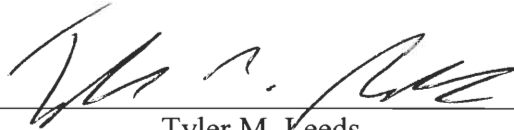
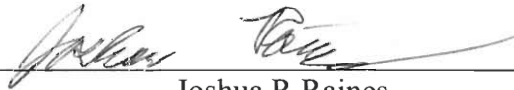


TECHNIQUES OF DATABASE-TO-INTERNET PUBLISHING FOR
LARGE SCALE ORGANIZATIONS

An Interactive Qualifying Project Report
Submitted to the Faculty of
WORCESTER POLYTECHNIC INSTITUTE
In partial fulfillment of the requirements for the
Degree of Bachelor of Science by:



Tyler M. Leeds

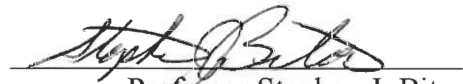


Joshua R Raines

Date: April 27th, 2003

Project Completed for F.I.R.S.T.
For Inspiration and Recognition of Science and Technology
Submitted to Project Manager at FIRST: Eric Rasmussen

Submitted to Project Advisor:



Professor Stephen J. Bitar
Department of Electrical and Computer Engineering

ABSTRACT:

FIRST, or “For Inspiration and Recognition of Science and Technology” is a non-profit organization which aims to involve teenagers in science and mathematics through robotics. By giving students the option to learn more about these interesting fields, FIRST is influential in today’s technology based world.

This project, completed in conjunction with FIRST, aimed to improve the Internet website, www.usfirst.org so that it would be more accessible and easy to use for potential FIRST participants. By globalizing the map and organizing the database program driving the site, we improved the ability of FIRST to reach this larger, potential audience.

Now that FIRST has become a major influence in many high schools around the country, the next focus of the organization can be on schools in other countries and across the globe. This project acts as a stepping-stone for other projects to assist FIRST in educating teenagers in mathematics and science.

Acknowledgements

We would like to thank Mr. Eric Rasmussen of FIRST for his guidance and patience throughout the project. His knowledge and wisdom was of great assistance during the term and without him, nothing that was accomplished would have been worthwhile for FIRST.

We also would like to thank Professor Stephen Bitar for his guidance and patience during the project. When things didn't always work, he understood, and offered guidance when there seemed to be none. His assistance was an integral part in the completion of this project, and for that, we would like to thank him.

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1 INTRODUCTION

The non-profit organization FIRST, or “For Inspiration and Recognition of Science and Technology” is an organization that tries to get today’s youth interested in science by giving them the opportunity to learn about and construct robots. Its social importance reaches across America and into other continents such as Europe and South America. Corporate America provides economic and professional support to FIRST, while parents and teachers provide the necessary man-hours so that today’s youth can grow and expand their horizons. Even government organizations such as NASA provide support to a number of the teams involved in FIRST.

Since its beginnings as a high school aged competition, FIRST has spread into middle school and even into college, giving students of many different ages the chance to get involved. As an expanding organization, FIRST needs to make sure that the infrastructure, which supports the competitions, expands at the same rate. Our team realized that FIRST had an issue with the expansion of the current web information system, and created a project to improve that system. We hope that through this project, accessing the available information will now be easier and more systematic for the public, so that more of today’s students can become involved and enjoy the experience of FIRST.

2 Background

2.1 What FIRST Is

Dean Kamen founded FIRST in 1992 as a means to spark an interest in the sciences in high school aged children. It began as an organization of only twenty-eight teams, and has, since then, grown to over eight hundred teams spanning from the United States, across parts of Canada, and even into South America and Europe.¹

The goal of each team is to assemble a robot using equipment supplied by the FIRST robotics organization and based on the team's own design. Each design focuses on a specific task, which must be completed for the competition, and changes each year. Also, each robot must meet particular criteria in order to be entered into competition. At a pre-determined date, assuming the robot meets those particular criteria, the robot is shipped off to the competition site at which point it is judged. It then waits for the competition day, when the individual teams arrive.

