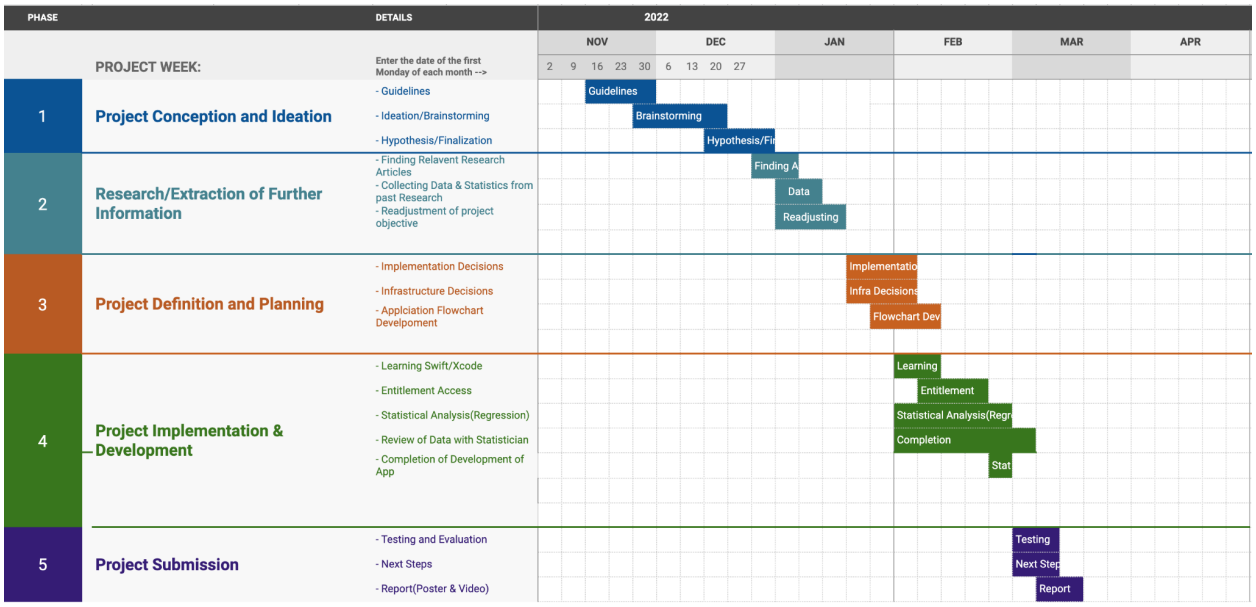
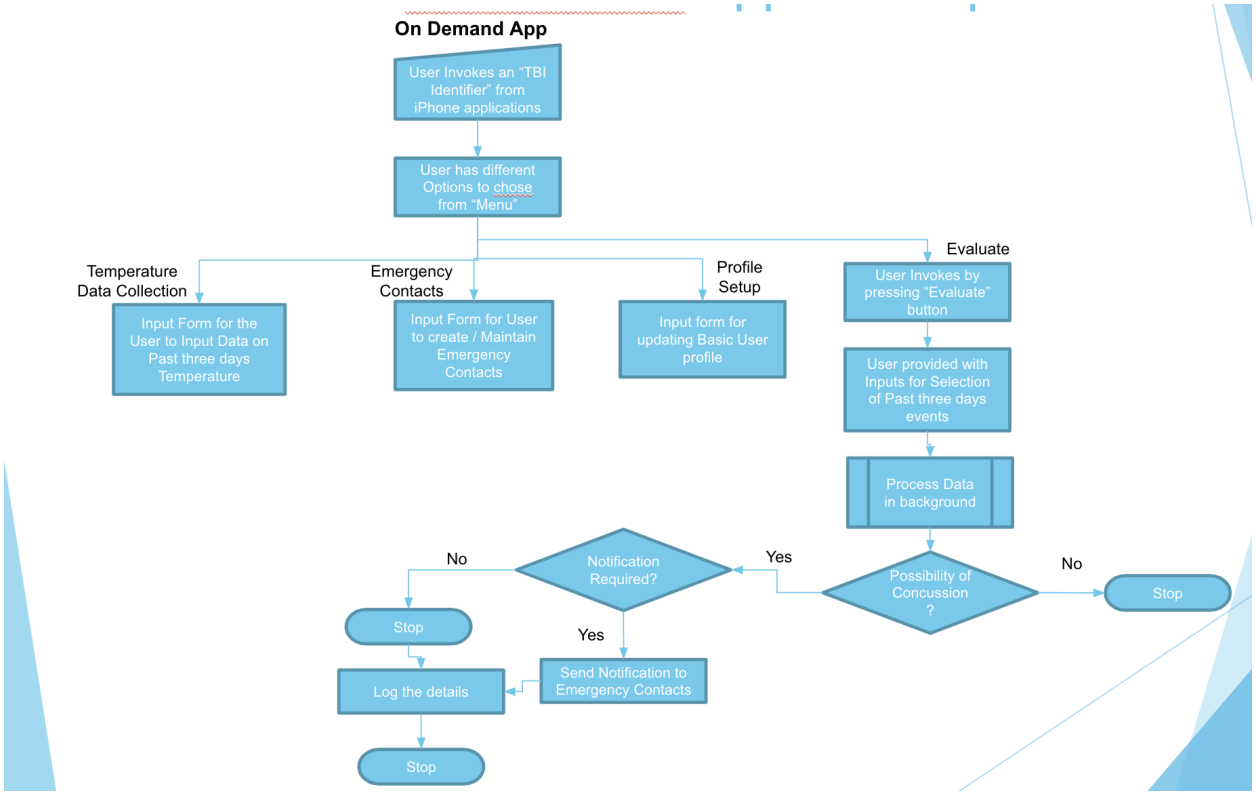
Project Plan - An application to predict Traumatic Brain Injuries through analyzing intervals of temperature.

