore for iOS by Category Source: (uquery AppStore Search Engine, Oct. 2010)
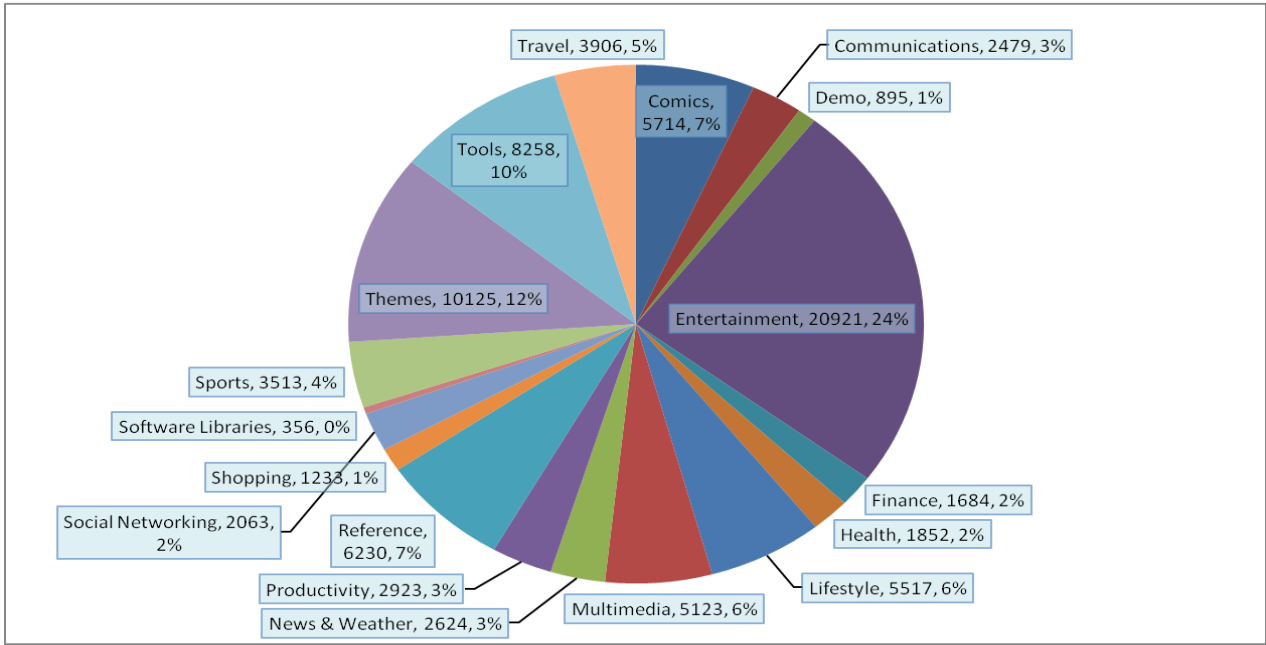
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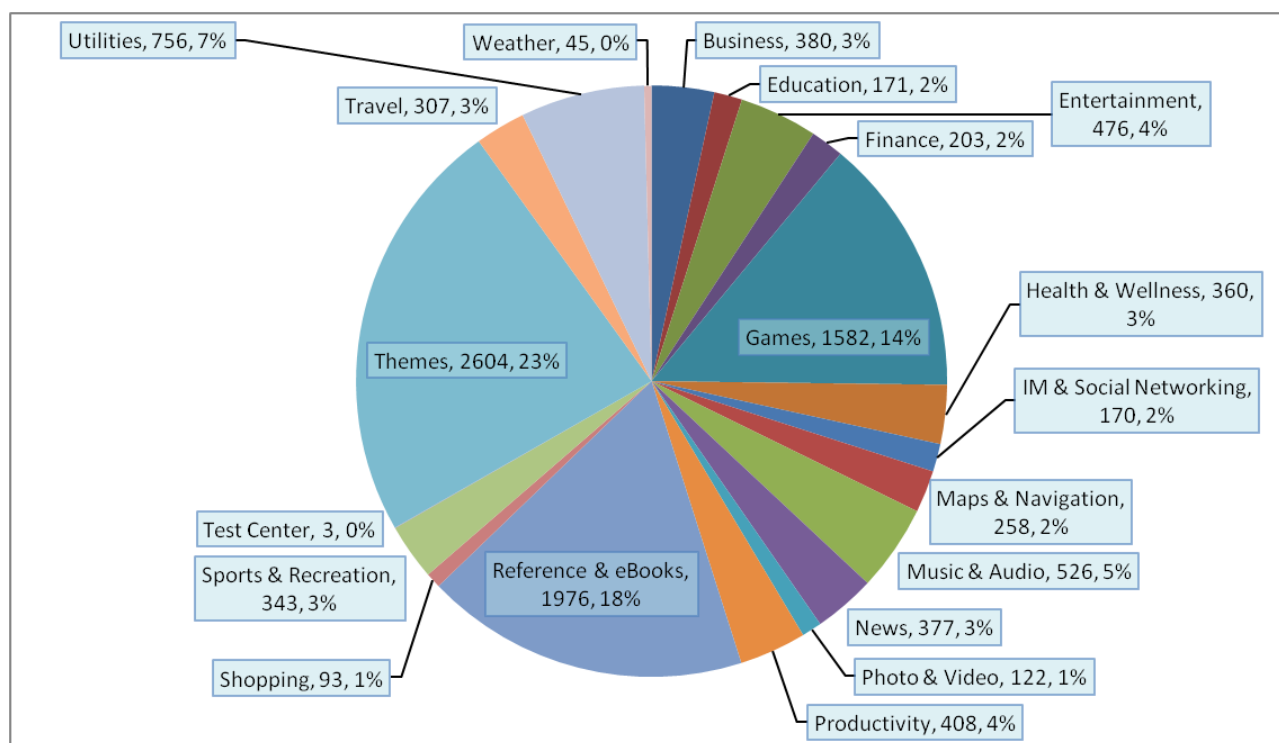
Figure 2-3: Distribution of Available Applications on the BlackBerry App World for BlackBerry by Category (BlackBerry AppWorld Search, Oct. 2010)

This surge of applications entering the market is mostly because of the ease of smartphone application development. All of the popular smartphone platforms have software development kits (SDK) available, which allows anyone with a computer and programming knowledge to develop and publish applications on the respective software market, for little money. These applications are available for free, for sale, or via subscription service (Hemmenginger, 2010). While the vast majority of applications currently available are for entertainment, there have been great advancements in business applications. Web browsing and email are now standard on smartphones, with the feature set expanding out to geo-location, video, and now even augmented reality (Hemmenginger, 2010). The medical sector has been heavily influenced by new mobile technology, from treatment to education. There are various types of medical applications available, ranging from drug information to exercise ("Selected list of," 2009). These applications target a variety of user groups from professionals to laymen and provide various levels of functionality and content.

The pharmaceutical sector has especially taken advantage of this new technology, releasing many corporate branded applications (Byrne, 2010). Table 2-1 represents various examples of applications developed by major pharmaceutical companies for the iPhone. This again shows the wide variety of uses for mobile technology in health related areas. These applications range from self-help tools to tools for medical professionals. While many of these applications are branded or linked to a particular product, they show the wide range of uses for mobile software for a variety of audiences.

Table 2-1: Examples of iPhone Applications by Major Pharmaceutical Companies (Byrne, 2010)

Name of App	Date Launched	Sponsor/Creator	Primary Category
CareConnector	12/28/2008	Johnson & Johnson Consumer Products Company	Healthcare & Fitness
Sleep Tracker Tylenol PM	5/30/2009	Tylenol (McNeill/ Johnson & Johnson)	Healthcare & Fitness
Dr. Mobile	6/5/2009	Wyeth Pharmaceuticals France	Medical
Blackbag Medical Resources	6/5/2009	Ortho-McNeil-Janssen-Pharmaceuticals, Inc.	Medical
Pneumonia Management Tool	6/22/2009	Ortho-McNeil-Janssen-Pharmaceuticals, Inc.	Medical
iChemoDiary	10/14/2009	Merck & Co., Inc.	Medical
GoMeals	11/4/2009	Sanofi-Aventis U.S. LLC	Healthcare & Fitness
Biotherapie	11/28/2009	Wyeth, une societe du groupe Pfizer	Medical
Eye Health	12/1/2009	Bausch & Lomb Inc.	Healthcare & Fitness
iManage Migraine	12/18/2009	Merck & Co., Inc.	Medical
INTUNIV (Guanfacine) Dosing Calculator	12/21/2009	Shire US Inc.	Medical

One of the best examples of a recent innovation for mobile medical technologies is the WebMD Health application. This cross platform smartphone application is geared toward physicians providing information on the go (Hardy, 2009). The application, called Medscape Mobile, provides information on medications, tools, medical news, and other educational information. The application relies on WebMD Health Network consisting of WebMD health, MedicineNet, eMedicine, Medscape, and other health resources (Hardy, 2009). The application allows doctors to reference vital information whenever they need it, providing a higher level of treatment.

Mobile technologies have also allowed for better education in medical schools. The training of physicians is an extremely important task. So much so, that many medical schools are utilizing new mobile technologies to facilitate a better educational experience. The major issue facing schools is the tracking of the performance of the students. These new innovations have also provided better communication between faculty and students as well as schedule and course management. Because many mobile applications, particularly smartphone applications, are cost effective, many institutions are taking advantage of them (Keane, & Rege, 2009). This not only allows for better management of the students from an administration standpoint, but also prepares students for the ever evolving medical field so they can become better physicians.

Another advantage of mobile medical technologies can be seen in the ease of deployment and how well they facilitate treatment, especially in developing countries. The Rockefeller Foundation has invested $100 million into an infrastructure for health systems in Africa and Asia (Fortner, 2009). The goal is to utilize smartphone applications on this new infrastructure to improve the efficiency, increase the overall access, and ultimately increase the quality of care. One of the major advantages to phone based applications is the versatility. Phones are able to be taken into environments not well suited for even laptops. A lot of developing countries have some form of cellular network, therefore allowing much easier deployment for such systems (Fortner, 2009). This allows physicians to continue to stay up to date with the latest information pertaining to their specialty wherever they may be.

Mobile technologies have allowed a drastic increase in the ability for doctors to provide the best care to their patients at a relatively low cost. The next step for mobile, specifically smartphone, systems is to empower patients. By keeping the patient at the center of the treatment of a disease, we can begin to shift to a preventative medical system, instead of the reactionary system we have today. The demand

is there, even for personal health records. According to a study the California HealthCare Foundation conducted in 2010, participants said they have taken additional steps to improving their health and becoming more knowledgeable because they had online access to their health records (California HealthCare Foundation, 2010). In addition, 40% of those surveyed that did not have personal health records stated they would like to use them. It is a seemingly logical response that if there is easier access to the information, the more people will use it, but speaks volumes to the value behind improving personal health. These new technologies have the potential to transform the way the world does healthcare, while also being extremely available, even to developing countries.

2.2.   Pregnancy

In humans, pregnancy lasts 40 weeks and, between conception and childbirth there are three phases, or trimesters, of pregnancy (Mayo Clinic, 2010). As the baby develops, see Figure 2-4, and the expecting mother moves from one trimester to the next there are numerous physical changes and behavioral recommendations.

The first trimester covers the time from conception through the twelfth week and has a number of special considerations and changes. This is the period of time during much of the initial development of the fetus occurs. During this time the baby will start to develop many parts of its anatomy including the skin, circulatory system, bladder, head, toes, neck, fingernails, and genitals (Mayo clinic, 2010). This is also the part of the pregnancy when the mother goes through the most hormonal changes, which can lead to a number of unpleasant symptoms including morning sickness or nausea, swollen breasts, food aversions or cravings, fatigue, headaches, constipation, mood swings, and dizziness (Mayo clinic, 2010).

The second trimester covers week 13 through week 28. During this time the baby starts to take a more definite form. Over the course of this trimester the baby develops many more parts of its core

anatomy, including bones and fat. As a result of this growth, the baby develops more definite human characteristics such as hair, fingernails, and fingerprints. In addition to these developments, the gender of the baby can be determined, usually around the 14th week of pregnancy, and by the 18th week the baby is capable of forming facial expressions and hearing (Mayo clinic, 2010).

The third trimester lasts from week 28 until the child is born. This last stage of pregnancy is when many intense changes occur. The fetus continues to develop physically, and during this trimester the baby will develop eyelids and eyelashes, and finish developing bones and sexual organs. In addition to these developments the baby will prepare for life after birth by practicing breathing, kicking, grasping, and even constricting the pupils in its eyes to react to changes in light. After these final developments occur, the baby will begin to rapidly gain weight and change its orientation for delivery (Mayo clinic, 2010).

Figure 2-4: Fetal Growth: Health Mango, 2010, Second Trimester of Pregnancy (Health Mango, 2010)

2.2.1 Nutrition

The key to a healthy pregnancy is proper nutrition. By eating healthy and maintaining an active lifestyle a number of complications, varying in intensity from anemia to miscarriage and stillbirth, can be avoided (American College of Obstetricians and Gynecologists, 2010, p. 241). While there are certain general dietary guidelines for the entire pregnancy, each trimester has certain dietary recommendations

to help the baby develop properly. The mypyramid.gov site provides recommended dietary plans based on a woman's height, pre-pregnancy weight and exercise habits. These factors helps create a plan to provide enough nutrition for a healthy pregnancy without resulting in excessive weight gain. Your Pregnancy and Childbirth points out that while a pregnant woman is technically eating for two, she should not be eating twice as much food (American College of Obstetricians and Gynecologists, 2010, p. 241). A pregnant woman who had a normal pre-pregnancy BMI only needs an additional 300 calories per day during pregnancy (American College of Obstetricians and Gynecologists, 2010, p. 241). Ultimately, a healthcare provider should provide the necessary amount of each food group, mypyramid.gov only provides recommendations. Table 2-2 provides sample recommendations for a healthy woman of average size.

Table 2-2: Sample Recommended Pregnancy Diet (MyPyramid.gov, 2010)

Food Groups	1st Trimester	2nd Trimester	3rd Trimester
Grains1	7 ounces	8 ounces	9 ounces
Vegetables2	3 cups	3 cups	3 ½ ounces
Fruits	2 cups	2 cups	2 cups
Milk	3 cups	3 cups	3 cups
Meat and Beans	6 ounces	6 ½ ounces	6 ½ ounces
1 Make Half Your Grains Whole			
Aim for at least this amount of whole grains per day	3 ounces	3 ½ ounces	4 ounces
2 Vary Your Veggies			
	Aim for this much weekly.		
Dark Green Vegetables	3 cups	3 cups	3 cups
Orange Vegetables	2 cups	2 cups	2 cups
Dry Beans & Peas	3 cups	3 cups	3 cups
Starchy Vegetables	3 cups	6 cups	6 cups
Other Vegetables	6½ cups	7 cups	7 cups
Oils and Discretionary Calories			
Aim for this amount of oils per day.	6 teaspoons	6 teaspoons	7 teaspoons
Limit your extras (extra fats & sugars) to this amount per day.	265 calories	290 calories	360 calories

In addition to eating healthy, one proven beneficial decision is taking supplements which contain 400-800 micrograms of folic acid during pregnancy, which has been shown to reduce birth defects (Office on Women's Health, 2010). By following dietary recommendations and taking supplements, the child is ensured the vital nutrients necessary to develop. Table 2-3 details the recommended levels of nutrients and what foods provide them.

Table 2-3: Key Nutrients for You and Your Baby During Pregnancy (American College of Obstetricians and Gynecologists, 2010)

Nutrient (Dietary Reference Intake [DRI]	Why You and Your Baby Need It	Best Sources
Calcium (1,000 milligrams)	Helps build strong bones and teeth.	Milk, cheese, yogurt, sardines
Iron (27 milligrams)	Helps red blood cells deliver oxygen to your baby.	Lean red meat, dried beans and peas, iron-fortified cereals, prune juice
Vitamin A (770 micrograms)	Forms healthy skin and helps eyesight. Helps with bone growth.	Carrots; dark, leafy greens; sweet potatoes
Vitamin C (85 milligrams)	Promotes healthy gums, teeth, and bones. Helps your body absorb iron.	Citrus fruit, broccoli, tomatoes, strawberries
Vitamin D (200 international units; some experts recommend 400 international units during pregnancy)	Helps build your baby's bones and teeth.	Sunlight exposure; vitamin D fortified milk; fatty fish such as salmon
Vitamin B6 (1.9 milligrams)	Helps form red blood cells. Helps body use protein, fat, and carbohydrates.	Beef, liver, pork, ham; whole-grain cereals; bananas
Vitamin B12 (2.6 micrograms)	Maintains nervous system. Needed to form red blood cells.	Liver, meat, fish, poultry, milk (found only in animal foods—vegetarians who do not eat any animal foods should take a supplement)

In addition to eating a healthy diet maintaining proper nutrient level, it is important to avoid exposing the developing baby to certain chemicals, such as alcohol and tobacco. Use of tobacco products exposes the child to carcinogens, and leads to increased risk of stillbirth or premature birth

(NIH, 2010). Consuming alcohol regularly or excessively is also advised against, and can lead to various complications, most notably fetal alcohol syndrome (NIH, 2010). Illicit drug use can also lead to birth defects, including underweight deliveries and withdrawal symptoms after delivery (NIH, 2010). By avoiding exposure to these chemicals women can lower the risk of birth defects.

2.2.2 Physical Activity

The American College of Obstetricians and Gynecologists in <u>Your Pregnancy and Childbirth</u> (American College of Obstetricians and Gynecologists, 2010, p. 25) state general activity and time specifically spent exercising are shown to have several benefits. These benefits include being healthier, reduction of physical and mental stress and an overall boost in energy levels. Regular activity and exercise during pregnancy can also result in (American College of Obstetricians and Gynecologists, 2010, p. 25):

- Reduction in backaches, constipation, bloating, and swelling

- Boost in mood

- Promotion of muscle tone, strength, and endurance

- Help in sleeping better

The American College of Obstetricians and Gynecologists recommends 30 minutes of moderate exercise every day. They define moderate exercise as exercise that gets the heart rate increased but does not prevent the woman exercising from talking at a normal level. The American College of Obstetricians and Gynecologists note that the actual act of physical activity and exercise do not need to be done at one time during the day. For example, three separate walks for 10 minutes each at a brisk pace during the same day would offer equal benefits as one 30-minute walk a brisk pace. It is recommended that women who have not been exercising regularly prior to pregnancy begin with as

little as 5 minutes per day and add 5 minutes/day weekly or as they feel comfortable until they reach 30 minutes per day. Recommended exercises for pregnant women beginning an exercise program are walking, swimming, cycling, aerobics. Most other exercises, except contact sports, are appropriate for pregnant women, such as running, racquet sports and strength training. However, they are not recommended for first time exercisers.

2.3.   Gestational Weight Gain

Pregnancy, or gestation, in humans is a well-studied research topic in the medical community of the process which has led to many guidelines to follow for a healthy pregnancy. Findings of the research produced guidelines to achieve a healthy pregnancy. One of the areas in which the medical community agrees upon certain guidelines is gestational weight gain (GWG) over the course of pregnancy. The Institute of Medicine, an independent, non-profit organization originally established under the National Academy of Sciences, provides guidelines for health care providers on gestational weight gain, which serves to recommend how much weight a woman should gain during her pregnancy.   The guidelines, updated by the Institute of Medicine in 2009, are designed for health care providers working with their patients to help women avoid many potential birth defects and unhealthy pregnancies due to inappropriate weight gain and are based on "evidence on relationships between weight gain patterns before, during, and after pregnancy and maternal and child health outcomes" (IOM, NRC 2009, p. 2). The Institute of Medicine guidelines provide a range of weights suitable for pregnant women to gain based on their pre-pregnancy Body Mass Index (BMI). BMI is a number derived from a person's height and weight; the Centers for Disease Control and Prevention say BMI is a reliable indicator of body fatness for most people (Centers for Disease Control, 2011). The IOM notes that a positive outcome can be

achieved over a range of weights and the IOM guidelines are developed specifically for American women.

The need for these revisions has developed from an increasing number of people who are obese in the United States. According to the National Research Council and Institute of Medicine women are currently "leading the epidemic" at a prevalence rate of 33%. National Research Council and Institute of Medicine find this rise in obesity to be particularly a concern in women of childbearing age because of "serious pregnancy-related complications," and the IOM warns these complications can extend into post-pregnancy years.

The National Research Council states that Gestational Weight Gain is a modifiable factor during pregnancy that can be controlled through habits including healthy eating, proper portioning, and exercise (National Research Council, 2007). However, the IOM contends that some women who fall in the normal weight category, and many women in the overweight and obese category, will exceed the GWG guidelines without an intervention. The IOM states that part of intervention needs to occur at the individual level and include "components related to both improved dietary intake and increased physical activity" (IOM, NRC 2009, p. 3). The IOM's gestational weight gain guidelines for pregnancy are provided in Table 2-4:

Table 2-4: 2009 IOM Gestational Weight Gain Guidelines (IOM, NRC 2009, p. 2)

Pre-Pregnancy BMI (kg/m2)	Total Gestational Weight Gain
Underweight (< 18.5)	28 – 40 lbs
Normal Weight (18.5 – 24.9)	25 – 35 lbs
Overweight (25.0 – 29.9)	15 – 25 lbs
Obese (≥ 30.0)	11 – 20 lbs

In addition to the basic guidelines provided in Table 2-4, the IOM provides gestational weight gain ranges for each BMI category on a weekly basis which can be found in Appendix A. The combination of the guidelines for weekly gestational weight gain, dietary intake, weekly exercise and the potential

need for an intervention implies that some form of individualized, continuous real time feedback could be beneficial to pregnant women.

Moore, Rosal and Waring summarized a set of studies that identify "risk profiles associated with non-adherence to ranges and rates of gain" during pregnancy (Moore, Rosal and Waring, 2010, p. 2). They found the following risks in under and over-gainers:

Under-gainers are at increased risk of:

- Small for gestational age (SGA) and low birth weight infants

- Preterm labor/delivery

Over-gainers are at increased risk for:

- preeclampsia

- gestational diabetes

- induced labor

- failed induction

- lacerations

- preterm delivery

- cesarean delivery

- large for gestational age infants or macrosomia

- postpartum infection

- early termination of breast-feeding

- postpartum weight retention

- maternal obesity

They also found that the neonates of over-gainers are additionally at increased risk of:

- low 5-minute APGAR scores seizure

- hypoglycemia

- polycythemia

- hyperbilirubinemia

- meconium aspiration syndrome

- obesity at age 3

One study noted that "although some conflicting or unclear results exist, the overwhelming majority of studies indicate that GWG consistent with BMI-specific IOM recommended ranges are associated with better maternal and infant outcomes" (Moore, Rosal and Waring, 2010, p. 2). Since there are a numerous amount of health risks that are caused by gaining more than the recommended amount of weight during pregnancy, and gestational weight gain is a controllable factor for most women, there is an opportunity for an intervention to help women gain the right amount of weight during their pregnancy, and significantly reduce their health risks during and after the pregnancy.

2.4. Pregnancy Resources

Because of readily available access to information that the internet provides, women now have many options for finding information pertaining to pregnancy. There are a variety of websites, social networks, and standalone applications that allow women to do everything from find nutrition information to track their own pregnancy with a customized profile; both free and paid.

2.4.1 Websites

The first type of pregnancy resources are extensions of general health or information websites. Websites such as WebMB.com, MedicineNet.com, BabyCenter, and Everyday Health have pregnancy

portals that allow users to access a variety of articles and tools for free. The most common areas covered by these websites are information about getting pregnant, basic pregnancy information, and labor/birth information. Most of this information is broken down into first, second, and third trimesters. These portals also include photo slideshows, newsletters, fitness/nutrition information, and other health related information. These resources also offer various tools women can use. These include due date calculators, ovulation calculators, and pregnancy calendars. Of these types of websites, WebMD appears to be the most up to date and complete- even offering expert blogs and a social community larger than most available. The important aspect of these sites is that they are part of a larger, commercial health company. As a result of this, the sites advertise very heavily. While this may not affect the quality of information provided, it does leave some question as to the slant the site is taking. These sites do offer very credible information with content by real doctors.

The next type of pregnancy resources are websites that the government and organizations have put up in order to provide similar information as the "name-brand" health resources. Some of the most popular are pregnancy.org, womenshealth.gov, and americanpregnancy.org. The important difference between the mainstream, name-brand websites and these smaller organizations is funding. Many of the pregnancy portals found on other sites advertise much more than these sites, especially with products that are very lucrative for health care companies such as formula. For example, Pregnancy.org is a not for profit resource started by parents that seeks to empower mothers to do what is best for their children. The important difference here is that these organizations' sites are specific to pregnancy and have been built from the ground up to address all aspects of pregnancy. As a result of lesser advertising revenue, there may not be as much of the specialty content (regularly updated expert blogs, etc.), but the social community rivals those of the mainstream health sites.

There are also websites that offer specific information related to pregnancy. Mypyramid.gov and Livestrong.com are resources that have heavy focus on nutrition. These sites offer a customizable nutrition plan for pregnant women as well as other tools to help tailor diet. While these sites are more specialized, they also offer additional information, but not at the same level as the larger, more full featured websites.

2.4.2 Social Networking

Social networking has been one of the most revolutionary innovations of the last few years, allowing online communities of people to share information and communicate in new ways. Health has been one of the areas where social networking has taken off, exemplified by the many forums and groups on popular social networking sites (facebook.com, etc.) for various medical conditions. Pregnancy is no exception. As previously mentioned, many of the pregnancy sites online today have social networking in their repertoire of features. Some are larger than others and differ in content, but they allow women to ask questions and support each other. Many of these pregnancy websites are also connected to more mainstream social networking sites such as Facebook and Twitter, mostly for content updates. The real difference between the pregnancy social networks is the size of the community and the contributors themselves. For example, WebMD's community has expert contributors in addition to the rest of the community participating in discussions. Smaller sites may not have the ability to have medical professionals regularly posting or even as large of a user base in general.

2.4.3 Applications

There are also a variety of standalone software applications available for women. These applications have been overshadowed by online resources, especially as most (if not all) of the tools are available without installing any additional software, and in many cases, without charge. A majority of

the applications available are pregnancy counters/calendars, such as Pregnancy Count (pregnancycount.com, Free) and Pregnancy Calculator (www.onelife2care.com, $18). Other applications offer an extended feature set, such as Pregnancy Planner (www.pregnacy.org.uk, Free) and Pregnancy Toolbar (www.pregnancytoolbar.com, Free). Pregnancy Planner offers pregnancy tracking much like the previous applications mentioned as well as a day-by-day checklist and multimedia (pictures and video). Pregnancy Toolbar is a toolbar embedded in a web browser. It has the ability to give access to a customized pregnancy calendar and other pregnancy information at all times, with the ability to set the home page to a woman's related pregnancy information. Overall, these applications are fairly outdated as they do not offer as regular updates or as great of a feature set as the web-based alternatives available.

2.5. Existing Smart Phone Applications for Pregnancy

There are a variety of pregnancy applications available for most smart phone operating systems, namely on the iPhone, BlackBerry, and Android platforms. We looked at a variety of alternatives currently available so that we can focus our efforts on features that are not fully developed or are more promising for this application. It is important to understand what exists on each platform; with special consideration for Android is the platform we have chosen to develop on. Table 2-5 highlights the pregnancy applications currently available on each of the most popular smartphone platforms. The data for these charts was based on searches of the respective application marketplaces (based on a query of "pregnancy").

Table 2-5: Applications Available Pertaining to Pregnancy (uquery, Androlib, AppWorld., 2010)

Platform	Total Applications	Pregnancy Applications	Price Range
Android	144,396	65	Free-$14.47
iOS	257,437	517	Free-$299.99
Blackberry	12,198	24	Free-$59.99

This particular project is focusing on weight gain during pregnancy; therefore the search needs to be narrowed down to applications that address this particular segment. Table 2-6 provides statistics of the applications available on Android market (based on the query of "pregnancy weight gain"). As one can easily tell, this search yielded more results than simply a search for "pregnancy". The results appear to be skewed as there are seemingly more applications for a narrower search. The search features of these application marketplace search engines will also display other results for just "weight" and "gain". While the results are slightly difficult to read, there is no application specific to gestational weight gain. These applications can display a varying degree of functionality, from purely informational to complete disease management. At the present time, there are no applications that are specifically for gestational weight gain. There are, however, applications that address certain functionality that our proposed plan will include.

Table 2-6: Applications Available Pertaining to Pregnancy Weight Gain (uquery, Androlib, AppWorld., 2010)

Platform	Total Applications	"Pregnancy Weight Gain" Applications	Price Range
Android	144,396	670	Free-$14.98
iOS	257,437	21	Free-$7.99
Blackberry	12,198	993	Free-$69.99

Of those available, these applications are primarily pregnancy information resources, exercise tracking, and nutritional tracking. By looking at applications that offer each of these different functionalities, we can compare them and take various ideas into consideration for the design of our application. Table 2-7 highlights the top applications currently available on the Android Market in each of those three criteria pertaining to weight gain management during pregnancy, based on the best reviewed and downloaded applications available at this time.

Title	Developer	Date Published	Price	Downloads (Estimated)	Functionality
Pregnancy Assitant	Dzieciowo mi!	2010	Free	50,000-250,000	• Fetal development tracking • Information about stages of pregnancy with photos • Average weight and height of baby; with descriptions of development • Countdown to due date
CardioTrainer	WorkSmart Labs Inc.	2010	Free	3,460,014	• GPA Tracking • Pedometer • Voice Notifications • Music Integration • Recording Feature • Social Networking
Calorie Counter	MyFitnessPal	2009	Free	676,506	• Mobile version of MyFitnessPal.com • Social networking • Food and exercise tracking • Progress Tracking • Access to large library of foods
Pregnancy Ticker	Bitcab	2010	Free	50,000-250,000	• Tracks days to go, trimesters, days passed, and other pregnancy stats • Illustrations of baby's development • Fact database

None of these applications fall into our specific niche, but rather each focuses on part of the functionality of our proposed solution. These applications also vary greatly in usability. For example, the Pregnancy Ticker application has a very simple interface with a plain color scheme. Other applications, such as Calorie Counter and CardioTrainer, offer a deeper feature set that includes a social networking aspect.

2.6.   User-Centered Design

The computer is an extension of a person- a tool that he or she can use. As such, it has been extremely important for designers and programmers to develop the physical device and the software that is on said device in order to efficiently complete tasks. There has been a lot of research into Human Computer Interaction (HCI) in order to come up with a better way to interact with machines people use every day. The goal is to eventually be able to design computers and other devices that are so intuitive that someone who has never used such devices can pick one up and effectively utilize it. For the success of this project, it is necessary we motivate the user to want to start and continue to use this application.

User-centered design is focused on having heavy user involvement to garner feedback on the user experience and satisfaction (Constantine and Lockwood, 1999), thus tailoring the application to the target group. The backbone of such design is user testing on iterations of prototypes. On a higher level, there are two major aspects of motivation in this application. The first is the usability of the application itself. The second is the content and value of the application. If either of these are lacking, no woman is going to want to use the application, especially for the entire duration of pregnancy. Our goal, then, is to instill confidence in the user in both her ability to use it as well as her perceived value of the application and information provided.

The first step in this process is to understand our user group. For this specific application, we are looking at pregnant women as the target user group. Even though we have narrowed our focus, there are still a variety of user types that need to be taken into account. Beyond cultural, financial, and age differences, there are tech savvy, expert smartphone users and complete novices that will be potentially using this application. The goal for design in this regard is to focus design on the least proficient users. Potential users who do not have much, if any, experience with using a mobile application (or the phones themselves) will immediately lose interest in using it. This is independent of the perceived value as most

users who are intimidated by technology generally shy away from using such devices (Lieberman, Paternò, & Wulf, 2006). The more technology savvy users will not give up nearly as quickly, especially since they have experience with particular devices, but that does not mean the application should be unnecessarily complex or obtuse.

The next step is to design the displays as intuitively as possible. To achieve this, we utilized display design heuristics and significant user input on our design throughout the process. There has been much study into user interface (UI) design and there are many points of view, but there are some agreed upon guidelines. Some of the pioneers in this field, Larry Constantine and Lucy Lockwood, have devised a set of principles for UI design that have been widely accepted (Constantine and Lockwood, 1999). These are more overarching suggestions than standards. The principles are: structure, simplicity, visibility, feedback, tolerance, and reuse principles. These principles are generally intuitive and logical. The structure principle states that the overall interface should be clear and consistent. The simplicity principle says that the information and interface design should communicate easily to the user with relation to the task at hand. The visibility principle is concerned with having all options available to the user. This also means not to include extraneous information that may bewilder the user. The tolerance principle relates to the flexibility of the application for errors and fixing said errors by the user. In addition, the application should attempt to prevent errors by properly responding to different, yet sensible responses. Finally, the reuse principle states that the design should be consistent in its look, feel, and behaviors whenever possible. All of these principles will instill confidence in the user because they address the broad aspects of how humans interact and complete tasks as straightforward as possible. There have been other variations of this philosophy, notably Raskin's in *The Human Interface* (Raskin, 2000) and Nielsen's *Usability Inspection Methods* (Neilson, 1994), that offer slightly different

takes on these basic design considerations, yet still maintaining the same thought. The major philosophy here is not to confuse the user and streamline the way by tasks are completed, which needs to be kept in mind the whole process.

While the guidelines are important, the feedback from focus groups and interviews by actual users will be the most important feedback we will get in tailoring the interface to this niche group. User feedback can be attained in a number of ways, for example conducting interviews and/or focus groups and showing various prototypes from which to get constructive responses on. The feedback given by the participants of such interviews has the potential for not only uncovering design feedback, but also opinions on functionality. The utilization of actual users interacting with various stages of the application can facilitate the custom tailoring to the target audience, thus resulting in a better product in a shorter period of time (Gould, 1995). This is particularly advantageous of applications with a niche user group, but the design of the interviews and focus groups will determine the quality of feedback, and eventually the final system.

The second step is to instill confidence in the application as a whole by providing content that is both trustworthy and seeks to motivate the user to not only start using the application, but then to find value in it and continue using it. This particular project relates to pregnant women and their weight, eating, and activity levels. All of these are sensitive topics, making it even more imperative that the content provided relate to the woman in a positive, constructive way. The difficult part in this case is there will be the potential for negative feedback if the user is not meeting goals in the application. Of all of the facets of the wording and feedback, addressing the negative properly will be most imperative to keep a user engaged. To accomplish this, the "negative" feedback must be framed in a positive light as more of a help than a criticism. The content aspect of this application requires extensive user feedback

to attain the proper level of user satisfaction and confidence, thus motivating to utilize the feedback and continue to use the application.

2.7.   Google Health

One of our goals is to allow patients to capture their own health information and record it in a centralized repository that they can access online from any mobile device or computer, and share it with their physicians and hospitals regardless of where they are. Therefore, we will be leveraging the Google Health platform to empower users to collect, store, and manage their own medical records online. Patients can create their own Google Health profiles online and manage their medical information. According to Google, Google Health offers the following features:

Portability: by establishing an online presence, Google Health allows its users to access and manage their health data from anywhere. Patients can import data from one medical facility and conveniently share this data with other facilities, thus decreasing the time it takes to transfer this information. This provides the user with flexibility in handling their own medical records and in choosing who they would like to share these records with.

Privacy and Security: Google Health counts with privacy policies and practices developed by the Google Health Advisory Council that help protect the privacy of its users' sensitive health information.

Platform: Google embraces a platform strategy, which means that the Google Health platform is built to allow interoperability with third-party services and tools so that users can import their health records from a variety of sources, such as doctor's records, prescription history, and test results.

User focus: Google Health provides a clean and easy to use interface for patients to easily manage their health information. In making this an easy and straightforward process, the average user who doesn't necessarily know much about technology can also create and manage their own Google Health profiles.

Google Health provides an Application Programming Interface (API) that allows third party developers like our team to develop applications that can interface with and make use of the Google Health services. Currently there are no 3rd party applications that help pregnant women optimize their weight gain during pregnancy.

2.8.   Android

Recently, Android has been gaining popularity and its market share in the mobile operating system market is rapidly increasing. According to a research from Gartner (2010), Android is poised to become number 2 worldwide mobile operating system by the end of 2010. This accelerated growth has been driven by the widespread adoption of the Android operating system by a number of smart phone manufacturers, such as Samsung, HTC, Motorola, among others (Gartner, 2010).

In our efforts to develop a robust mobile application to help pregnant women optimize their gestational weight gain, we decided to leverage the Android platform. Android is a software platform designed by Google for mobile devices that includes an operating system, middleware, and key applications (Android Developer, 2011). The Android Software Platform, also known as the Android Software Stack, is illustrated in Figure 2-5 and consists of the following components:

Applications layer contains the core set of applications that are delivered with the Android operating system such as the email client, calendar, maps, SMS program, and others.