For the six years after it's founding, FIRST grew as an organization, drawing and attracting students from all over the United States. The list of competitions since the founding of FIRST is:

1992—Maize Craze

1993—Rug Rage

1994—Tower Power

1995—Ramp n' Roll

1996—Hexagon Havoc

1997—Torroid Terror

¹ <http://www.usfirst.org/robotics/aoubtrb.htm>

1998—Ladder Logic

1999—Double Trouble

2000—Co-Opertition FIRST

2001—Diabolical Dynamics

2002—Zone Zeal

All of these competitions were designed to make the participants think in new and different ways, getting them to explore science and technology so they could complete the tasks placed before them.²

Then in 1998, the FIRST organization branched out and created the FIRST LEGO League for children between the ages of nine to fourteen. The goal of this particular group is to introduce younger generations to the FIRST organization, with the hope that they will continue in high school with the FIRST competitions. In the first year of Lego League, over two thousand children were involved, and that number has since grown to over twenty thousand.³

The FIRST organization has several goals that, through the entire design and competition process, it wishes to instill in the participants:

- An increase in desire to continue pursuing a science, math or engineering career in college and life
- A positive outlook on the working world
- A rise in self-image and feeling of accomplishment
- An increase in knowledge and positive attitude about Math and Science⁴

² http://www.usfirst.org/robotics/abr_art1.htm

³ <http://www.usfirst.org/robotics/aboutrb.htm>

⁴ *Ibid.*

2.2 Social Importance of First

The FIRST organization has become a large influence in today's society as an early resource for young adults in high school who are thinking about heading into college and are making decisions about what they would like to do with their lives. In addition to this positive influence, FIRST has also been able to increase the experience of women and racial/ethnic minorities in engineering and mathematical fields. The organization has also been able to help create some public and private partnerships between local high schools, local companies, and some national companies such as NASA, General Electric, Proctor and Gamble. These are companies that may someday be hiring the same students they are now sponsoring. For a more complete list of the main sponsors, please visit <http://www.usfirst.org/about/sponsors.htm>.⁵

Through student and faculty surveys, both pre and post competition, it has been recorded that at least ninety-five percent of school personnel at these events have shown an increased enjoyment of both math and science, improved problem solving, and may be considering a Science, Math, Engineering and Technology (SME&T) career.

It is also noted that “one out of three sponsors participate in FIRST to interest students in SME&T” and “One out of five sponsors participate in FIRST for involvement in the larger community”. This can lead to increased growth for the company, as well as increased awareness in students about the possibilities for future jobs in SME&T fields. FIRST also has a reputation for attracting both minorities and women into these competitions, and with 90+% of participants entering college.⁶

⁵ http://www.usfirst.org/about/FIRST_success.ppt

⁶ *Ibid*

3 PROBLEM POSED

3.1 Issues With Current Informational Pages

FIRST has a national website, <http://www.usfirst.org/> which contains not only information about the program itself, but also information about many of the teams participating. When looking at what could be improved on the FIRST website, one of the largest problems was the team locator. This locator is actually a map that uses a database driven program called Filemaker, and through the use of Filemaker's own CDML coding, the map displays teams in a given state once the user has clicked on that particular state. Through sub menus, a user can then find any competitions that were being held within the state, as well as some limited information about teams from that particular state.⁷

3.2 Globalization in Today's Market

The first version of this map (see Figure 1) had several features that could be improved. The map only displayed the United States, along with a single graphical link to a Toronto. This seemed inadequate because there are now teams from South America, Europe, Puerto Rico and other Canadian Provinces that were not shown on the main page. These teams could be accessed through a drop down menu at the top of the page, but this menu is easily overlooked, and did not provide adequate exposure for teams outside the United States. FIRST needed to expand the map to match the expansion of the organization as a whole.

