

# Abstract

Polytrauma is a serious health condition that arises following traumatic events. Research into new technologies for diagnosing polytrauma is essential to improving health outcomes for patients. Technology development in this domain would be aided by better research tools that allow for simultaneous analysis of traditional evaluations and novel biosignals. There are currently no analysis pipelines designed for polytrauma-specific research. Based on previous research and models, we developed a web application designed specifically for speech and neural data analysis relating to polytrauma research. It allows users to make a secure account, store and analyze study data and results. The user study showed that there was a favorable response to our system, and inspired ideas for future improvement to support a variety of users.

# Polytrauma

**Definition:** The development of various mental and physical ailments due to a traumatic event.

### **Comorbidities:**

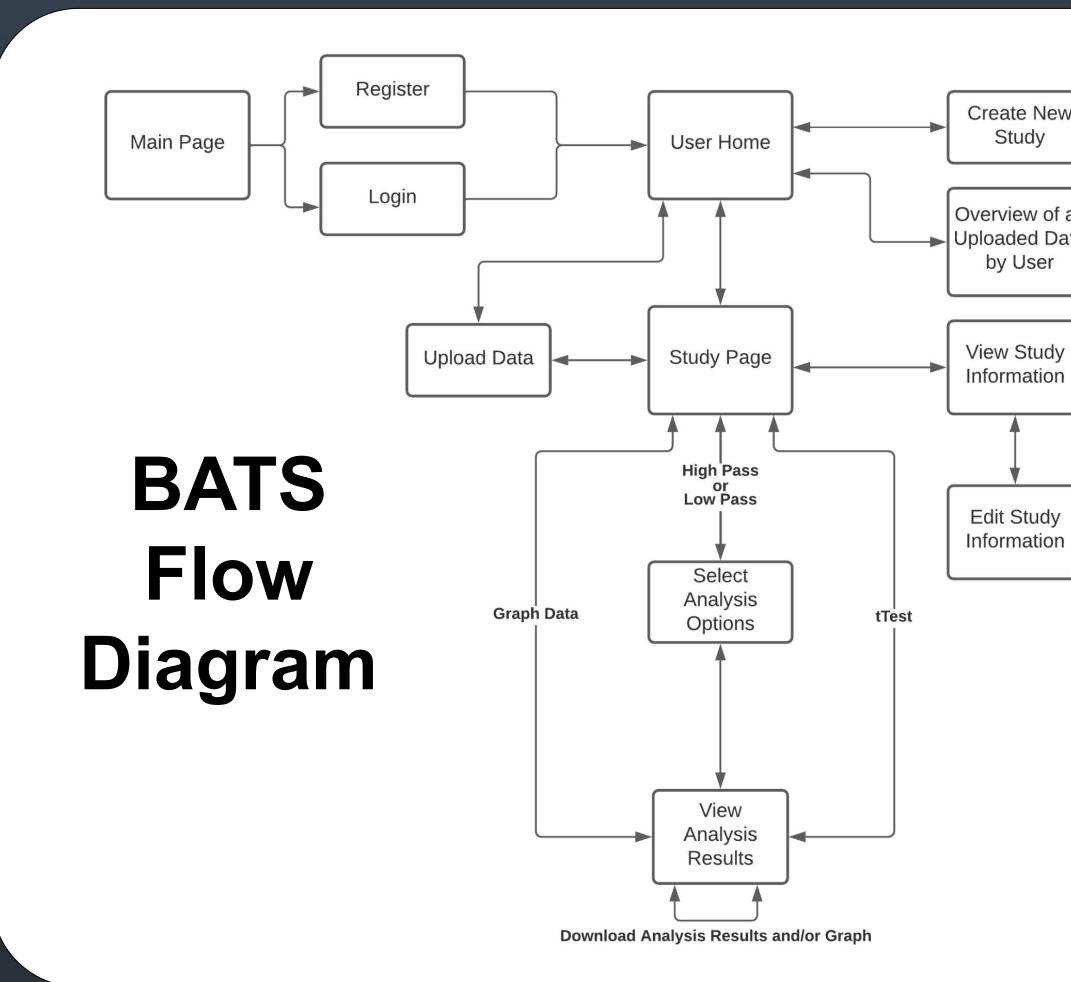
- Post Traumatic Stress Disorder
- Major Depressive Disorder
- Generalised Anxiety Disorder
- Chronic Pain
- Postconcussive Syndrome

### **Diagnosis:**

Psychiatric evaluations & Objective biosignal analysis Need:

Continuous, low-cost monitoring of patient progress. <u>Goal:</u>

Develop a web-based pipeline that allows for the simultaneous analysis of biosignals and psychiatric evaluations to facilitate multifaceted polytrauma research.



# **BATS: Development of a Biosignal Analysis Toolkit and Pipeline for Polytrauma Research**

Nathan Draudt (BME), Claire Nicolas (BME), Carlos Velasquez (CS), Lauren Wasserman (CS) Advisors: Professor Mark Claypool (CS), Professor Adam Lammert (BME)

# **Our System**

#### **User functions:**

Users can create password protected accounts, where they can create and maintain studies.