Visual representation of Work Log and Project Plan:



Additional Information:

Application Flowchart (1/25):



ABSTRACT:

The purpose of this project is the development of an alert system app that delivers individuals' recorded temperature intervals to decision-makers such as parents and coaches to promote more effective efforts in the treatment of head-injured students early enough to save lives and reduce the severity of brain damage. The researcher hypothesized that awareness of daily human temperature intervals in comparison to post-head injury changes in temperature intervals can predict traumatic brain injury (TBI) and facilitate more effective medical care. The researcher created an app that predicts traumatic brain injuries (TBI) through the analysis of temperatures monitored at sleep and wake intervals, in comparison to temperatures following head injury / impact. The results include the task of informing decision makers of the subject (i.e. parents / coaches) through highly-efficient graph algorithms, by transferring temperature data and instructions in advance of head injuries that could be used in comparison to post-head injury temperature data.

RATIONALE:

Approximately 300,000 cases of mild concussions occur each season for high school and collegiate athletes. Concussions make up approximately 5.5% of high school

injuries and 6.2% of collegiate injuries (Theye & Mueller, 2004). Death due to traumatic brain injury (TBI) is often preventable when early care is provided. Early detection and treatment of brain injury is key to reducing mortality rates and brain damage from TBI. An effort has been made to correlate data from research done on brain temperature and the severity of TBI. In 2022, new findings related to the fluctuation of brain and body temperature intervals were reported to predict mortality (Rzechorzek et al., 2022).

With the development of an alert system application that delivers an individual's recorded temperature intervals to decision-makers such as parents and coaches, more effective efforts can be made to treat head-injured students early enough to save lives and reduce the severity of brain damage.

RESEARCH QUESTION(S):

Can analysis of intervals in human temperature be utilized to more effectively treat traumatic brain injuries (TBI)?

HYPOTHESIS(ES):

Awareness of daily human temperature intervals in comparison to post-head injury changes in temperature intervals can predict traumatic brain injury (TBI) and facilitate more effective medical care.