⁷ [Http://www.usfirst.org/frc/map](http://www.usfirst.org/frc/map)

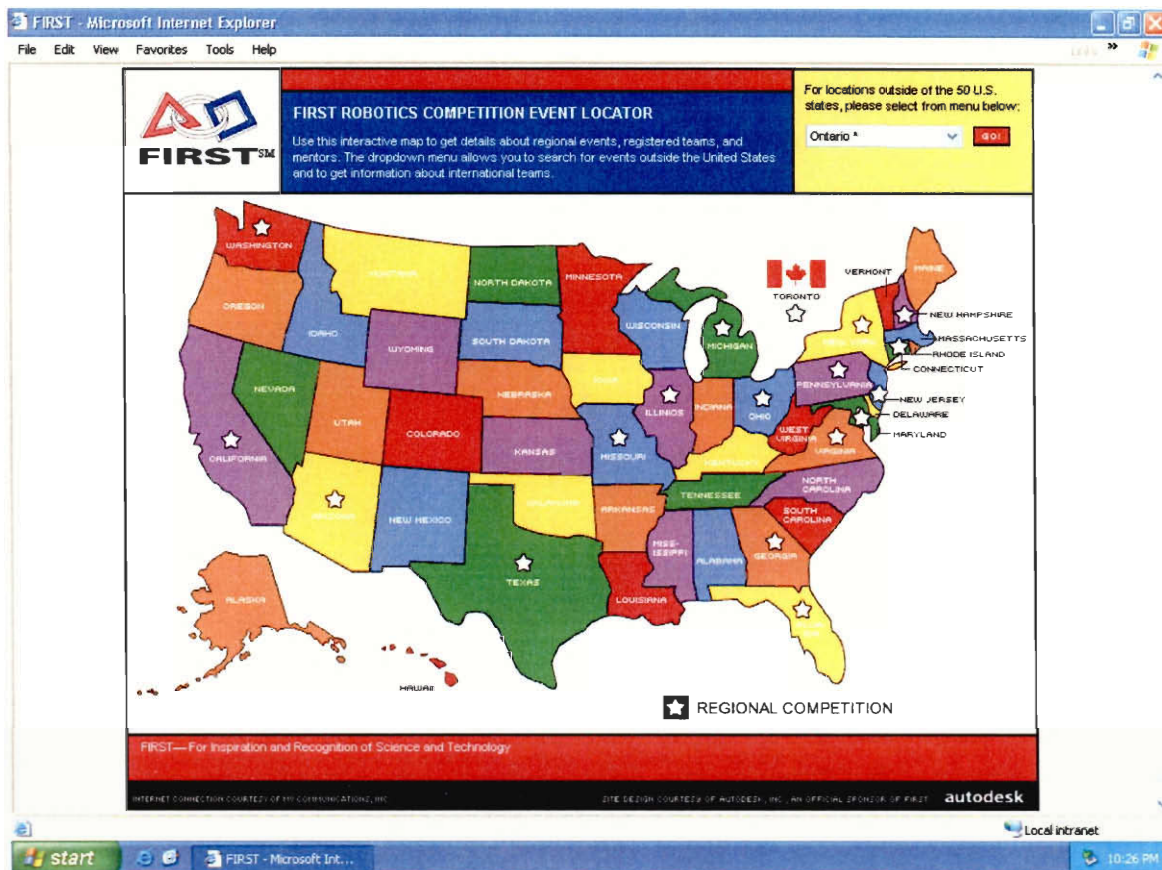


Figure 1 - Original map on FIRST website

3.3 Why Update?

On the sub menus there seemed to be room for improvement as well. When a user accessed a particular state, a list of all teams from that state, sorted numerically by the team number, was returned. Any team that had also registered a website would also have a link to their site attached to their team name. Although this was beneficial to teams with websites, not all teams had one, and of those that did, some sites were old, no longer in service, or contained broken links (a link that does not work).

It would be more beneficial to allow the web user to decide how he/she would like to sort the information being presented to them, either numerically by team number, or alphabetically by team name or hometown. Also, part of the project was to build a simple informational page about each team that didn't have a website, thus letting any user find out some very basic information about any team that is registered with FIRST for the current season. However, before any improvements could be made, an investigation into the method of information presentation needed to be done.