Application framework layer provides a set of Application Programming Interfaces (APIs) used by the core applications, which can also be used by developers to develop their own applications.

Libraries layer provides a set of C/C++ libraries used by the various components of the Android system. Developers can access this library for more advanced development features such as 2D and 3D graphics engines and media support.

Android runtime layer includes a set of core libraries that provides most of the functionality available in the core Java source files. This layer also includes the Dalvik virtual machine, which creates instances of virtual machines for Java-based applications to run on.

Linux Kernel: the abstraction layer between the hardware and the rest of the software stack; provides core system services such as security, memory management, networking, drivers, etc.

For our application, we will mostly be utilizing the Application Framework and Libraries components from the Android Software Stack to develop our Android application. We will also employ some outside libraries such as gData to connect to Google Health to store and retrieve information.

Figure 2-5: Android Software Stack, Source: (Android Developer, 2011)

Google provides an Android Software Development Kit (SDK) which contains the tools code libraries necessary for developing applications that run on Android-powered mobile devices using the Java programming language.

The reasons for choosing this programming platform in lieu of other platforms such as the iPhone's iOS are the following:

- First and foremost is our experience with the Java programming language. Android is based on Java, and because the project team is familiar with this programming language, we are able to easily ride the learning curve, as opposed to having to learn the iOS programming language.

- Second, Android provides an open-source environment, which allows us to look at existing pieces of code that can deliver some of the functionality we are trying to achieve. That is, some of the components we are looking to develop, such as the activity tracker,

might have already been developed by someone else. By reusing this code we are able drastically save development time.

- Third, the Android Market place is open to all developers. Anyone who develops an Android application can then upload it to the App Market and share it with other people. This is a huge advantage given the time constraints of our project, because we plan to develop and distribute the application in less than 9 months. On the other hand, if we develop an iPhone application, it has to go through Apple, and Apple has to approve of it before it becomes available in the iTunes store.

2.9.   Summary

With more people than ever connected to the internet wherever they go with the many smartphones and other mobile devices on the market, it makes sense to develop solutions for tasks that were previously cumbersome. While the healthcare industry has widely accepted mobile technology, this project falls into a niche. Pregnancy applications and websites have provided a multitude of tools and a wealth of information, but there has yet to be a gestational weight gain specific solution. Because weight gain during pregnancy can greatly affect both the child and the mother, the value of such a tool that eliminates many of the challenges of previous solutions is great. As previously stated, our goal is to design and implement a smartphone self-help application based on the Android platform to aid expecting mothers maintain better health. While this application does not replace a physician, it does have the potential to be an effective supplement in empowering patients to take better care of themselves. This development process will require many special considerations as a result of the target demographic of pregnant women.

3. Methodology

3.1.　　Software Development Life Cycle

In our efforts to design and implement the Android application we adopted a software development life cycle methodology to guide our development endeavors. The Software Development Life Cycle (SDLC) is a highly structured approach to developing software that development teams employ to build software systems (Brown, DeHayes, Hoffer, Martin, & Perkins, 2009). It provides a set of guidelines that help architects, analysts, developers, and project managers to work together to build a software system. Over the years, a number of different SDLC methodologies have surfaced: structured, rapid application development (RAD), and agile. Each methodology suits a different type of development environment and selecting a proper SDLC methodology depends on the type of software project in question and the goals, objectives, and requirements of said project. Table 3-1 shows an overview of some of the different methodologies:

Table 3-1: Criteria for selecting a methodology (Dennis, Wixom, Roth, 2006)

Usefulness in Developing Systems	Structured			RAD			Agile
	Waterfall	Parallel	V-Model	Iterative	System Prototyping	Throwaway Prototyping	Extreme Programming
with unclear user requirements	Poo r	Poor	Poor	Good	Excellent	Excellent	Excellent
With unfamiliar technology	Poor	Poor	Poor	Good	Poor	Excellent	Poor
That are complex	Good	Good	Good	Good	Poor	Excellent	Poor
That are reliable	Good	Good	Excellent	Good	Poor	Excellent	Good
With short time schedule	Poor	Good	Poor	Excellent	Excellent	Good	Excellent
With schedule visibility	Poor	Poor	Poor	Excellent	Excellent	Good	Good

Structured design methodologies adopt a step-by-step approach to the SDLC and moves from one phase to the next. These methodologies make use of modeling and diagramming techniques to describe a system's functionality by outlining the different business processes and the data that support them. Some examples of structured design methodologies are: waterfall and parallel development. These methodologies include a series of steps: planning, analysis, design, and implementation that must be done in order. Once we move to the next step, it is very hard to go back to the previous step to make changes. Thus, these methodologies are not very flexible, as they are tailored towards the development of very complex and highly structured software systems.

Rapid application development (RAD) methodologies focus on developing some part of the system quickly and delivering it to the customer for more timely feedback. This allows analysts to interact more with the customer and better understand and anticipate the customer's needs. However, RAD methodologies still need some level of modeling, diagramming, and documentation in order to get development started, but the development speed for software systems is higher than structured methodologies.

Agile development methodologies eliminate much of the SDLC overhead by removing the modeling and documentation tasks and focus on simple, iterative application development. That is, the project is split into several small incremental iterations that will add up to the final product. After each iteration the customer and the analysts get together to determine where the project currently stands, and whether modifications need to be made. These methodologies, therefore, are more flexible in allowing the customer to add/change/modify the requirements of the system, and in allowing the developers and analysts to adjust the project to accommodate these changes. Because development

starts in the early stages of the project, the project can be completed a lot faster than if the team were employing structured or RAD methodologies.

3.2.   Methodology Selection

In determining the methodology our team used to develop our software system, we refer to Table 3-1. According to this table, the methodology that best suited our project was Agile. The software system we developed was relatively simple, for which we knew what the requirements were and which we were able to break down into several smaller modules. This allowed us to skip some of the more time-demanding tasks such as modeling and diagramming, and start off development as soon as possible. Next we look at our familiarity with the technology. Android applications are built using the Java language, and our team has extensive experience programming in this language. The third and most important factor is time. Our schedule was strictly limited to 21 weeks, which was a fairly short development cycle, considering that software systems usually take from 6 months to 2 years to develop. This said, adopting an agile methodology allowed us to develop a system within a shorter period of time than other methodologies and provided us with very clear schedule visibility.

3.3.   Agile Development Methodology

Agile software development is a programming methodology that focuses on flexibility to streamline the system development lifecycle (Fowler, 2005). The standardized tenets of the agile development process are given in the Agile Manifesto that was written in 2001 by a panel of experts who practice different programming methodologies (Beck & Cunningham, 2001). The main values of the Agile Manifesto are individuals and interactions, working software, customer collaboration, and responding to change (Beck & Cunningham, 2001). The main idea behind agile development is that it is to be flexible and efficient to deliver the most value.

Beyond the main values the Agile Manifesto lists, there are some basic principles that have been agreed upon for successful use of the agile method. These principles stress flexibility, delivering working software on a regular basis, close collaboration, division of labor, regular meetings, regular pace within development, attention to detail, and constant improvement in order to produce the best final product (Beck & Cunningham, 2001). Agile development breaks down a project into individual modules of the final project over iterations (Cockburn & Williams, 2003). Each iteration requires the full system development process, thus allowing working software to be available after each iteration. Agile development is best suited for smaller teams where many tasks can be shared (Cockburn & Highsmith, 2001). It is a highly collaborative environment that does not take into account the corporate level of the team members. This kind of teamwork allows for more creative thinking in effectively creating simple solutions to problems. The key to success with this methodology is constant communication, which is easier to accomplish with a smaller group. In the end it is the team's goal to appropriately translate the need into a solution that produces the most value.

Agile development has evolved into different methods over time, including Extreme Programming (XP), Scrum, Agile Unified Process, and Agile Modeling (France, Rumpe, & Turk, 2003). While all of these different methodologies share the basic tenets of the Agile Manifesto, they all differ in some logistical ways. It is important to understand that the performance measurement of the project is primarily based on a working final product. While the overall agile development plan is very flexible, it is not without a plan (Cockburn & Highsmith, 2001). The reason for this flexibility is to allow the team to adapt to potential problems or changes in requirements of the project.

Among the various agile development methodologies we have decided to choose scrum and the next section explains our reasons for doing so.

3.3.1 Scrum

Scrum development is a form of agile development that splits up the final product into incremental pieces. Using this method, each module of the final application is split up into short "sprints" of development. Each sprint lasts from 1-4 weeks depending on the project timeline. A scrum project consists of 3 roles, 3 main artifacts, and 3 main meetings. We will go over each of these in the following sections.

a) Roles

The three roles that come into play at a scrum project are: the product owner, the scrum master, and the team.

The **product owner** represents the customer's interests and is responsible for communicating these interests to the team in the form of product requirements. The product owner is also responsible for maintaining this list of requirements, which often changes, and making sure the team is aware of changes to the product backlog.

The **scrum master** is responsible for managing the scrum process, meaning that the scrum master makes sure that the team remains focused and does not fall behind in its development endeavors by measuring the progress and removing impediments. The scrum master helps the product owner and the team to negotiate the sprint backlog for each sprint. The scrum master also leads team meetings, acting as a liaison between the product owner and the development team, and works on the product as well.

The **team** is responsible for completing the tasks in the product backlog. The team usually consists of 7-9 cross-functional members including software engineers, programmers, QA experts,

testers, UI designers, and architects. The team is also responsible for managing themselves and determining how it will accomplish its tasks.

b) Artifacts

The three main artifacts in a scrum project are: the product backlog, the sprint backlog, and the sprint burn down chart.

The product backlog is a dynamic list of high level requirements ordered by priority. Items with the highest priority are completed first. The list usually changes as items are added or removed from it due to change in the customers' interests. These requirements become the tasks that the development team must complete in order to develop the product.

The sprint backlog is a subset of items from the product backlog that a team commits to complete during a particular sprint. This allows the team to break down the product into smaller and therefore more manageable units of work.

The sprint burn down chart shows the daily progress for a particular sprint as the sprint progresses. This allows the scrum master to stay on top of the sprint backlog and make sure that the development team is keeping up with the tasks and that deadlines are met.

c) Meetings

For each sprint in the scrum project, there are usually three main meetings: the sprint planning meeting, the sprint review meeting, and the sprint retrospective. Aside from these, there are also daily scrum standup meeting.

The sprint planning meeting occurs before the start of each sprint. The main objective in this meeting is to prepare the sprint backlog for the current sprint so that the development team will know what tasks to work on.

The sprint review meeting occurs at the end of the sprint. During this meeting, the scrum team reviews and presents their completed work to the stakeholders and gets feedback from them. This feedback is then incorporated into the product backlog in the form of requirement changes or changes in the priority of certain items.

The sprint retrospective meeting occurs after the sprint has finalized. In this meeting, all team members meet and reflect on their work during the past sprint to determine what was done well and what needs to be improved in the current way they are doing things. This will allow the team to do a better job in the next sprint.

The daily scrum meetings are 15 minute meetings that occur every day. During these meetings, the scrum master marks the progress of the team's work and makes sure that it is in line with the project schedule and that the team will be able to finish the tasks in the sprint backlog by the end of the sprint.

3.3.2 Our Scrum

For our project we decided to implement our own flavor of scrum, that is, we followed parts of the scrum process, and modified some parts to suit our project. In the following sections we describe how we implemented the scrum process and why we chose to implement it the way we did.

a) Roles

First of all we will identify the players in the scrum team and their roles:

Product owner: Thomas Jenkins – his role was to communicate the vision of the end product and its features through requirements. Thomas acted as the liaison between the customers, Milagros and Tiffany Rosal, and the development team. This is where our project deviated from the original scrum process.

Scrum Master: Michael Ng - the scrum master was in charge of organizing and communicating the development goals to the team. The scrum master also acted as a liaison between the product owners and the team, organized the items from the product backlog into the sprint backlogs for each sprint, and assessed the team's development work through weekly reports.

Team members: Given that our team consisted of only five people, each of the team members assumed 1 or more development roles.

Application development team

The application development team was in charge of coding the application and its core components as well as writing out unit tests to test out the individual components.

Ken Miyauchi – software engineer, QA engineer

Michael Ng – architect, software engineer

Brendan Harris – tester, QA engineer

UI design and content management

The user interface design team was in charge of laying out all the user interface elements of the application and designing the look and feel of each individual screen, and generating all the feedback content for the application through research.

Evan Duderewicz – UI designer, content manager

Thomas Jenkins – UI designer, content manager

Artifacts

Next we look at the product backlog for the project. These components were designed to deliver the functionality we agreed upon with the customer. For details on the system request and specifications please refer to appendix Appendix A.

1. **Android Application UI component**

   This component consists of all the screens and UI elements that the user interacts with.

2. **Notifications / Reminder component**

   This component is used to generate notifications to remind the user to input his/her weight, food, or activity data.

3. **Weight Monitoring component**

   This component is for the users to input and keep track of their weight and get feedback based on their gestational weight gain.

4. **Dietary Information component**

   This component is for the users to input and keep track of the food that they eat on a daily basis and get feedback on whether they are eating a balanced and health diet.

5. **Activity Monitoring**

   This component is for the users to input and keep track of their sedentary, active and exercise times to make sure that they are exercising enough.

6. **Google Health component**

This component is used to interface with the Google Health service in order to log the user's weight, dietary, and exercise information into their Google Health profile.

7. **Feedback component**

This component is used to generate feedback for the user based on his/her weight, food, and activity input.

8. **Information library**

This component contains all the text for the help screens, information on serving sizes, food information, suggestions for users, and textual feedback for the feedback component.

9. **User manual**

This component consists of a comprehensive guide on how to use the application.

This is where we started to deviate from the original scrum process. Our artifacts only include the product backlog and the sprint backlogs for each sprint, which we will talk about when we cover the sprints later in the chapter. We decided not to create a scrum burn down chart because the scrum master had to focus more on the development tasks, and therefore had no time to assess the progress daily. Additionally, our product backlog did not evolve much during the development cycle. The required changes identified during the meetings were small and relatively easy to implement.

b) Meetings

Our team did not have daily standup meetings, but rather weekly meetings, for the same reason we decided to omit the scrum burn down chart. Additionally, our development team was fully invested in the project and was clear on the goals of each sprint. Progress tracking was a matter of calling up a team member to ask him about his tasks and then updating the project timeline document. The team, however, did have sprint planning meetings before the start of each sprint in order to go over the

product backlog and organize the sprint backlog for that particular sprint. Sprint review meetings were also conducted at the end of each sprint to review the completed work with the customers and make sure that the product is coming along as they had envisioned it. As for the sprint retrospective meetings, we decided to skip this part of the scrum process due to our time constraints. Aside from these meetings we met weekly with our customers to go over the product backlog and other research related aspects of the project.

Work Plan and Sprints

The timeline for our project is split into three seven-week terms. For details on the dates and durations of each term please refer to appendix Appendix B. The following sections go over the details of our work plan for each of the terms.

a) A-term

During the first term we conducted initial background research into gestational weight gain, and we gathered and documented all the requirements for the software application that we are building, which lead to a technical specifications document (Please refer to appendix Appendix A). We also started building a small prototype of each of the different components of our application, in order to determine the technical and economic feasibility of building each module in its entirety. The feasibility studies lead to the decision of whether we can build the application, and the time it will take us to do so. Using all this information we then came up with a work plan for the rest of the terms. At the end of this term we formed our product backlog.

Research

Literature review was the primary method of gathering background information for our project. We utilized a variety of sources mainly discovered through the WPI Gordon Library. Additionally, our

sponsors provided us with a few background documents and books. Other resources included general web searches and application catalog searches to determine the availability of solutions similar to our project.

Requirements Gathering

Before we began development of the application, we gathered the requirements for the application and produced the product backlog. We met our customers for the first time on the third week of A-term. From this meeting we were able to determine the high-level requirements of the product. We prepared a document detailing our understanding of the product and its requirements and presented it to the customers before the end of the term for feedback. We then used this feedback to finalize the requirements and form our product backlog, and got the signoff from the customers.

b) B-term

During the second term the team concentrated on building the software system. Our goal was to spread the development of the application across both B and C terms. We also conducted focus groups to gather feedback on the UI and the usability of the application. Therefore we focused on developing the high priority components, which were the front-end components, such as the UI, weight tracking, food tracking, etc., to use for the focus group sessions.

This term was split into 3 two-week development sprints. Each sprint consisted of a sprint backlog with a number of components from the product backlog, which depended on the complexity of said components.

The team met with the sponsors once a week to discuss the progress of the project and made changes as needed.

Sprint 1: October 26th – November 8th

Sprint backlog: Application UI, Notifications/Reminder component

We decided to develop these two components first because our first objective was to demonstrate a prototype of the UI to the customers.

During this time, the team focused on designing all the application screens as well as the flow of between the different screens. The user interface design team designed the focus group sessions to be carried out during the second iteration. The research team worked on usability design and testing to make sure that the application was intuitive and user-friendly.

The team met with the customers on the following dates:

October 27th: the team discussed the full set of requirements identified by the team and went over the scrum product backlog to make sure that we were not missing any required functionality.

November 3rd: the team presented the UI designs and got feedback from the sponsors which allowed the team to finalize the UI designs in order to start building the actual application screens.

Sprint 2: November 9th – November 23rd

Sprint backlog: Weight tracking, Nutrition tracking, Activity tracking components

During the second sprint we conducted two focus groups get more in-depth feedback about the usage of our system. Therefore the team developed the weight, nutrition, and activity tracking components because these were the main components that the user would be interacting with. In the meantime, the user interface team focused on designing the focus-group protocols.

Focus Groups

Design

In order to further the analysis of different user interface (UI) designs, we conducted two focus groups of women. These focus groups have critical meaning to the usability of the application and the evolution of the interface as we continued development because of the feedback gleaned. The people who were included in the focus groups were pregnant women who have varying degrees of experience with smartphones, from a non-user to a power user, between the ages of 18 and 35. The purpose of this was to gather feedback on the usability of our application by allowing the participants to interact with our application running on an actual smartphone. The focus group started with an introduction of the project, gestational weight gain, and smartphone applications. We then distributed phones and demonstrated a walk-through of the important sections we were focusing on, specifically the input screens. Below are the areas of the application that we covered:

- o Application UI
- o Weight tracking
- o Activity tracking
- o Nutrition tracking
- o Reminders/Notification

The subjects were then encouraged to discuss with each other during and after they have the opportunity to interact with the application. This helped generate discussion between non-smartphone and smartphone users that yielded valuable feedback on not only our current design, but also how they expected the application to look and feel. We were able to use this to adjust our interface to accommodate both the experienced user as well as the novice user based on responses and criticisms as well as establish areas for future work. We recorded these discussions to make sure we get every

comment from the participants and can relate those to the entry survey responses, taking care to maintain anonymity of the participants.

Questions

As a part of these focus groups, we conducted an intake survey with the participants for basic demographic information. The questions we asked in the surveys were brief and gave us an opportunity to understand the participants' background which stuck to the essential points of our research. We paid close attention the thinking involved by the participants as the discussion evolves throughout the course of the focus group, allowing us to quantify the attributes they considered to be most important and arrive at themes of discussion we prioritized to continue development.

The intake survey included the following questions to gain basic demographic information. We also included questions on cell phone ownership and use. The last set of questions pertains to the participants' health and standing as it is related to gestational weight gain and pregnancy. These questions are important for us to understand who participated in the focus group, which will influence how they perceive the application.

- o Age
- o Race/Ethnicity
- o Employment
- o Do you own a cell phone?
    - ▪ Model?
- o If you have a phone, what do you use it for?
- o Have you used an application on a mobile device?
- o Did your doctor(s) ever talk to you about the amount of weight that would be healthy for you to gain in pregnancy?

- Have you used any sort of program to help monitor your weight, diet, or physical activity?

- Do you know your ideal weight? (When not pregnant)

- Do you have a scale to weigh yourself at home?

- If you are pregnant, what week are you on?

- Is this your first pregnancy?

We sought to not only collect information on the participants' use of mobile technology, but also their understanding of their health. We included the question about use of a program to monitor health as a way to connect pregnancy and mobile technology, allowing us to understand how these women track their health (if at all).

The following questions were those we used as prompts for discussion. These questions were targeted at individual aspects of the application interface, with specific focus on the input functionality of the application and overall look and feel. We put added emphasis on this aspect of the interface because it is the major contributing part of the application that will influence the user's adoption and continued use of the application. If it is confusing or hard to use, there will be little or no user base for the application. These questions also gave us insight into the factors that go into using such an application from the viewpoint of various user demographics, which allowed us to tailor the application to appeal to a wide variety of users in this specific niche market.

- What did you like and not like about navigating the application?

- What did you like and not like about the application?

- What do you think of the appearance of the screens we have shown you?

- Given what we have shown and told you about the application. Would you be interested or not interested in using it?

- Based on what you have seen, what changes do you suggest making to the application?

We specifically designed these questions to be very open ended with the goal to elicit discussion amongst the group. The application was stepped through to ensure all relevant sections of the application were covered and discussed. The discussion can go in any direction as long as it pertains to something relevant to the application. We used a variety of probing questions whenever there was any lull in discussion:

- o Would you explain further?
- o Would you give me an example of what you mean?
- o Would you say more?
- o Tell us more.
- o Say more.
- o Is there anything else?
- o Please describe what you mean.
- o Does anyone see it differently?
- o I don't understand.

While also open ended, these questions gave guidance to the discussion and helped rouse conversation. One of the most important things in a focus group was to hear from everyone, hence the use of questions seeking different opinion.

Analysis Strategy

Upon completing each focus group, the team debriefed and compared their notes. This was important in order to determine the major themes of the conversation as well as to identify and prioritize relevant items to the backlog. Because of the timeframe of this project, it was imperative that we prioritized the most important facets of the application that came from the discussions and incorporated them into our development plan. After both focus groups were conducted, we identified

major themes and produced a summary of our findings that were them put into the backlog. Because we linked the entry survey with comments in the discussion, it was possible to see what items concerned those with various backgrounds as well. The extraneous items that were discussed, but did not fall within the scope of our project were put into our suggestions for future work (see Chapter 5 for details).

The team met with the customers on the following dates:

November 10th: the team discussed the details of the focus group designs and the development progress on the application so far.

November 17th: the team finalized the details for the focus group sessions and got feedback from the customers. Once this feedback was incorporated, the group submitted the focus group designs for IRB approval. The team also presented the developed components to the customers for feedback.

Sprint 3: November 29th – December 14th

Sprint backlog**:** Weight tracking, Nutrition tracking, Activity tracking components

In the third and final sprint the development team incorporated the feedback on the weight, nutrition, and activity tracking components from the customers in order to have a functional prototype for the focus groups.

During this sprint, the team carried out the focus group sessions on **December 1st** and **December 3rd, 2011** and gathered qualitative information on the usage of the application. These focus groups were conducted in the UMass Medical school campus and each session had 4-6 participants. Food and refreshments were provided for the participants as well.

From this feedback the team analyzed the feasibility of incorporating the required changes and chose the ones that were feasible to implement given the time constraints. This is detailed in Chapter 5.

The team met with the customers on the following dates:

December 8th: the team presented the summary of the focus group feedback to the customers. The team also asked the customers for additional guidance on building the feedback component of the application.

c) C-term

During this term the development team focused on polishing the UI, coding the rest of the application and writing up the documentation of the application. These tasks were split up into three more sprints. The research team focused on building the information library and writing the term paper. For this we performed two more sprints.

The team also decided to carry out a number of interviews to gather more qualitative data on the usability of the application. The interviews were conducted on **February 23rd, 2011**. Our goal was to finish building the product by **February 18th** so that we could have a finalized version to use during the user interviews.

While waiting for IRB approval for the interviews, the team focused on writing the documentation and the rest of the term paper.

Sprint 4: January 17th – January 28th

Sprint backlog**:** Feedback component, Google Health component, Information library

The team met with the customers to obtain more information and guidelines on providing feedback on nutrition based on calorific intake and the type of food. The team developed flowcharts to describe how we envisioned the feedback engine to work, and presented them to the customers for feedback. The customers then provided us with more information and guidelines as to how the feedback engine should work. The development team then used this information to build the feedback engine. The research team started compiling the information library and drafting the first three chapters of the term paper.

Sprint 5: January 29th – February 18th

Sprint backlog**:** Feedback component, Information library

During this sprint, the team finished developing the feedback component and focused on finishing the information library and polishing the application UI. We also conducted the user interviews to gather some more feedback on the usability of the final product.

User Interviews

To further refine the development of our application, we conducted one-on-one interviews with volunteers. The interviews were conducted with potential users of our application. The purpose of these interviews was to gather intuitiveness of the different screens, menus, buttons and navigation of the application. Additionally, the interviews may review minor bugs or unusual developmental decisions that we have overlooked. The interviews can also help us identify areas for potential future development.

Our interview protocol was to give the volunteers a phone running the application and then ask them to perform tasks that would be both typical of a new user, but would also be reoccurring throughout the application's use. The tasks we asked the user to perform were:

A. Launch Application – The user will be asked to turn on the phone and access the application by clicking on its icon.

B. Input Weight – The user will then be asked to go to the weight input screen and instructed to input a weight (they will be told their real weight does not need to be inputted). The user will not be asked to do anything between this step and the next one, for example the user will not be asked to return to the home screen of the application.

C. Input Food – The user will be asked to input a sample lunch, again they will not be asked to input what they really ate today in this test. The user will not be asked to do anything between this step and the next one, for example the user will not be asked to return to the home screen of the application.

D. Input Activity – The user will be asked to input 30 minutes of running exercise. The user will not be asked to do anything between this step and the next one, for example the user will not be asked to return to the home screen of the application.

E. View Progress / Feedback – The user will be asked to view progress for the weight, food and activity screens. The user will not be asked to do anything between this step and the next one, for example the user will not be asked to return to the home screen of the application.

F. Set reminder(s) – The user will be asked to set a weight reminder for 8 PM on Sundays.

After the volunteer had performed the requested tasks we asked the following questions, each question is detailed with what we hoped to garner from their responses.

The first set of questions was designed to gather the user's impression of the application. If the user did not seem to have any opinions we asked them to rate these questions on a 1-10 scale, when they provided their number rating, we asked why they gave that rating.

- What did not work as you expected when you were navigating the application?

- This question was designed to specifically evaluate how intuitive the application's navigation was. Since we, the developers, were not the intended audience, this question would help us determine if our intended audience was able to easily navigate the different screens of the application. By asking what did not work as expected, we hoped they could tell us where navigation did not function logically from a user's perspective.

- What made this application intuitive? (What worked as you expected?)

  - This question sought to confirm what navigation and functionality worked as the user would expect.

- What did you like most about the application?

  - This question could potentially help us identify future expansion or development if there was a particular feature that was well liked.

- What did you like least about the application?

  - This question was designed to help us find difficult to use parts of the application, bugs and just general features that were not desired.

- What did you think of the appearance of the application?

  - The colors of the screens?

  - The icons?

  - The font used?

  All of these appearance questions were designed to make sure the application was both visually appealing and easy to read. The question about the icons was designed to make sure the icons and buttons implied to the users what we selected them to represent.

This is the second set of questions and relates to each specific task we asked the volunteers to complete. We went through each section of the aforementioned tasks asking these questions. Each section was

opened with "let's talk about the weight input screen…." (Repeated for the food input screen, activity input, view progress/feedback and set reminders).

- What areas were difficult to understand or use?
    - The purpose of asking this question was to go in depth about each of the tasks, because these tasks represented the major functionality of our application. The answers to these questions would help us identify what needed to be changed – either by us or future development – to improve the core functionality of our application.

The final set of questions was wrap-up/conclusion questions.

- What would you change or not change in the application?
    - This question was designed to elicit any specific or generic changes about the application as well as potentially identify future development.
- What do find useful about the application?
    - This question sought to confirm whether the features we had developed in the application, namely the tasks we asked the volunteer to perform, were actually useful to our intended user base.
- Would you use this application?
    - This question would help gauge whether our target audience would actually use this application. This question was important because it would not be unreasonable for the volunteer to give favorable answers to the other questions yet still say they would not use the application. If the user answered no to this question, we would follow up by asking why to determine whether there was a question we failed to ask or if there is another outside reason that has nothing to do with the quality of our application (an example of an outside reason would be a volunteer who is a non-smartphone user).

Sprint 6: February 19th – March 4th

Sprint backlog: Bug fixes, UI polishing, User manual

During this final sprint, the team focused on fixing bugs, polishing the UI and summarizing and analyzing the results of the user interviews and writing up the final research paper. A user manual (see appendix Appendix C) was also created to help users learn how to use the application. The team conducted one last sprint review meeting on **March 2nd, 2011** to present the final product to the customers and discuss the future of the project.

3.4.   Summary

The adoption of a structured, agile approach to tackle the development process played a key role in allowing us develop the application in a timely manner. We were able to divide the system into smaller components and concentrate on a small number of components per sprint to speed up development and finish the product within our proposed project timeline.

4. System architecture and implementation

In this chapter we discuss our architectural approach towards designing and implementing the system. We first talk about the Android development environment and how it fit in with our development strategies. We will then delve into the high level overview of the architectural design we have chosen to develop our application. Next we will go into the details of our system design with the class diagrams and the database model. Then we will look at how our feedback engine works to provide informative feedback for the users. Finally we will look at some more detailed documentation on the implementation of the system through use case diagrams and logical flow diagrams.

4.1. Android development environment

Android applications are written using the Java programming language, which is an object-oriented programming language. Using this high-level language we were able to develop our application using a fairly modular approach. The software development pattern in the Android environment is very similar to the Model-View-Controller (MVC) used in other software development environments.

4.1.1 Model View Controller Pattern

The model-view-controller pattern is a software development pattern that separates the modeling of the domain (business entities), the presentation (user interface), and the logic of the application (Microsoft, 2011). This allowed more modularity since we split the application into three separate independent layers. Doing so also allowed us to test each individual layer independently so that we could divide up the work among the several developers.

The **model** represents the data of the application domain and responds to requests for information about it state and requests to change its state.

The **views** display information on the screen and is comprised of all the user interface (UI) elements.

The **controllers** respond to user inputs and actions and instruct the model or the view to change their states or properties accordingly.

Figure 4-1 depicts the structural relationship between the three layers.
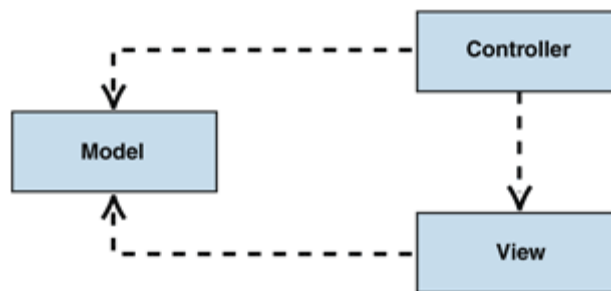
4.1.2 Android MVC

In Android, the programming model is similar to MVC. Android application development is centered on views and activities.

The model, or the application domain, is represented through Java classes. These classes maintain information about our business (or application) entities, such as a Food Category.

The views represent the user interface layer, which displays information for the user and allows the user to interact with the application. Views in Android are implemented as layouts, which are XML files that define the different UI elements in the view and their properties such as height and width.

Activities are the equivalent of controllers from the MVC pattern. An activity contains logic that displays the views and reacts to user input or actions that change the model or the view. Each activity is given a window, which it can fill with a view. Because activities are the main components in Android, we will go over them in a little more detail in the next section.

4.1.3 Android Activities

As mentioned before, the activity is the component that listens to user instructions to perform changes in the application. Each activity must implement the base class Activity and must be started by passing an Intent object to Context.startActivity(). Figure 4-2 shows the events in the activity lifecycle. Once an activity is started, it can run on the background until it is terminated, allowing other activities to be started as well. The developer can override all these events and implement their custom logic in any of them. Most of the screen setup and variable initialization occurs during the onCreate() event.
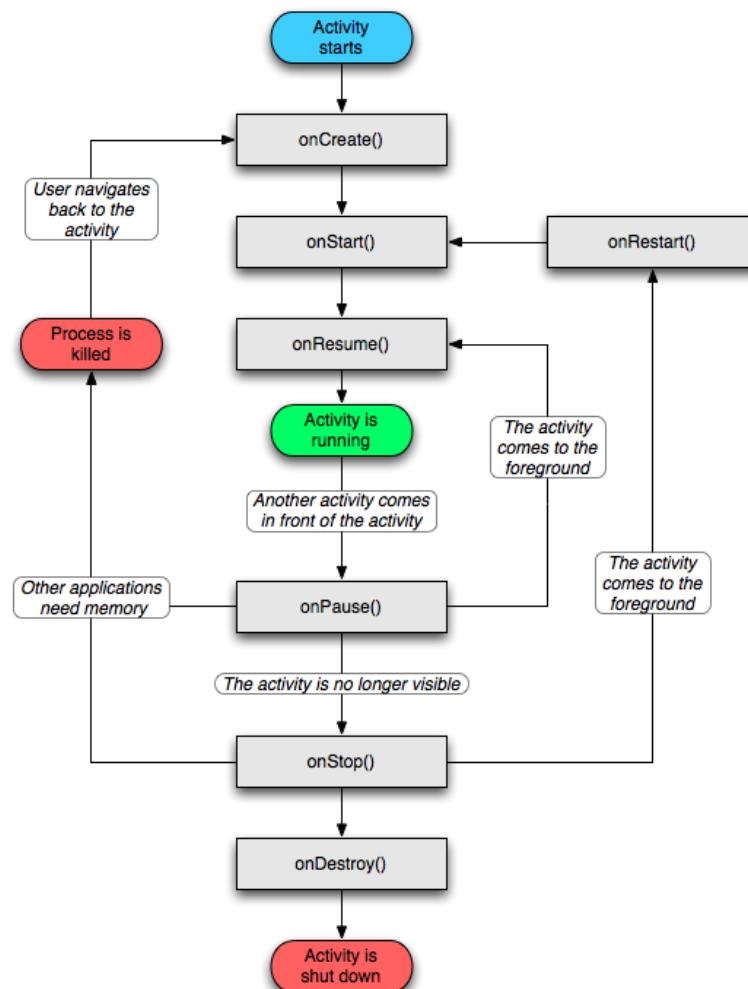
Figure 4-2: Android Activity Lifecycle (Android Developer, 2011)

4.1.4 Other Android components

The Android software stack is a complete set of libraries that provide a number of components that applications utilize for their day-to-day activities and tasks. The activities mentioned the previous sections were the main components we utilized. Aside from activities we also employed the following components:

d) Notification manager

The notification manager is a component from the Android operating system that servers to alert/notify the user about events that happen. These notifications are sent to the notification bar, also known as the launcher, at the top of the screen, which the user can pull down to check. The reminder component of the system makes use of the notification manager to set up repeating reminders for specific dates and times.

e) Broadcast receivers

According to the Android developer's guide (2011), a broadcast receiver receives and reacts to broadcast announcements. In our application we used broadcast receivers to listen for reminders set by our reminders component. Once the broadcast receiver receives a reminder to input weight, food, or activity data, it will call the notification manager to alert the user that it is time to input his/her data.

f) Account manager

The account manager provides access to a centralized registry of the user's online account accounts. The account manager manages the user's credentials and permissions to access the accounts through other applications. Our system makes use of the account manager to gain access to the Google Health services through the user's Google/Gmail account.

4.2. System design

Based on the requirements of our application and the amount of resources we had, we decided to abstract our code into multiple layers using the MVC pattern. This allowed us to clearly separate our development tasks in order to have each developer work on his/her own independent layer without affecting the other layers. As mentioned in section 4.1, we were able to easily divide the system into several modules, as seen on Figure 4-3, that could be isolated and tested individually:

4.2.1 Feedback engine

The feedback engine is the component that generates both qualitative and quantitative feedback based on data the user has inputted over a period of time. The activity, nutrition, and weight tracking components all rely on the Feedback Engine to provide feedback on how the user is doing based on his/her input. The Feedback Engine, in turn, retrieves data from the database and processes this data to provide the requested feedback. We will go into more details about the feedback engine later in the chapter. The content we used to provide the feedback to the users can be found in appendix Appendix E.

4.2.2 Google Health client

The Google Health client allows our application to communicate with Google Health (for more information on Google Health please refer to section 2.7) to store user input as wellness data. In this application we record wellness data in the form of weight readings, calorific intake, and time spent exercising. This wellness data is then stored on the user's Google Health profile, which is a Google account. This allows the user to access their health information wherever they are and share it with their doctors and physicians.

As the user fires up the application for the first time, our application prompts the user to select a Google account to associate the application with and a Google Health profile. If no profile exists, then the application creates a default one.