ENGINEERING GOAL(S):

My engineering goal is to improve health care for Traumatic Brain Injuries (TBI) including concussions, by developing and implementing an Application / Service that can alert decision-makers (such as parents and coaches) of the subject's healthy temperature intervals and promote collection and analysis of post head-injury of temperature interval changes, thus reducing the risk of complications and death.

Through the development of this alert system via app, more education and effort can be made to treat head-injured athletes early enough to save lives.

EXPECTED OUTCOMES:

Procedures: Oral temperature will be the measurement used to analyze interval changes in response to traumatic brain injury (TBI). Synthetic data generators will be utilized to temporarily fill in, for the lack of data that will be collected. Analysis tools such

as Biodare2 and Cosinor will be used to analyze existing intervals of human temperature data from a published study (Rzechorzek et al., 2022) to develop a unique algorithm for app development.

Risk and Safety: By utilizing commonly used tools such as Biodare2, Cosinor, and app development software the risks are minimal or non-existent. No data security issues will exist at this stage of the project due to using published interval data. Any input of human temperature data at this stage of the project will be synthesized to allow for testing of the app.

Data Analysis: Data analysis will primarily consist of utilizing libraries such as Biodare2 and Cosinor to thoroughly analyze the intervals of human temperature. However, since Brain Temperature (TBr) is highly dependent on certain factors of the human body that vary throughout the day, the usage of a linear mixed-model approach will be chosen to account for these issues. Specifically, when making measurements, the time interval was chosen to be spread out through three parts of the day (morning, afternoon, and evening) to account for the possible variations and time of diagnosis. The intended purpose of this measurement system is to clearly differentiate between standard temperature variations and abnormal temperature deviations, which would not be eminent in two-point systems. Therefore, a three-point system is the most efficient and accurate way to achieve this intended goal. Due to the duration of time to obtain and fulfill the project, tools like Synthetic Data Generators will be utilized. Additionally, analysis includes the task of informing decision makers of the subject (i.e. parents / coaches) through highly-efficient graph algorithms, by transferring temperature data and instructions in advance of head injuries that could be used in comparison to post-head injury temperature data.

BIBLIOGRAPHY:

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Sensors for brain temperature measurement and monitoring – a review,
Neuroscience Informatics, Volume 2, Issue 4, 2022, 100106, ISSN 2772-5286,
https://doi.org/10.1016/j.neuri.2022.100106

(https://www.sciencedirect.com/science/article/pii/S2772528622000681)

Abstract: Cerebral temperature is one of the key indicators of fever, trauma, and physical activity. It has been reported that the temperature of the healthy brain is up to 2°C higher than the core body temperature. The main methods to monitor brain temperature include infrared spectroscopy, radiometry, and acoustic thermometry. While these methods are useful, they are not very effective when portability is desired, the temperature needs to be monitored for a longer period, or localized monitoring is required. This paper presents a short review of invasive and non-invasive brain temperature monitoring sensors and tools. We discuss the type of temperature sensors that can be integrated with probes. Furthermore, implantable and bioresorbable sensors are briefly mentioned. Biocompatibility and invasiveness of the sensors in terms of their functional materials, encapsulation, and size are highlighted.
Keywords: Brain temperature; Temperature monitoring; Temperature sensors; Fever; Neural temperature

“Heads up”; Concussions

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1069089/

https://www.wareable.com/wearable-tech/wearables-and-temperature-tracking-8878

A number of newer Fitbit devices – the Fitbit Sense and Charge 5 (and Charge 4) – measure your skin temperature throughout the night to determine your average temperature.

After three nights, the Fitbit app will show you a personal skin temperature baseline and a personal range of variation. Instead of producing a skin temperature number, which Dr Tyler says bears little resemblance to your core temperature, the wearable will look for deviations from what's normal.

“Your baseline is used to provide insight into when your skin temperature is higher or lower than your baseline and if it is within your personal range, as it is natural for your skin temperature to vary night to night,” Dr Conor Heneghan, of Fitbit says.