4 DATABASE OPPORTUNITIES

4.1 Database Software Possibilities

There are many different software programs, which are designed to make large amounts of information more organized and easy to access. Each program has positives and negatives, and each is usually geared towards a different market. For example, Microsoft Access, perhaps one of the most popular programs and most marketed towards the individual consumer, is designed to be user-friendly, inexpensive, and manageable for the even the most inexperienced of computer users. However, the ease of use of Microsoft Access as a database doesn't account for the extreme difficulty of making an Access database into a web-accessible database.⁸

Other popular database software programs include Lotus Notes 5+ Domino, and DB/Textworks + Webpublisher 6.1. On more technical machines running an operating system of either BSD or Linux, there are open-source programs (open-source meaning free, easily changeable programs) available online, including MYSQL and Firebird. For experienced users and technical professionals, these options are favorable because of customizability as well as low cost, but for a large organization such as FIRST, it is generally better to focus on programs which are more user-friendly and more maintainable without the need for experienced information technology (IT) professionals. For this project, only the more popular, user-friendly programs were investigated.⁹

When purchasing database software for a large-scale, web-based organization such as FIRST, there are a couple of factors which are very important to consider. One

⁸ [Http://www.maxus.net.au/compare.htm](http://www.maxus.net.au/compare.htm)

⁹ *Ibid*

of the most important factors is, of course, cost, as well as ease of use, ability to store and access large amounts of data quickly, special features, and web-interface.

As with most things, cost has a strong influence when selecting database software. Generally most are within a reasonable price-range, under \$1,000, and most are far under that. However, it must be noted that overly complicated software programs often require an IT professional working full-time on maintenance. A program which seems inexpensive may end up costing thousands more in the long run. For example, Microsoft Access, which is designed to be user-friendly, works very well for simple information storage. However, as soon as the information needs to be published on the Internet, a professional must be called in to manage the software, which will cost the company the full salary of that IT professional.

In terms of ease of use and speed, database programs can vary greatly. As was said, on a simple level, Microsoft Access is very easy and worthwhile. However, as things progress into more complicated and large-scale realms, it just does not do the job. At that point, a more concerned IT manager would look into another program, such as Lotus. However, one quickly realizes that, based on tests, Lotus notes has trouble with large amounts of data. The Textworks/Publisher amalgamation can handle many of the jobs and is rather easy to use. However, it is more expensive than the majority of the other programs, and has many different parts that need to be installed and maintained to really be effective.¹⁰

¹⁰ [Http://www.maxus.net.au/compare.htm](http://www.maxus.net.au/compare.htm)

4.2 Why Choose Filemaker?

Depending on the consumer, there are a number of different database options available. Upon examining the needs of the current FIRST program, Filemaker appears to be the best available program. Because the IT professionals at FIRST are busy maintaining a number of other, large systems, the ease of use of Filemaker is definitely a selling point. Similarly, the cost and ability to interface large amounts of data on the web makes it a very advantageous program to use. Upon further examination of the possible database programs, Filemaker appears to be the best suited to the needs of FIRST. ¹¹

¹¹ http://www.filemaker.com/downloads/pdf/datasheet_fm.pdf

5 DEVELOPMENT AND IMPLEMENTATION

5.1 The Map

The first objective of the project was to create a map that would include graphical access to all countries. Once the problem was pinpointed, a contact was made with Mr. Eric Rasmussen, one of the IT professionals at FIRST, headquartered in Manchester, New Hampshire. At the first meeting with Mr. Rasmussen, a list of improvements for the site was created:

- Show Canada, The United States, South America, Europe and Puerto Rico
- Fit within a, 800X600 Internet Explorer window
- Color scheme and design layout must pass inspection by Mr. Rasmussen and others before it can go on the website
- Each state, province and country must have a graphical hypertext link tailored to the specific dimensions of that state, province or country.
- Every state, province and country must be labeled
- Any state or province that is hosting a competition must be recognized as such by having a small graphical star placed within their borders.¹²

The first task was to determine how the links for each state had been created. After some investigation a program, called GeoHTML, and created by Alexander Samsonov, was located. (<http://www.fegi.ru/geohtml/>) After loading a specified image or

¹² Rasmussen, Eric. January 11th, 2003.