For the Google Health client we utilized the *org.apache.http* libraries to create HTTP GET requests to the Google Health service, which are comprised of the URL with an appropriate header. The Google Health service then returns an HTTP response containing the data we requested or posted our application processes that data.
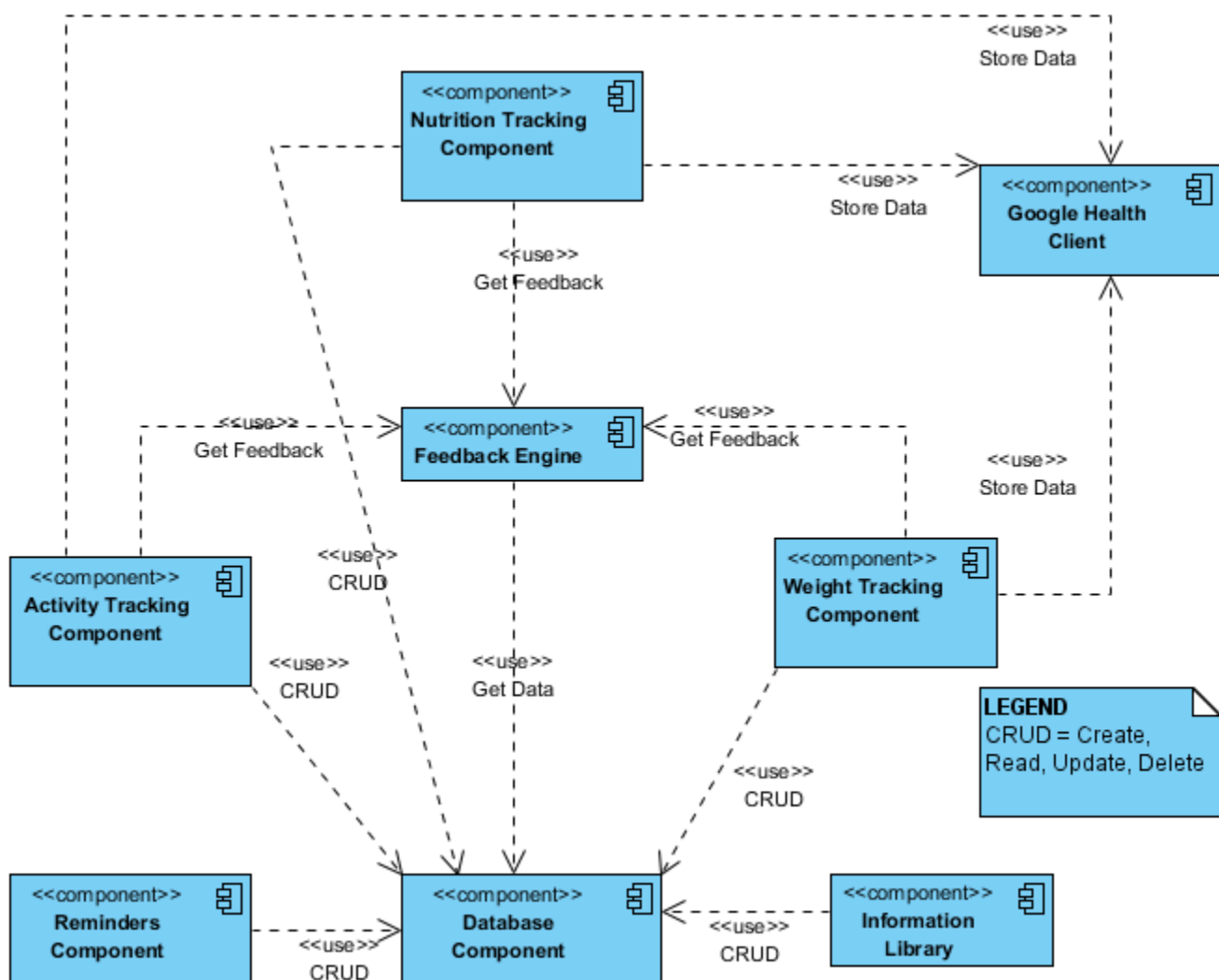
Figure 4-3: System Architecture

4.2.3   Database component

In order to persist user data and configuration settings we have used the following components: the shared preferences and the SQLite database.

a) *Shared Preferences*

The shared preferences component provides a framework for saving and retrieving persistent key-value pairs of primitive data types. This allows us to store based configuration information without the need to create database tables. Data stored in shared preferences are persisted across sessions, so even if the application is closed or the phone is rebooted, this data will remain intact. The application uses shared preferences to store the following information:

- Starting pregnancy week – the week into the pregnancy when user first started using the application

- Starting weight – the weight of the user when he/she started using the application

- Starting height – the height of the user when he/she started using the application

- Database setup – whether the database for the application has been setup

- Starting date – the date the user first started to use the application

- Google Health account – the Google account and the Google Health profile associated with the application

b) *SQLite Database*

In order to store more complex data in the application, we made use of SQLite database. With the power of SQL we were able to perform complex queries and calculations with the data we obtained from the user. Later in the chapter we will go over the database model we designed for the application, which will list all the tables, their properties, primary keys, and relationships.

4.2.4 Weight tracking, Activity tracking, and Nutrition tracking components

These components are used to record input data, such as weight, physical activity, and food intake data from the user and store this data in the database. The weigh component also retrieves data from the database and passes this data to the feedback engine to generate feedback for the user.

4.2.5 Reminders component

The reminders component allows the user to create and manage reminders and notifications to record their wellness data. For example, the user can set up a weekly reminder to record her weight so that the application can keep track of her Gestational Weight Gain and provide feedback on whether the amount of weight is appropriate. As mentioned before, the reminders make use of broadcast receivers to listen for when the application needs to alert or notify the user.

4.2.6 Information library

The information library is the component that provides educational information on pregnancy and gestational weight gain, as well as the fun facts that we present throughout the application. This information is stored in the SQLite database and the information library component accesses the database to retrieve information requested by one of the following components: activity tracking, weight tracking, or nutrition tracking. The content of the information library can be found in appendix Appendix F.

4.3. Package diagrams

We utilized packages to separate our source code into the different components. Figure 4-4 shows how we organized our packages. The main package is the mqp.momometer package. Inside of this package we have create a separate package for the different components we are implementing. The activities package contains all of the application's activities (controllers) and within this package, the

activities are further divided into their respective components. The model package contains the classes that represent the business entities in the application.
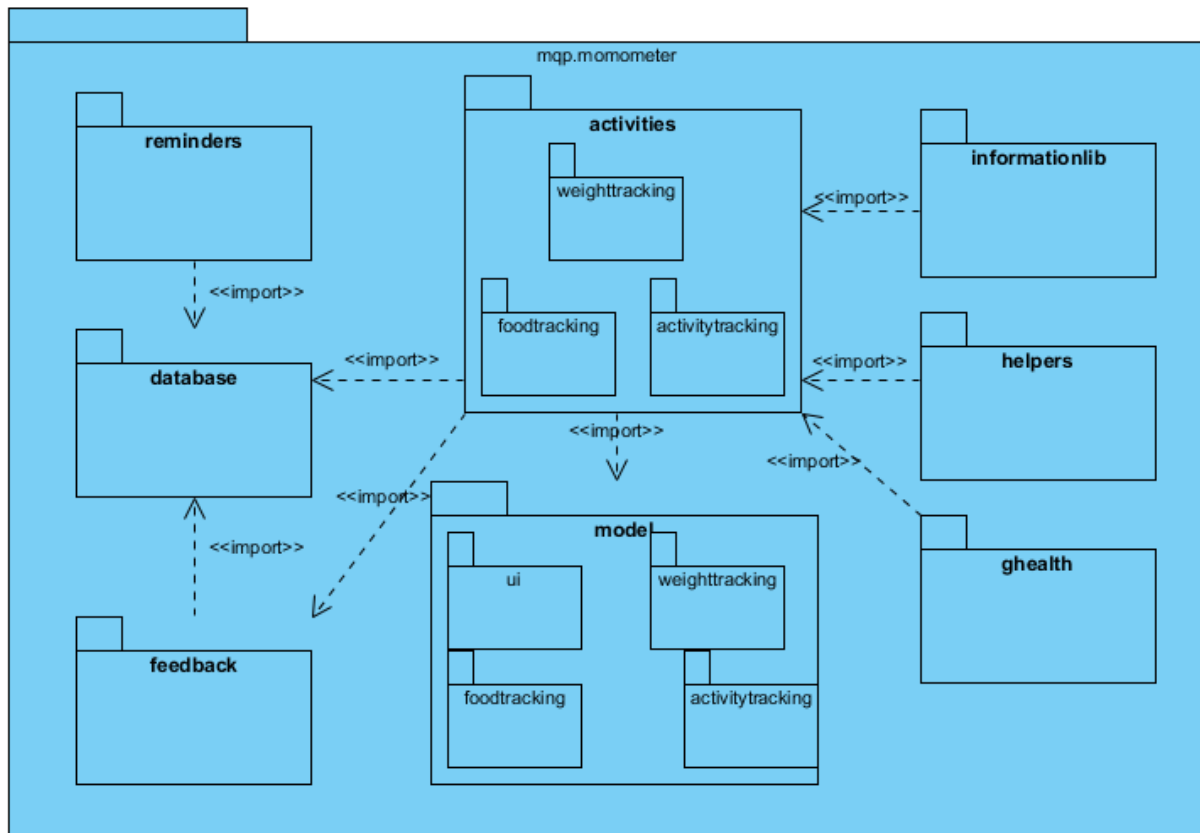
Figure 4-4: Package diagrams

4.4.   Database model

The database model represents the business entities we identified based on the product requirements. From this model we were able to build the objects and classes in our application to encapsulate and represent these entities. Figure 4-5 shows the entities that we created in the SQLite database for the application.

4.5.   Feedback engine

The feedback engine for our application is used to provide qualitative and quantitative feedback to the user based on their data input. It is used to let the user know if she is gaining the appropriate amount of wait, eating a healthy diet, and exercising enough, all of which are important factors to take

into account during pregnancy. The information and criteria used by the feedback engine were taken from the research project our sponsors provided to us. This information is summarized in our background chapter (section 2.2). The feedback component is divided into the following sub-components: weight gain feedback, nutrition feedback, fitness activity feedback.
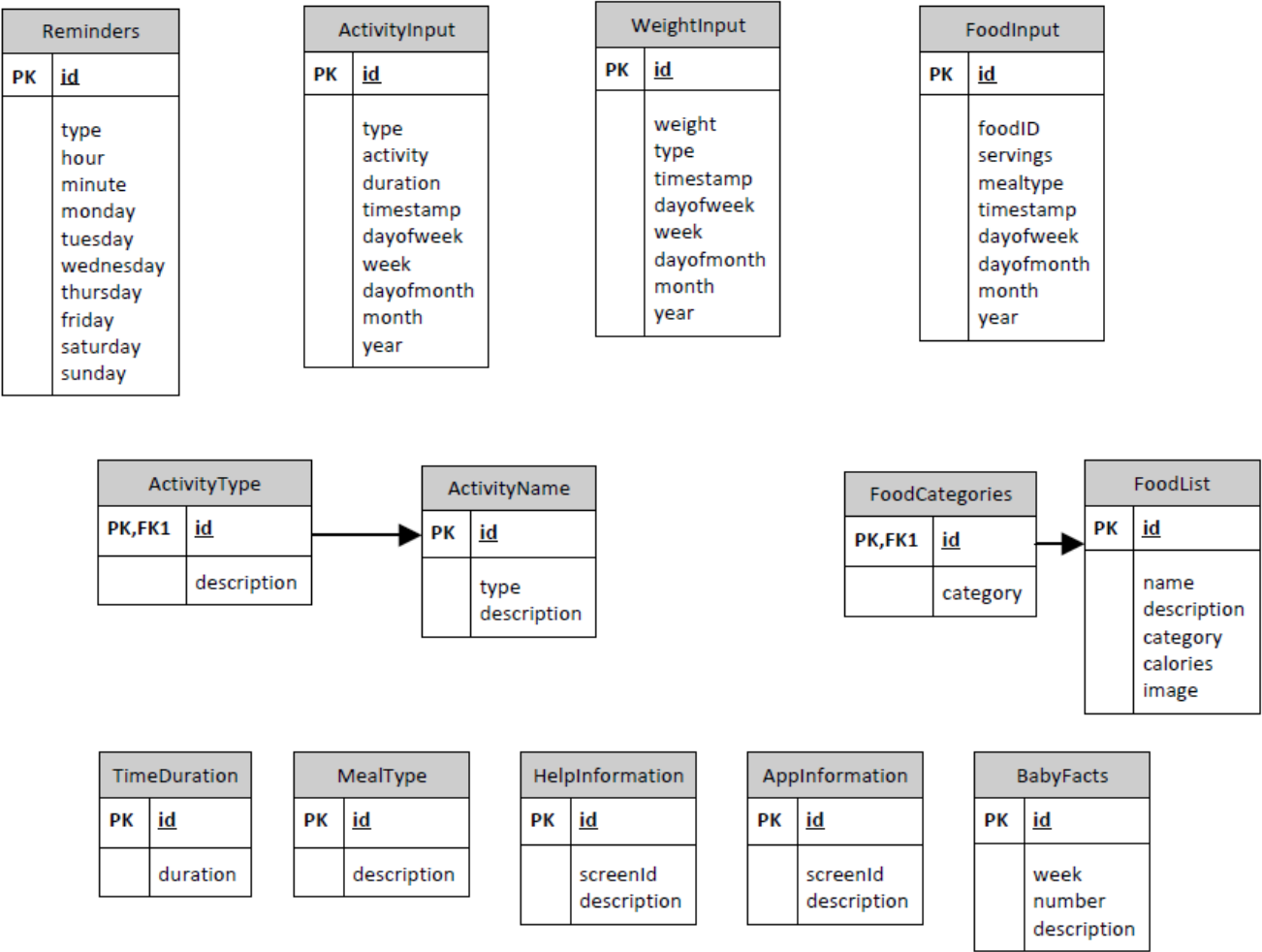
Figure 4-5: Entity-Relationship diagram

4.5.1 Weight Gain Feedback

The weight gain feedback subcomponent uses the pre-pregnancy BMI information and the current week in pregnancy in order to determine the GWG trajectory. It then compares the user's weight gain during the week (GWG) to see whether this weight gain falls in line with the GWG trajectory. Figure 4-6 summarizes how this sub-component works.
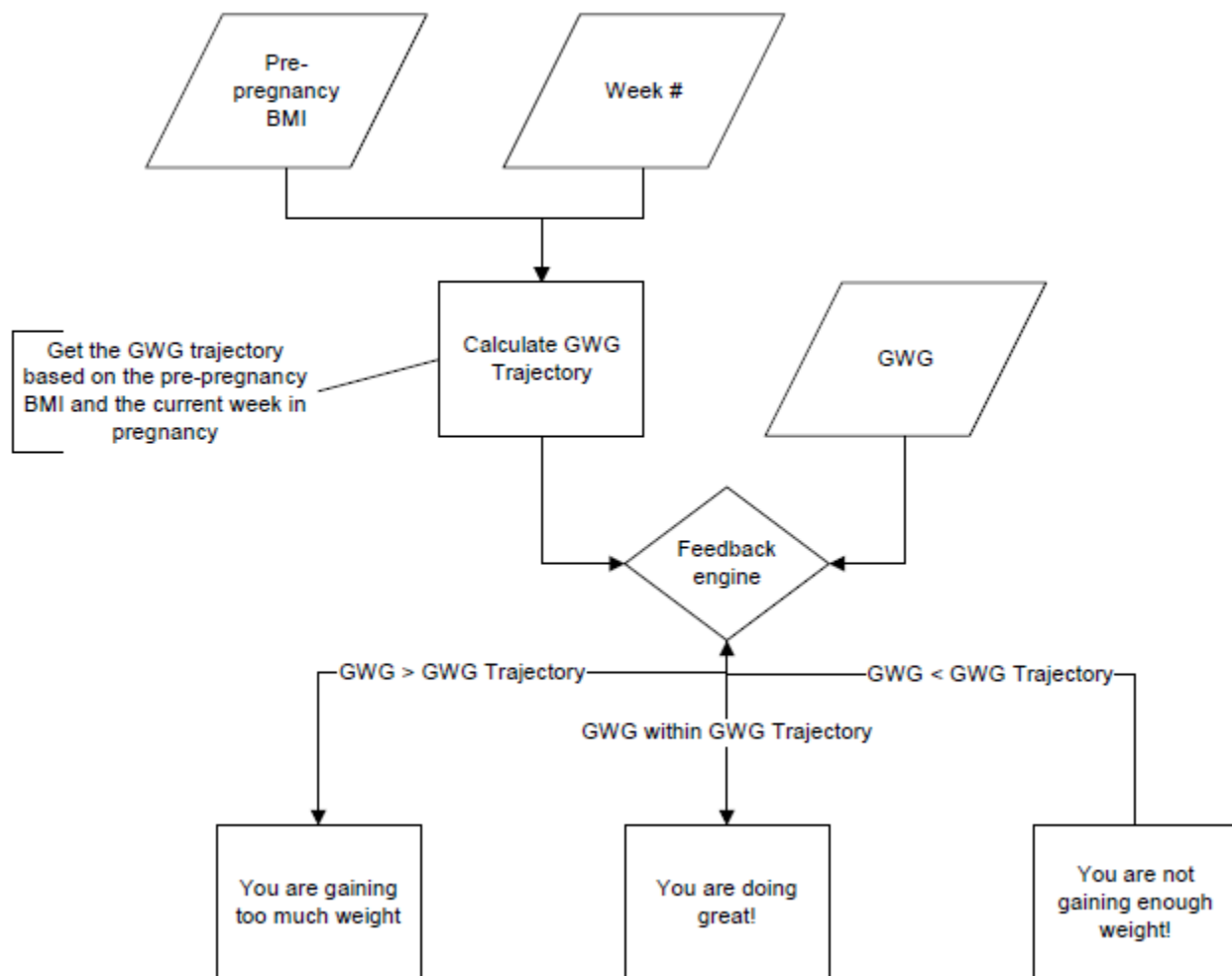
Figure 4-6: Weight feedback algorithm

4.5.2 Nutrition Feedback

The nutrition feedback sub-component looks at the user's daily food intake and determines whether the user is eating a healthy, balanced diet based on his/her BMI and exercise pattern. Figure 4-7 summarizes this feedback process.
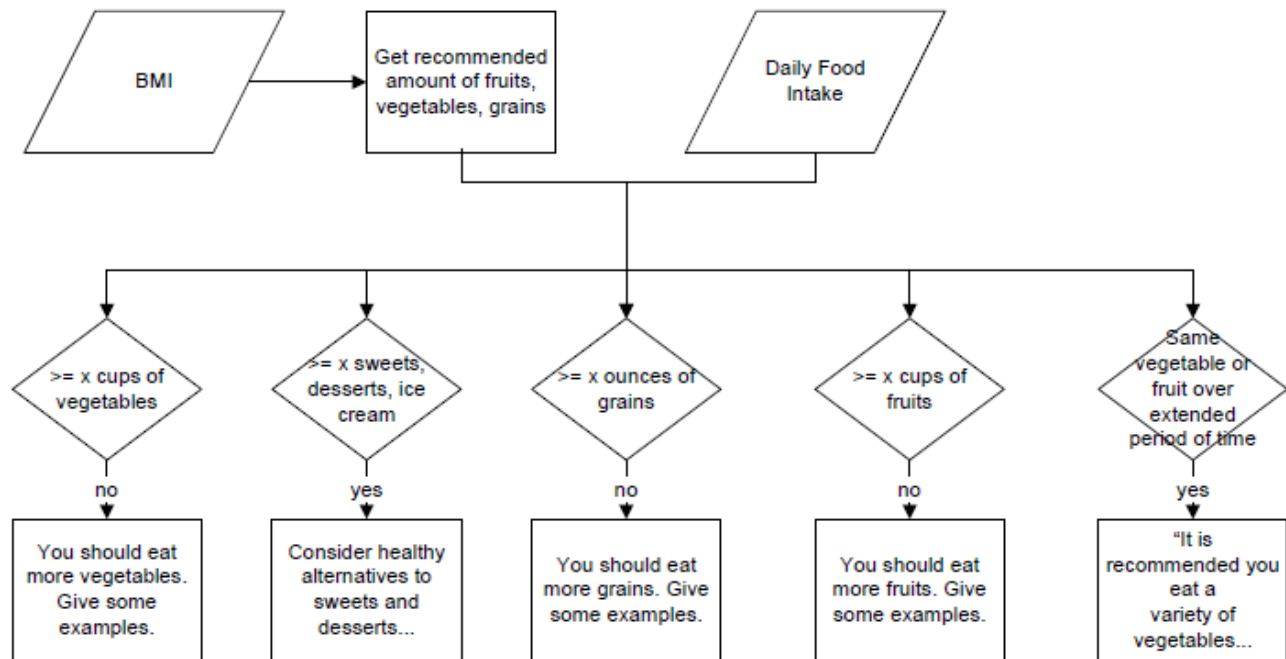
Figure 4-7: Nutrition feedback algorithm

4.5.3 Fitness Activity Feedback

The fitness activity feedback checks to make sure that the user is exercising at least 30 minutes a day and lets the user know if he/she is not doing so and encourages the user to exercise more. It also provides a list of exercise activities that the user could try out.
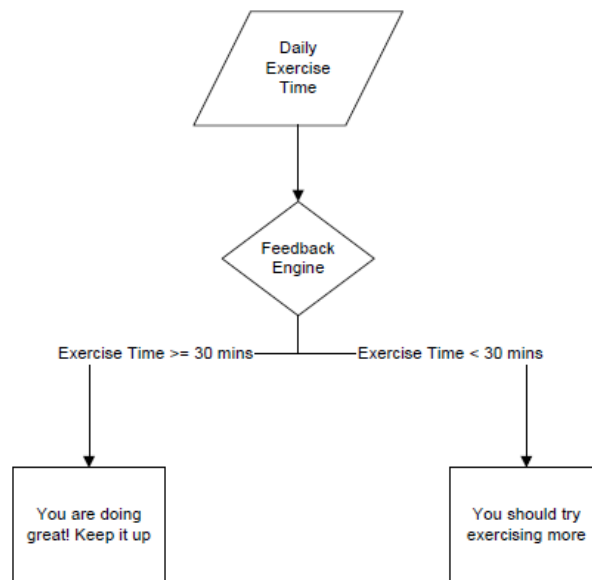
Figure 4-8: Activity feedback algorithm

4.6.   Use case diagrams

In this section we look at how the user interacts with the application. Since this application is a smartphone application, there is only one user interacting with the system, therefore we assume that the user interacts with all the use cases in the diagram. Figure 4-9 shows the main front-end components with which the users interact and the different functions of each component.
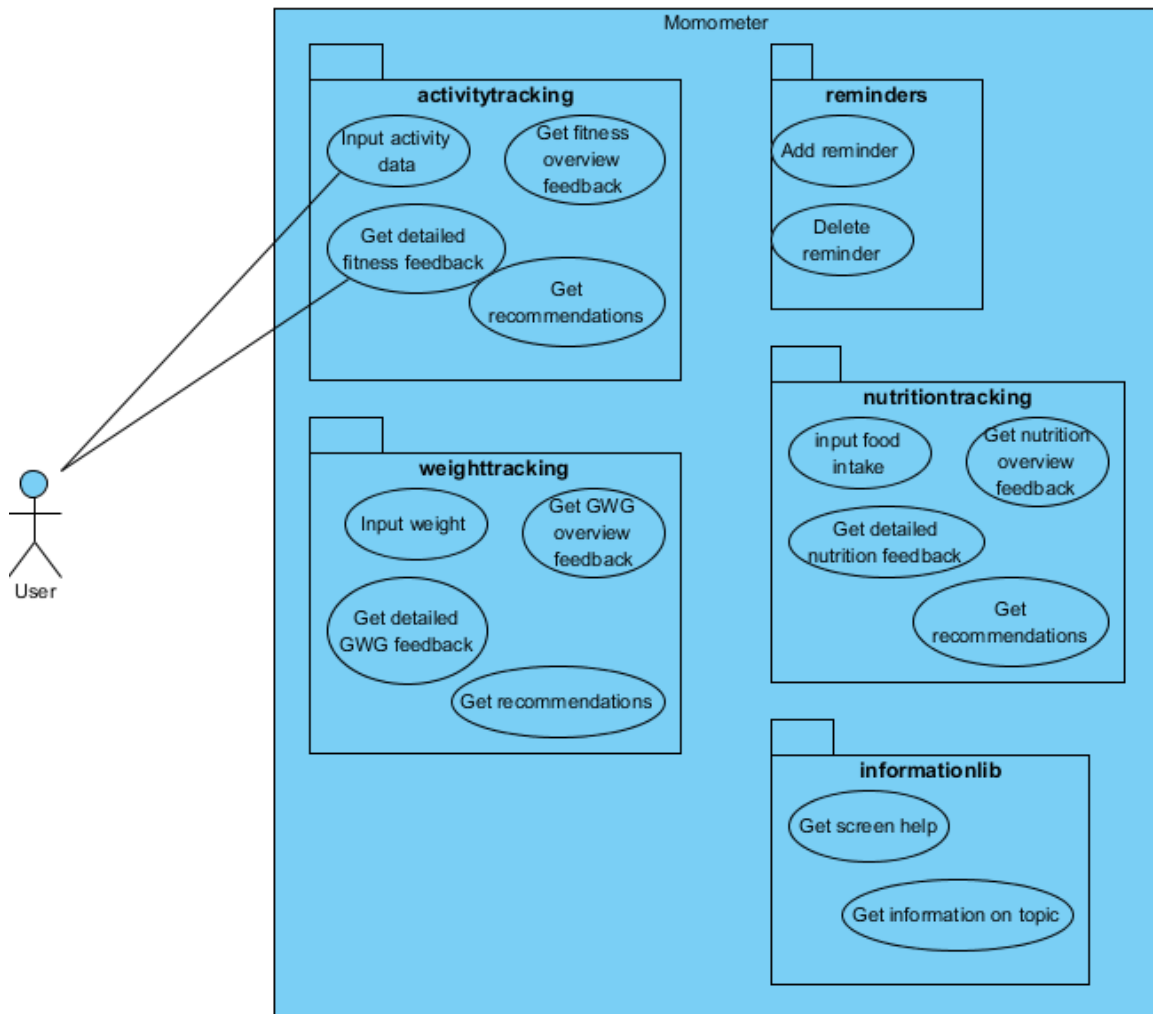
Figure 4-9: Use case diagram

4.7. Logical flow diagrams

In this section we look at how the application logic flows. Each figure represents an individual activity in the application. Figure 4-10 shows the logic behind the main activity, that is, the first activity that is launched when the application starts. When the application starts, it checks to see if the database has been set up. If not, the activity goes ahead and sets up the database by creating and populating the required tables. Next, it checks to see if the user's Google Health profile is setup. If not, then it will start the GHealth Setup Activity. If it is set up, then the activity checks to see if the user's profile has been setup. If not, then it will start the Setup Activity. Otherwise, if both the Google Health profile and the user's profile have been setup, the activity will launch the Home screen activity.
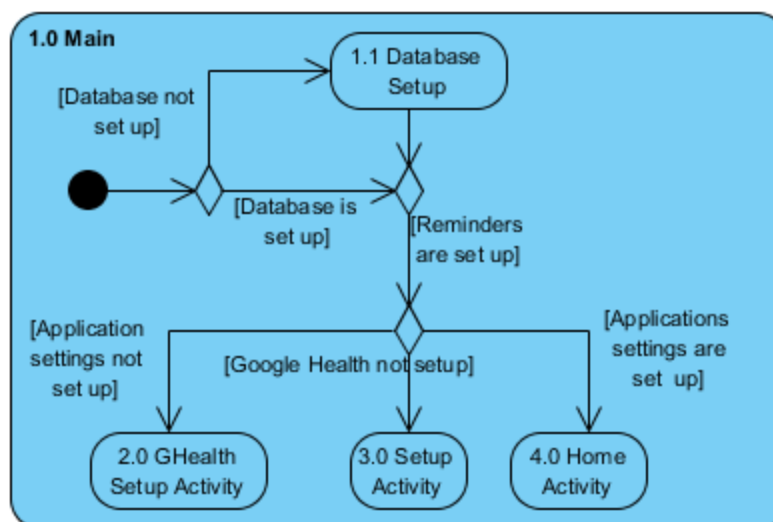
Figure 4-11 shows how the GHealth Setup Activity. First, the activity will pull up a list of the Google accounts stored in the user's phone and ask the user to choose one to associate with the application. This information is then stored into the shared preferences so that the application does not need to ask the user again. Next, the application retrieve's the selected account's authorization token from the phone's account manager component, in order to log into Google Health. The application will then retrieve the user's Google Health profile and prompt the user to select one to use with the

application. If the user does not have a Google Health profile set up, then a default one will be created.

This profile information is then stored into the shared preferences and the set up activity is launched.
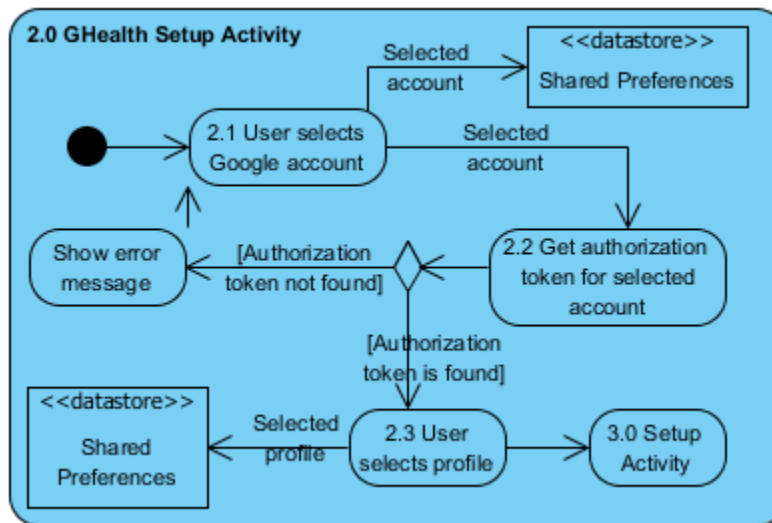
Figure 4-11: GHealth setup activity

Figure 4-12 shows how the setup activity works. The activity asks the user for her current

pregnancy, height, and weight and stores this information into the shared preferences. It then launches

the home activity.
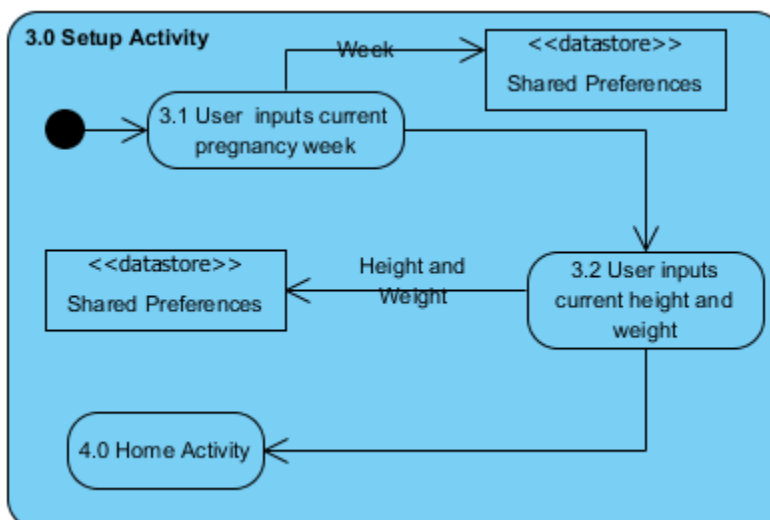
Figure 4-12: Setup activity

Figure 4-13 shows how the home activity works. The home activity represents the application's home screen, from which the user can access all of the application's features.
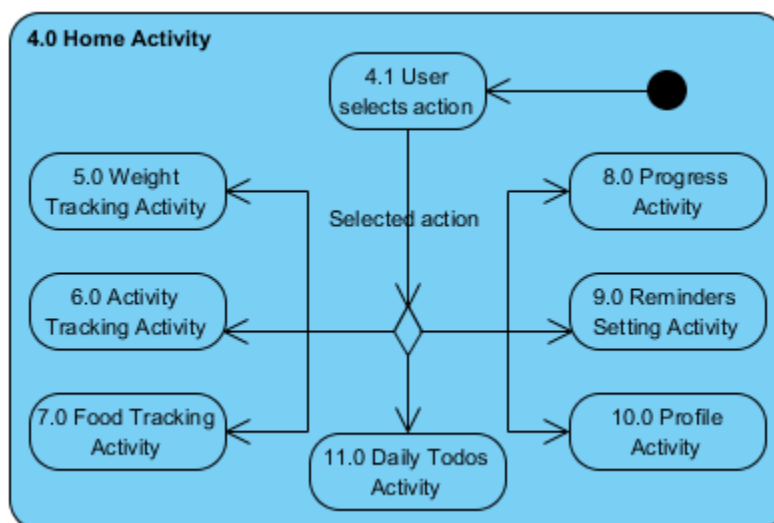
Figure 4-13: Home activity

Figure 4-14 shows how the weight tracking activity works. This activity allows the user to access the weight tracking features. The user can selected from one of the three tabs: weight overview, details or input, and can also get general feedback on her weight gain by pressing the feedback button. Feedback is generated by getting the user's weight data from the SQLite database, calculating the GWG, and retrieving feedback from the Feedback Generator using the current week and the calculate GWG. The feedback is then displayed to the user.
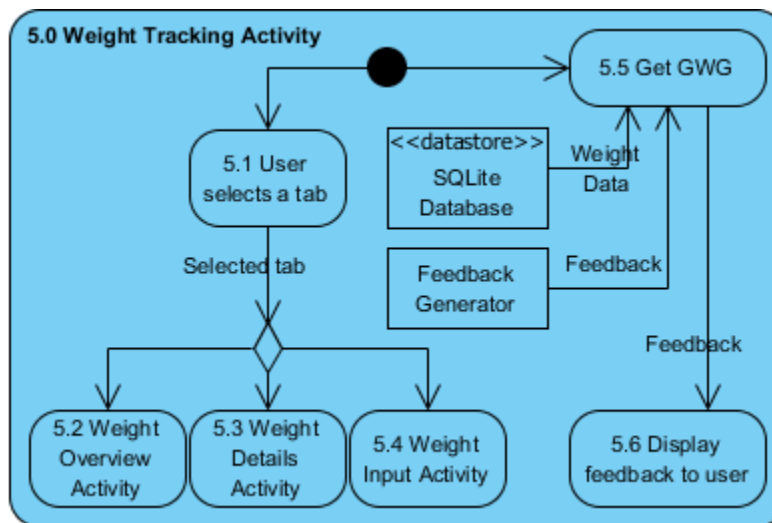
Figure 4-14: Weight tracking activity

Figure 4-15 shows how the weight overview activity works. The activity calculates the user's GWG over the past week using data retrieved from the SQLite Database. It then retrieves the GWG trajectory for the current week from the Feedback Generator, and compares this to the current GWG to calculate the user's progress. This progress is then displayed to the user using the progress bar.
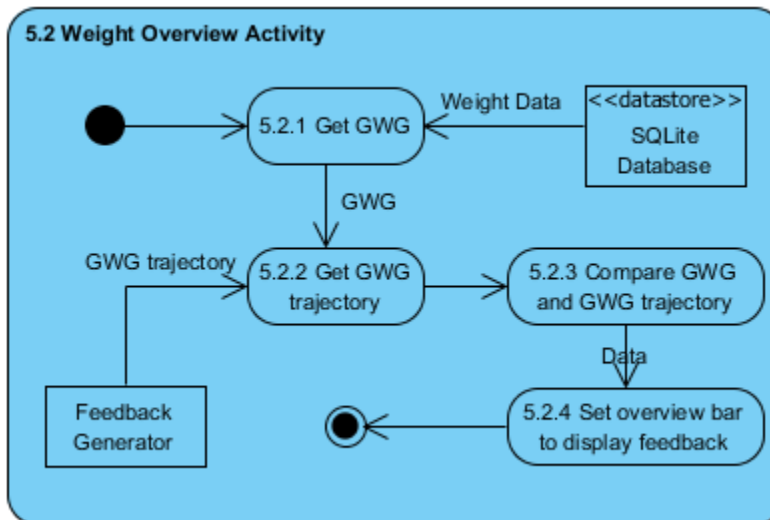
Figure 4-15: Weight overview activity

Figure 4-16 shows how the weight details activity works. This activity displays the user's weight gain over by week over the past weeks. It retrieves the user's weight data from the SQLite database and

constructs a Google Charts URL, which will be used to generate a webview chart from the Google Charts

services. This chart is then displayed to the user.
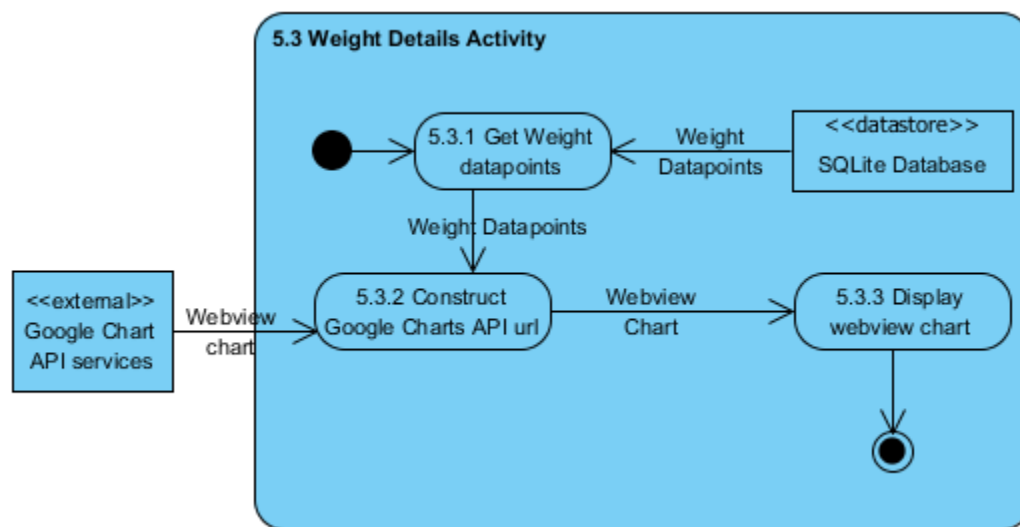
Figure 4-16: Weight details activity

Figure 4-17 shows how the weight input activity works. The user inputs her current weight in

either pounds or kilograms. The activity will store this data in the SQLite Database and will pass it to the

Google Health Client so that it stores the data in the user's Google Health profile. The activity will then

notify the user that the data has been stored and will navigate back to the weight overview screen.
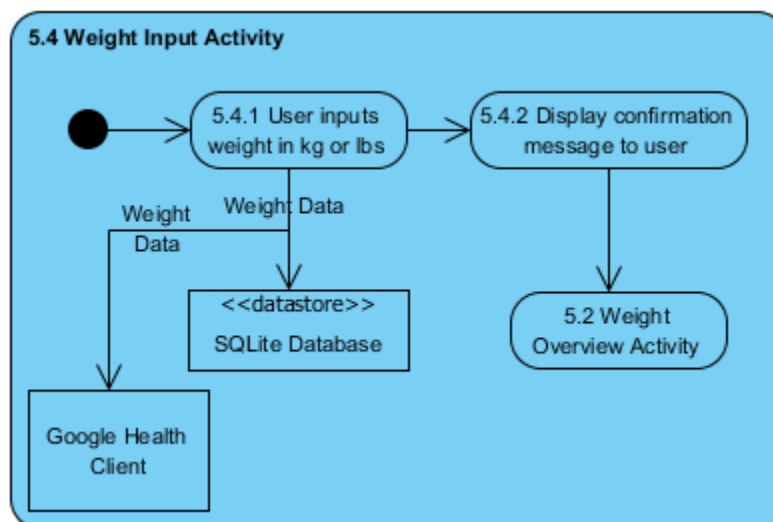
Figure 4-17: Weight input activity

4.8.　　　Summary

This chapter outlines the architecture of the system we built, as well as the implementation of the general logic and flow of the application, thus providing enough details and documentation for any other group to pick up our project and be able to recreate it or expand upon our final product without having to spend too much time looking through our source code and trying to understand it.