			_				New Study Add New Data			
				dies to view a study						
ATC Have Children	Abstract				Creator	Study Contact	Institutions Involved	Is IRB Approved	Visibility	
		team decided to conduct a us and effectiveness of our syste		in which a user would use the application and tial users.	User	BATS Team	WPI	yes	yes	
Nodeling of Speech Patterns of Adults with Najor Depressive Disorder	The goal of this stud	ly is to confirm that there is a	speech pattern in people wi	th diagnosed MDD and those without.	User	MDD Team	WPI	yes	yes	
ome About View Data								Help & Suppo	ort Logou	
k View Study Info Add N	Vew Data									
k View Study Info Add N	lew Data									
			BATS	User Study						
Data				Analysis Tools						
				/ manyone reens			11.12			
ick on a row to graph its data				To use an analysis tool, click on c	one from t	the below to	olkits			
-	ilename	File Extension	Data Type	To use an analysis tool, click on c Graphing Toolkit	one from t	the below to	olkits			
Name of Data Fi	<b>ilename</b> est_d	File Extension	Data Type	Graphing Toolkit	one from t	the below to	olkits			
Name of Data Fi T_Test_Data te					one from t	he below to	olkits			
Name of Data Fi   T_Test_Data te   Collected From Audio te	est_d	CSV	Log Data	Graphing Toolkit	one from t	the below to	olkits			

### **Data**

BATS 2022

.NIRS, .WAV, and .CSV files can be uploaded to a study. Data can be categorised as neural, speech, log, or other data. This data can be analysed using the various toolkit

Graphing Toolkit

Graph CSV Data

Statistical Toolkit

two groups

its a	vailable.	Selected Data: Data Name Test Wave
File Type	For Data Type	20 13 10 (1) 10
ine type	All	
	All	
	All	Taa
	All	<u>Too</u>
		The
		into

<u>Too</u>
The
into
neu
too

# **User Testing**

To assess BATS, our team decided to conduct a user study that simulates ways in which a user would use the application to determine the usability and effectiveness of our system for a wide variety of potential users.

#### The user testing followed three scenarios that tested BATS' important features:

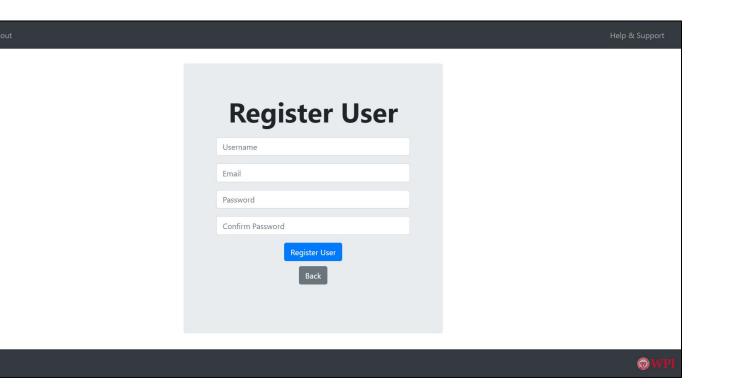
- Scenario 1: Creating an account, creating a study, and uploading the data provided.
- Scenario 2: Graphing the data provided.

Determines if there is a statistical different between the mean o

• Scenario 3: Analyzing the data with a specific analysis tool and downloading the results.

#### Seventeen individuals participated in our virtual user study.

Create New Study Overview of by User View Study Information



## Studies

Studies allow for users to store specific data and analyses in one place. Users can create and view studies as well as view and edit study information.

Home About View Data			Help & Support Logo
Back Done			Download Result File Download Graph
		View Analysis Result	
Selected Data:		Selected Analysis Tool:	
Data Name	Filename	Analysis Tool Name	Filename
T_Test_Data	test_d	tTest	ttest
T-Value:,-0.1486233978479289 Degree(s) of Freedom:,4.0 P-Value:,0.8890424525414472			
BATS 2022			@\
		View Analysis Result	
Selected Data:		Selected Analysis Tool:	
Data Name	Filename	Analysis Tool Name	Filename
Test Wave	Test_Wave	Graph CSV	grophesv
Test_Wave Grap			
	°°°°°°°	Time [seconds], Navelength(meters) 0.1.4.107232370 0.2.000000000000000000000000000000000	
0.8-			

## lkits

available analysis tools are divided major toolkits: graphing, statistical, ural, and audio. The neural and audio olkits must be run locally.

# **Group comparison:**

User Metric Averages
----------------------

Total Time Taken

Total Negative score

Filled Silences per min User Score (1<sub>Bad</sub>-5<sub>Best</sub>)

We saw improvements in Final Group performance compared to Prototype Group. User score was nearly statistically significant: t(15) = -2.07 and p = 0.057.

# **Metric Analysis:**

We investigated filled silences vs. total negative score , with results of r(8)=0.509 and p=0.0663. This indicates a positive association between the user pausing in speech (um,hm) and difficulty completing tasks.

- easily operated and efficient.

- Ability to create a "biomarker"
- Python, or MATLAB





Learn More To view our bibliography, learn more about the system, and watch **BATS** in action, please scan the QR code



# **Results & Discussion**

Prototype Group	Final Groun	Percentage Difference
12.4	10.9	13.9%
40.1	31.5	27.5%
5.57	3.93	41.7%
3.67	4.27	14.2%



• Group comparison confirms that the changes to the system improved user friendliness. • Comprehensive metric analysis suggests that BATS is

# **Future Improvements**

• Ability to upload custom analysis tools written in Java,

• Ability to revisit previous analysis results

• Ability to share studies and data between users