HTML file, the program would then allow the user to graphically draw the desired links, and then convert those links into HTML coordinates.¹³

The next task was to come up with a suitable map, color scheme, and layout design that would be suitable to Mr. Rasmussen. Three different models were made, all with different color schemes, layouts and overall designs. It was from these three that Mr. Rasmussen chose determined exactly how the site should look. After close to sixty different versions, a final design was approved, and construction on the links and hypertext markup language commenced. This portion of the project took over 3 weeks.

5.2 The Informational Pages

The informational pages proved to be slightly more challenging than originally anticipated. One of the primary goals was to make sortable lists of any information gathered. When a user requested all the teams from a particular state for instance, the database would return with Team number, Team name and Team Location. The next idea for the project was that Mr. Rasmussen wanted the user to be able to sort any of these data fields, alphabetically or numerically, in either ascending or descending order. After struggling with the software for about a week on this particular issue, it was finally realized that the software had not been designed to do this specific function, so that portion of the project had to be terminated.

There was much more success with the individual team pages however. After a very in-depth study of the CDML code for Filemaker, especially looking at how the information was retrieved from specific points in the database system, a clear system was devised for gathering team specific information from the database system. The new page

¹³ [Http://www.fegi.ru/geohtml/](http://www.fegi.ru/geohtml/)

(as shown in Figure 2) can now display a teams rookie year, motto, how many students are on the team and much more.