5. Results

The goal of this project was to create a system that would serve as a self-help health tool for pregnant women to better care for themselves and maintain a higher level of health for them and their children. Through close support and collaboration with Dr. Tiffany Moore-Simas and Dr. Milagros Rosal of UMass Medical School, we were able to design, develop, and implement the Mom-O-Meter smartphone application. Because of the timeframe of this project, we were forced to limit our scope to include essential functionality and content specific to gestational weight gain.   Throughout development, we concluded there is significant future development that would take this application from a gestational weight gain specific tool to a full-featured pregnancy application.   This section summarizes the changes that we have implemented based the feedback we received based on the focus group sessions and interviews. This chapter also serves to summarize the results of the various other aspects of the project, such as discussion of results, bugs and limitations of the application, implications, and overall recommendations.

5.1.   User Interface Design

The Graphical User Interface (GUI) of our application went through a number of revisions before the final layout was accepted. Our first version, illustrated in Figure 5-1 and Figure 5-2 was our initial proof of concept, and our first attempt at making a UI utilizing Android technology. Our purpose with this design was to break down the application into manageable segments, and establish menu hierarchy. One of the major things we decided on in this phase was to implement the six-button home screen, and tabbed overview, details, and input screens. The intent was to make it easy to navigate to different parts of the similar nature.

Figure 5-1: Initial Home Screen UI Design
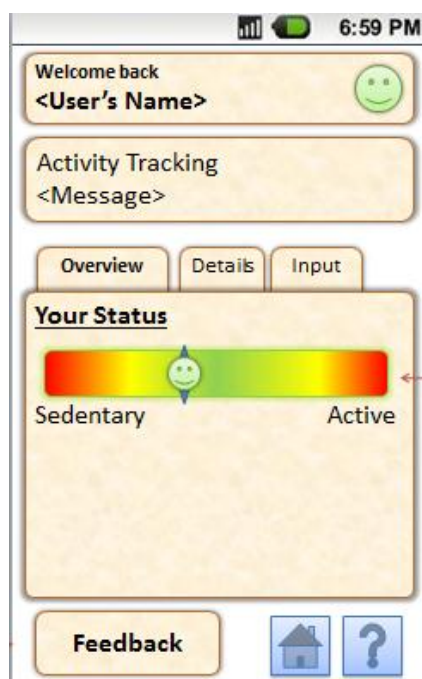
Figure 5-2: Initial Overview Screen UI Design

Our next iteration of the User Interface had one goal, make it look nicer. Our first interface stressed the functionality of the application, but was too unrefined to bring to our focus groups. We wanted our feedback from participants to focus mostly on the layout and ease of use of the application. In order to limit discussion on the bland and sterile nature of the UI a number of small changes were made. One major change to the home in this iteration was adding a background image, and changing from large text buttons, to smaller icons with text below. This made the application easier to follow and easier to look at. In addition to making changes to the home screen, at this point we implemented our first food input screen. The Interface in this iteration can be found in Figure 5-3 and Figure 5-4.

5.1.1 Focus Groups Summary
Background

Focus group research was conducted to aid in the design of the User Interface (UI) design of the application. There were two groups conducted at UMass Memorial Medical Center:

One group on 12/6/10 from 6:00pm-7:30pm

One group on 12/8/10 from 3:00pm-4:30pm

The participants for the groups were recruited to be pregnant women and English speaking.

The focus group discussions lasted approximately 90 minutes (see appendix Appendix D for the full transcripts of the focus groups). Participants were asked to complete an entry survey for demographic information. The initial discussion covered general background of weight gain guidelines during pregnancy and an introduction to smartphone applications and key vocabulary that would be used during the discussion. Participants were given demo phones with the application on it and were asked to follow along to a presentation of the application that was focused on particular aspects of the UI. Both groups were shown the same material.

Summary of Focus Group Demographics

The two focus groups consisted of a total of 9 pregnant women ranging in age from 19-31. The women were in their 11th-38th week of pregnancy. The following races were represented: black (1), white (7) and Asian (1). One participant did not report her race and another reported white and Asian. Two participants identified themselves as being Hispanic/Latina, five identified themselves as not Hispanic/Latina and the remaining two participants did not respond. All participants reported having graduated high school or attained a GED. Five participants reported graduating college, while three reported they had either attended or were attending some college. Five Participants reported their employment status as unemployed but looking for work, three of these participants also reported being students. Three participants reported being employed (two full time and one part time). The remaining participant reported their employment status as being a housewife. All participants reported owning a

cell phone that included phones manufactured by LG, Samsung, RIM (Blackberry), and Apple (iPhone). Seven of the participants reported having used an application on a mobile device (such as a cell phone or an iPod), while two did not. Table 5-1 presents the reported cellphone usage among participants:

Table 5-1: Survey participants cellphone usage

Cell Phone Uses	Participants
Making Phone Calls	9
Text Messaging	9
Applications	6
Scheduling/Calendar	7
Browsing the Internet	7
Send/Receiving Email	6
Multimedia (such as watching videos or listening to music)	5

Eight of the participants reported their doctor had talked to them about the amount of weight that would be healthy for them to gain. Seven of the participants reported that they had never used a program to help monitor their weight, diet or physical activity. Seven of the participants reported that they knew their ideal weight when not pregnant. Five of the participants reported that they did not own a scale at their homes. Six of the participants reported they are currently on their first pregnancy.

Results/Themes

a) Desire for a full featured pregnancy application

There was an overall desire for a fully featured pregnancy application that would provide the participants with a one stop shop for everything related to their pregnancy. This is an overall theme that resulted from the focus group. Several of the components from the other themes involved suggestions to make the application into a full featured pregnancy application. Many of the participants wanted an application that did more than help them manage their weight gain during pregnancy. They wanted the application to be their information source for everything related to their pregnancy; they requested a variety of features that ranged from nutrition and baby development facts to a social networking

component. While the purpose of this particular group of focus groups was to evaluate the user interface, it was important to note that this theme was prevalent throughout the discussion.

b) *More information*

The most prevalent theme from the focus groups were the women desired a lot and a variety of information regarding their pregnancy. This desired information included:

- Activity based information
    - How much is healthy? There were concerns about how much they should get and how to avoid getting too much.
    - Calories burned during activities, particularly non-exercise specific ones such as cleaning. There is a desire to see the calories consumed compared to calories expended in activity.
- Progress related information
    - Pictures of baby development
    - General information about development of the baby, such as what body parts are developing that week.
    - A pregnancy tracker/ countdown to delivery
- The participants wanted a tip of the day that would either appear on the main screen of the application or appear as a pop-up when they entered the application. They noted the following information for inclusion in the tip of the day:
    - Managing symptoms of pregnancy – such as back pain or nausea
    - For healthier eating
    - Tip of the day related to the risks of excessive weight gain (high blood pressure, gestational) and how to prevent the excessive gain.
- Food related information
    - The participants wanted information about alternatives to meals when they were dining out (e.g. compare options at McDonalds to subway)
- An example a participant gave was if she were craving pizza, she needs to know how much of her desired pizza she can eat (essentially, what is the size of a serving of that pizza?).

c) *Customization of the Look/Feel of the Application*

The participants also expressed a high level of interest in customizing the look of the application. They made suggestions for how we could change the application and for how they would like to be able

to customize the application specific to their preferences.   The things the participant would like to customize in the application specific to their particular use are:

- The participants wanted the ability to select their own color schemes, including being able to change the font type and color. The participants also provided the following feedback regarding what color schemes to offer:
  - Boy/Girl theme colors
  - Neutral theme (suggested yellow/green) for those women who do not know or do not want to know what their baby's gender is.
  - Other images that symbolize a baby/child (a suggestion was a rubber ducky)
  - Model the color schemes and themes after those typically used to decorate baby rooms.
  - The yellow bar used to display messages was disliked; a different color would be preferred.
- The participants all liked being able to view graphs of their progress, however some preferred different types of graphs (e.g. bar graph vs. line graph). Thus, they requested the ability to customize which type of graph showed their pregnancy.
- The participants differed in opinion on the proposed smiley face in the center of the application home screen. The purpose of the smiley is it would change how big of a smile was visible based upon the participants' progress. Some women did not want to have this additional form of feedback on the home screen, while others thought it was fine. Regarding alternatives, the participants suggested being able to upload their own picture (e.g. an ultrasound of their baby) or they would prefer a picture of a developing baby (ideally the picture of the baby would represent where the woman is in her pregnancy).
- The participants also wished to be able to set a picture that would be the entire background of the application.

d) The Application should Generate Suggestions

This theme linked closely with the participants desire for a high volume of information, they want the application to make suggestions on how to make changes to their habits, what is allowed, what they need to do and more. An example of this desire for suggestions was highlighted by one participant who said if the application does not make specific suggestions e.g. it just said she was consuming too many calories, she would probably not use the application.

- An example of a desired suggestion was that the application suggests the user get some exercise if they're gaining too much weight. Additionally, the participant would be amenable to other

alternatives (e.g. eating a healthier food option vs. their current option). They specifically noted they do not want to be told they're gaining too much weight.

- o Related to the exercise component, the participants wanted the application to make recommendations for particular exercises that appropriate and low impact.
- Another desired suggestion was what particular foods, vitamins and minerals the participant should eat that they are currently not eating. This could be tied into the desire for more information, since there are times when a pregnant woman needs more of certain nutrients because it is vital to the baby's development. The participants would like to know what these nutrients are and what they do for the baby's development.
- In general, the participants wanted the suggestions tailored based on their recorded information.
- A recommendation was to create suggestions that are based on the date for example:
  - o During the end of the year holiday season when extra weight gain is common, the application could offer suggestions for minimizing this weight gain.
  - o During the summer the application could give suggestions and reminders to and how to stay hydrated.
- A desired suggestion was tips for cooking at home.
- The participants noted aversions to certain foods and desired food suggestions based on these foods that are disliked. In addition, if they noted that they disliked foods that offer key nutrients for the baby's development, than the applications should provide suggestions on how to acquire these nutrients.
- The participants would prefer the feedback is supportive and/or funny, they do not want to feel like their phone is yelling at them.

e) *Feedback on Food Input Screens*

The food input screen requires the highest amount of inputs of any screen and therefore generated a lot of feedback. This feedback included, again, the desire for more information. The participants wanted information about serving sizes, particularly what is a serving size of a particular food and how do you know how much they had, available directly from the food input screen. Coupled with this desire for more information, the participants wanted the food input screen to offer a dialog that showed a sample food label and how to read it. Additional food input screen feedback included:

- The participants wanted a list of favorite of preferred foods to come up immediately when they input what meal they are entering. Additionally, they wanted their favorite foods to show up

regardless of what meal they are entering (e.g. they noted they often eat the same core foods, regardless of time of day).

- The participant's wanted to be able to create a list of favorite foods for easy access and entry; this was opposed to the application generating the list of foods based on the user's past entries.
- There was a strong desire to be able to create and enter a food that does not already exist in the food library of the application.
- There was an interest in the ability to customize the stored food menu and be able to track vitamins and other additional nutritional information not already defined in the application.
- There was a suggestion to offer an alternative library that consists of vegetarian foods since they contain different or no additives.
- Several participants wanted a search box that they could type in and search for foods opposed to searching for them by picture.

f) *Preferred Methods of Receiving Reminders and Information*

The participants expressed a desire to receive reminders and updates outside of the application but would like to be able to customize if they were email or text message reminders. Some examples of what the participants would like to receive: a message updating them on their weight gain, whether they are on track and a message announcing they have reached a milestone (such as the end of the first trimester).

g) *General Suggestions*

- On the weight input screen, when the onscreen keyboard appears, it should only provide numbers, not letters.
- Does the application adjust if the user is carrying multiples?
- One participant wants feedback from the application when something is submitted (e.g. the user enters a meal for the day and submits it; she wants a dialog saying the information was submitted).
- Include a notes section where the user could enter whatever she desired. A sample use of this would be so the information could later be shared with the doctor (e.g. noting what days the user got sick).
- One participant would like for the application connect to a forum or chat room to be able to talk to other pregnant women.

The Information button should contain the following information:

- How to easily delete inputs, an example use is if the user entered too many items for a meal.
- How to modify an input, an example use is if the user accidentally entered the wrong weight.

Figure 5-3: Iteration 2 Home Screen

Figure 5-4: First attempt at input screen

After conducting the focus groups and receiving generally positive feedback (detailed in section 5.1.1), we decided to make a few smaller changes to the interface. This mostly involved changing the color scheme, and making baby facts more accessible to the user. The final iteration is shown in Figure 5-5 and Figure 5-6.

Figure 5-5: Iteration 3 Home Screen
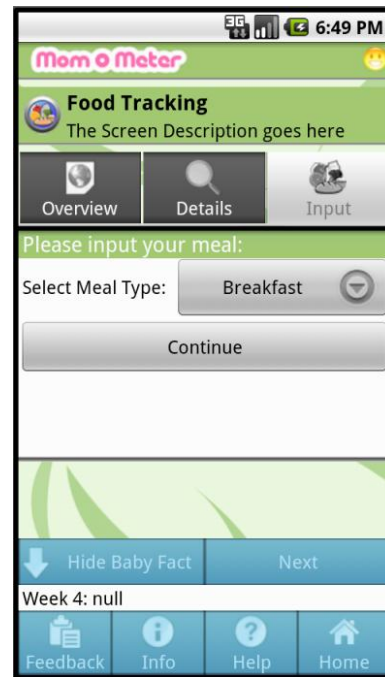
Figure 5-6: Iteration 2 Input Screen

5.1.2 Data Storage & Graphing

In order make the application run smoothly and to finish on time, we made changes to our data storage, features, and graphing mechanism. Initially we wanted all of our data to be stored online via Google Health. As we progressed further, we realized that if the user didn't have an internet connection with their phone, then the data would not be saved. In order to address this we created a local database of all the information and synchronized it with Google Health whenever possible. This change not only fixed several bugs with data storage, but also made our application run smoother. By reducing dependency on outside data new features and ideas could be implemented.

One of these major changes was changing the way that our graphs were created. Initially all of our data was graphed using a local algorithm to generate a single graph. However, after hearing that different women would like to see different kinds of graphs, we discovered the Google Charts API. This

open source addition to the project enabled much cleaner looking graphs, and enabled a greater variety

of graphs to be generated. The different graphs are illustrated in Figure 5-7 and Figure 5-8.
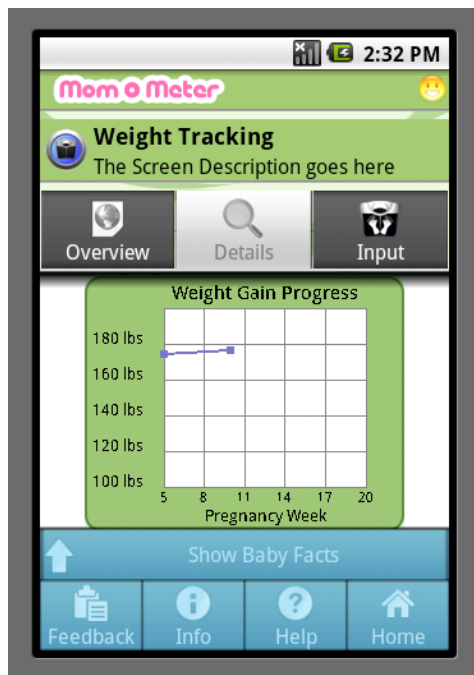
Figure 5-7: Old Details Graph
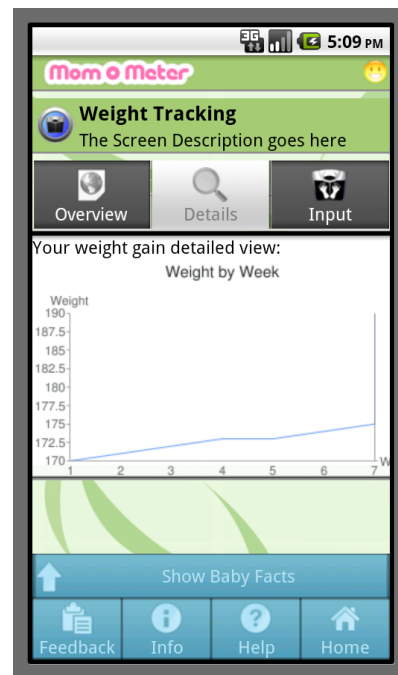
Figure 5-8: New Details Graph

5.1.3 Scoring and Personal Goal Management

Due to the development constraints surrounding our project we had to remove a scoring

component and personal goal tracking in order to deliver a high quality application on time. Initially we

wanted to provide each user with a single progress score which could be compared with other users in a

social network. After meeting with doctors we realized that this feature was not feasible. Since each

patient responds to different activities and diets in such a unique way, finding a way to quantify that

data in a non-arbitrary way was not easy. In order to adjust for this, we outlined a way for users to set

specific goals for weight gain, activity level, and nutrition. However, due to time restrictions this new

feature was never implemented, and has been moved to future work (see Chapter 6).

5.2. Interview Summary

As part of the final feedback gathering aspect of this project, we designed and conducted key informative interviews (KIF). The goal of these interviews was to generate some discussion with potential users to help us understand the clarity, appeal, and feasibility of a Smartphone application which proposes to inform women about gestational weight gain guidelines and motivate them to use and adhere to such recommendations. To accomplish this, we allowed potential patients to use the application, following some guidance as to what parts of the application to cover. Later the participant was asked a series of questions as to her opinions of the application as a whole as well as specific areas of the application (food input, etc.).

The results from the three key informative interviews were positive. The participants had a moderate degree of technology savvy and did not express much frustration in using the application during the time allotted. All of the participants were open to the application and expressed interest in using a final version and recommending it to a friend. There was a general acceptance of the design of the user interface and navigation of the application, with one participant noting, "It's just easy, you know? Everything is right there on the screen." The participants were especially excited about the fact that they did not have to manually write and keep track of all of this information and that it was easily available. The content of the application was also something the participants felt was useful and valuable. While the general consensus was that the application included a lot of relevant information, there was room for improvement and expansion of the content, especially as it pertained to the food and exercise library.

As a part of these interviews, we sought to learn what could be further improved as far as the user interface. The more prominent of these improvements is increased, or the ability to increase, font size in the application. There were also additions to the food input, outside of overall content, that

some of the participants wanted to see. The first is the ability to add custom foods readily from the input screen. Another is that the food selection screen does not save the foods selected or prompt the user to submit changes when the back button is pressed. There were also some bugs that were discovered. The most important of these is the food servings input screen in which the keyboard blocks the text box for inputting the number of servings. This proved slightly confusing for all of the participants.

In addition to the discussion on the interface and the application as a whole, there was discussion on possible future development. Aside from the expansion of the content, the participants wanted more customization. This pertains to customizing the colors, the ability to add custom foods, and the ability to add custom reminder text. These findings were consistent with those we gathered from the focus groups.

5.3.   Discussion

5.3.1   Implications, Takeaways, and Achievements
Because of the specific nature of this project, our group learned a lot about developing an application in the healthcare environment. Aside from the design and development of the application, there were additional special considerations for dealing with pregnant women at many levels.

The first aspect of this that we were careful to keep in mind throughout the project was that this application is not a replacement for a doctor. This influenced our development in a number of ways so that we not only provide relevant information, but also to not provide conflicting information that may have the potential to negatively affect the user. By working with our sponsors, we were able to carefully design and review every aspect of the application to follow generally accepted information and to also

motivate the user to eventually improve her health. This was especially important because the application gives feedback on the information the user provides.

While we were aware that there would be organizational differences between WPI and UMass Medical School, we quickly learned that scheduling and planning of the various aspects of our project was going to be fundamental to our success. Because of the nature of our agile development methodology, we collaborated with our advisors and sponsors on a regular basis and gathered feedback throughout the entire length of the project. Scheduling everything from our meetings to milestones far in advance allowed us to stay on track and mitigate any unforeseen setbacks. For example, the Institutional Review Board (IRB) between WPI and UMass Medical School operate significantly differently. A review of our proposed focus groups and interviews takes 1-2 weeks at WPI as opposed to UMass Medical School's 2-3 weeks as there is additional deliberation for "at-risk" populations, which include pregnant women. We took this into account when we had to file for a review for interviews toward the end of the project. Because we needed to design the interviews far in advance, we were able to adequately prepare for them by properly finishing and testing the application before we gave it users we interviewed in the time it took to get approval. Scheduling meetings with our sponsors was also very important because they both have very busy and different schedules. We could not have developed this application without the regular meetings with them, especially as a result of the special considerations we needed to take into account with our target demographic.

Obviously the implementation of the application was one of the major challenges necessary to overcome to call this project a success. While we all possess various degrees of programming knowledge, none of our group was a pure software developer let alone an Android developer. As a result, we had to learn all of the many facets of this kind of development. Integrating the various parts

of the application, from Google Health to the various modules of the application, meant that everyone had to have a clear understanding of the project and the systems in use. This is a major achievement, especially when it comes to the timeframe.

One of the most important of these challenges was to create a system that was not only functional and aligned with our goals, but also to design a system that was easy for another group to continue development on. Early on we realized that this application had great potential and that it had the possibility to be extremely valuable to both the woman using it and her doctor. We took particular care in adhering to as many best-practices as possible as well as carefully documenting the development. We know that if someone cannot readily understand what we did, there is not much opportunity to improve on it and turn it into an even more valuable tool.

The major implication of this kind of application is that it is adding to the changing paradigm of reactive medicine to proactive medicine. This application not only empowers the user to improve her health, thus improving the health of her child, but also increases communication between her and her health care provider in a positive way. While the application is not a replacement for a doctor, it is a helpful supplement that will lead to better healthcare in the future.

5.3.2 Limitations

Like any tool, our application is only as good as the person using it. Although our application is based around the idea of enhancing patient-centered healthcare, it requires accurate information to do so. If users fail to provide accurate information, or do not provide enough information, then the application will be unable to provide meaningful feedback, and may actually provide feedback or advice that is wrong.

The purpose of our application is meant to guide pregnant women in making healthy decisions during their pregnancy regarding their weight gain, nutrition, and physical fitness. However, it is not meant to serve as a replacement or substitute for visits with doctors or other medical personnel. Each patient is a unique case with a unique medical record that needs to be considered when medical decisions are made. Due to the confidential and complex nature of these medical records it is impractical to import them into the application, which makes it extremely difficult for the application to make a wholly informed medical decision. Our information and feedback is based on facts which are accepted by the medical community, however anything that our application recommends should also be discussed with the patients doctor. It is also important to note that the information that is stored in the application is only valid for a single fetus pregnancy, since multiple fetus pregnancies bring in so many unique variables to an already involved process.

6. Conclusions and Recommendations

In order to enhance mobile healthcare technologies we developed a functional Android smartphone application which will empower pregnant women to better monitor their gestational health. By utilizing Scrum, an agile methodology, we were able to quickly develop a prototype application, and held focus groups to solicit feedback on our initial design. After analyzing the initial feedback, we were able to refine our prototype, and gather more feedback through a series of interviews. In order to build a more comprehensive pregnancy application we have several recommendations.

Recommendation 1: Add Functionality to Enhance Real-time Communication

The patient-provider communication was taken into account with the ability to share information with providers through Google Health, but it can be taken a bit further. For instance, there could be a feature that would allow the user to live-chat with a real person for questions or concerns. There could also be a reporting feature that would allow the user to print out a report to bring to her doctor or nutritionist. In addition, there is the potential for social networking that could not only allow professionals to contribute, but also allow other women to connect with each other.

Recommendation 2: Expand Content and Enable Further Customization

To better allow the user to understand patients' behaviors, the application could be expanded in content as well as customization. The food library is one area that can be improved on. For example, there is potential to query an online food database to maintain an up-to-date listing of food and nutrition information. This would allow the user to input and find information on a wider variety of foods without additional effort. An enhanced food library would also help in tracking of how nutritious the user's diet is because all of the macro and micronutrients could be taken into account when giving

feedback. The application could also track the exact times foods are eaten and perhaps give feedback on alternative times to eat. It could also include a key for problematic foods so that it can give better feedback on alternatives. As the application stands now, there is no feature for including problematic toppings on foods, such as unhealthy dressings on vegetables. Future iterations could include a prompt to add those toppings when the foods are added. This could also include common pairings of foods when one item is selected. The exercise portion of the application could also be improved upon. As the application is now, only exercise is tracked, and feedback based on active vs. sedentary time is optional. This could be improved by developing a better way of defining active and sedentary time to help motivate the user to change her habits. The input for activities could also be expanded upon with a pedometer or the ability to incorporate Bluetooth pedometers to give more accurate feedback on how many calories were actually consumed. This could be supplemented with the GPS capabilities of the phone as well.

In addition to expanding the content, the application could also allow users to personalize their experience by customizing the look and feel of the interface. The application could be improved by adding additional color themes for the user to choose from. The food library could also allow input of custom foods that are unlisted in the current library in order to allow the patient to keep even more accurate records.

Recommendation 3: Enhance Provider's Access to Information

From the provider point of view, there is also a lot that can be improved. The first of these improvements is in the ability to generate reports on specific patients. This would allow doctors to keep up on their patients between visits and also have the ability to do more with those visits. Another feature that would be valuable for physicians and researchers is the ability to aggregate all the data from

a pool of users that can be used for a variety of research on gestational weight gain and pregnancy in general. There is potential for data on usability to be aggregated as well, which would be especially helpful in conducting a pilot study of the application and further improving its effect on users.

To conclude, our application enables pregnant women to monitor their weight gain, nutrition, and activity levels throughout their pregnancy. To enable these women to fully utilize the application, a comprehensive reminder system was created to ensure continued use for the duration of the pregnancy. By using the information provided by the user, we generate graphs to chart the progress of the pregnancy, and provide relevant feedback in order to keep the women on track for a healthy delivery. This data can be shared with the patients' doctor through the integrated Google Health profile, providing the doctors with an in depth look into the patients' pregnancy.

This application is a bold step in the world of mobile and patient driven healthcare, and we endorse using our application as the framework for a comprehensive pregnancy application. For future developers, we recommend expanding the overall feature set by integrating the application with providers' information systems, and making it more customizable. The nutritional component of the application could be improved as well by tracking additional nutrients and eating habits. We also advocate running further focus groups and clinical trials to test the effectiveness of the application. By following these recommendations, a comprehensive mobile pregnancy application can be produced.

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APPENDICES

Appendix A.   **System Request**

Project Name

Pregnancy Smartphone Application

Project Sponsors

Name: Tiffany A. Moore Simas, MD, MPH, MEd, FACOG

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Business Need

To empower patients with the ability to better and more effectively manage their gestational weight gain.

Functionality

Record daily physical activity data

Record daily diet information

Record weight

Daily Reminders/Alerts

Feedback on weight gain, exercise levels and diet

Personal goal tracking and management

Interface with Google Health

Provide information about pregnancy

Utilize Android platform

Expected Value

By allowing patients to take matters into their own hands and better manage their gestational weight gain, both patients and hospitals save time and resources since the patients make fewer trips to the hospital. Moreover, patients could attain a higher quality of life as the application will help them with dietary recommendations, reminders to exercise and to weigh themselves and ubiquitous access to information about having a healthy pregnancy in general. This would also lead to lower insurance premiums for the patients and further improve their living conditions for themselves and their children.

Clients get portable access to information about Pregnancy

- Higher quality of life

- Dietary recommendations

- Reminders to keep active

- Improved treatment options from health care professionals

a) Constraints

We have the constraint of the timeframe for this project, but with adequate communication and coordination we will be able to finish this project in an efficient manner within the time allotted.

b) Standards

- Any function must have its description before coding that specifies, the name of the function, the description of what the function do, and what input and output variables are available including all datatypes

- Any variable and function must be named first word lowercase, and capitalize first letter of every words that follow after the first word

    o eg. helloWorld

    o eg. getCharCocaCola()

- Any name value of string at strings.xml must be all lowercase

    o eg. capturefoot

    o eg. @strings/myprofile

- Any strings must be retrieved from strings.xml

c) CASE Tool

For the application we are developing, our team will utilize Visual Paradigm, which is installed on school computers, during the analysis phase to create integrated diagrams of the system. The team will create UML class and package diagrams that will describe the overall structure of the system as well as data models that will describe the tables and entities we have identified for the application. We will also create diagrams for the various components of the application. These diagrams will serve as the blueprint for that will guide our development efforts throughout the agile software development lifecycle.

d) Risk Assessment

The following set of risks posed to our project includes both internal team risks (e.g. limited mobile application development experience) and external risks involving access to sponsors.

1.	Likelihood of risk:	Potential impact on the project:	Ways to address this risk:
The development of the application may be slowed because several group members have limited programming experience, especially regarding Android applications.	High probability of risk	This risk actually poses two potential risks. Either the application delivery date may be delayed a few extra weeks and/or some components of the application may need to be moved out of scope.	Two group members have significant programming experience and the other members do have some experience. The workload and resource allocation is set to maximize each member's ability.
2.	**Likelihood of risk:**	**Potential impact on the project:**	**Ways to address this risk:**
The current requirements may require too much design and programming time.	Low-medium probability	This risk will result in the finished product being smaller than currently scoped.	The team is working to develop prototypes already and will scope the work required to complete component to assure the highest value components make it into the application. While this risk may not be fully prevented, the impact can be minimized with scoping and identifying the highest priority components.
3.	**Likelihood of risk:**	**Potential impact on the project:**	**Ways to address this risk:**
The finished application may be cumbersome to use despite a high quality design.	Low probability	The risk will likely result in a reduced adoption rate for pregnant women.	It is very important that the project team creates prototypes and continuously gathers feedback on those prototypes to enhance the functionality and usability of the application. The team will also deploy a pilot program to gather feedback and overall usability of the application. This risk will be

4.	Likelihood of risk:	Potential impact on the project:	Ways to address this risk:
			heavily managed by focusing heavily on the usability of the application.
Patients are not receptive to the technology.	Low probability	The patients will not provide adequate feedback on the application which will hinder further development.	It is important that the project team's test groups consist of women that are also receptive to new technology, which is the target group for this application.

e) *Economic Feasibility*

1) According to our project timeline, during A term we will spend approximately 268 hours researching and working out the project plan. These tasks are broken down into the following components:

Planning, Analysis, Design	
Project Plan	42 hrs
Paper	29 hrs
Program Analysis & Design	51 hrs
Documentation	5 hrs
Program Prototype	146 hrs
Total	**273 hrs**

Each team member will contribute to the research paper and will help design a project plan for developing the application the following term. Assuming that we project member puts in 8 hours per week and there are 5 project members, we can accomplish around 40 hours of work per week. The time frame for building the application is 7 weeks. Therefore we have a total of 280 hours to build the

application and test it. Given the above calculations we deem it economically feasible to deliver the project plan and a rough draft of the research paper in the given time frame.

The standard entry level IT consultant hourly rate range is between $14.41- $31.11/hr. [http://www.payscale.com/research/US/Job=Information_Technology_(IT)_Consultant/Hourly_Rate] The median of this hourly rate is $22.76/hrso the total cost of consulting in A term will be **$6213.48**.

2) According to our project timeline, during B term we will spend approximately 235 hours developing the software application. The application is broken down into the following components:

Google Health Component	40 hrs
Smartphone Component	80 hrs
Object Layer	10 hrs
Notifications Component	35 hrs
Data Layer	10 hrs
Scoring Mechanism	60 hrs
Total	**235 hrs**

Each member of the team will be coding part of a component. Assuming again that we have 280 working hours as in A term, we deem it economically feasible to deliver the functionality outlined in the requirements section within the given time frame.

The standard application developer rate is $27/hr, so the total cost of development in B term will be **$6345**.

3) According to our project timeline, during C term we will spend approximately 259 hours writing the final research paper, conducting the pilot and training programs, and performing the final presentation. These tasks are broken down into the following components:

Final Paper	200 hrs
Pilot Program	25 hrs
Training	30 hrs
Presentation	4 hrs
Total	**259 hrs**

Given that the standard IT consulting rate is $22.76/hr, the total cost of consulting in C term will be **$5894.84**. From the above information we calculate that the total cost of the project over the three terms will be **$18453.32.**

f) Staffing Plan

Our team consists of members with strong business and technical background, with experience in various aspects of the information technology industry. Some of the skills we possess are:

- Project Management
- Microsoft Office proficiency
- Database systems
- Knowledge of various programming languages: (SQL, Java, Visual Basic, …)
- Software Engineering Principles
- CASE Tools

- User Interface Design

- Graphical Design

g) Communication

Our team's major strength is the strong communication skills each member has. We have routine meeting times where we discuss progress, address new issues, share information, and collaborate toward a finished product. Outside of these regular meeting times, we rely heavily on email and phone communications.

h) Team Members

Tom Jenkins has experience in various aspects of information systems from hardware implementation to business analytics. His previous experience lies in IT consulting for various companies, from purse makers to financial institutions such as Merrill Lynch, to make sure each business has access to the technology and services that allow them to compete in the digital world. This experience will allow him to properly identify the business needs by communicating with the customer and come to the best possible solution the delivers the most value. His experience with rational databases, object oriented design, hardware, program/project management, and business intelligence will make sure the project aligns with the customer needs.