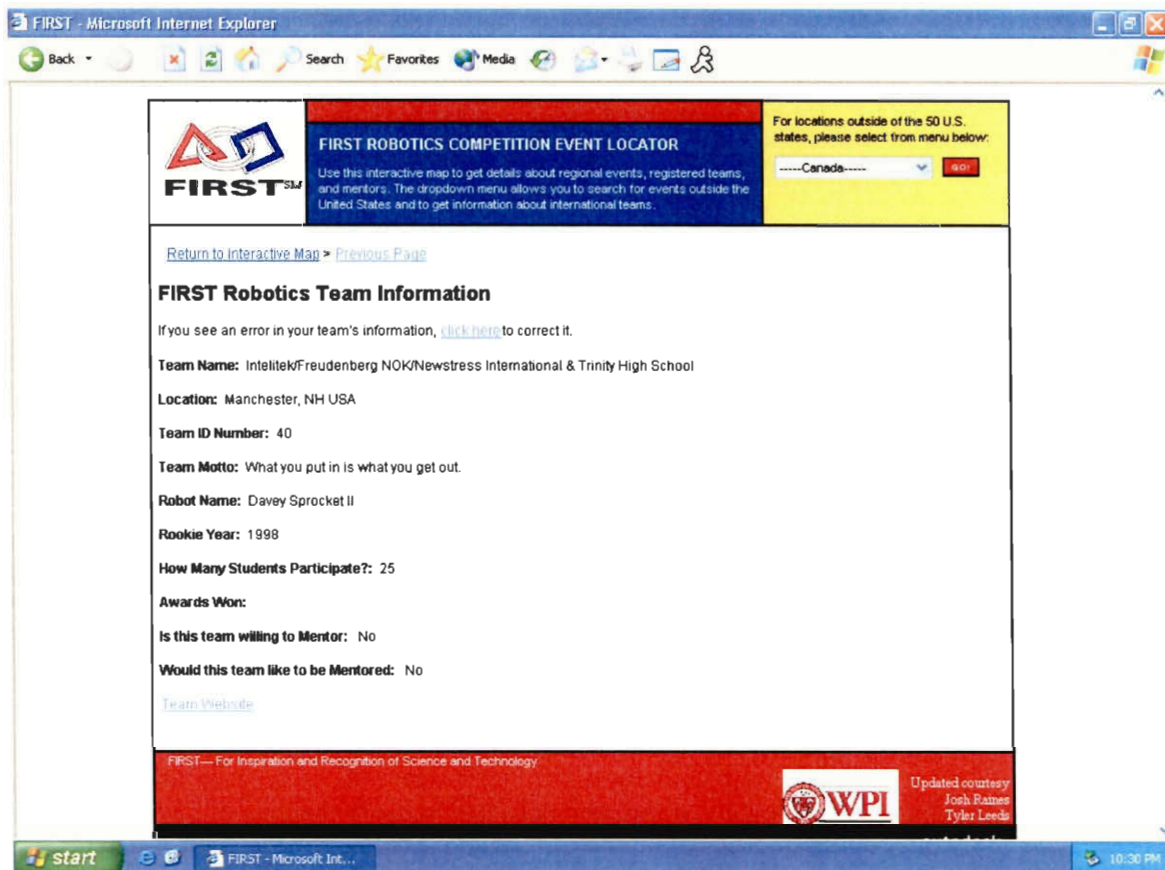


Figure 2 - Sample Team Information Page

5.3 Other Issues

One particular problem occurred when the database containing the awards that a team has won was referenced. This occurred because the awards information was being held in a database separate from the main teams.fp5 database. It was unclear whether or not Filemaker had the ability to access a separate database inside the program and then import that specific data back to the web user. After a meeting with Mr. Rasmussen, he

mentioned the PORTAL command that Filemaker uses for exactly that purpose. Using the PORTAL command, when an individual team is selected, any and all awards that the team has won can be displayed on the individual team page.

In addition to the added pages and updated map there were some minor adjustments made to the website in general. The dropdown list at the top of the page originally started with the name Ontario, and it seemed that instead of a particular State or Province, a general country name should be displayed, so the default name displayed was changed to Canada. (As shown in Figure 2)

Mr. Rasmussen had also expressed some concern in regards to the map, mainly that it be able to fit into an 800X600 window, for the ease of some users that may still be using a small screen size. It was noted that even their current map did not fit in that size window without having a left to right scroll bar appear at the bottom of the screen. (See Figure 3) The map_top.html file was altered by changing the table widths so that it would truly fit the 800X600 requirement. Also, permission was given by Mr. Rasmussen to place the project team member's names along with a Worcester Polytechnic Institute logo in the bottom corner as recognition for updating their site. Figure 4 shows the completed version of the front page.



Figure 3 - Original map as viewed in an 800 pixel window (Scroll Bars present)

5.4 Reaching a Large Audience

As was said earlier, the responsibility of FIRST is very high. By redesigning these pages, the organization has a chance to reach a larger, more diverse audience. Students in a state such as Minnesota and the Dakotas don't have many opportunities to be involved in things like robotics competitions because of location and expense, and some schools have trouble finding funding, sponsors, or mentors to help get off the ground. However, by having a well-maintained system, FIRST can give these new schools information about schools that have already gone through the same task of building a new system from the ground up. By having this system, a new student in Minnesota might have the chance to learn about some other school in the area that can be helpful.