Michael Ng has experience in the software engineering and systems analytics field. He has experience coding in both .Net and Java and the overall infrastructure that support both development environments. Michael has worked as an IT consultant developing .Net solutions for the past couple of years and as an application developer at Travelers Insurance. This experience will allow him to better understand and anticipate the needs of the customer and deliver the most cost-effective solution. Michael focuses on core design patterns and principles that will allow the team to develop an application with clean code and that is easily maintainable and extensible.

Evan Duderewicz has experience in information systems, both on a small scale for a restaurant and on a large scale for Fidelity Investments. He has working experience as a systems analyst and has worked on initiatives including bringing an order management system to a restaurant and working closely with a financial unit on automating their client reporting. He is very experienced in working on project teams. His experiences include working with relational databases, object oriented design, UI analysis and design and hardware. Evan's combined experiences and skill set enable him to work closely with businesses to design a system that fully meets their needs.

Ken Miyauchi has experience in both e-commerce marketing and designing at a small scale company in Japan. The experience lies in launching iPhone application to the AppStore, as well as analyzing and designing six different e-commerce websites. His expertise on both marketing and development aspects will contribute on identifying true wants of the users, their behaviors on the application, and the most efficient programming solution to the project members.

In this project Brendan Harris will be the User Interface Lead. His strong background in UI design makes him a strong candidate for this position. Additionally, Brendan will bring the interpersonal skills necessary for him to explain the interface to new users, and to gather information about the interface in order to make appropriate design decisions for the end users. While Brendan might have prior UI and coding experience, they are far from his strong suit and will be a challenge for him. In addition to working with the coders and end users to identify interface improvements, Brendan will also work as a writer for the final report.

Appendix B. Project Timeline

Task Name	Duration	Start	Finish	Actual Hours	Add
⊟ A Term - Planning, Analysis, Design	32 days	Wed 9/1/10	Thu 10/14/10	1,580 hrs	
⊟ Project Plan	15 days	Wed 9/1/10	Tue 9/21/10	600 hrs	
Gantt Chart	5 days	Wed 9/1/10	Tue 9/7/10	40 hrs	
System Request	10 days	Wed 9/1/10	Tue 9/14/10	80 hrs	
Project Requirements	6 days	Tue 9/7/10	Tue 9/14/10	48 hrs	
⊟ Feasiblity study	6 days	Tue 9/14/10	Tue 9/21/10	96 hrs	
Technical	6 days	Tue 9/14/10	Tue 9/21/10	48 hrs	
Economic	6 days	Tue 9/14/10	Tue 9/21/10	48 hrs	
⊟ work plan	6 days	Tue 9/7/10	Tue 9/14/10	96 hrs	
Task identification	6 days	Tue 9/7/10	Tue 9/14/10	48 hrs	
Time estimation	6 days	Tue 9/7/10	Tue 9/14/10	48 hrs	
staffing plan	6 days	Tue 9/7/10	Tue 9/14/10	48 hrs	
project charter	6 days	Tue 9/7/10	Tue 9/14/10	48 hrs	
CASE tool	6 days	Tue 9/7/10	Tue 9/14/10	48 hrs	
Standards list	6 days	Tue 9/7/10	Tue 9/14/10	48 hrs	
Risk Assessment	6 days	Tue 9/7/10	Tue 9/14/10	48 hrs	
⊟ Paper	30 days	Wed 9/1/10	Tue 10/12/10	752 hrs	
Introduction	5 days	Wed 9/1/10	Tue 9/7/10	40 hrs	
Background	5 days	Wed 9/1/10	Tue 9/7/10	40 hrs	
Motivation	16 days	Tue 9/14/10	Tue 10/5/10	128 hrs	
Problem Statement	6 days	Tue 9/7/10	Tue 9/14/10	48 hrs	
Literature Review	30 days	Wed 9/1/10	Tue 10/12/10	240 hrs	
Methodology	16 days	Tue 9/14/10	Tue 10/5/10	128 hrs	
Proposed Solution	16 days	Tue 9/14/10	Tue 10/5/10	128 hrs	

⊟ **Program Analysis & Design**	**19 days**	**Wed 9/1/10**	**Mon 9/27/10**	**132 hrs**	
Logical Flow Diagrams	7 days	Wed 9/1/10	Thu 9/9/10	8 hrs	
Use Cases	7 days	Wed 9/1/10	Thu 9/9/10	8 hrs	
Database Model	7 days	Wed 9/1/10	Thu 9/9/10	8 hrs	
⊟ **UI Design**	**7 days**	**Thu 9/9/10**	**Fri 9/17/10**	**32 hrs**	
Use Scenarios	7 days	Thu 9/9/10	Fri 9/17/10	8 hrs	
Physical Architecture	7 days	Thu 9/9/10	Fri 9/17/10	8 hrs	
Logical Architecture	7 days	Thu 9/9/10	Fri 9/17/10	8 hrs	
Physical Design	7 days	Fri 9/17/10	Mon 9/27/10	8 hrs	
Logical Design	7 days	Fri 9/17/10	Mon 9/27/10	44 hrs	
Data Storage	7 days	Fri 9/17/10	Mon 9/27/10	8 hrs	
⊟ **Program Prototype**	**22 days**	**Wed 9/15/10**	**Thu 10/14/10**	**80 hrs**	
⊟ **Development Environment**	**7 days**	**Wed 9/15/10**	**Thu 9/23/10**	**32 hrs**	
Install SDK	7 days	Wed 9/15/10	Thu 9/23/10	8 hrs	
Hello World Program	7 days	Wed 9/15/10	Thu 9/23/10	8 hrs	
Familiarize with API	7 days	Wed 9/15/10	Thu 9/23/10	8 hrs	
Make Google Account for Phone	7 days	Wed 9/15/10	Thu 9/23/10	8 hrs	
⊟ **Smartphone Component**	**7 days**	**Thu 9/23/10**	**Fri 10/1/10**	**24 hrs**	
Feedback Component	7 days	Thu 9/23/10	Fri 10/1/10	8 hrs	
UI Component	7 days	Thu 9/23/10	Fri 10/1/10	8 hrs	
Reminder Component	7 days	Thu 9/23/10	Fri 10/1/10	8 hrs	
⊟ **Google Health Component**	**10 days**	**Fri 10/1/10**	**Thu 10/14/10**	**24 hrs**	
Weight Component	10 days	Fri 10/1/10	Thu 10/14/10	8 hrs	
Exercise Component	10 days	Fri 10/1/10	Thu 10/14/10	8 hrs	
Food Component	10 days	Fri 10/1/10	Thu 10/14/10	8 hrs	

Task Name	Duration	Start	Finish	Actual Hours	Add
⊟ B Term - Implementation	38 days	Tue 10/26/10	Thu 12/16/10	150.27 hrs	
⊟ Sprint I	12 days	Tue 10/26/10	Wed 11/10/10	32 hrs	
⊟ User Interface	12 days	Tue 10/26/10	Wed 11/10/10	26 hrs	
⊟ Screen Layout XML Markup	12 days	Tue 10/26/10	Wed 11/10/10	18 hrs	
Home Screen	12 days	Tue 10/26/10	Wed 11/10/10	2 hrs	
Reminders Screens	12 days	Tue 10/26/10	Wed 11/10/10	2 hrs	
Weight Screens	12 days	Tue 10/26/10	Wed 11/10/10	2 hrs	
Activity Screens	12 days	Tue 10/26/10	Wed 11/10/10	2 hrs	
Food Screens	12 days	Tue 10/26/10	Wed 11/10/10	2 hrs	
Profile Screens	12 days	Tue 10/26/10	Wed 11/10/10	2 hrs	
Progress Screens	12 days	Tue 10/26/10	Wed 11/10/10	2 hrs	
⊟ Screen Display Code	12 days	Tue 10/26/10	Wed 11/10/10	8 hrs	
Android Activity Declarations	12 days	Tue 10/26/10	Wed 11/10/10	2 hrs	
Tab Helper	12 days	Tue 10/26/10	Wed 11/10/10	2 hrs	
Dialog Handler	12 days	Tue 10/26/10	Wed 11/10/10	2 hrs	
Google Health	12 days	Tue 10/26/10	Wed 11/10/10	6 hrs	
⊟ Sprint II	8.25 days	Fri 11/12/10	Wed 11/24/10	65.6 hrs	
⊟ User Inputs	8.25 days	Fri 11/12/10	Wed 11/24/10	49.6 hrs	
Weight Input	8 days	Fri 11/12/10	Tue 11/23/10	6 hrs	
Activity Input	8 days	Fri 11/12/10	Tue 11/23/10	6 hrs	
Food Input	8 days	Fri 11/12/10	Tue 11/23/10	8 hrs	
Reminder Input	1.25 days	Tue 11/23/10	Wed 11/24/10	10 hrs	
⊟ Data Storage	1 day	Tue 11/23/10	Tue 11/23/10	16 hrs	
Weight Reading	1 day	Tue 11/23/10	Tue 11/23/10	4 hrs	
Activity Reading	1 day	Tue 11/23/10	Tue 11/23/10	4 hrs	
Nutrition Reading	1 day	Tue 11/23/10	Tue 11/23/10	4 hrs	

⊟ **Sprint III**	**16.75 days**	**Wed 11/24/10**	**Thu 12/16/10**	**52.67 hrs**	
⊟ **Graph Outputs**	**14 days**	**Mon 11/29/10**	**Thu 12/16/10**	**26.67 hrs**	
Weight Over Time Chart	14 days	Mon 11/29/10	Thu 12/16/10	10 hrs	
Acitivity Over Time Chart	14 days	Mon 11/29/10	Thu 12/16/10	5 hrs	
Nutrition Over Time Chart	14 days	Mon 11/29/10	Thu 12/16/10	5 hrs	
⊟ **User Interface Polish**	**1 day**	**Wed 11/24/10**	**Thu 11/25/10**	**16 hrs**	
Home Screen	1 day	Wed 11/24/10	Thu 11/25/10	2 hrs	
Reminders Screens	1 day	Wed 11/24/10	Thu 11/25/10	2 hrs	
Weight Screens	1 day	Wed 11/24/10	Thu 11/25/10	2 hrs	
Activity Screens	1 day	Wed 11/24/10	Thu 11/25/10	2 hrs	
Food Screens	1 day	Wed 11/24/10	Thu 11/25/10	2 hrs	
Profile Screens	1 day	Wed 11/24/10	Thu 11/25/10	2 hrs	
Progress Screens	1 day	Wed 11/24/10	Thu 11/25/10	2 hrs	
SQL Database Implementation	14 days	Mon 11/29/10	Thu 12/16/10	10 hrs	
Focus Groups	2 days	Fri 12/10/10	Mon 12/13/10	6 hrs	
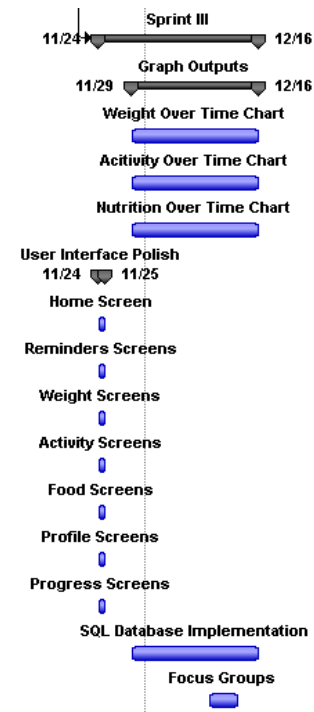
Task Name	Duration	Start	Finish	Actual Hours	Add
⊟ **C Term - Conclusions**	**37 days**	**Thu 1/13/11**	**Fri 3/4/11**	**180 hrs**	
Paper	37 days	Thu 1/13/11	Fri 3/4/11	100 hrs	
⊟ **Sprint 4**	**11 days**	**Thu 1/13/11**	**Thu 1/27/11**	**30 hrs**	
Feedback Engine	11 days	Thu 1/13/11	Thu 1/27/11	20 hrs	
Information Library	11 days	Thu 1/13/11	Thu 1/27/11	10 hrs	
⊟ **Sprint 5**	**23 days**	**Mon 1/31/11**	**Wed 3/2/11**	**25 hrs**	
UI Polishing	23 days	Mon 1/31/11	Wed 3/2/11	20 hrs	
Bug fixes	23 days	Mon 1/31/11	Wed 3/2/11	5 hrs	
Presentation Poster	1 day	Mon 2/28/11	Mon 2/28/11	10 hrs	
Interviews	1 day	Wed 2/23/11	Wed 2/23/11	9 hrs	
Presentation	37 days	Thu 1/13/11	Fri 3/4/11	6 hrs	
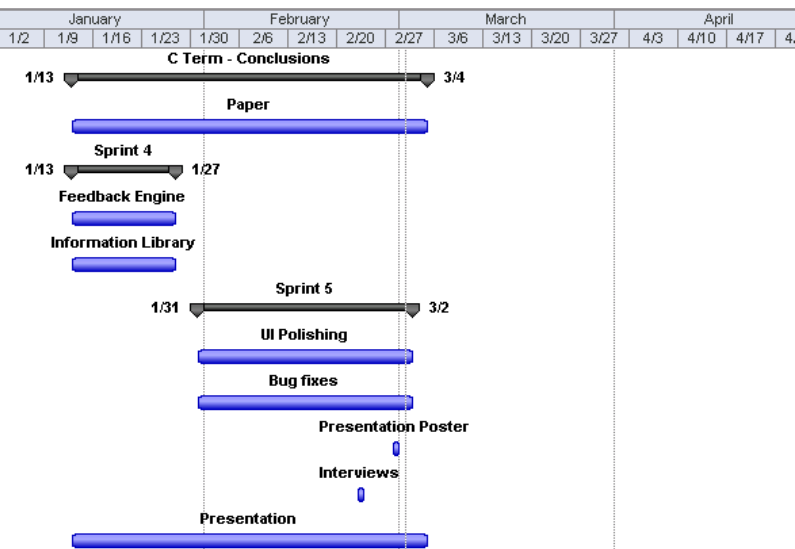
Mom-O-Meter: A self-help pregnancy Android app

3/14/2011
Brendan Harris, Michael Ng, Ken Miyauchi, Thomas Jenkins, Evan Duderewicz

1. Setting up Mom-o-Meter

Pregnancy Week Menu Button

Please enter the following information:

Current week in pregnancy:

Select a week

Your Height:

Inches Box

Feet Box

feet   inch

Pounds/Kilograms Toggle

Your Weight:

Weight Box

○ lb ○ kg

OK Button

Ok

The account set up screen is what you will see the first time that you launch Mom-O-Meter. The application will ask you information regarding your pregnancy. After filling in the fields, press the OK button to go to the home screen.

Creating a Profile

1. Press the Pregnancy Week Menu Button	Select a week
2. Select your current week in pregnancy, use the scroll bar on the left side to see more options	Week 1 Week 2 Week 3 Week 4 Week 5
3. Press the feet and inches boxes, and type your current height	Your Height: feet inch
4. Press the OK button	Ok

2. The Home Screen

Screen Description Bar	Reminders Button
Weight Button	Activity Button
Food Button	Profile Button
	Progress Button
	Information Button
Daily Checklist Button	Help Button

The Home screen is what you will be greeted with after setting up an account. From this main menu you can access your reminder settings, your weight, nutrition, and activity tracking screens, and view your progress or profile. At the bottom of the screens there are buttons which you can use to check your Daily To-Dos, and get information or help on the current screen from the program.

Navigation

To get to another screen, press and release the button of the desired screen.

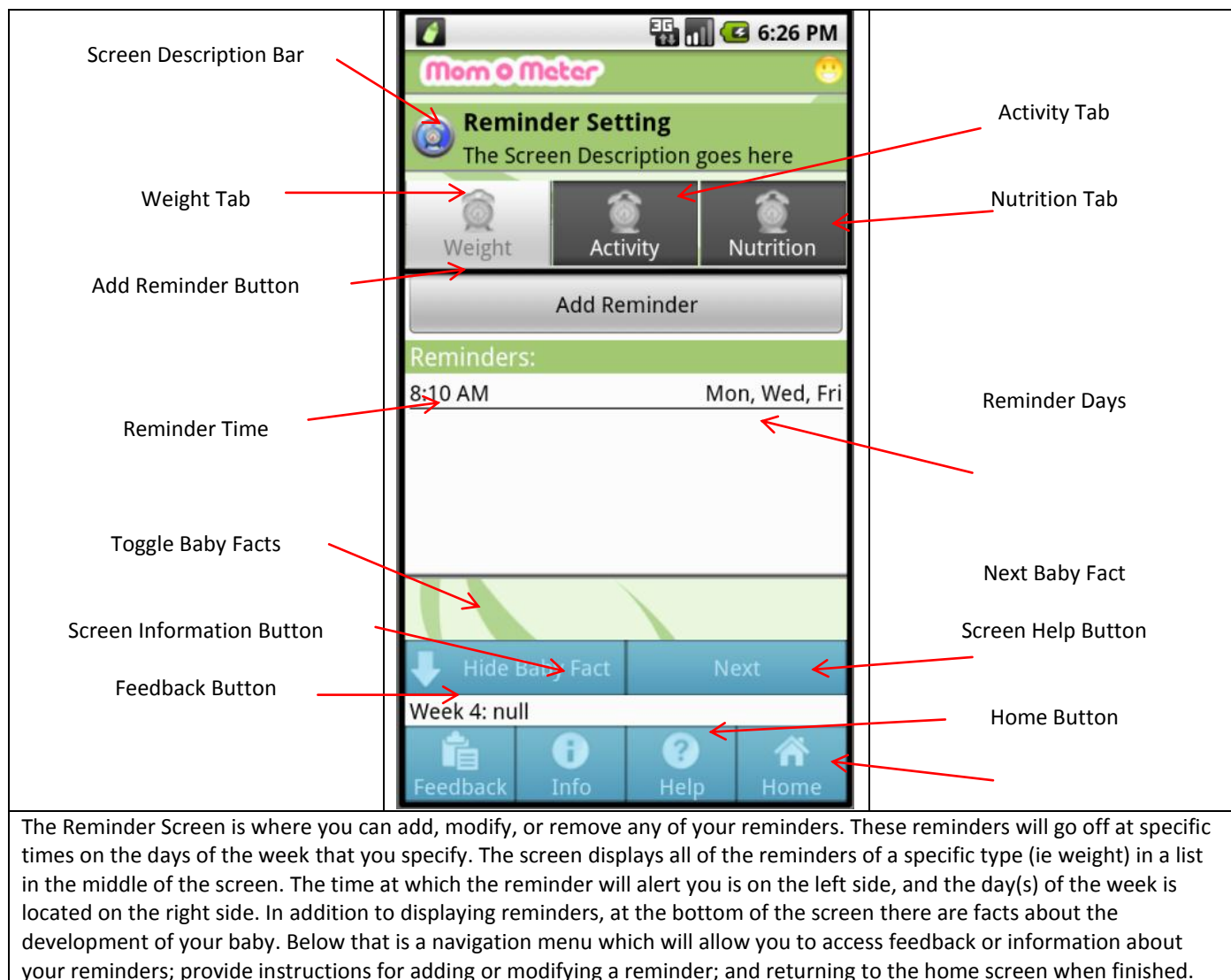In order to return to the home screen at any time, press the Home Button in the bottom right corner.

3. The Reminder Screen

Screen Description Bar

Activity Tab

Weight Tab

Nutrition Tab

Add Reminder Button

Reminder Days

Reminder Time

Toggle Baby Facts

Next Baby Fact

Screen Information Button

Screen Help Button

Feedback Button

Home Button

The Reminder Screen is where you can add, modify, or remove any of your reminders. These reminders will go off at specific times on the days of the week that you specify. The screen displays all of the reminders of a specific type (ie weight) in a list in the middle of the screen. The time at which the reminder will alert you is on the left side, and the day(s) of the week is located on the right side. In addition to displaying reminders, at the bottom of the screen there are facts about the development of your baby. Below that is a navigation menu which will allow you to access feedback or information about your reminders; provide instructions for adding or modifying a reminder; and returning to the home screen when finished.

Navigation

Switching Reminder Types

In order to switch reminder types press and release the tab of the desired type.

Getting Feedback

In order to access feedback on your reminders, press the feedback button on the bottom left.

Getting Information

To get more information about reminders, press the info button at the bottom of the screen.

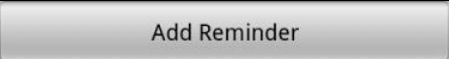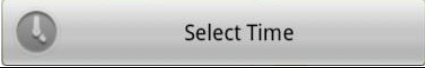#### Getting Help

In order to get help with creating, editing, or removing a reminder press the help button on the bottom bar.

Returning to the Home Screen

To return to the Home Screen press the Home button at the bottom right of the screen.

4. Creating a New Reminder

1. Press the "Add Reminder" button	Add Reminder
2. Select days by pressing the corresponding check box	Sunday ☑ Monday ✔
3. Press "Select Time" button	🕐 Select Time
4. Select a Time with the +/- and AM/PM buttons	+ + 12 00 AM − −
5. Press "Set" button	Set
6. Press "Ok" button	Ok
7. New Reminder Appears in list	

Editing an Existing Reminder
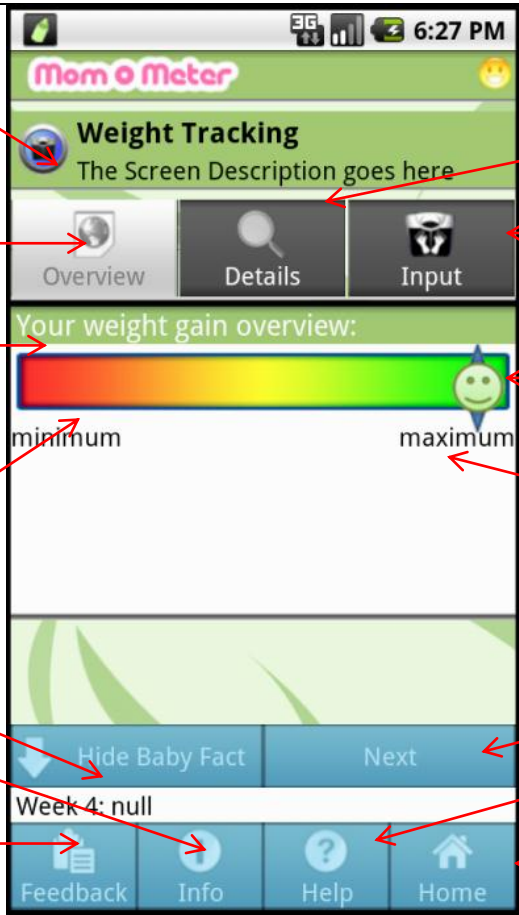
1. Press and hold a reminder on the list	Reminders: 8:10 AM Mon, Wed, Fri
2. Select "Modify Reminder" from the menu	
2. Select days by pressing the corresponding check box	Sunday ☑ Monday ✔
3. Press "Select Time" button	🕐 Select Time
4. Select a Time with the +/- and AM/PM buttons	+ + 12 00 AM − −
5. Press "Set" button	Set
6. Press "Ok" button	Ok
7. Changes appear in list	

Removing an Existing Reminder

1. Press and hold a reminder on the list	Reminders: 8:10 AM Mon, Wed, Fri
2. Select "Delete Reminder" from the menu	

5. The Weight Screen

Overview

Screen Description Bar		Details Tab
Weight Tab		Input Tab
Quick Overview		Your Status Indicator
Recommended Minimum Weight		Recommended Maximum Weight
Toggle Baby Facts		Next Baby Fact
Screen Information Button		Screen Help Button
Feedback Button		Home Button

The overview screen provides a brief summary of your current weight, and weight gain goals. This is expressed through the combination of the "quick overview" bar and your status indicator. Your status indicator will be closer to the green end if you are doing well at following your goals and closer to the red if you are having difficulty. In addition to displaying your weight gain overview, at the bottom of the screen there are facts about the development of your baby. Below that is a navigation menu which will allow you to access feedback or information about your reminders; provide instructions for adding or modifying a reminder; and returning to the home screen when finished.

Navigation

Changing Tabs

In order to access other tabs, press the desired tab

Getting Feedback

In order to access feedback on your reminders, press the feedback button on the bottom left.

Getting Information

To get more information about reminders, press the info button at the bottom of the screen.

Getting Help

In order to get help with creating, editing, or removing a reminder press the help button on the bottom bar.
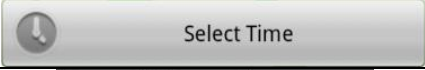
Returning to the Home Screen

To return to the Home Screen press the Home button at the bottom right of the screen.

Details

Screen Description Bar
Details Tab
Input Tab
Weight Tab
Weight Display Box
Graph Title
Weight
Weight Reading
Week
Toggle Baby Facts
Screen Information Button
Screen Help Button
Feedback Button
Home Button

The weight Details screen is where you View a detailed graph of your weight over time. The line shows all of the weight readings throughout your pregnancy. In addition to graphing your weight readings, at the bottom of the screen there are facts about the development of your baby. Below that is a navigation menu which will allow you to access feedback or information about your reminders; provide instructions for adding or modifying a reminder; and returning to the home screen when finished.

Input

Screen Description Bar

Weight Tab

Weight Input Box

Cancel Button

Toggle Baby Facts

Screen Information Button

Feedback Button

Details Tab

Input Tab

Pounds/Kilograms Toggle

Submit Button

Next Baby Fact

Screen Help Button

Home Button

The weight input screen is where you can input your periodic weight readings. In addition to inputting weight readings, at the bottom of the screen there are facts about the development of your baby. Below that is a navigation menu which will allow you to access feedback or information about your reminders; provide instructions for adding or modifying a reminder; and returning to the home screen when finished.

Inputting a Weight Reading

1. Press the Weight Input Box	145
2. Type your weight	
3. Select pounds or kilograms	lb kg
4. Press the submit button	Submit
5. A confirmation message will display	

6. The Activity Screen

Overview
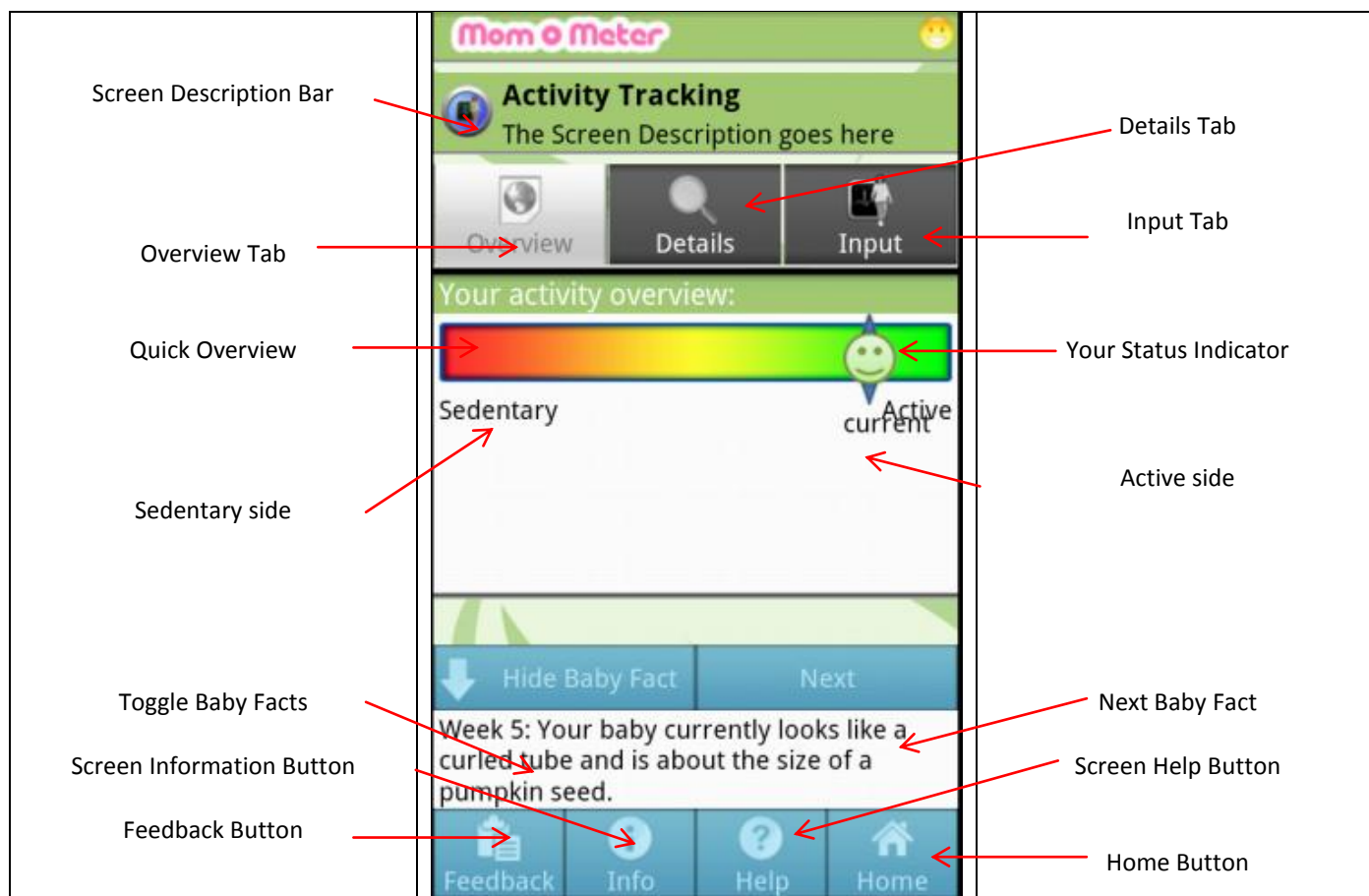
The activity tracking overview screen provides a brief summary of your current activity level, and activity goals. This is expressed through the combination of the "quick overview" bar and your status indicator. Your status indicator will be closer to the green end if you are doing well at following your goals and closer to the red if you are having difficulty. In addition to displaying your activity overview, at the bottom of the screen there are facts about the development of your baby. Below that is a navigation menu which will allow you to access feedback or information about your reminders; provide instructions for adding or modifying a reminder; and returning to the home screen when finished.

Navigation

Changing Tabs

In order to access other tabs, press the desired tab

Getting Feedback

In order to access feedback on your reminders, press the feedback button on the bottom left.

Getting Information

To get more information about reminders, press the info button at the bottom of the screen.

Getting Help

In order to get help with creating, editing, or removing a reminder press the help button on the bottom bar.

Returning to the Home Screen

To return to the Home Screen press the Home button at the bottom right of the screen.

Details

Screen Description Bar	Details Tab
	Input Tab
Weight Tab	
Weight Display Box	Time Frame of Graph
	Color Key
Toggle Baby Facts	Screen Help Button
Screen Information Button	
Feedback Button	Home Button

The Activity Details screen is where you can see a detailed graph of your activity break down over time. A color key is located to the right of the graph. In addition to graphing your activity readings, at the bottom of the screen there are facts about the development of your baby. Below that is a navigation menu which will allow you to access feedback or information about your reminders; provide instructions for adding or modifying a reminder; and returning to the home screen when finished.

Changing the Time Frame

1. Press the Time Frame Menu Button	Time Frame
2. Select the desired time frame from the menu	All Weeks Week 1 Week 2

Input Screen

Labels pointing to the screen:

- Screen Description Bar
- Weight Tab
- Cancel Button
- Toggle Baby Facts
- Screen Information Button
- Feedback Button
- Details Tab
- Input Tab
- Activity Type Menu Button
- Activity Menu Button
- Activity Duration Menu Button
- Submit Button
- Next Baby Fact
- Screen Help Button
- Home Button

The activity input screen is where you can input a new activity reading. In addition to inputting activity readings, at the bottom of the screen there are facts about the development of your baby. Below that is a navigation menu which will allow you to access feedback or information about your reminders; provide instructions for adding or modifying a reminder; and returning to the home screen when finished.

Inputting an Activity Reading

1. Press the activity type menu button	Select a type:
2. Select activity type from the menu	Standing / Sitting / Exercising
3. Press the activity menu button	Select an activity:
4. Select the activity that best matches what you performed from the menu	Walking / Standing / Doing chores

5. Press the activity duration menu button	Select a duration: ⊙
6. Select the duration that best matches what you performed the activity for	15 20 30
7. Press the submit button	Submit
8. A confirmation message will display	

7. The Nutrition Screen

Overview
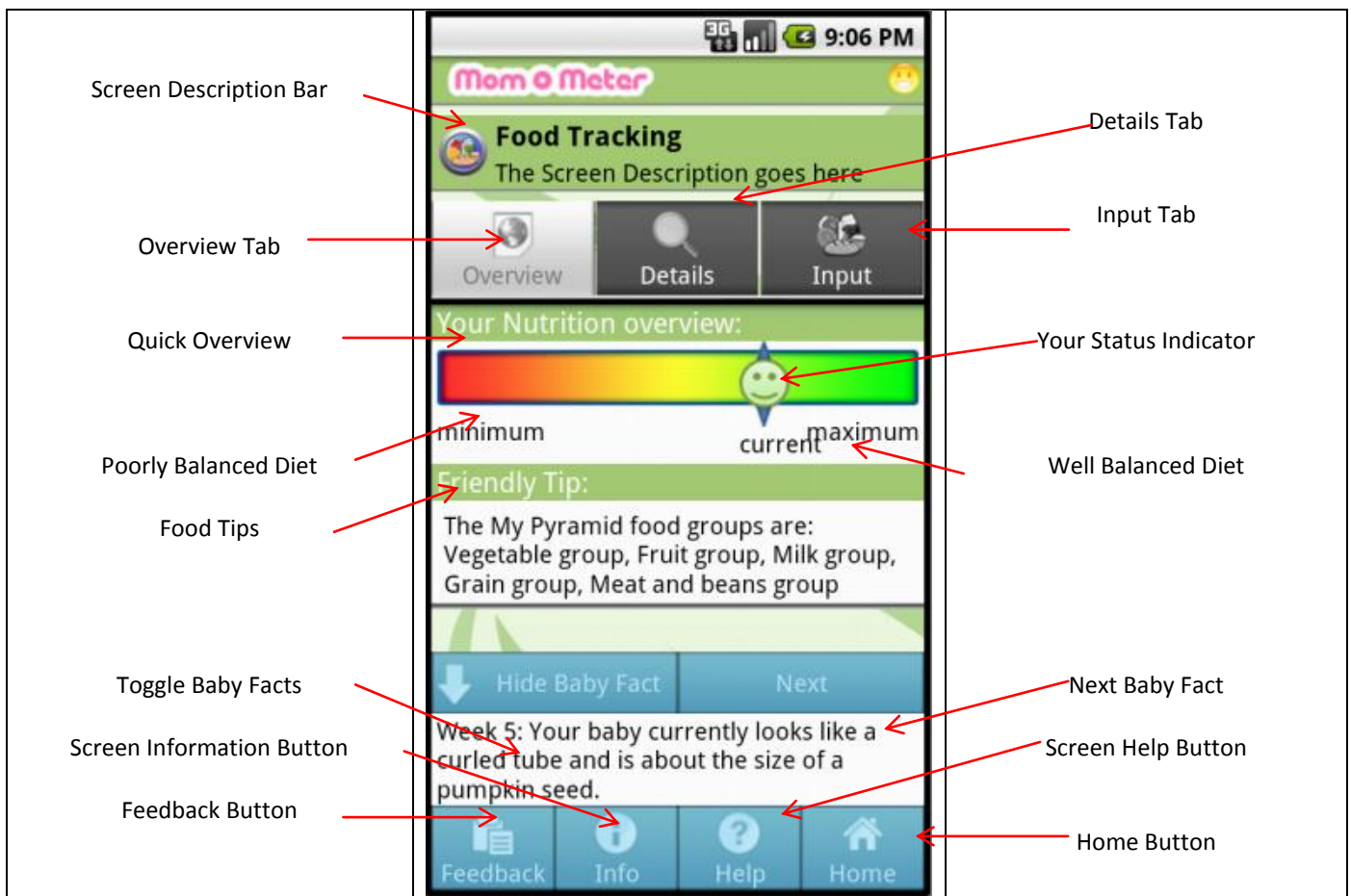
The Nutrition tracking overview screen provides a brief summary of your current nutrition level, and nutrition goals. This is expressed through the combination of the "quick overview" bar and your status indicator. Your status indicator will be closer to the green end if you are doing well at following your goals and closer to the red if you are having difficulty. Below the quick overview bar is a friendly tip to help you meet your dietary goals. In addition to displaying your Nutrition overview and tips, at the bottom of the screen there are facts about the development of your baby. Below that is a navigation menu which will allow you to access feedback or information about your reminders; provide instructions for adding or modifying a reminder; and returning to the home screen when finished.
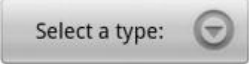
Navigation

Changing Tabs

In order to access other tabs, press the desired tab

Getting Feedback

In order to access feedback on your reminders, press the feedback button on the bottom left.

Getting Information

To get more information about reminders, press the info button at the bottom of the screen.