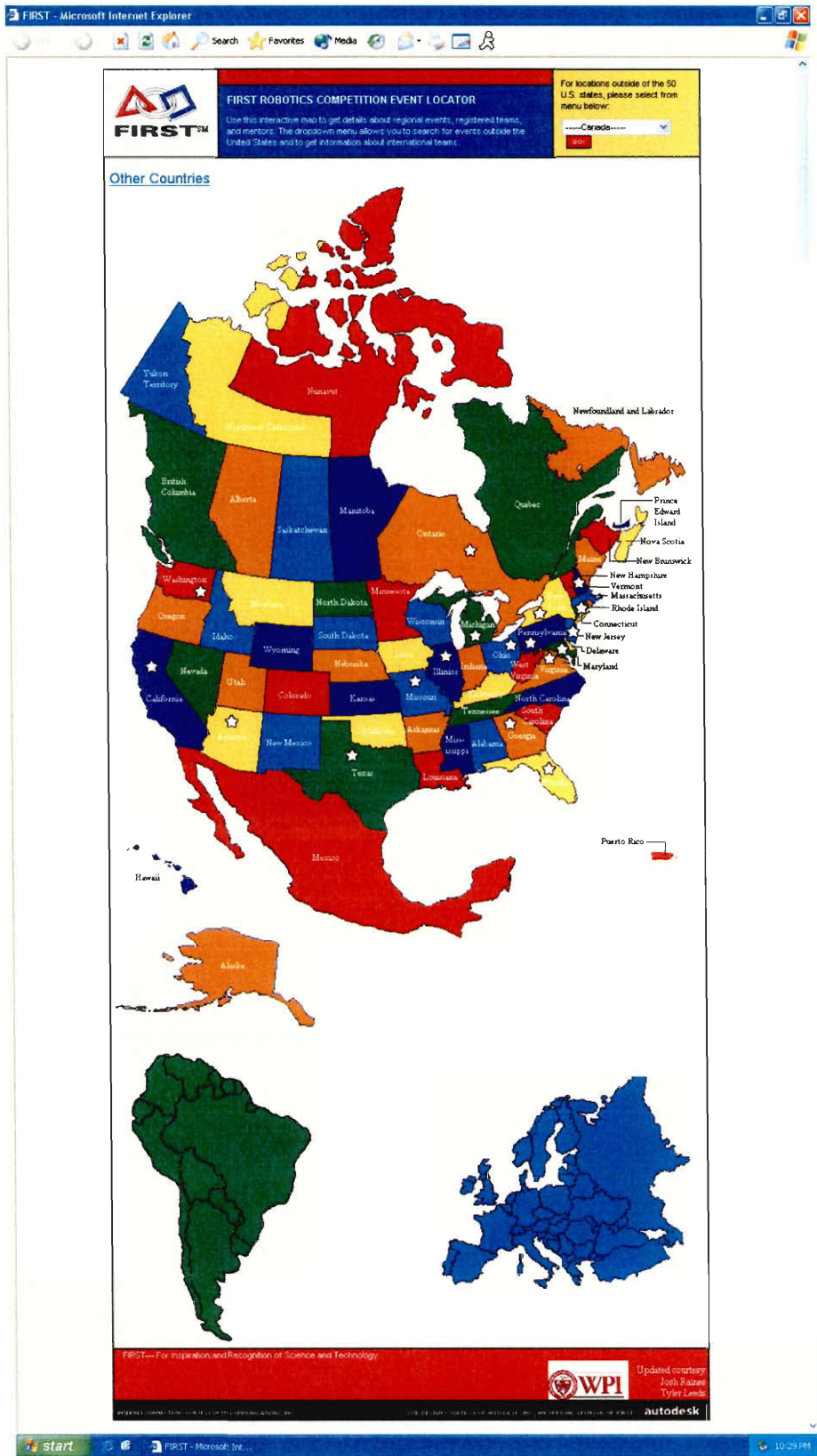


Figure 4 - Final map page

6 COMPLICATIONS

6.1 Why Not Filemaker?

Although the investigation of possible database software programs produced Filemaker as the optimal choice, as with everything, there are going to be problems. At the beginning of the project, the goals seemed to be relatively clear: update the map and make the information more accessible. However, because of software limitations and a few other, outside factors, not every goal was accomplished in full.

The Internet-database interface run by Filemaker requires that a server be continuously running, accessible from the Internet, and capable of running smoothly for long periods of up-time. The software utilizes the server and every time a user requests information about a certain state, team, competition, or anything else, the server answers that request. This means that the code for the pages that appear online must be written to directly access the server. This also means that the IT professional responsible for creating the web interface must be familiar with the appropriate computer language to do this. In this case, that language is CDML or Claris Dynamic Markup Language, designed specifically as an offshoot of HTML, or Hyper Text Mark-up Language, the base language for web design. CDML was designed specially as a Filemaker interface and is relatively easy to learn.

6.2 Software Limitations

Despite the fact that CDML is a well-designed, relatively easy language to use, there were a few issues, which arose during the project. One of the most prevalent was the fact that, when referencing a database, one can only request information from one particular database at a time. Because of the large amounts of information contained on

the FIRST server, much of the information has been organized into secondary databases, which are then connected to an overall database called Teams.fp5. However, this raised issues at points where information such as the teams from a state could not be placed on the same page as information about the competition in that state. Essentially, the information returned to the web-user must be broken down into either information about the team or information about a competition, but not both.

Another goal, which changed because of the software, was the desire for a sort-able table of information about teams from a state. In some instances, a user might be looking for a specific team number, team location, or team name. The original goal was to make this search easier for the user. However, because of software limitations, the SORTFIELD tag, a CDML tag, could not be used. Because this project focused less on the technical aspects of the site, and more on the social aspects, time was focused away from this particular goal and onto the informational pages. Although slightly disappointing, the software just made it too difficult to create a sort-able page within 7 weeks.

There were a few other, minor technical complications, which arose during the project. Many web browser software packages differ in ability to fit into an 800-pixel window, as well as ability to read updated code. The site had to be readjusted so that all browsers, even the older ones, would fit in an 800-pixel window properly. This meant some trial and error in the process. It also meant that the HTML code needed to be readjusted at the end of the project to accommodate all of these different software packages.¹⁴

¹⁴ [Http://www.filemaker.com/support/reference.html](http://www.filemaker.com/support/reference.html)

6.3 Filemaker Prevails

Upon completing the project and after dealing with some of the issues with the Filemaker software, it appears to still be the best possible program for FIRST and its needs at this point in time. Because of the large amount of traffic through the FIRST site, and the rather simple type of information being accessed, Filemaker seems to be a reasonable program to handle it all. It requires little maintenance and provides an ease of use which doesn't require a full-time IT professional working solely on it.

7 CONCLUSION

7.1 Future Possibilities for FIRST

Although most of the original goals for the project were met, there are still more improvements that can be made to the FIRST site. A group with a higher understanding of CDML could easily extend the functionality of the current site to be even more accessible. Perhaps a zip code finder, which allows a user to locate the closest team to him or her, could be implemented, or a way to locate specific teams could be used. Something that will surely be an issue in the future, as FIRST expands its horizons, will be improvements to the clickable map. The update in this project, from a simple United States page to a North America, South America, and Europe page was a step forward, but FIRST will surely move beyond that and into the global market.

As FIRST expands, so too must its infrastructure. One consideration for a future plan might be to hire another full-time IT professional to develop and maintain a new database system such as Microsoft Access. Although this might not seem like a good idea financially, one must realize that business often relies on information, and making that information accessible can often lead to a better future.

7.2 Social Implications for Database-Networks

Information is of course useful to the entire community. FIRST is an important program because it gives students in both high school and college a chance to explore interests in engineering and robotics. It provides a safe alternative to students and gives them a chance to be creative and learn something in the process. By providing a site which allows people to find other schools who participate in FIRST and allows people to

find other schools that are mentors or need a mentor, the program as a whole can expand and provide even more opportunities to students around the world.

By improving the informational system of FIRST, the overall program will hopefully expand into other countries and even at home. The more students who are involved in a socially beneficial program like FIRST, the better. There are a number of projects and opportunities for furthering the FIRST website and other informational tools, and the more that are accomplished, the better. Hopefully the program will stay strong and give students a chance to learn mathematics and science for years to come.

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Appendix B

Appendix B contains the updated code created during the course of this project. It is copyrighted material, property of FIRST Robotics, and for Internet security reasons as well as general copyright protection can not be released in this version of the project. If you have genuine interest in the materials involved for this project, please contact FIRST, at FIRST Place in NH:

FIRST Robotics
200 Bedford St.
Manchester, NH 03101
Phone: 1-800-871-8326

Information can also be requested from Professor Stephen J. Bitar at Worcester Polytechnic Institute, under the approval of FIRST.

Appendix C

Similarly, the attached CD is copyright material and cannot be made available to the general public. Necessary information can be requested from FIRST robotics at the address given above.

Appendix not included
in original submission

IQP/MQP SCANNING PROJECT



George C. Gordon Library
WORCESTER POLYTECHNIC INSTITUTE