Getting Help

In order to get help with creating, editing, or removing a reminder press the help button on the bottom bar.

Returning to the Home Screen

To return to the Home Screen press the Home button at the bottom right of the screen.

Details

Screen Description Bar	Details Tab
Overview Tab	Input Tab
Calories	Time Frame Menu Button
	Calorie Reading
Toggle Baby Facts	Week of Pregnancy
Screen Information Button	Screen Help Button
Feedback Button	Home Button

Mom O Meter — 5:08 PM

Food Tracking
The Screen Description goes here

Overview | Details | Input

Please choose a time frame: All Weeks

Average Daily Consumption by Week

Calories
300
250
200
150
100
50
1 2 3 4 5 6 7

Show Baby Facts

Feedback | Info | Help | Home

The Activity Details screen is where you can see a detailed graph of your activity break down over time. A color key is located to the right of the graph. In addition to graphing your activity readings, at the bottom of the screen there are facts about the development of your baby. Below that is a navigation menu which will allow you to access feedback or information about your reminders; provide instructions for adding or modifying a reminder; and returning to the home screen when finished.
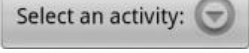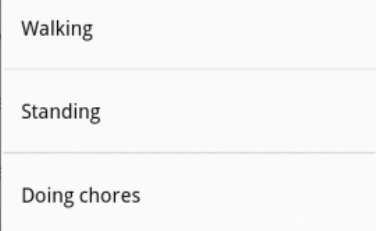
Changing the Time Frame

| 1. Press the Time Frame Menu Button	Time Frame
2. Select the desired time frame from the menu	All Weeks Week 1 Week 2

Input

The activity input screen is where you can input a new activity reading. In addition to inputting activity readings, at the bottom of the screen there are facts about the development of your baby. Below that is a navigation menu which will allow you to access feedback or information about your reminders; provide instructions for adding or modifying a reminder; and returning to the home screen when finished.

Inputting a Nutrition Reading

1. Press the meal menu	Select Meal Type:
2. Select the meal from the menu	
3. Press Continue button	Continue
4. Press the Add Food button	

5. Select the category of the food from the menu	Vegetables Fruits Dairy Meats Poultry
6. Select the food that best resembles your food from the gallery	Choose Food Apple - 1 medium Oranges
7. Enter the number of Servings	Number of Servings: 2 Ok
8. Press OK	Ok
9. Repeat Steps 4-8 until all foods have been selected To delete an entry, press and hold it	
10. Press the submit button	Submit
11. A confirmation message will display	

8. The Profile Screen

Screen Description Bar

Information Tab

Goals Tab

Profile Information

Toggle Baby Facts

Screen Information Button

Feedback Button

Screen Help Button

Home Button

Your Profile screen is where you can view a quick summary of your pregnancy information, including the stage, height, current weight, and Body Mass Index (BMI). In addition to your pregnancy profile, at the bottom of the screen there are facts about the development of your baby. Below that is a navigation menu which will allow you to access feedback or information about your reminders; provide instructions for adding or modifying a reminder; and returning to the home screen when finished.

Appendix D.   Focus Group Transcripts

12/6/2010 Focus Group

Moore: You all kind of came from within the system and so I work with all of them. And so, at the end of tonight if you have any questions, especially medically related, then I would sort of be your "go-to" person for that and/or would refer you back to your providers. Let me introduce…

Rosal: I am Milagros Rosal and the principle investigator for the project. Basically what we are going to do doing tonight is just a discussion- very informal. You are going to be helping us with giving us ideas for the application that the students are developing and your feedback will be helpful and who knows, it might help you in the future too if you other babies.

Jenkins: I'm the, I guess, lead person from our group here working on this project- my name is Tom Jenkins. We are not doctors, so I defer to Tiffany and Milagros for any sort of medical advice. We want all of your feedback, so feel free to talk about anything you want. It doesn't matter if you have never used the phone before or if you have had smartphones your whole life. It really doesn't matter- we really want to know what you think of all parts of our application. We're going to kind of go through a presentation in a minute to kind of go through everything.

Rosal: Do we have the consent forms?

Jenkins: We have the consent forms- they filled those out. And right below the consent forms in this packet here there is a one page survey. Oh ok cool you guys filled that out too. Awesome.

Rosal: Do we have the original?

Jenkins: Yes, we have the original right here. Yeah that's it. *pause* It doesn't matter- positive or negative comments. You won't hurt our feelings if you say anything about our application. You know, we really all comments. We have name tents, so if you guys could just write your name on it so I can refer to you during our discussion. Let's get started with the presentation in just a sec. Oh, do you guys want to hand the phones to them too?

Evan: Sure.

Jenkins: So we are going through a presentation- we will show you on the screen what the application looks like. You guys will actually be able to click through and follow along with us a little bit too. This will maybe get you a better idea of how the application is going to work.

Rosal: If we are doing things too fast or whatever, feel free to stop us, ok?

Jenkins: Especially because it is a smaller group tonight we can actually go through a lot more.

Moore: Any comment is helpful, so feel free to, you know, interrupt.

Jenkins: Try to speak kind of loudly. I know it is just us here but I'm not sure how the microphone will work for us. Also, underneath this packet there is a little thing about vocabulary and a page showing you kind of what the main buttons are on our application. I know you guys probably aren't familiar with this specific kind of phone, but on the bottom there are four "soft key" buttons. It will say on your screen, you know "back", "menu", "home", and "search". Those will work within the application, like the back button will take you back one screen. Basically the main menu there are 6 buttons there. That's the different functionalities we are going to go through- I will show you how each of those works too. And then there is the "feedback", "home", and "help" button. We will kind of go through that too, I'm just trying to get you familiar with it. Ok, so the application overview. As Tiffany kind of said there are guidelines for pregnancy weight gain. We are not doctors and we didn't come up with these guidelines, but this application is supposed to help the patient to kind of, you know, manage weight better and keep track of different areas. So there is the weight tracking, which is the main goal of the application. And there is food and activity tracking too. This is supposed to help you- its not supposed to replace your doctor, obviously. You are still supposed to go and establish goals, although not necessarily for all pregnancies. Alright, this user interface we are trying to streamline a little bit just to make it easier for someone to use, ideally on a daily basis because this sort of application you would go in and set reminders for yourself to, you know, input your food this certain time. Brendan, do you want to start the presentation? Ok, so the main menu screen here , as you guys can see on the phone, has 6 little pieces to this. There is the weight, food, and activity tracking, which are the buttons here. Those are the things you actually input, you know, things into. Your profile allows you to set up your profile, like basically your age, weight when you started, and that sort of thing. Progress will give you sort of idea of how well you are doing with a graph of your weight within the ranges. Basically on this main screen it will show the overview with this smiley face. This is very general, but if you are within the ranges, it will show a happy face, right? And if you are not within the ranges it will be like a little unhappy, so it kind of gives you sort of an idea of how well you are doing in this. So lets go through this- key terms we kind of covered, we didn't go through the vocabulary. You guys are a little bit familiar with applications, with software, just a little bit.   Like you have used a computer with Microsoft Word, which is kind of an application or piece of software. This is a piece of software on a cell phone essentially, so its mobile. Its, you know, made for you to take with you. Its not something you are supposed to leave. So back to the buttons- those 6 buttons I was talking about there and on the bottom of the screen there is the feedback-help-info buttons. And then below that are like the hard buttons built into the phone. Really the only one you are going to worry about is the back button, and that is the one with the little arrow. Ok, so lets go to the weight input screen. So the goal of this is to capture your weight and give you an idea of how well you are doing. On each screen there are 3 different tabs. There is the overview screen tab, the details tab, and the input tab. Right now it is selected on the input tab, but the overview tab basically will show you, like you see on your screen, this little graph. It shows kind of overall how you are doing- just like a very basic idea of how you are doing. The details we are not going to cover today- it is just basically a graph over time. We are not going to worry about that today, but the input is really

what we want feedback on. Basically on the input for activity here you are going to pick your standing or your sedentary activities. We are trying to balance those two. So you would go ahead and pick standing for instance and then you click select activities, and there are list of activities. If you click select activity, a dialog box will pop up and you can select the activity, and then when you submit it adds it to your thing. The different screens have kind of similar input screens. If we can go back we can see the weight input screen. The weight input screen is basically the same idea- you have a box that you add the weight to and submit that.

Rosal: Do you know what inputs are? Do you know what input screens are?

Jenkins: Yeah, these are things that you are going to give the application. You are going to tell it, you know, these specific types of information.

Rosal: You are going to type it in?

Jenkins: Yeah, you are actually going to type in the box. The rest of this application will show you things. So let's go back to the-

Rosal: Are you going to talk about what types of things are in the application?

Jenkins: Yes- so the weight input is the most basic type of input. You just put your weight at a certain time, and submit that, and it will sync. The activity input is a little more complicated. Like I said before you have to pick what type of activity- standing or sitting activities- your active times and your sedentary times. When you click on those little radio buttons- click select activity- it will come up with a list of things that are active things, like walking, swimming, you know, that sort of thing. And if you pick sedentary, it would be like, you know, watching TV, sleeping, that sort of thing. Then you just pick a duration and submit that- Oh yeah go ahead and try it. You guys can go ahead and give it a try. I will catch her up really quick.

1: Can you jump ahead till how many weeks pregnant?

Jenkins: It knows when you start it, so it keeps track of how long you have been pregnant. This just happens to say I think week 7-or week 5. It will keep track and give you facts based on what time and how long you have been pregnant.

1: I always like to look ahead and see what's coming.

Jenkins: Oh, ok. See this is the kind of comments we are trying to get- things we wouldn't have thought about, so go ahead and feel free to make any comment.

2: So what does it track once you put in your activity? Then what?

Jenkins: The overarching thing is that it saves these all in a database essentially and this is accessed online through Google Health as well, but once you save all these things it keeps track of it all and it will

give you a progress report type of thing. Maybe there will be feedback on how you didn't walk really much this week and you should go out for a 20 minute walk now or something like that.   Or you haven't eaten, you know, this many vegetables or something like that. You should probably go ahead and eat some more. So that's kind of why we are tracking these things. And now we are going to look at the food input screens now. This is a little more complicated and it requires a little more effort, but we are trying to streamline this a little bit more. This screen is split up into meals. You would click the select meal type button right there and when you click that it will open up a dialog box that will say breakfast, lunch, dinner, or snack. Then you pick one of those and then click continue. It will open up a dialog box with your most popular foods you have had for that specific meal. If none of those are there, you can select additional food types by clicking more. We have split it up into different categories, so within each category, let's say we pick potato. We don't have pictures up yet, but then there would be pictures of the food you would pick, so you would click the picture and it would give you information like caloric intake, that sort of thing. You would add that to your list of foods, and then at the end on that main screen of the food input there will be a list of the selected foods. So when you are done with the list of foods for that specific meal you would click submit. Obviously there are fair amount of things to add to this over time, so we have developed a reminders part of this, which will allow you to set times where it will remind you when to input food information, when to input you weight, that sort of thing. This screen is split up into 3 tabs for the 3 different things we are tracking, so like for weight, we will see the reminders that you want- 12am Monday, Tuesday, etc. to remind you to enter your weight. Or you click on the activity tab and it would have reminders for that. Basically they all work the same as far as adding the times, as well as the days you want to be reminded for that specific thing. You check the boxes and then you would select the times on those days you would want to have it to ask you to input things. Do you guys have any questions on the input screens? I know this is kind of a lot, but we are trying to get you more familiar with it. Feel free to ask us anything.

Rosal: What questions do you have so far? Or what comments?

Jenkins: Anything- like it is maybe overwhelming.

1: I think this is a good idea. Ive always gone to babygaga.com to find out things like how much weight to gain- I think this is a good idea.

Jenkins: Yes, this is also more customizable.

Rosal: So what do you like about where you go?

1: Um, I like that it tells you like how much weight the baby gains and like how or what your eating does for the baby, stuff like that.

Rosal: So you would like baby weight information in addition to your weight information? Would that be helpful?

1: Yeah.

Rosal: Anything else that you think would be valuable to add to what you have seen so far?

1: Maybe like more information about how the baby grows- information like that.

Jenkins: This focus group is specifically focuses on the user interface, but that is definitely part of it. Like you can see there is the little week 6, the baby is developing something. That is going to show up in the reminders as well, so like it would pop up "week 7: your baby is growing bones, but they are not hardened yet, you should eat some more broccoli, you haven't had that many vegetables this week." That sort of thing. I liked your comment about the looking ahead in pregnancy.

Rosal: Other comments?

Jenkins: What do you guys think of the overall navigation, or how you go through the pages of the application? Does that seem straightforward?

3. Yeah, seems pretty straightforward.

Jenkins: Anything you didn't like about it really?

Rosal: What would you like to see differently?

2. I'm wondering when you do the weight, is there a way when you go to input it and there are pounds and kilograms, is there a way for just the numbers to come up versus the full keyboard. You click on this and you don't even get the numbers- you get the full keyboard instead. I don't know if that's possible…

Jenkins: Let's go back to the main menu so that we can take a look at it again. As far as the actual appearance of the screens, like the icons for instance, does the design explain how it works? Is there any better way you think we could do it?

Rosal: What do you interpret? How do you interpret those buttons?

2. Yeah just how they are pretty much.

1: The activity one could be someone jogging or something.

Jenkins: Ok.

1: Yeah because you can't really tell what she is doing- looks like she is just standing there.

2. Do your activities only have walking, standing, and running? I think there should be more.

Jenkins: There will be more- this is just some sample content for this demo.

Rosal: What other things would you want to see?

2. Like other things people do- pilates, yoga, like other things like that and the duration. Things that are more, you know, like yeah maybe some moms go out running, but a lot of times that might be a setback in their pregnancy. So maybe more- like swimming- things that are less impact.

Rosal: Any other activities you can think of? Any activities you have done that you would like to see in there?

Jenkins: Was there anything you didn't like about the application? How about anything you particularly liked so far?

Rosal: What are other improvements that could be made?

3. The food, I know like you said you were putting in a lot of them- like the pictures. I know I was clicking on one and I put in broccoli and it said it was like 1 serving. Maybe if there was a measurement so people knew- like that's a big misconception with nutrition is that people don't know what a serving is. So maybe putting in, if its possible, something like that.

Jenkins: There is help section where information like serving sizes is listed in the application.

Rosal: Where would you like to see it?

3. Well I think I was doing it when I was selecting the food.

Harris: Like when you select the food you would like to know how many servings there are or…

3. Yeah- like if you were putting in, you know, you ate such and such a food, just to know how much it is. A lot of people don't know.

Rosal: You are absolutely right- where the food shows you would want to know what a serving of that food is, is that what you would like to see?

3. Yeah, something like that.

Rosal: Ok, that's a great idea.

3. You know, you could be putting in you meatballs and you might just say one serving, but you might have had like 4.

Rosal: Right, exactly. And not know it, but if you have it right there you would easily be able to know. What other things related to the food or recording the food might be helpful?

3. So does it- it comes up in food groups, right?

2. So would there be an option to enter your own food. Like if it is not in the list.

Rosal: So you would find that helpful to be able to enter your own foods into the application? Great idea.

Jenkins: Right away when you click here?

2. Yeah, you could put in your foods.

Rosal: Rather than going through your categories of food.

Moore-Simas: Maybe it can kind of create a list of favorite for you?

Jenkins: That is what it shows under each specific meal. The first page that comes up is your favorite foods from that meal, but after that maybe we could add a customizable list.

Evan: Would you like to have it create a favorites list?

3. Yeah- early on in pregnancy you are probably very stuck to certain regime of what's working for you and whats not, so maybe like 10 foods that you are able to tolerate. You know so instead of always scrolling for those same things at the beginning. It might be nice if they were kind of right there as your favorites.

Jenkins: For the specific meal or just in general? For example, would you split it up into breakfast, lunch, and dinner or just have an overall favorites list?

2. Yeah if they just came up.

3. Like yogurt, pineapple- I mean if each one came up individually.

Jenkins: How about the colors and the readability of the screens? Were you able to see everything easily? Were there different colors you would like to see?

1. Maybe you can personalize it? Like for your pregnancy. Like you are having a boy or having a girl, you know?

Jenkins: Oh ok, that's a good idea.

Rosal: How would you personalize it? Any specific things?

1. I don't know- like on my computer I keep track of my pregnancy by going to baby-somethin.com. I keep track but it is my own personal profile. Like it says "Welcome ***, you are how many weeks. You baby has this much progress…" And you set a background to it.

3. When that progress comes up is that gunna be like a chart? Just like the icon is? You could show, you know, your weight gain on a graph.

Rosal: How would you like to see it?

Jenkins: What would be easier for you look at and understand?

3. I think what would almost be a good idea based on my experience is almost when you are inputting your data to begin with and you ask what your ideal weight is, its almost like a graph that would show you under or over so that you have a comparison to know because I mean you might see a steady incline but is it too rapid of an incline or are you falling off at the beginning. Things like that.

Rosal: So you would like the see the comparison. You would like to see the data and then the comparison?

3. Yeah

Moore-Simas: You know some people like graphs and others do not, so you know, are there other ways other people might want to see that? Are there other ways of representing that better or more to you?

Rosal: What type of graphs would you like?

2. Like a line graph or a bar graph.

1. A line graph would be easy to look at.

Jenkins: If you were to click on weight, for instance, would you like the first screen to be the line graph?

1. I wouldn't because I know that I would be gaining too much so I don't know how I would want that.

Moore-Simas: That's a good point, part of this is about getting feedback, right? So if you are gaining the right amount your phone would say something like "Oh, great, you are going a great job." But what if you were not following the ranges and gaining too much, how would you like it to know that?

1. Probably like something funny. Like so you wont get offended easily.

Rosal: So using humor somehow, so for example what might that look like?

1. I don't know, like "Lay off the cheese its."

Rosal: Any other suggestions?

3. Yeah like comical and maybe it could even give you tips based on what you have recorded in the previous weeks. Like if you are recording activity and food for the last 3 weeks, like if it can pull from your data and maybe try increasing your activity another 30 minutes one more day a week or try switching a snack to a fruit. Like if it can actually give you feedback on your data.

2. Give you hints or tips for healthier eating.

Jenkins: Like outside- lets say you go the page to add activity or food?

2. Yeah like when you open it up maybe it can say a tip of the day or something.

Rosal: Great idea, what other things would you like to see? These are great ideas.

1. I'm just curious, how is it like you are saying. Cuz I know, I think it was one month out of the pregnancy I gained like a lot of weight but the next month I only gained 2 pounds. How is it going to tell you that you are gaining too much weight? How is it going to track it?

Rosal: How would you like to see it?

1. I don't know- like how is it going to track our weight?

Jenkins: There is graph with a range on that graph for your weight gain, so you would put in what your weight is before, like when you start your pregnancy, it will know how you are going along.

1. So it will be able to show me my whole pregnancy on there?

Jenkins: Yes, it will have all of that information and show you your weight and where it is within that range within pregnancy.

1. Does it work with your age and weight? Or what?

2. Like how was it going to be for us? Like how would it track mine?

Moore-Simas: So you input your weight, your pre pregnancy weight- that is the weight you were before the pregnancy. And you input your height and your due date, so it knows how much you weigh and also how much you should gain throughout the pregnancy and the day you input it also tells it where you are in your pregnancy. And there are recommendations on if you are on track or not on track based on these ranges.

2. But you know every pregnancy is different. For my son, he's 11 months old. I'm 7 months pregnant but I'm not gaining as much as I did for him because I still have some weight on. So how would it track it?

Moore-Simas: It's a little black and white meaning it takes your information and makes a recommendation, and you know, of course there should be discussions with your physician about how you are going. Especially if you get a message saying you are gaining too little or too much. There are tips to help you.

Jenkins: This is obviously not going to replace your doctor, but it will help you.

2. Im just curious as to how it is going to track it.

3. What if you are carrying multiples? Would there be a difference?

Rosal: Yes there would be a difference. The recommendations for multiples are much different.

Moore-Simas: Presumably you are pregnant the second time and I think what you are saying is…

2. Like the weight gain is always different.

Moore-Simas: Yeah, it is always different but if there is recommendations for a certain amount of weight regardless of your past history.

Harris: So one of our concerns going forward is getting this message on your phone like, "what are you telling me to do?" and they are going to throw it against the wall and not listen to it anymore. So is there anything we should definitely not do?

4. If you are going to use it you know what you are looking for and you know what it is going to turn out to be, so it should get irritated if you choose to use it.

3. Yeah as long as the sun doesn't turn into a little devil with horns, you know, spitting fire at you.

Rosal: What types of things would make someone want to use this type of information.

4. Stay healthy.

Rosal: Anything else?

1. Well I'm on my phone daily so it would help me out because I would be looking at it all day.

Rosal: So just seeing it all the time would help you?

1. Yeah like where my house computer isn't with me, my phone is, so I can just look at it.

Moore-Simas: Several of you mentioned getting on a computer based program to sort of help you throughtout pregnancy. What is it about those that you like or maybe would be appropriate to put in a handheld device so it becomes a reminder?

1. Well I have this pregnancy ticket on my phone, and it is just counting down the days until the baby is there. It has every month that has a new picture and it says every couple weeks it will have a new fact or something like that. I could show you what it looks like I have my phone here.

2. Yeah because I like watching the baby develop.

Jenkins: You guys touched on the smiley face- instead of that, what would be a good indication of how well you are doing, like something on the home screen to kind of show progress a little differently?

2. Like a pregnany belly- I like watching like they show pictures every month and they show pictures of the fetal development and inside.

Jenkins: Oh, ok cool.

Rosal: So the information about the baby would draw you in the application.

2. Yeah cuz that is what I always check on my computer. Like I'm always checking the baby's weight.

Rosal: This is kind of like what you were saying with the information about the baby.

Jenkins: What's that called- baby ticket?

1. Um, yeah its called a baby-ticket but I got it off of babygaga.com.

Rosal: What types of information about the baby do you find moticational or inspring? What types of things would you like to see on your phone or computer.

2. Like development- maybe have it show you how the baby is growing week to week.

Jenkins: So you were saying graphically show that too?

1. Yeah it shows the baby's development inside

Moore-Simas: So it gives you some text about the baby and it shows the picture of it going from the tadpole shape to a baby.

Rosal: What other things might be fun to see on your phone?

Jenkins: What will keep you coming back to use this application? Besides the obvious health benefit. Is there anything you want to add to it?

Rosal: What are some things about your own health, I mean like you mentioned being healthy, but what types of things about your own health do you want to find out in the phone.

2. How much activity is good and healthy and you don't overexert yourself.

Rosal: So how much is good for you, ok.

2. My question is am I working too hard? Should I walk that long?

Rosal: So not only about the activity but also about the intensity. You were saying about walking faster.

3. So depending on what trimester you are on, it will be different for you.

Rosal: So specific messages related to your activity and how much is safe.

3. Well on of the main things for me is managing different symptoms or you know back pain or you know nausea. Anything, you know? How to stay hydrated when you are on the go all day- just little tips. Could be tips of the day based on the week you are on.

Rosal: Because as you pointed out the beginning of pregnancy, or the middle or the end. So the message of the day could realte to where you are at in the pgrenancy would be helpful.

2. Sadly we are all on facebook, but it would be cool to look and see these kind of tips- to keep you coming back daily. You want to kow what it says…

Rosal: What other type of health information would you want to see or would be helpful?

1. Maybe what types of foods are bad to eat. I know you aren't supposed to eat some things, like certain fish or cheeses or something like that.

Jenkins: Not just good foods, but also the bad foods.

2. Yeah like foods you should avoid.

Rosal: What else about foods would you want to know?

3. I think a good thing to add would be beverages and to be able to track that type of thing. Suggary, caffeinated things that aren't too good for pregnancy. Something like that so if you are putting in too many bad drinks, it will be able to tell you. Maybe even make recommendations to try different things. A lot of websites say stuff like try a water and throw an orange slice in there. Smoothies and that sort of thing too.

Rosal: So specific recommendations about healthy diet, including beverages, to make it healthier.

1. Or even substitutes.

Rosal: Oh yes, great ideas.

1. Then what happens when you get to the 40th week of pregnancy, then what happens with this application?

Jenkins: So all this information will be uploaded to Google Health, which is online, and you can share that with your doctor. Basically you will be able to see overall how you did. What would you like to see after?

2. Does the app have a way to get you back down to your starting weight?

Rosal: That is a possibility.

Moore-Simas: Would you like to see the graph go this way and then back down again?

2. I'll be on the treadmill watching it!

Rosal: What other types of food messages would you like to receive?

1. If there is a food, like a vegetable you don't like, maybe it can give suggestions for an alternative or a recipe that would be good or something. Or maybe even a hint to try that food.

3. Maybe information on the benefits to the mom and baby for breastfeeding. Getting people into the precontemplation stage of starting to think about what your plan is going to be when you get to a specific week. Maybe some of the benefits for not just the baby but for the mom too.

Rosal: Basically preparing the mother to be a mom.

Jenkins: How would like you like to see this on the screens?

3. Like if you put in the foods and it would kind of break down the meal. Maybe it would track vitamins and nutrients specific to pregnancy, like folic acid and fiber and things of that nature.

Moore-Simas: Ive heard a lot about wanting feedback on a variety of things. How about if we made it that, making up and example here, maybe you had ice cream 6 nights in a row and it came back and said maybe this wasn't the best decision. Would you look at this as a turn off or a turn on?

2. Maybe have it try and get you to switch those foods for other, healthier alternatives.

Moore-Simas: Like maybe it would see you weren't eating enough vegatables this week and it would give you a tip to up vegatables. Would this be taken favorably do you think?

3. I think it would be

4. I want to know what would be good for me and the baby

2. Yeah if it gave you suggestions.

Moore-Simas: But more concrete suggestions, like you are not doing this and you should try and do this.

4. Maybe it could have something for when you are craving something, you can type in pizza for example and it would tell you how much to eat.

3. You were talking about recipes, maybe instead of going out it could tell tell you to make something at home. Like if you look up Papa Ginos, it would give you a hint to eat something homemade. Quick tips for how to do it and customize it.

Rosal: So it is kind of like tailoring your cravings and your weight. Not necessarily to not eat a certain food.

2. I know when I'm told not to eat something I kind of overdo it.

Rosal: Well that would not be productive, so maybe offering suggestions.

3. Maybe it could even tailor to different times of the year. Like if it around Christmas, how with holidays can you- there could be tips for this kind of thing. Kind of how to piece it all together with what's going on now, in the present.

Rosal: Yes that would be good especially as there are big differences in what is available in the summer vs the winter. And for you you feel the positive messages are important. I heard you say that earlier. What type of weight messages would you like to receive, for example if you are over gaining? What types of messages would you like to see?

4. More healthier foods, maybe things you should stay away from if possible.

Rosal: So you want that if you enter weight that is above what you should be gaining, that it would give you suggestions right there?

2. It could tell you to cut down on the sweets or something along those lines.

Rosal: So it could give suggestions based on the foods that are being inputted.

1. Even for an activity- maybe it could tell you what to do.

3. Maybe it could even say the risks associated with high weight gain or low weight gain. A lot of research states these things, and it is very important. Especially to a mother, this would be great to keep up with you and your baby. Take control of it before it is too late with information and education.

Rosal: So by getting this beforehand as opposed to after it is too late, ok…

Jenkins: How would you want to see that so it is not depressing or discouraging?

3. So if it tracking your weight and you are starting to gain more, it would say excessive weight gain leads to high blood pressure and other stuff. If it could correlate the weight, food and activity tracking it could give you a more tailored

Rosal: We have covered a lot of suggestions, but what are some things you wish you had learned earlier on in your pregnancy or in previous pregnancies.

Moore-Simas: Or even things you still don't know.

Rosal: What other things do you want to know about- you weight, diet, or physical activity…things that would make you feel in control with your pregnancy.

3. Is anybody interested in how to read food labels? Something like that where it can be slightly confusing, you know, like if it were a tip of the day. Like to look for things like fiber and calcium. Maybe it could also point out bad aspects to food, like total fat and serving sizes- things like that. If there are things being inputted into the food, there should be things to help you do that.

Rosal: Do you have any sense of what might be helpful to help read food labels or other aspects to food?

1. Well maybe with the food part when you click on what food you are searching for it could give you information on it, and you could click the back button or whatever so you could know all of that.

Harris: Key nutrition facts or a more elaborate, full set of information?

1. Maybe the full one, just so like if there is something you guys maybe wouldn't have put in there.

Rosal: So you are talking about entering the food with the brand perhaps?

1. Yeah and the nutrition labels. Cuz different brands have different labels.

Rosal: Did you mean to say anything about how to bring nutrition label into the application? You mentioned the tip of the day kind of thing, is there anything else you can suggest?

3. There are important aspects to what you would want to be looking for on the label. For example, calcium and fiber and the total fat low. Have it point out servings.

Rosal: So those could be single messages or separate tips for different days.

3. Yeah maybe it could talk about calcium one day and give you some information on that.

Rosal: That's the educational piece.

Moore-Simas: Do you think it would be valuable or undesirable to get the same message a couple times, maybe worded slightly differently? Like something about calcium monthly or what have you. How would you like to see this kind of message?

4. Not that repetitive.

3. Maybe focusing on a specific time, like you are at this week and your baby's bone growth is important now, so then you get the message. Something like that. Maybe you are at a certain week and you have having digestive issues- here's stuff about fiber.

Rosal: So tailoring it to your pregnancy?

Jenkins: How would you want to see that? A reminder in the application or something on the home screen- there are different ways to do this.

1. Maybe you could send it through a text message or something to remind you.

Jenkins: So something that would appear on the front screen of your phon?

Moore-Simas: So you wouldn't have to go into the application.

Rosal: What types of messages do you think would be interesting? Because text messages don't require you to buy into the application, and you can just receive then, what would you want to see there?

1. Well maybe like every week you would get a summary or something showing how much weight you should have gained and your progress- something like that. Maybe update your app with a summary to make sure you are on track.

3. Or maybe even something when you reach like your third trimester and it would give you a longer summary with more key points.

Rosal: That sort of mark the major times in the pregnancy.

Jenkins: Like milestones…cool.

Mike: Is there any specific brand s of foods that you prefer or you think is healthier?

3. Well it depends on the type of food, there is pasta, and you know yogurt- it could be anything. But if you were to do it you could maybe start with what's most popular or whatever.

1. I know downstairs in the women's center they have a poster on the walls that compares if you were to get this sandwich at McDonald's vs another place you can see which one is healthier. It is basically a breakdown comparing if you get this lunch from Subway or some other place. I can't think of exactly what was on it…

Rosal: And how would you apply that to this, what would you like to see? Some people find these comparisons very helpful, so I'm just curious as to what you would like.

1. Like when you are putting in a food it can give you an option. Or if you are eating ice cream for a whole week like we said, maybe it can tell you to do something. If you are getting a BigMac everyday it will tell you to get something else.

Jenkins: We have flushed out quite a few things so far- this is great. So this is just the main screen again with the icons. Is there any way you would make this different? The location of thebuttons, or anything you guys would like to see. What other information would you want there?

2. So I know with a lot of phones you can customize how it looks and where things are. I think mine is just a list of grid or something like that.

Jenkins: Would you like anything more on the main screen? What other things would like to have when you open the application? Feedback for that area perhaps?

1. I think it's good- its organized.

2. Yeah I think it's good too.

1. And it's really simple too so…

Moore-Simas: You could even think of specifics as to color, size, round or square buttons.

Jenkins: Or how you interact with it and where things are or what you want to see first.

Moore-Simas: It sounds like you guys use applications- what appeals to you?

1. Well it looks simple.

Harris: Are the buttons big enough to use and can you read them alright?

1. Does it look different on other phones or is it just the same?

Jenkins: With Android phones there are different screen sizes, so depending on the phone it could look a little different. It will be much the same layout, just a little stretched and larger. What would be more appealing to you?

1. Well my phone I have to use a little mouse thing to scroll around, so I don't know when I'm really clicking on stuff. So maybe it could pop up and got a little bigger.

Jenkins: Like when you click on it, it moves or something.

Rosal: Have you used applications before? Your opinion is very important because this is supposed to be for everybody. Many people that don't have that experience.

4. Yeah I don't have anything to compare it to, so I don't know much about it.

Jenkins: Ok, lets say you just started off with an idea of what this application would do, how would you like to have it look right from the start? What kind of menu would you like to see? What differences?

4. Its nice because its all labeled and there are pictures that show what they do.

2. It seems straightforward really. Cuz I had a phone where everything was really small and it was hard to use and see. There were so many different options I didn't know what I was doing and I actually returned it. It was too complicated.

1. This one tells you what you are clicking on and it seems easy.

4. Maybe have the option to pick graphs or charts where you can customize it.

1. Yeah like if you don't like the line graph you can choose a different way.

Rosal: So you want to have the option to choice?

2. Yeah to be able to customize it how you want it.

Jenkins: how would you want it?

2. I like it just like this- it makes sense.

Jenkins: As far as graphs maybe?

2. I would like a line graph.

3. Some phones Ive had before had other stuff- like when you click on activity or something it would be a pedometer. If there were different options for how data is inputted, like if you were just carrying your phone with you it could track something like that.

Jenkins: Based on all that you have seen and said today, is this an application you would like to use potentially or recommend to friends? If not, then how could we improve it?

1. I would, its easier than going through the internet and stuff.

Rosal: So that is one thing that would make you want to use it yourself. Is there anything else? Any other reason why someone would want to use this application as opposed to the internet or nothing?

2. Well you click on one thing and it all comes up for you. Instead of searching online for a certain food, you want to lose weight or gain weight or whatever at a certain week you aren't looking up each thing- it's all kind of right there.

Rosal: What are some reasons why someone would not use it? What are some things that would not make you want to use it as well?

3. It may be a little bit time consuming if you are putting in everything all of the time. If you forget to each day, even though there is a reminder there.

Rosal: So entering the information could be challenging or take time.

Jenkins: How would you like to see it made maybe a bit easier?

3. I don't know. I don't think the activity and weight take that long because in the food thing there are so many foods to scroll through. That could be tedious.

Jenkins: Can you think of a better way to organize that information besides the gallery of pictures we have?

3. Instead of the more button, maybe you could search for a food and as you type it finds it. Like everything is alphabetized.

Rosal: So instead of scrolling, just typing in the name of a food and having it search for you. I am going to ask you because you haven't used applications before, what would make the use of an application like this appealing for women like you who have not had all the exposure to all of these phones.

4. I am very interested in using something like this to stay educated and on top of things.

Rosal: So you would use the baby information?

4. Right.

Jenkins: Is there anything else you guys want to add? Any last comments or anything else you would like to see?

3. If you are talking about personalizing it, maybe you could have a place where you could put in a picture. Like you got a baby picture taken and you upload it and have it as the background.

Jenkins: We talked about that a little bit ago about customizing the themes and colors, what other ways would you like to personalize or customize the application?

1. Maybe there could be templates you could download and use with different colors.

Rosal: What color schemes do you think would be appealing?

1. More like baby colors like, I don't know, like kid stuff like rubber duckies.

Jenkins: So besides baby blue and pink, what other colors would you want to see.

1. What if someone doesn't want to know, maybe have a yellow or green color maybe.

Jenkins: Thank you guys for your input, thank you again for coming. This is definitely going to help us out a lot.

12/8/2010 Focus Group

Moore: We are in the process of developing a program for handheld devices. That we hope will help women gain the right amount of weight in pregnancy, which is a tough thing to do. Since a lot of people now have devices and have various programs for lots of different things, we thought that we might see if something like this might be helpful. We are in the very beginning phases of this, so really, anything you have to say about what yours like to see there, or what you'd like it to look like, anything. Although we all are in the room, and will have something to do with what =, ultimately our goal is to make it the best it can possible be. No comment is too small. We take everything as good positive feedback and we'd rather you tear apart, rip it up and tell us everything so we can move forward and make it the best possible. You are invited because you're pregnant and this is the population we anticipate using this device. Because, this is a research study, we're going to record what you say. We don't take pictures of you, or take your names or anything. But because we need to type the notes you have green cards that have a number on it. In the notes you'll be referred to as a number. We will never be able to go back and say "so and so" said what. It's just to keep everything anonymous so that you feel very comfortable talking and saying whatever you want to say. Also because we are researching. There is a consent form, which is what we gave you. There's the one that is stamped "Original" on the top of the blue signature, if you could read through that. It basically says that you should know this is research, you don't need to participate, and this is purely voluntary whether or not you do participate or no matter what you say. It will not affect your healthcare in any way, shape or form; your doctors don't know you're here. If at any point in time you don't want to answer a question, you've just had enough of this, you just want to get up and leave, you can do that. One you need to sign and we put it on file. The other you should keep, in case at the end of this you want to read it more carefully or you have a question about anything or you want to contact us there's information in here. Additionally, for human comforts there's food at the back of the room if you'd like anything and there's also several bathrooms on this floor. At the end of

this you will receive a $30 gift card and we'll make sure your parking is taken care of. I'll give you all a moment to read through this if you haven't already and I'll just do a quick recap. There is also what we call a demographics survey that has a couple of questions for you to answer if you feel comfortable with answering them. If you have any questions, medically related or otherwise please feel free to talk to me and/or your doctor. There will be one other person joining us, her name is Milagros Rosal.

Jenkins: In the packet of information, we will give you a phone to play with the application. So here is kind of a quick explanation of what buttons are. We will go through a presentation when we get started.

Moore: We've loaded the program up on the phone so you can click through and play with it during the focus group

A: are these the Droid's?

Jenkins: They are, the original Droid. I guess we'll get started... *fire alarm*

A: Can you find this on the Android Market?

Jenkins: No, we're just developing it. Eventually, we hope it will be up.

Moore: We're in the pre-beta phase

A: Are you planning on having it free? Or charge for it?

Jenkins: We have no idea yet, this is a UMASS thing. We will see what happens when we finish the app. I think we can start now that the fire alarm is finally done. My name is Tom Jenkins, this is my group, we are working on this project. We are not doctors, but we are working with Tiffany and Milagros to develop this application. We just want to reiterate that this is being recorded, so try and keep your voices up when you talk just so we get everything. Also, anything you have to say we want to hear, anything – good or bad –you're not going to hurt our feelings. We just want to make this the best application we can because eventually it's going to help other people. Also, feel free to use the phones the whole time; we're trying to get as much feedback as we can. All comments will improve our design. *fire alarm* we'll start with the presentation to get you guys familiar with the application. Basically, this is a cellphone application that is supposed to be a self-help to help you guys and other pregnant women when it's done to maintain your weight and to eat healthy and educate you about other things, such as reading food labels. This is the main screen you see on the phones. There are three different main components to this that we record, that you use in this application. The weight tracking, overall seeing if you're in the recommended ranges for pregnancy, food tracking that tracks your calories for different meals and activity tracking which tracks how many calories you expend. Also on this screen, there's profile where you set up your profile and progress, but we won't be worry about those too much. We'll be looking at the weight, food and activity tracking and the reminders section. Let's start with the weight overview. On all of these screens, the weight, food and activity tracking, they look very similar. The first screen you will see is an overview screen; it gives you an idea of how well you're doing. Pretty much, it

will say "good" if you're in the range. For the details tab there will be a graph showing your overall time and the input tab is where you actually input it. The activity, weight and food tracking have these three main tabs. Also, at the bottom there is a feedback, help and info button. We won't be going over those too much today though. We'll be focusing on the input screen, specifically because this is where you'll be interacting with the application. We want more feedback on them. For the weight input, this is the simplest of them, you'll just input your weight into that box and click submit and it will record it. The more complicated one we'll go to next, the activity input, but I'll let you play with the weight input first quick and you can try adding your weight or just look at it and get a feel for how you actually type things into the application.

B: Does this thing slide?

A: Yeah, turn it and push up.

B: To the side? Oh I've got it.

Moore: Then how do they input?

Jenkins: You click on the box and a keyboard will pop up.

A: Or you can slide it open

Jenkins: Or you can slide it and then you can type there as well, not all Android phones have the sliding keyboard, so we didn't really focus on that too much.

Moore: So a keyboard that they can touch the numbers and also the letters?

Jenkins: yep

A: It's missing a thing

Jenkins: Like I was saying this is kind of the most basic input. Brendan could you go to the activity. So activity, same overview as before. The input this time is a little bit different. The idea is to balance your sedentary vs. your physical activity. So, you would choose the type of activity, so you're you know either a standing activity or a sitting activity. Then, you'll click the select activity box and a pop up will come up and it will say "what activity is it?" walking, running, swimming, that sort of activity and you'll select duration after that and submit it. Then it will record your activity information. The next input screen is the food input screen and this one requires a little bit more effort as well.

A: You guys really have peas and broccoli under snacks?

Jenkins: this is just a sample food library, we don't have the full one in there yet. For the food overview is the same as the others, but the input is a little different. So you select the meal type and we've got breakfast, lunch, dinner and snacks in there. Once you select the meal type you click continue and it will show you what foods are on your list of foods for that specific meal. To add foods to that list, you click

the add food and the first thing that will come up as your most commonly chosen foods. So let's say for breakfast you eat a lot of bananas and orange juice for breakfast, those would show up there because you've added them a lot. Let's say you're going to eat mini wheat's or some of different cereal, you'd click more and then it would give you a list of food categories, within there you'd find the foods you'd want to add to your list. Right now we don't have pictures in there yet, but there will be a gallery of pictures of the different foods so you click on the food you want to select. So, it will give you calories, fat, just pretty basic information.

Rosal: What are your thoughts about the information that is in there right now?

C: I am assuming you guys are just putting in random foods for things

Jenkins: The initial library is very small

C: So when I hit fruit, I get pizza, that's what's supposed to happen? The other thing is I keep hitting submit on this screen and it's not going anywhere. Is that supposed to happen?

Jenkins: No not really. What kind of confirmation what you like to see? Would you like to see a confirmation that says "this has been added to the list"?

C: Yeah… I'm not very computer savvy and I need to be told with a popup that I've done something right.

Rosal: Because you're not very computer savvy, we want your feedback. What is it like when you go through it?

C: Cause it says add foods below and press submit and I hit submit and then nothing changes so I don't know if it's gone through or not.

A: You should have a spot just to be able to type in like "chips" or something, so you don't have to go through all this stuff to be able to

Jenkins: Like a search?

A: Yeah, or a custom input because then you don't have to sit there and take the time to go through all the different categories and search for what you're looking for.

Rosal: So what you're suggesting is you start entering the information perhaps and it moves you to where it is and you just click yes?

A: Or you could just input it yourself, like chips and then press okay and it would be added to the list and the information would come up.

B: it could give a sample of chips to choose from

A: Yeah, cause different ones do have different calories… And then, for like vegetarians you should have like… cause they have different foods without all the additives. So a lot of their foods wouldn't even be considered in the ones you have because there are different ingredients in theirs.

Rosal: So you're suggesting considering brands as well?

A: Well, how they have the all-natural, if you go to the vegetarian shop on Chandler St. they have the ones without additives. I work with someone and she was explaining to me how theirs are all natural vs. the ones with chemicals in it. So that has a factor in the food too

C: I would find it more useful if I could customize my menu, instead of picking from a pre… if I could put in the name, the serving, the calories and I could do it myself and then have it be stored in my own personal menu and then I could just select it. Cause maybe, I eat 3 pieces of pizza instead of 2… Just be able to customize it myself, make it my own menu.

Rosal: So you would want to enter the calories, you would want to enter the…

C: I would be able to read my little thing on the package and…

Jenkins: What other information would you want to be able to track?

C: Vitamins, right now I do a lot of label reading for vitamin D, vitamin C, I track folic acid, calcium. The things your OBGYN tells you are very important to be taking in. I also to try to track the food pyramid, the servings of bread and the serving's fruit per day that I take in, just to try to keep my intake balanced. It's not necessarily… like I could eat pizza all day but it's not really good for me, so I want to be able to know I got my 4 servings of vegetables, my 3 servings of milk and things like that.

Rosal: How do you normally know that?

C: I keep a food diary and write it down

A: Maybe in the different stages of the pregnancy you could give suggestions on what to eat to get the most vitamins, I know at the end of the pregnancy the baby is storing up iron so it tells you to eat a lot of red meats. So maybe at different stages you could give suggestions on what the person could eat to get the most of them.

Jenkins: When you set up your profile in this application, it knows when your due date is, so it will know what time you are.

C: Which trimester?

Jenkins: Yeah

Rosal: So that would be feasible… Also certainly entering the information would also be feasible. Those are great suggestions. Any other suggestions up to now?

Jenkins: As far as the weight input screen or the activity input screen, do you have any input on that?

A: You know how you do the calorie counter? If one of your meals is a little bit over, you can make suggestions for the meals for the rest of the day to kind of even out the calories. You could give a couple suggestions to help the person out to stay with the calories.

Rosal: So you would like the suggestion based on the number of calories that you've eaten so far?

A: Yeah, that you've eaten so far during the day or that you have left for the day or that you need to eat. I know some people don't gain enough weight, so they need more calories.

B: And then also with the activity, with walking let's see I've had so many calories per day and I wanted to lose some, it can suggest if "you walk 30 minutes you're going to lose this much calories", that would be fine too

Rosal: So you want to know the calorie expenditure?

B: Yes

A: Some way to even things out, kind of

Rosal: Any specific activities that you would want to know about, in terms of the number of calories

A: What about cleaning?

D: Housework

A: Cause you're lifting, you're bending

Rosal: Absolutely

A: I know it's a lot of work now

Rosal: Any other activities that you normally do?

A: Shopping

C: Maybe yoga

Rosal: Any other activities? Walking is something that we always hear. We can add that too.

A: Well, I know a lot of pregnant women now are cleaning and getting the baby stuff set up. So you're lifting, you're bending

Rosal: Dusting right?

C: How many calories do I burn while dusting?

A: I know at work the other day I burned a lot cleaning

Jenkins: How about the sedentary activities? We're trying to balance the active time vs. sitting and laying down time?

C: Do we get those? Does anyone have sedentary time during the day?

A: We're always burning calories cause the baby's always doing something, our body is always doing something

C: I don't know, in the evening I'll sit down with my husband and watch TV

Jenkins: That's kind of what we had in there, watching TV

C: During the day it's pretty much running errands, cleaning, walking,

A: Working

C: walking the dog, I'm unemployed right now but I still have a very full day unfortunately

Rosal: Walking the dog is a good one

B: When you look through the pregnancy book, they have stretches you can do at home. I haven't done them though so I don't know

Rosal: We can include those

A: You look at the pictures though

Jenkins: Any other way you want to see that shown? Besides the little bar we have?

Rosal: What does the bar tell you?

A: You should have red to green or something or green to red instead of red to red, so that you know what zone you're in. Like green is good, yellow is okay, red is "you shouldn't be over there"

Rosal: So you want it

Jenkins: Just straight across

C: I was wondering that everything seems to be on the top half of the screen and there seems to be blank space on the bottom half of the screen. Is that on purpose? Are there going to be more graphs?

Jenkins: There's going to be some more text feedback in that top bar. So there's a fact there now, like your baby's fingers and toes are now present but most of the feedback will be on that feedback button.

Harris: What kind of information would you like to see on that screen?

A: Is there a way to take a picture and get measurements of your stomach? I don't know if you could scale it down, but like every week you're supposed to gain a centimeter, you could take a picture and see if you're where you're at. Seeing that you have the updates on the baby or even what the mom's going through that week. I know on some websites they have what your baby's doing and then what you should be going through and stuff like that.

Rosal: So some feedback about the mother that could be measurements or perhaps weight? Would you want to see there, measured waist circumference?

A: Or maybe daily tips, like put your feet up to get rid of swelling or something like that. Something helpful.

B: I also think if they put some of the things that they have in the pregnancy book about like your baby's lungs are developing this week, stuff like that. That will make me appreciate this because I won't have to carry that huge book around because I can just look it up on my phone.

Rosal: Where would you like to see that on this screen? Is that something you'd like to see on the top, middle or the bottom? Can you take a look at this screen and see what's in there right now, what it tells you?

B: You mean on the main screen?

Rosal: On that screen

Jenkins: For instance, this is the food screen

Rosal: Oh I'm sorry, are you saying you might want to see it on the main screen?

B: Yeah, if you have a button for it, "your baby this week" or something, then you can just hit on that from the main screen and it will tell you "you are 6 weeks in " maybe "your baby's lungs are developing".

A: Maybe it will give me more motivation to remember to actually use the app cause if it's just telling us you're just eating too many calories, we're not going to want to use it. But, if it's telling us "you're baby doing this" we'll want to go and look and see what our baby is doing.

Rosal: Does that mean adding another button there that says "Your baby's Development"

B: Your baby this week

Rosal: Or your baby this week

B: Since you put your date due in, let's say every week it's gonna tell you what the baby is doing and it can have a reminder pop up. I signed up for this on babycenter.com and every week they send me an email telling me what's developing in the baby and what's normal for me to go through and what's not

normal and what you should contact your doctor about. So if I have something pop up on the screen and say "your baby this week" I would want to look at instead of going to Barnes and Noble and buying a huge book.

Rosal: So you prefer having it in the phone as opposed to the book or the internet? Cause you are using the internet, how would it compare to having it in the phone vs. the internet? What might you use more?

B: The phone you can just check it anywhere. It's just gonna be a summary instead of a whole chapter.

A: I have an app on Facebook that every week it sends a little picture of what your baby looks like this week. It tells you what the baby is doing and if you click on it, it will bring you to a website and it will tell about you what the mom should be feeling.

Rosal: So very similar to what you're describing, in a different program, but both programs are pretty much the same.

Jenkins: What are they called?

B: babycenter.com

Jenkins: That's a good point too; you said it gets sent in email, how would you like that shown in this application for instance? Would you like it to be like a text message on the main screen of your phone or would you want to go into the application and find it somewhere in there.

B: A text message reminder would be nice, that would direct you to the application.

A: Maybe it could even be the background, you could have it so it updates right?

Jenkins: That's another thing we're going to look at to, the reminder feature. For all of these, you can set custom reminders for when you want it to remind you to put in your weight, or record foods or your activities. Here's the reminders page, it has 3 tabs like before but those 3 tabs are now for the specific things you're going to be recording. For weight for example, you click add reminder and it will ask you what days you want it to remind you to put in your weight.

A: It's babygaga.com. If you want to take a look at it, this is what it looks like.

Jenkins: this is on Facebook?

A: yeah

D: I have an app on my iPod, it's called Pregnancy Facts. Every week it gives you updates on what you should eat, what you should do, what the baby is doing, what you're doing

Rosal: Very much like the others one?

D: Yes

Rosal: So what is the name of that one?

D: Baby Center Pregnancy and my baby light.com. That one's the one I basically use more. It tells you how far along you are, how many weeks you have left and the sign of the baby, like if it's a Scorpio. Just little facts.

Jenkins: Back to the reminders feature, you can set the times for all these different things and it will actually show up on the home screen of phone. There's a reminders part of the phone, so it will show up when you turn on your phone and you'll see that there will be a reminder there. You do that for weight, activity and nutrition. Is there any way you would like to see this different? How you actually set up reminders or how the reminders are given to you.

Rosal: What kind of things would be helpful to have in the reminder and how it shows on the screen?

C: Can you connect it to your email? I am very bad with cellphones, I leave them in the other room, I leave them in the car, things like that and I don't always have it on me. Or, I go to the library a lot or I go to places where you need to be quiet.

Rosal: Not everybody uses their cellphone as much.

C: I'm on the computer all the time, all day. So if I had it in my email, then that would be better than having to cart my phone with me everywhere.

Rosal: So a text message can also be set by choice to an email

C: If I could choose to send it to me email instead of my phone or choose both, that would be more helpful.

A: What are the reminders for?

Jenkins: For inputting this data, so it will remind you to put in your weight for that week. It will remind you to put in foods for breakfast, lunch. Let's say you set it for the evening and then you do all your meals or you set it for after lunch.

A: What if it was the day you go up a week? So that you get your reminder and get your weekly update, so you do everything at once. Cause some people don't check it, so if you're reminded

Jenkins: So an all-encompassing reminder that just says "do all of it"

A: Yes, Some people won't remember, so if you reminded to check your weekly update on the baby and you. You can just do it all at once.

C: Can you delete a reminder?

Jenkins: Yes, but you'd have to just change it.

C: like deselect it?

Jenkins: You'd go through the reminders again and just deselect or change the time.

Rosal: That would be a helpful feature to have, someone may think they want a reminder and then they want to change it.

C: I may think I may want to be told 5 times a day I need to eat a piece of fruit and then suddenly realize.

A: Are you going to have a part that includes instructions?

Jenkins: That's part of the info, but we're trying to figure out what actually people want to have in there

A: How to easy delete, how to change stuff, you should make the background customizable. Like if you're having a girl you can pick from like purple and pinks and a boy you can pick different colors. So it's more customized to you. Have different wallpapers instead of just a sun and yellow.

Jenkins: Speaking of the appearance of it, what other color schemes like you were saying boy or girl you could pick a different theme…

A: You could do different hues of purple or how people do polka dots for girls

Rosal: stripes for boys…

A: Yeah, different room ideas. Something that makes it fun, that makes you want to use it, that's helpful too.

Jenkins: What other colors would you guys like to see?

B: Pink for girls

D: Blue for boys

Jenkins: How about the default theme that would show up, because you wouldn't know at the beginning of your pregnancy. What kind of colors would you like to see?

A: Light colors, light greens like neutral, like if you go to a baby store and you wanna be the person who doesn't know what you're having. What colors you'd pick, neutral.

Rosal: Going back to the text messages vs. emails, how many of you text?

Rosal: All of you text. What type of plan do you have?

All: unlimited.

Rosal: You don't get any additional charges for the text messages you receive.

Jenkins: So you guys all use cellphones all the time…

B: Is it possible, to have a forum that other pregnant women that are using this can have discussion, without them knowing your phone number and other person.

Rosal: So like a chat room?

Jenkins: Like a social network?

C: Maybe not necessarily on the phone, but because again the phone is not the center of my world, the computer is. So if there was something linked, if you had a forum online or a webpage attached to the app.

Jenkins: Well the app uploads this data to Google Health. Google Health is a free service, anyone with an Android phone it links to their Gmail account. So all of your information is up there, and you can actually share that with your doctor or something like that or you want to share your progress. So it is on the computer, but it doesn't have that social networking aspect.

Jenkins: Welcome

Rosal: Maybe we can bring you up to speed as to what we're doing.

Jenkins: So basically, you're here because you're part of our demographic for this application as a pregnant woman. This application, we're not doctors, but this is supposed to be a self-help tool to allow you to maintain your weight gain during pregnancy and stay within guidelines. To do that we are tracking three major things, your weight, your food intake and your activities. This is the main screen of the application and these buttons correspond to the different parts of the application that you'd be using. Theres the profile, you'd put in your due date, your age, your initial weight. After that, you'd be tracking on a regular basis, your weight, activity and food. Within there, there's different input screens that we kind of looked at. Then you'd set reminders for when you'd actually want to put this information in, and then you it would give you progress and feedback as well. So we're trying to figure out, just basically any input you'd have on how we can make this better, what information you'd want to see, any appearance things. So, we were talking about the appearance. How do you want to see the main screen layout? What do you like or not like about this?

A: You could do like a grid or a block, like you have different options on your phone. Some people just like to read it and click on it, instead of seeing pictures.

C: I'm not too fond of the yellow bar, would like a different color.

Rosal: What would you like to see there?

C: Maybe if the color was blended with the blue background. Not so red, it looks like a yield sign.

A: Less invasive

Jenkins: The sun in the middle is not really scoring how you do on this but it's very loose are you within your boundaries?

A: So if we're doing bad, it's going to have a sad face?

Jenkins: It will have a little bit of an unhappy face, not a sad face

Rosal: What would you like to see?

C: I maybe wouldn't want that on the opening screen.

A: It would make me feel bad

C: I wouldn't want that yelling at me

A: I wouldn't want to open it

Rosal: Maybe not as up front

C: Maybe a little farther into it, so if someone picks up my phone and says "oh what's this?" oh I'm doing terribly… I don't really need my mom to see that

Rosal: So a matter of privacy

Jenkins: How would you like to see how you're doing?

C: Your graphs that are on the activity and food page, seem to be…

Jenkins: There's a line graph too on the details page that we didn't go over

C: You already have that measurement, within the app… I'm not sure I need an icon on the front to tell me how I'm doing

Harris: Is there anything you'd like to see in place of that?

Jenkins: Or in general?

C: If you want to keep the smiley face sun and not have it change, that would be fine.

D: I like the smiley face, if I'm doing bad I want it to tell me I'm doing bad. Not a lot of people tell me if I'm overweight or… So if I open the phone and it has a sad face, it will let me know I should be walking or eating less..

Jenkins: How would you like it to tell you that?

D: I like the frown or the smiley face, because it lets you know you are doing bad. It's better to have someone or something tells you. The facial expression would be good for me.

Rosal: How do others feel about that type of feedback up front?

B: I don't think people would know much about it. They would just think it's a picture, but for you, you would know what it was.

C: Yeah, if you open it up and it's smiling yeah it's just an icon and the sun is frowning…

A: That's why it should be customizable because some people want it and some don't.

Rosal: How about for you, your suggestion is good, cause the women can pick and choose.

A: I would like to just have a background that would have to do with the baby. Cause you have the bars in all the other sections.

Jenkins: So leave the feedback in the other sections and not on the main screen?

A: Yeah, I think you should have that option.

E: I don't like the smiley face. I think you should have a picture of the ultrasound, not a smiley face.

B: So that means, you should provide a way to customize it based on what the person wants.

Jenkins: You guys have said you have used some applications that show you pictures. What that be something you want to see on the main screen or elsewhere in the application?

C: Can I input my own graphics? If I have an ultrasound picture and I want to put it there, will I be able to do that?

Jenkins: We're open to suggestions; give us anything you've got

C: I didn't know how that difficult would be

Moore: Pretend this is all the easiest thing, this is pie in the sky, so easy they could do it by snapping their fingers. What would you want it to look like? What would you want it to be different?

C: I want to be able to find an icon or a background that I like and be able to input it from my computer. Like the way I do on my own phone, the picture I have on it is something I downloaded from the web. It's not part of the phone, if I could do that with that.

Rosal: One of the things we discussed is how you would want reminders sent to you. Reminders related to entering information, reminders to look at where your baby is at, whatever the reminder might be. I was wondering what you feel or whether you have used any internet websites, related to the baby or the pregnant woman. Not every woman uses websites…

E: I use baby center online

Jenkins: What information do you use or like from it?

E: The weekly updates

A: It's basically the same thing I showed you

Jenkins: Little overview:

A + E: Yes

Rosal: Sounds like most of you find that very helpful, the weekly updates. Do you text?

E: Yes, I would probably want a text message sent to remind me.

Rosal: What type of plan do you have for texting? Are you able to text unlimitly?

E: Yes

Jenkins: As far as the overall appearance, do you have any color schemes or anything you had in mind that would be different, better or appealing?

E: I just don't like the smiley face

Rosal: We got that.

Jenkins: As far as the icons, do you like them or not like? How could we change them to make them better? As far as the main navigation, how you go through the app?

E: Icons are fine

Rosal: What do the icons tell you?

A: Exactly what they say

Rosal: because you all saw the application already but she hasn't seen it, so her input would be very valuable

E: My opinion? I think the icons are fine, they tell you right to the point what they are. I would probably want them more on the side, not in the middle of the phone.

Jenkins: Would there be anything else you'd want to see on this screen? Tip of the day? Or facts? Progress?

E: I'm on Facebook, every Friday it sends me an update and what to expect

C: Would you be able to have an area to input how many times a week you throw up? Things like that.

Jenkins: Just like a notes section?

C: Something you could track how nauseous you are, when you get tired

Rosal: Any type of symptoms?

C: So when I go see my doctor I just pull out my phone and say this is what happened to me this week or this month. When I'm feeling sick, I don't want to be writing it in my daily journal.

A: I didn't gain weight how you normally do, I gained a lot in the beginning and then I went a month or a month in half without gaining anything. My doctor said it was fine because I had gained so much already that she wasn't worried about it. People gain weight at different rates, so I don't know if you could use that for something?

Rosal: So information about the rate at which people gain weight?

A: So the sun would have a sad face but you'd actually be where you're supposed to… I don't really know how to explain it, because not everyone gains weight at the same pace. There's other underlying health issues that could be part of it.

Rosal: So your suggestion is to take that into consideration when giving feedback?

A: So maybe if you have a thyroid problem or diabetes, that's all going to come into play too. So if there's a space where you could put that in.

Rosal: So information about things that could make weight gain different for different women.

A: So the sun is not discouraging you because of something it isn't aware about.

Rosal: What other thoughts do you have? Things you would like to see? Things that you don't see that you think would be helpful.

C: Could you have a daily or weekly diary section? Or a notes section?

Jenkins: Everything is possible.

C: Something that is instead of just notes, a calendar where you put in notes for the day?

Jenkins: So you'd want that on the main screen?

C: Yes, another icon that says "diary" or whatever.

Jenkins: As far as feedback, we talked about this a little bit, but we'll be giving like "You haven't eaten vegetables in a few days" how would you like that shown or told to you? Or, you haven't walked or done any exercise in a week. Maybe negative things is there a way that you'd want to have that told to you, so that you wouldn't be discouraged but you would still want to…

A: We know.

B: A little pop-up icon.

Jenkins: okay

A: Those are just things we don't want to acknowledge but we know deep down we haven't exercised or eaten fruits and vegetables.

Jenkins: So you would want it to remind you?

C: I think if you have a reminder to do your walking, you already have the reminders programmed in.

Jenkins: Right, to input the information, but let's say you haven't input the information in a while. Would you want it to tell you that you haven't done that for a while?

C: I suppose it could... I don't know what good it would do quite honestly, it's very easy to ignore those things.

A: You should definitely have other activities that women do, like cleaning. Walking is obviously exercise, but not everyone does that for exercise. It's not like you don't exercise when you're cleaning, especially with all the extra weight, it's twice as hard to do anything.

Jenkins: Based on what you guys have seen of the application, would you be interested in using it? Would it be something you would find useful?

A: I would probably download it, if it was free. I don't really pay for any apps.

Moore: That's good to know, that's important for us to know.

Jenkins: How about the rest of you, would this be something that would be helpful for you to use?

B: I would use it if it has other reminders and weekly updates.

A: Maybe if you guys didn't want to put it for free, you could have a "lite" version, where you would have just the basics and in the paid version you could have the full blown thing.

Jenkins: With all the libraries of information?

A: Just because someone doesn't want to pay for it doesn't mean they shouldn't be able to utilize some of the features.

Moore: Frankly, we're not knowledgeable about how all these cost. As physicians, we just want to make a great product that would be helpful to help pregnant women.

A: But it does cost money to do all this, so if you want all the extra things, charge like 2.99 or something and if you don't you can just use the "lite" version, which would just give you the weight, the food, the stuff to keep you healthy.

Moore: It sounds like many of you already use online computer based things or for those you that have these types of phones, is there anything in them that we haven't already talked about that we don't have here that you would really like to see here that would be critical to make this something you would use? Or if we have talked about it, we'd like to make sure we hear you loud and clear.

A: Maybe if you've done good for a certain amount of time, it could suggest junk food you could eat or something.

Moore: Give you a bye for that time?

C: Congratulations have a chocolate bar!

Jenkins: So like alternatives to different foods?

A: Like a day to splurge or something like that. If it's seeing that you've been keeping track, and staying on your calories and eating healthy. Not everyone wants to eat healthy all the time.

Jenkins: As far as eating healthy, let's say you put in a bunch of foods that aren't good, would you want it to tell you alternatives to foods? Or other things you should eat.

A: Yeah, maybe even how they have the regular food and the all-natural. Maybe you could suggest that vs. the other one to lower the calories.

Jenkins: So you want it to go both ways, if you're doing well you want it to give you some foods to have fun with and then if you're not doing well you want it to give you some alternatives.

A: Yeah, some alternatives either way I guess. And then the time of the day that you eat, maybe it could suggest meals that will fill you up at night, so you're not eating in the middle of the night and gaining those calories cause you're just sleeping and not doing anything. So meals that will fill you up more, later, like for dinner and then lighter ones in the afternoon or for snacks or something.

C: You know what else would be good? Instead of just food, your liquid intake, cause you have to stay so hydrated all the time. So knowing how many ounces of water or juice or milk that you've been tracking for the day or the week or whatever. That would be really helpful, because I carry this bottle of water around all the time but I'm still probably not getting enough.

A: And then for people who can't drink milk, cause I can't, a way to get those vitamins.

Moore: This is a very specific question, if you had to think about your friends and family, you know maybe other pregnant women you know. What would you say, how many or what percent of them have cellphones.

All: All of them.

Moore: How many text?

All: All of them.

Moore: How about the phones that can do this type of thing, that allow you to have applications. How many would you say? Cellphones are pretty common but, I call them the fancy phones, the fancy phones are less so.

A: A lot of them.

Moore: So not a 100%...

C: No, I'd probably put it at like 30% of the people I know have smartphones.

Moore: Anyone else, a guess?

C: Especially right now, I know a lot of people who had smartphones and got rid of them because they were too expensive. Right now, people are not too attached to their smartphone.

Moore: With the texting piece, do you feel like most people have unlimited texting or a pay per text.

A: It depends, I had another phone that was $25/month for just 300 minutes but everything else was unlimited. So they're doing a lot more unlimited text and web.

Moore: There's a lot of variety.

Jenkins: As far as texts vs. email, would you want both in this sort of application to give you reminders? Or just one or the other?

C: I want to be able to choose.

A: Yeah.

Jenkins: Does anyone else have anything else they would like to add to the discussion? Anything from the font used to the colors, anything.

A: It should just all be customizable.

Moore: Another very specific question, it sounds like all of you text, at least back and forth to family and friends. Do any of you, currently receive texts from a baby type of program or anything like that? Do you actually read them or do they just pop up and you ignore them?

D: I read them.

A: I signed up for emails and it's annoying because they just send so many emails. I get them sent as updates to my phones as text messages and notifications. So, they just keep coming.

Moore: So if some of these reminders came to by text. Generated by the system when you signed up. Do you think they would be the kind of things you'd open and read or do you think eventually you'd grow tired of them and start ignoring them?

C: I would read them religiously at first and then eventually I'd see a pop-up and say "oh I have to eat lunch". Probably, after a while once I got used to what they were. They'd pop up and it'd be a reminder and I probably wouldn't read it so closely.

Moore: So what would keep you invested in reading them?

C: Honestly, I have no idea. Because I do tend to ignore that kind of stuff after a while. Even my bank statements, "oh I got my bank statement" and then I don't open it for 3 days. But, I'm just lazy, that's just me.

Jenkins: a lot of you use online things. You use that Facebook thing that sends you weekly information. Does that seem like something you would want in this as well?

A: Maybe a countdown to your due date. I know there is a website called I am Pregnant. You put in your due date and it comes up with what week you are, what your trimester you are, how many weeks until next trimester and how many days until your due date. Then it has a picture of the baby for that month. Like it will have the blocks of the week and the picture of the baby.

Jenkins: What kind of tips or things would you want to get out of this application? You were talking about the baby book and having that information. What kind of things would you want to know?

C: I suppose if you have something telling you what vitamins you've been good at taking, say if I'm not eating enough iron. It gives a suggestion that I eat spinach with dinner that night. Not telling me what to eat, a suggestion that I might want to think about a leafy green with my chicken.

A: You can think about it.

C: Something like that, if you do start tracking vitamins and minerals that it tells you're overdoing on calcium but you're not getting enough vitamin D.

A: The vitamins that are hard to get. Prenatal vitamins make a lot of people sick, so a lot of people don't take them. I know a lot of my friends couldn't take, cause they would just get really sick. So maybe a way to supplement that.

Jenkins: You guys talked about things you track before, you were saying you track omega 3s.

C: I track folic acid especially, folic acid, calcium, iron, vitamin A, D and E. I always read the nutrition labels to track that. I also try to track that I'm not eating too much sodium or Trans fats, things like that.

Moore: My sense of the room is that we're coming to close to an end on what we can sort of tease out of you.

A: I would say a lot of meal suggestions.

Jenkins: Like recipe suggestions?

A: Maybe you can input your favorite food and you can go from there? Like healthy suggestions, because I don't know about you guys but I haven't had any weird cravings. I had one and it was the worst idea ever and I never went for another one.

C: I actually have had this weird aversion to bananas.

A: Hot dogs…

C: I can't stand the smell, but you get a lot of potassium from bananas. If I could put in, I can't eat bananas. I have an allergy to shrimp, I can't eat shrimp. What's an alternative to bananas that I can eat since I can't get anywhere near bananas; I can't even have it in my house right now. Something like that. If you could put in carrots.

Jenkins: Like a list of favorites and a list of not so favorites.

C: Well, not so much, I know what my favorite foods are and what I don't like. I used to eat bananas on my cereal everything morning but suddenly one day I tried and I had to run to the bathroom. I'm not getting the nutrients that I used to get every morning. If you could put in "I'm never eating this for the rest of my pregnancy", what can I eat instead?

Jenkins: You wouldn't want bananas to show up in your reminders.

A: Just things I want to stay away from… I definitely wouldn't want to see hot dogs.

C: I can't even feed my dog anymore. Cause the smell of the dog food… So my husband has to feed the dog.

Moore: Anything you haven't said that you really want to get out there. Pretend like this magically happens.

A: I feel like we're around suggesting a lot for an app but I know what apps are capable of. It just seems like a lot of work. If you get it all together, it would probably be really good. Maybe not even just a weight tracker, like an all-around pregnancy app. Cause I know they have other ones where they do certain things, but if you have everything in one spot, it just makes it so much easier. Like they have the what to expect book. Everything's in there and you can just go right to that book and use it, but you're not gonna carry that book with you wherever you go. So it would be easy cause you carry your cellphone with you.

Jenkins: So based on that thought, an all-encompassing pregnancy application that would make you want to use it more than just a weight tracker.

C: Honestly, if I just want to track my weight, I can go to weightwatchers.com. If you want a real pregnancy weight tracking and things like that, there needs to be things that, if I'm pregnant, I have certain needs, certain requirements that I need to track, not just my weight.

A: We have a lot of worries, a lot of questions, especially if it's your first kid. I know I spent a lot of time going on the internet looking for something but if it's right there, you don't have to take the time to go search, you could put a search bar in there but it would still be in one spot. That's something else you could charge a price for, that would be in the full version, compared to the "lite" version. The lite version could be this and the full version could be the one with everything you need. Cause it's a long 9 months, or however long it is after you find out, you have a lot of questions a lot of things you don't know, a lot of worries.

Moore: Terrific, thank you so much.

Jenkins: Thank you guys a lot, this is great.

Appendix E.   Feedback Content

Dietary Feedback:

If the amount of fruit servings entered is less than recommended, suggest a fruit from the library and show a tip to help eat more fruit. "It is recommended you eat [insert servings] of fruit per day, considering trying one of these fruits: [display 2 or 3 fruits from library]. A good way to eat more fruit is [show tip]".

If the same fruits are always inputted the application will say: "It is recommended you eat a variety of fruits, consider trying one of these fruits: [display 2 or 3 fruits from library]".

If the amount of vegetable entered is less than recommended, suggest a vegetable from the library and show a tip to help eat more vegetables. "It is recommended you eat [insert servings] of vegetables per day, considering trying one of these vegetables: [display 2 or 3 vegetables from library]. A good way to eat more vegetables is [show tip]".

If the same vegetables are always inputted the application will say: "It is recommended you eat a variety of vegetables, consider trying one of these vegetables: [display 2 or 3 fruits from library]".

Include the 7 ways to size up your portions guide from the book.

Include Understanding food labels from the book.

 Tips to help eat more fruits:

General:

· Keep a bowl of whole fruit on the table, counter, or in the refrigerator.

· Refrigerate cut-up fruit to store for later.

· Buy fresh fruits in season when they may be less expensive and at their peak flavor.

· Buy fruits that are dried, frozen, and canned (in water or juice) as well as fresh, so that you always have a supply on hand.

· Consider convenience when shopping. Buy pre-cut packages of fruit (such as melon or pineapple chunks) for a healthy snack in seconds. Choose packaged fruits that do not have added sugars.

At meals:

· At breakfast, top your cereal with bananas or peaches; add blueberries to pancakes; drink 100% orange or grapefruit juice. Or, try a fruit mixed with low-fat or fat-free yogurt.

· At lunch, pack a tangerine, banana, or grapes to eat, or choose fruits from a salad bar. Individual containers of fruits like peaches or applesauce are easy and convenient.

· At dinner, add crushed pineapple to coleslaw, or include mandarin oranges or grapes in a tossed salad.

· Make a Waldorf salad, with apples, celery, walnuts, and dressing.

· Try meat dishes that incorporate fruit, such as chicken with apricots or mango chutney.

· Add fruit like pineapple or peaches to kabobs as part of a barbecue meal.

· For dessert, have baked apples, pears, or a fruit salad.

At snacks:

· Cut-up fruit makes a great snack. Either cut them yourself, or buy pre-cut packages of fruit pieces like pineapples or melons. Or, try whole fresh berries or grapes.

· Dried fruits also make a great snack. They are easy to carry and store well. Because they are dried, ¼ cup is equivalent to ½ cup of other fruits.

· Keep a package of dried fruit in your desk or bag. Some fruits that are available dried include apricots, apples, pineapple, bananas, cherries, figs, dates, cranberries, blueberries, prunes (dried plums), and raisins (dried grapes).

·   As a snack, spread peanut butter on apple slices or top frozen yogurt with berries or slices of kiwi fruit.

·   Frozen juice bars (100% juice) make healthy alternatives to high-fat snacks.

Tips to make fruit more appealing:

·   Many fruits taste great with a dip or dressing. Try low-fat yogurt or pudding as a dip for fruits like strawberries or melons.

·   Make a fruit smoothie by blending fat-free or low-fat milk or yogurt with fresh or frozen fruit. Try bananas, peaches, strawberries, or other berries.

·   Try applesauce as a fat-free substitute for some of the oil when baking cakes.

·   Try different textures of fruits. For example, apples are crunchy, bananas are smooth and creamy, and oranges are juicy.

·   For fresh fruit salads, mix apples, bananas, or pears with acidic fruits like oranges, pineapple, or lemon juice to keep them from turning brown.

Tips to help eat more vegetables:

In general:

·   Buy fresh vegetables in season. They cost less and are likely to be at their peak flavor.

·   Stock up on frozen vegetables for quick and easy cooking in the microwave.

·   Buy vegetables that are easy to prepare. Pick up pre-washed bags of salad greens and add baby carrots or grape tomatoes for a salad in minutes. Buy packages of veggies such as baby carrots or celery sticks for quick snacks.

·   Use a microwave to quickly "zap" vegetables. White or sweet potatoes can be baked quickly this way.

·   Vary your veggie choices to keep meals interesting.

·   Try crunchy vegetables, raw or lightly steamed.

At meals:

·   Plan some meals around a vegetable main dish, such as a vegetable stir-fry or soup. Then add other foods to complement it.

·   Try a main dish salad for lunch. Go light on the salad dressing.

·   Include a green salad with your dinner every night.

·   Shred carrots or zucchini into meatloaf, casseroles, quick breads, and muffins.

·   Include chopped vegetables in pasta sauce or lasagna.

·   Order a veggie pizza with toppings like mushrooms, green peppers, and onions, and ask for extra veggies.

·   Use pureed, cooked vegetables such as potatoes to thicken stews, soups and gravies. These add flavor, nutrients, and texture.

·   Grill vegetable kabobs as part of a barbecue meal. Try tomatoes, mushrooms, green peppers, and onions.

Make vegetables more appealing:

·   Many vegetables taste great with a dip or dressing. Try a low-fat salad dressing with raw broccoli, red and green peppers, celery sticks or cauliflower.

·   Add color to salads by adding baby carrots, shredded red cabbage, or spinach leaves. Include in-season vegetables for variety through the year.

·   Include cooked dry beans or peas in flavorful mixed dishes, such as chili or minestrone soup.

·   Decorate plates or serving dishes with vegetable slices.

·   Keep a bowl of cut-up vegetables in a see-through container in the refrigerator. Carrot and celery sticks are traditional, but consider broccoli florettes, cucumber slices, or red or green pepper strips.

Sources:

http://www.mypyramid.gov/pyramid/fruits_tips.html

http://www.mypyramid.gov/pyramid/vegetables_tips.html

Exercise Feedback:

If no exercise is inputted, display a message saying:

"Exercise during pregnancy offers many health benefits, including: [insert one of the benefit bullet points]. It is recommended that you get 30 minutes of moderate exercise most days of the week. A Recommend exercise for pregnant women is: [insert one of the beginner sports bullets]"

Benefits Bullets

·   Helps reduce backaches, constipation, bloating, and swelling

·   May help prevent or treat gestational diabetes

·   Increases your energy

·   Improves your mood

·   Improves your posture

·   Promotes muscle tone, strength, and endurance

·   Helps you sleep better

·   Regular exercise helps keep you fit

·   Regular exercise may improve your ability to cope with the pain of labor

Beginner Sports Bullets

·   Brisk Walking

·   Swimming

·   Cycling (stationary or recumbent is recommended if you're in the later part of your pregnancy)

·   Aerobics (there are classes specific for pregnant women, or low-impact or water aerobics are also good options).

·   Dancing

If the same sport is always inputted, the application will say:

If some exercise is inputted but less than 30 minutes/most days:

"Exercise during pregnancy offers many health benefits and you have done a good job with the amount of exercising you've been doing. If you feel comfortable doing so and haven't already, trying lengthening your exercise routine by 5 minutes this week. It is recommended that you do 30 minutes of moderate exercise on most days of the week, to achieve a range of health benefits including [insert one of the benefit bullet points].

If exercise is inputted and is equal or greater to 30 minutes/most days:

"Exercise during pregnancy offers many health benefits and you have done a great job meeting or exceeding the recommended minimum amount of exercise. Keep it up!"

Definition of Moderate intensity exercise:

·   Moderately intense exercises are those that increase your heart rate while you can still have a conversation.

·   If you measure your physical exertion on a 1-10 scale, moderately intense exercise would be a 4-6.

Tips/Suggestions

·   30 minutes of moderate exercise on most days of the week is the recommended amount of exercise, but you don't have to do all 30 minutes in one session. For example, you could go for 3 walks that are each 10 minutes long.

·   Be sure to follow your doctor's recommendations. If you're just starting an exercise program, be sure to start slowly and add 5 minutes per week until you're able to exercise for 30 minutes in a day.

·   You should be careful to avoid activities such as contact sports and scuba diving because they put your baby at an increased risk of harm. You should also avoid gymnastics, water and downhill skiing and horseback riding because they put you at an increased risk of falling.

·   Exercising should begin with a 5-10 minute warm-up, such as slow walking, that includes stretching. At the conclusion of your workout you should do a 5-10 minute cool down, such as slow walking again. Stretching after your workout will help you avoid sore muscles.

·   If you are after your first trimester you should avoid exercises on your back.

·   You should avoid brisk exercise in hot and humid weather as well as if you have a fever.

·   Wear comfortable clothing that will help you remain cool while exercising.

·   Wear a bra that fits well and gives lots of support to help protect your breasts.

·   Be sure to drink plenty of water to keep you from dehydrating and overheating.

·   If you exercised regularly before your pregnancy, then running, some racquet sports and strength training, if done in moderation, may be appropriate for you to continue. Consult your doctor before participating in one of these more advanced sports.

Sources:

http://www.acog.org/publications/patient_education/bp119.cfm

Your Pregnancy and Childbirth. Month to Month. 5th edition. The American College of Obstetricians and Gynecologists. 2010.

Appendix F.   Nutrition, GWG Guidelines, Food Information

F.1.   MyPyramid Gov Nutrition Equations

Equations to determine energy needs in pregnancy and breastfeeding:

Age in years, weight in kg, and height in meters are calculated from user input. PA coefficient is assigned from user input, and addition for P/B is determined by trimester. The necessary Kcal to add for trimester is determined from the "Addition for P/B equation:

If age ≥ 19 and ≤ 50:

Energy need (calories) = 387 − (7.31 × age [y]) + PA × (10.9 × weight [kg] + 660.7 × height [m]) + addition for P/B

Where PA is the physical activity coefficient:

PA = 1.00 if PAL is less than 30 minutes

PA = 1.14 if PAL is 30 to 60 minutes

PA = 1.27 if PAL is 60 minutes or more

If age ≥ 14 and ≤ 18:

Energy need (calories) = 135.3 − (30.8 × age [y]) + PA × (10.0 × weight [kg] + 934 × height [m]) + 25 + addition for P/B

Where PA is the physical activity coefficient:

PA = 1.00 if activity is less than 30 minutes

PA = 1.16 if PAL is 30 to 60 minutes

PA = 1.31 if PAL is 60 minutes or more

Addition for P/B equation:	
Trimester	**Addition for P/B**
1st trimester	0 kcal
2nd trimester	340 kcal
3rd trimester	452 kcal

Pre-pregnancy BMI Category 1990 → 2009	1990 IOM GWG Guidelines			2009 IOM GWG Guidelines		
	Pre-pregnancy BMI* (kg/m^2)	Total GWG	GWG Trajectory	Pre-pregnancy BMI** (kg/m^2)	Total GWG	GWG Trajectory*** (tri 2&3 mean and range lb/wk)
Low weight → Underweight	<19.8	28-40 lbs	5 lb (2.3 kg) first tri 1.07 (0.49 kg)/wk tri 2&3	< 18.5	28-40 lbs	1.1-4.4 lbs (0.5-2 kg) first tri 1 (1-1.3) lbs/wk tri 2&3
Normal weight → Normal weight	19.8-26.0	25-35 lbs	3.5 lb (1.6 kg) first tri 0.97 lb (0.44 kg)/wk tri 2&3	18.5-24.9	25-35 lbs	1.1-4.4 lbs (0.5-2 kg) first tri 1 (0.8-1) lbs/wk tri 2&3
High weight → Overweight	26.1-29.0	15-25 lbs	2 lb (0.9 kg) first tri 0.67 lb (0.5-0.75 lb or 0.3 kg)/wk tri 2&3	25.0-29.9	15-25 lbs	1.1-4.4 lbs (0.5-2 kg) first tri 0.6 (0.5-0.7) lbs/wk tri 2&3
Obese → Obese	>29.0	At least 15 lbs		≥ 30.0	11-20 lbs	1.1-4.4 lbs (0.5-2 kg) first tri 0.5 (0.4-0.6) lbs/wk tri 2&3

* BMI categories as per Metropolitan Life Insurance tables cutoff points for BMI categories

** BMI categories as per World Health Organization (WHO) cutoff points for BMI categories

*** first trimester based on Siega-Riz et al., 1994; Abrams et al., 1995; Carmichael et al., 1997

F.3.   MyPyramid Food Information

What foods are in the grain group?

Any food made from wheat, rice, oats, cornmeal, barley or another cereal grain is a grain product.

Bread, pasta, oatmeal, breakfast cereals, tortillas, and grits are examples of grain products.

Grains are divided into 2 subgroups, **whole grains** and **refined grains**.

Whole grains contain the entire grain kernel -- the bran, germ, and endosperm. Examples include:

- whole-wheat flour

- bulgur (cracked wheat)

- oatmeal

- whole cornmeal

- brown rice

Refined grains have been milled, a process that removes the bran and germ. This is done to give grains a finer texture and improve their shelf life, but it also removes dietary fiber, iron, and many B vitamins. Some examples of refined grain products are:

- white flour

- degermed cornmeal

- white bread

- white rice

Most refined grains are *enriched*. This means certain B vitamins (thiamin, riboflavin, niacin, folic acid) and iron are added back after processing. Fiber is not added back to enriched grains. Check the ingredient list on refined grain products to make sure that the word "enriched" is included in the grain name. Some food products are made from mixtures of whole grains and refined grains.

Whole grains:
brown rice
buckwheat
bulgur (cracked wheat)
oatmeal
popcorn

Ready-to-eat breakfast cereals:
whole wheat cereal flakes
muesli

whole grain barley
whole grain cornmeal
whole rye
whole wheat bread
whole wheat crackers
whole wheat pasta
whole wheat sandwich buns and rolls
whole wheat tortillas
wild rice

Less common whole grains:
amaranth
millet
quinoa
sorghum
triticale

Refined grains:
cornbread*
corn tortillas*
couscous*
crackers*
flour tortillas*
grits
noodles*

Pasta*
spaghetti
macaroni

pitas*
pretzels

Ready-to-eat breakfast cereals
corn flakes

white bread
white sandwich buns and rolls
white rice.

*Most of these products are made from refined grains. Some are made from whole grains. Check the ingredient list for the words "whole grain" or "whole wheat" to decide if they are made from a whole grain. Some foods are made from a mixture of whole and refined grains.

Some grain products contain significant amounts of bran. Bran provides fiber, which is important for health. However, products with added bran or bran alone (e.g., oat bran) are not necessarily whole grain products.

What counts as an ounce equivalent of grains?

In general, 1 slice of bread, 1 cup of ready-to-eat cereal, or ½ cup of cooked rice, cooked pasta, or cooked cereal can be considered as 1 ounce equivalent from the grains group.

The chart lists specific amounts that count as 1 ounce equivalent of grains towards your daily recommended intake. In some cases the number of ounce-equivalents for common portions are also shown.

		Amount that counts as 1 ounce equivalent of grains	Common portions and ounce equivalents
Bagels	WG*: whole wheat RG*: plain, egg	1 "mini" bagel	1 large bagel = 4 ounce equivalents
Biscuits	(baking powder/ buttermilk—RG*)	1 small (2" diameter)	1 large (3" diameter) = 2 ounce equivalents
Breads	WG*: 100% Whole wheat RG*: white, wheat, French, sourdough	1 regular slice 1 small slice French 4 snack-size slices rye bread	2 regular slices = 2 ounce equivalents
Bulgur	cracked wheat (WG*)	½ cup cooked	
Cornbread	(RG*)	1 small piece (2 ½" x 1 ¼" x 1 ¼")	1 medium piece (2 ½" x 2 ½" x 1 ¼") = 2 ounce equivalents
Crackers	WG*: 100% whole wheat, rye	5 whole wheat crackers 2 rye crispbreads	
	RG*: saltines, snack crackers	7 square or round crackers	
English muffins	WG*: whole wheat RG*: plain, raisin	½ muffin	1 muffin = 2 ounce equivalents
Muffins	WG*: whole wheat RG*: bran, corn, plain	1 small (2 ½" diameter)	1 large (3 ½" diameter) = 3 ounce equivalents
Oatmeal	(WG)	½ cup cooked 1 packet instant 1 ounce dry (regular or quick)	

Pancakes	WG*: Whole wheat, buckwheat RG*: buttermilk, plain	1 pancake (4 ½" diameter) 2 small pancakes (3" diameter)	3 pancakes (4 ½" diameter) = 3 ounce equivalents
Popcorn	(WG*)	3 cups, popped	1 microwave bag, popped = 4 ounce equivalents
Ready-to-eat breakfast cereal	WG*: toasted oat, whole wheat flakes RG*: corn flakes, puffed rice	1 cup flakes or rounds 1 ¼ cup puffed	
Rice	WG*: brown, wild RG*: enriched, white, polished	½ cup cooked 1 ounce dry	1 cup cooked = 2 ounce equivalents
Pasta--spaghetti, macaroni, noodles	WG*: whole wheat RG*: enriched, durum	½ cup cooked 1 ounce dry	1 cup cooked = 2 ounce equivalents
Tortillas	WG*: whole wheat, whole grain corn RG*: Flour, corn	1 small flour tortilla (6" diameter) 1 corn tortilla (6" diameter)	1 large tortilla (12" diameter) = 4 ounce equivalents

*WG = whole grains, RG = refined grains. This is shown when products are available both in whole grain and refined grain forms.

What foods are in the vegetable group?

Any vegetable or 100% vegetable juice counts as a member of the vegetable group. Vegetables may be raw or cooked; fresh, frozen, canned, or dried/dehydrated; and may be whole, cut-up, or mashed.

Vegetables are organized into 5 subgroups, based on their nutrient content. Some commonly eaten vegetables in each subgroup are:

Dark green vegetables
bok choy
broccoli
collard greens
dark green leafy lettuce
kale
mesclun

Starchy vegetables
corn
green peas
lima beans (green)
potatoes

Other vegetables

mustard greens
romaine lettuce
spinach
turnip greens
watercress

Orange vegetables
acorn squash
butternut squash
carrots
hubbard squash
pumpkin
sweet potatoes

Dry beans and peas
black beans
black-eyed peas
garbanzo beans (chickpeas)
kidney beans
lentils
lima beans (mature)
navy beans
pinto beans
soy beans
split peas
tofu (bean curd made from soybeans)
white beans

artichokes
asparagus
bean sprouts
beets
Brussels sprouts
cabbage
cauliflower
celery
cucumbers
eggplant
green beans
green or red peppers
iceberg (head) lettuce
mushrooms
okra
onions
parsnips
tomatoes
tomato juice
vegetable juice
turnips
wax beans
zucchini

What counts as a cup of vegetables?

In general, 1 cup of raw or cooked vegetables or vegetable juice, or 2 cups of raw leafy greens can be considered as 1 cup from the vegetable group. The chart lists specific amounts count as 1 cup of vegetables (in some cases equivalents for ½ cup are also shown) towards your recommended intake:

	Amount that counts as 1 cup of vegetables	Amount that counts as ½ cup of vegetables
Dark-Green Vegetables		
Broccoli	1 cup chopped or florets 3 spears 5" long raw or cooked	

Greens (collards, mustard greens, turnip greens, kale)	1 cup cooked	
Spinach	1 cup, cooked 2 cups raw is equivalent to 1 cup of vegetables	1 cup raw is equivalent to ½ cup of vegetables
Raw leafy greens: Spinach, romaine, watercress, dark green leafy lettuce, endive, escarole	2 cups raw is equivalent to 1 cup of vegetables	1 cup raw is equivalent to ½ cup of vegetables
Orange Vegetables		
Carrots	1 cup, strips, slices, or chopped, raw or cooked 2 medium 1 cup baby carrots (about 12)	1 medium carrot About 6 baby carrots
Pumpkin	1 cup mashed, cooked	
Sweetpotato	1 large baked (2 ¼" or more diameter) 1 cup sliced or mashed, cooked	
Winter squash (acorn, butternut, hubbard)	1 cup cubed, cooked	½ acorn squash, baked = ¾ cup
Dry beans and peas		
Dry beans and peas (Such as black, garbanzo, kidney, pinto, or soy beans, or black eyed peas or split peas	1 cup whole or mashed, cooked	
Tofu	1 cup ½" cubes (about 8 ounces)	1 piece 2 ½ " x 2 ¾ " x 1" (about 4 ounces)
Starchy Vegetables		
Corn, yellow or white	1 cup 1 large ear (8" to 9" long)	1 small ear (about 6" long)
Green peas	1 cup	
White potatoes	1 cup diced, mashed 1 medium boiled or baked potato (2 ½ " to 3" diameter) French fried: 20 medium to long strips (2 ½" to 4" long) (Contains discretionary calories.)	
	Amount that counts as 1 cup of vegetables	**Amount that counts as ½ cup of vegetables**
Other Vegetables		
Bean sprouts	1 cup cooked	
Cabbage, green	1 cup, chopped or shredded raw or cooked	
Cauliflower	1 cup pieces or florets raw or cooked	
Celery	1 cup, diced or sliced, raw or cooked	

	2 large stalks (11" to 12" long)	1 large stalk (11" to 12" long)
Cucumbers	1 cup raw, sliced or chopped	
Green or wax beans	1 cup cooked	
Green or red peppers	1 cup chopped, raw or cooked	
	1 large pepper (3" diameter, 3-¾" long)	1 small pepper
Lettuce, iceberg or head	2 cups raw, shredded or chopped = equivalent to 1 cup of vegetables	1 cup raw, shredded or chopped = equivalent to ½ cup of vegetables
Mushrooms	1 cup raw or cooked	
Onions	1 cup chopped, raw or cooked	
Tomatoes	1 large raw whole (3")	1 small raw whole (2 ¼ ")
	1 cup chopped or sliced, raw, canned, or cooked	1 medium canned
Tomato or mixed vegetable juice	1 cup	½ cup
Summer squash or zucchini	1 cup cooked, sliced or diced	

What foods are in the fruit group?

Any fruit or 100% fruit juice counts as part of the fruit group. Fruits may be fresh, canned, frozen, or

dried, and may be whole, cut-up, or pureed. Some commonly eaten fruits are:

Apples
Apricots
Avocado
Bananas

Berries:
strawberries
blueberries
raspberries

Cherries
Grapefruit
Grapes
Kiwi fruit
Lemons
Limes
Mangoes

Melons:
cantaloupe

Mixed fruits:
fruit cocktail

Nectarines
Oranges
Peaches
Pears
Papaya
Pineapple
Plums
Prunes
Raisins
Tangerines

100% Fruit juice:
orange
apple
grape
grapefruit

honeydew
watermelon
What counts as a cup of fruit?

In general, 1 cup of fruit or 100% fruit juice, or ½ cup of dried fruit can be considered as 1 cup from the fruit group. The following specific amounts count as 1 cup of fruit (in some cases equivalents for ½ cup are also shown) towards your daily recommended intake:

	Amount that counts as 1 cup of fruit	Amount that counts as ½ cup of fruit
Apple	½ large (3.25" diameter) 1 small (2.5" diameter) 1 cup sliced or chopped, raw or cooked	½ cup sliced or chopped, raw or cooked
Applesauce	1 cup	1 snack container (4 oz.)
Banana	1 cup sliced 1 large (8" to 9" long)	1 small (less than 6" long)
Cantaloupe	1 cup diced or melon balls	1 medium wedge (1/8 of a med. melon)
Grapes	1 cup whole or cut-up 32 seedless grapes	16 seedless grapes
Grapefruit	1 medium (4" diameter) 1 cup sections	½ medium (4" diameter)
Mixed fruit (fruit cocktail)	1 cup diced or sliced, raw or canned, drained	1 snack container (4 oz) drained = 3/8 cup
Orange	1 large (3-1/16" diameter) 1 cup sections	1 small (2-3/8" diameter)
Orange, mandarin	1 cup canned, drained	
Peach	1 large (2 ¾" diameter) 1 cup sliced or diced, raw, cooked, or canned, drained 2 halves, canned	1 small (2" diameter) 1 snack container (4 oz) drained = 3/8 cup

Pear	1 medium pear (2.5 per lb) 1 cup sliced or diced, raw, cooked, or canned, drained	1 snack container (4 oz.) drained = 3/8 cup
Pineapple	1 cup chunks, sliced or crushed, raw, cooked or canned, drained	1 snack container (4 oz) drained = 3/8 cup
Plum	1 cup sliced raw or cooked 3 medium or 2 large plums	1 large plum
Strawberries	About 8 large berries 1 cup whole, halved, or sliced, fresh or frozen	½ cup whole, halved, or sliced
Watermelon	1 small wedge (1" thick) 1 cup diced or balls	6 melon balls
Dried fruit (raisins, prunes, apricots, etc.)	½ cup dried fruit is equivalent to 1 cup fruit ½ cup raisins ½ cup prunes ½ cup dried apricots	¼ cup dried fruit is equivalent to ½ cup fruit 1 small box raisins (1.5 oz)
100% fruit juice (orange, apple, grape, grapefruit, etc.)	1 cup	½ cup

What foods are included in the dairy group?

All fluid milk products and many foods made from milk are considered part of this food group.

Foods made from milk that retain their calcium content are part of the group; while foods made from milk that have little to no calcium, such as cream cheese, cream, and butter, are not. Most dairy group choices should be fat-free or low-fat.

Some commonly eaten choices in the dairy group are:

Milk*
All fluid milk:
fat-free (skim)
low fat (1%)
reduced fat (2%)

Cheese*
Hard natural cheeses:
cheddar
mozzarella
Swiss

whole milk

parmesan

flavored milks:
chocolate
strawberry

soft cheeses
ricotta
cottage cheese

lactose reduced milks
lactose free milks

processed cheeses
American

Milk-based desserts*
Puddings made with milk
ice milk
frozen yogurt
ice cream

Yogurt*
All yogurt
Fat-free
low fat
reduced fat
whole milk yogurt

*****Selection Tips**

Choose fat-free or low-fat milk, yogurt, and cheese. If you choose milk or yogurt that is not fat-free, or cheese that is not low-fat, the fat in the product counts as part of the empty calorie allowance.

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If sweetened milk products are chosen (flavored milk, yogurt, drinkable yogurt, desserts), the added sugars also count as part of the empty calorie allowance.

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For those who are lactose intolerant, lactose-free and lower-lactose products are available. These include hard cheeses and yogurt. Also, enzyme preparations can be added to milk to lower the lactose content. Calcium-fortified foods and beverages such as soy beverages or orange juice may provide calcium, but may not provide the other nutrients found in milk and milk products.

What counts as 1 cup in the dairy group?

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The chart lists specific amounts that count as 1 cup in the dairy group towards your daily recommended intake:

	Amount that counts as 1 cup in the dairy group	Common portions and cup equivalents
Milk *[choose fat-free or low-fat milk most often]*	1 cup 1 half-pint container ½ cup evaporated milk	
Yogurt *[choose fat-free or low-fat yogurt most often]*	1 regular container (8 fluid ounces) 1 cup	1 small container (6 ounces) = ¾ cup 1 snack size container (4 ounces) = ½ cup
Cheese *[choose low-fat cheeses most often]*	1 ½ ounces hard cheese (cheddar, mozzarella, Swiss, parmesan) 1/3 cup shredded cheese 2 ounces processed cheese (American) ½ cup ricotta cheese 2 cups cottage cheese	1 slice of hard cheese is equivalent to ½ cup milk 1 slice of processed cheese is equivalent to 1/3 cup milk ½ cup cottage cheese is equivalent to ¼ cup milk
Milk-based desserts *[choose fat-free or low-fat types most often]*	1 cup pudding made with milk 1 cup frozen yogurt 1 ½ cups ice cream	 1 scoop ice cream is equivalent to 1/3 cup milk

What foods are in the protein foods group?

All foods made from meat, poultry, fish, dry beans or peas, eggs, nuts, and seeds are considered part of the protein foods group. Dry beans and peas are part of this group as well as the vegetable group. [For more information on dry beans and peas click here.](#)

Most meat and poultry choices should be lean or low-fat. Fish, nuts, and seeds contain healthy oils, so choose these foods frequently instead of meat or poultry. (See [Why is it important to include fish,](#)

nuts, and seeds?)

Some commonly eaten choices in the protein foods group, with selection tips, are:

Meats*
Lean cuts of:
beef
ham
lamb
pork
veal

Game meats:
bison
rabbit
venison

Lean ground meats:
beef
pork
lamb

Lean luncheon meats
Organ meats:
liver
giblets

Poultry*
chicken
duck
goose
turkey
ground chicken and turkey

Eggs*
chicken eggs
duck eggs

Dry beans and peas:
black beans
black-eyed peas
chickpeas (garbanzo beans)
falafel
kidney beans
lentils
lima beans (mature)
navy beans
pinto beans
soy beans
split peas
tofu (bean curd made from soy beans)
white beans

bean burgers:
garden burgers
veggie burgers

tempeh
texturized vegetable protein (TVP)

Nuts & seeds*
almonds
cashews
hazelnuts (filberts)
mixed nuts
peanuts
peanut butter
pecans
pistachios
pumpkin seeds
sesame seeds
sunflower seeds
walnuts

Fish*
Finfish such as:
catfish
cod
flounder
haddock
halibut
herring
mackerel
pollock
porgy
salmon
sea bass
snapper
swordfish
trout
tuna

Shellfish such as:
clams
crab
crayfish
lobster
mussels
octopus
oysters
scallops
squid (calamari)
shrimp

Canned fish such as:
anchovies
clams
tuna
sardines

***Selection Tips**

Choose lean or low-fat meat and poultry. If higher fat choices are made, such as regular ground beef (75 to 80% lean) or chicken with skin, the fat in the product counts as part of the discretionary calorie allowance. [Click here for more details on discretionary calories.](#) ————————————————————

If solid fat is added in cooking, such as frying chicken in shortening or frying eggs in butter or stick margarine, this also counts as part of the discretionary calorie allowance. [Click here for more details on discretionary calories.](#) ————————————————

Select fish rich in omega-3 fatty acids, such as salmon, trout, and herring, more often (See [Why is it important to include fish, nuts, and seeds?](#)). ————————————————————

Liver and other organ meats are high in cholesterol. Egg yolks are also high in cholesterol, but egg whites are cholesterol-free. ————————————————

Processed meats such as ham, sausage, frankfurters, and luncheon or deli meats have added sodium. Check the ingredient and [Nutrition Facts label](#) to help limit sodium intake. Fresh chicken, turkey, and pork that have been enhanced with a salt-containing solution also have added sodium. Check the product label for statements such as "self-basting" or "contains up to __% of __", which mean that a sodium-containing solution has been added to the product. ————————————————

Sunflower seeds, almonds, and hazelnuts (filberts) are the richest sources of vitamin E in this food group. To help meet vitamin E recommendations, make these your nut and seed choices more often.

Dry beans and peas

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Dry beans and peas are the mature forms of legumes such as kidney beans, pinto beans, lima beans, black-eyed peas, and lentils. These foods are excellent sources of plant protein, and also provide

other nutrients such as iron and zinc. They are similar to meats, poultry, and fish in their contribution of these nutrients. Many people consider dry beans and peas as vegetarian alternatives for meat. However, they are also excellent sources of dietary fiber and nutrients such as folate that are low in diets of many Americans. These nutrients are found in plant foods like vegetables.

Because of their high nutrient content, consuming dry beans and peas is recommended for everyone, including people who also eat meat, poultry, and fish regularly. The Food Guide includes dry beans and peas as a subgroup of the vegetable group, and encourages their frequent consumption—several cups a week—as a vegetable selection. But the Guide also indicates that dry beans and peas may be counted as part of the protein foods group.

How to count dry peas and beans in the Food Guide

Dry beans and peas can be counted **either** as vegetables (dry beans and peas subgroup), **or** in the protein foods group. Generally, individuals who regularly eat meat, poultry, and fish would count dry beans and peas in the vegetable group. Individuals who seldom eat meat, poultry, or fish (vegetarians) would count some of the dry beans and peas they eat protein foods group. Here's how:

Count the number of ounce-equivalents of all meat, poultry, fish, eggs, nuts, and seeds eaten.

1. If the total is equal to or more than the suggested intake from the protein foods group (which ranges from 2 ounce-equivalents at 1000 calories to 7 ounce-equivalents at 2800 calories and above) then count any dry beans or peas eaten as part of the dry beans and peas subgroup in the vegetable group.

OR

2. If the total is less than the suggested intake from the protein foods group, then count any dry beans and peas eaten toward the suggested intake level until it is reached. (One-fourth cup of cooked dry beans or peas counts as 1 ounce equivalent in the protein foods group.) After the suggested intake level in the protein foods group is reached, count any additional dry beans or peas eaten as part of the dry beans and peas subgroup in the vegetable group.

What counts as an ounce equivalent in the protein foods group?

In general, 1 ounce of meat, poultry or fish, ¼ cup cooked dry beans, 1 egg, 1 tablespoon of peanut butter, or ½ ounce of nuts or seeds can be considered as 1 ounce equivalent from the protein foods group.

The chart lists specific amounts that count as 1 ounce equivalent in the protein foods group towards your daily recommended intake:

	Amount that counts as 1 ounce equivalent in the protein foods group	Common portions and ounce equivalents
Meats	1 ounce cooked lean beef	1 small steak (eye of round, filet) = 3 ½ to 4 ounce equivalents
	1 ounce cooked lean pork or ham	1 small lean hamburger = 2 to 3 ounce equivalents
Poultry	1 ounce cooked chicken or turkey, without skin	1 small chicken breast half = 3 ounce equivalents

	1 sandwich slice of turkey (4 ½ x 2 ½ x 1/8")	½ Cornish game hen = 4 ounce equivalents
Fish	1 ounce cooked fish or shell fish	1 can of tuna, drained = 3 to 4 ounce equivalents 1 salmon steak = 4 to 6 ounce equivalents 1 small trout = 3 ounce equivalents
Eggs	1 egg	
Nuts and seeds	½ ounce of nuts (12 almonds, 24 pistachios, 7 walnut halves) ½ ounce of seeds (pumpkin, sunflower or squash seeds, hulled, roasted) 1 Tablespoon of peanut butter or almond butter	1 ounce of nuts or seeds = 2 oz eq
Dry beans and peas	¼ cup of cooked dry beans (such as black, kidney, pinto, or white beans) ¼ cup of cooked dry peas (such as chickpeas, cowpeas, lentils, or split peas) ¼ cup of baked beans, refried beans ¼ cup (about 2 ounces) of tofu 1 oz. tempeh, cooked ¼ cup roasted soybeans 1 falafel patty (2 ¼", 4 oz) 2 Tbsp. hummus	1 cup split pea soup = 2 oz eq 1 cup lentil soup = 2 oz eq 1 cup bean soup = 2 oz eq 1 soy or bean burger patty = 2 oz eq

What are "oils"?

Oils are fats that are liquid at room temperature, like the vegetable oils used in cooking. Oils come from many different plants and from fish. Some common oils are:

- canola oil

- corn oil

- cottonseed oil

- olive oil

- safflower oil

- soybean oil

- sunflower oil

Some oils are used mainly as flavorings, such as walnut oil and sesame oil. A number of foods are naturally high in oils, like:

- nuts

- olives

- some fish

- avocados

Foods that are mainly oil include mayonnaise, certain salad dressings, and soft (tub or squeeze) margarine with no *trans* fats. Check the Nutrition Facts label to find margarines with 0 grams of *trans* fat. Amounts of *trans* fat will be required on labels as of 2006. Many products already provide this information.

Most oils are high in monounsaturated or polyunsaturated fats, and low in saturated fats. Oils from plant sources (vegetable and nut oils) do not contain any cholesterol. In fact, no foods from plants sources contain cholesterol.

A few plant oils, however, including coconut oil and palm kernel oil, are high in saturated fats and for nutritional purposes should be considered to be solid fats.

Solid fats are fats that are solid at room temperature, like butter and shortening. Solid fats come

from many animal foods and can be made from vegetable oils through a process called

hydrogenation. Some common solid fats are:

- butter
- beef fat (tallow, suet)
- chicken fat
- pork fat (lard)
- stick margarine
- shortening
- **How do I count the oils I eat?**

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The chart gives a quick guide to the amount of oils in some common foods:

	Amount of food	Amount of oil	Calories from oil	Total calories
		Teaspoons /grams	Approximate calories	Approximate calories
Oils:				
Vegetable oils (such as canola, corn, cottonseed, olive, peanut, safflower, soybean, and sunflower)	1 Tbsp	3 tsp/14 g	120	120
Foods rich in oils:				
Margarine, soft (*trans* fat free)	1 Tbsp	2 ½ tsp/11 g	100	100
Mayonnaise	1 Tbsp	2 ½ tsp/11 g	100	100
Mayonnaise-type salad dressing	1 Tbsp	1 tsp/5 g	45	55
Italian dressing	2 Tbsp	2 tsp/8 g	75	85
Thousand Island dressing	2 Tbsp	2 ½ tsp/11 g	100	120
Olives, ripe, canned	4 large	½ tsp/ 2 g	15	20
Avocado*	½ med	3 tsp/15 g	130	160
Peanut butter*	2 T	4 tsp/ 16 g	140	190
Peanuts, dry roasted*	1 oz	3 tsp/14 g	120	165
Mixed nuts, dry roasted*	1 oz	3 tsp/15 g	130	170
Cashews, dry roasted*	1 oz	3 tsp/13 g	115	165
Almonds, dry roasted*	1 oz	3 tsp/15 g	130	170
Hazelnuts*	1 oz	4 tsp/18 g	160	185
Sunflower seeds*	1 oz	3 tsp/14 g	120	165

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*Avocados are part of the fruit group, nuts and seeds are part of the protein foods group.

What are "discretionary calories"?

You need a certain number of calories to keep your body functioning and provide energy for physical activities. Think of the calories you need for energy like money you have to spend. Each person has a total calorie "budget." This budget can be divided into "essentials" and "extras."

With a financial budget, the essentials are items like rent and food. The extras are things like movies and vacations. In a calorie budget, the "essentials" are the minimum calories required to meet your nutrient needs. By selecting the lowest fat and no-sugar-added forms of foods in each food group you would make the best nutrient "buys." Depending on the foods you choose, you may be able to spend more calories than the amount required to meet your nutrient needs. These calories are the "extras" that can be used on luxuries like solid fats, added sugars, and alcohol, or on more food from any food group. They are your "discretionary calories."

Each person has an allowance for some discretionary calories. But, many people have used up this allowance before lunch-time! Most discretionary calorie allowances are very small, between 100 and 300 calories, especially for those who are not physically active. For many people, the discretionary calorie allowance is totally used by the foods they choose in each food group, such as higher fat meats, cheeses, whole milk, or sweetened bakery products.

You can use your discretionary calorie allowance to:

- Eat more foods from any food group than the food guide recommends.

- Eat higher calorie forms of foods—those that contain solid fats or added sugars. Examples are whole milk, cheese, sausage, biscuits, sweetened cereal, and sweetened yogurt.

- Add fats or sweeteners to foods. Examples are sauces, salad dressings, sugar, syrup, and butter.

- Eat or drink items that are mostly fats, caloric sweeteners, and/or alcohol, such as candy, soda, wine, and beer.

For example, assume your calorie budget is 2,000 calories per day. Of these calories, you need to spend at least 1,735 calories for essential nutrients, if you choose foods without added fat and sugar. Then you have 265 discretionary calories left. You may use these on "luxury" versions of the foods in each group, such as higher fat meat or sweetened cereal. Or, you can spend them on sweets, sauces, or beverages. Many people overspend their discretionary calorie allowance, choosing more added fats, sugars, and alcohol than their budget allows.