CSED Group 11 Semester 2 Report

Computing as a Science and Engineering Discipline (CM10251)

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Abstract

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1 Introduction

1.1 Overview of Domain

Personal informatics is a term used to refer to devices and software that help people gather information about themselves, so they can reflect upon it and gain motivation to make changes to their lifestyle and habits to improve their overall wellbeing. Personal informatics is used for effectively motivating people to gain self-knowledge, change behaviours.

The area of personal informatics has started to expand in popularity in recent years mainly due to the increased availability and usability of affordable hardware. Consumer products such as the FitBit and Apple Watch allow users to collect data on a wide variety of metrics including heart rate, blood pressure, motion and many others. Products such as the Neuroon, a wearable EEG eye mask, and Zeo Sleep Manager Pro, an EEG headband, allow the user to collect information on brain waves for the purpose of sleep tracking.

Another factor that has contributed to the growth of personal informatics is the ubiquity of smartphones, meaning that users have an ever-present device that allows them to collect and collate data from their personal informatics hardware. Many personal informatics apps also add an element of socially driven competition and gamification, driving users' motivation to continue to use them and push their friends to also begin using this technology. In addition, there is a larger social force pushing people to take steps to improve themselves.

1.2 Challenges

Although personal informatics systems for wellbeing has been on the rise, it inherently presents flaws that need to be taken into account. In a survey conducted by / where participants were regular personal informatics users it was revealed that the most significant shortcomings of personal informatics systems supplied by commercial companies was a lack of understanding for the end user's requirements and an absence of assistance and alerts for users who didn't meet their goals. Apart from users who are familiar with personal informatics systems it is also important to consider the challenges faced by the common user; a user who is new to using a personal informatics device. It was discovered by / that the main challenge for personal informatics systems was the lack of motivation faced by the end user to continue to use the system. These challenges need to be taken into account because these hinder the end user from improving themselves which is contradictory to the goal of personal informatics systems.

1.2.1 Privacy and Security of Data

1.2.2 Health Risks

One crucial problem in the realm of health is sleep deprivation. Sleep deprivation is defined by British Medical Association (2018) as "a lack of sufficient sleep resulting from disruption to the natural sleep cycle". This is important to highlight because as as opposed to fatigue, sleep deprivation isn't subjective. In accordance to Alhola and Polo-Kantola (2007), it was estimated that the main effect of sleep deprivation was the reduction in cognitive performance. This includes: impaired attention; longer delays in making decisions; poor quality of decisions and a reduction in long memory. This is especially important to monitor for individuals who have high risk jobs. In 2010, passenger's lives were lost when a plane overshot the runway by 600 meters; although concrete details haven't been exposed, it was claimed that the accident unfolded due to the pilot's severe sleep deprivation (BBC, 2010). Even in circumstances where the individual isn't responsible for people's lives, a reduction in cognitive performance is still observed. Hence, the validity of this problem is justified.

Sleep deprivation has the potential to be a dangerous to anyone and even fatal, if it is not identified and managed.Over a third of adults get less than seven hours of sleep during a typical 24-hour period.Lack of sleep affects a person's abilities and health in many ways and can limit their ability to perform in their line of work.This can be seriously, especially for professions that the general public's lives rely on greatly such as doctors and nurses. Each year, 100,000 deaths occur in US hospitals due to medical errors and sleep deprivation in the medical staff has been shown to contribute to this statistic.(Sleep Association) Driving whilst feeling drowsy has been shown to be similar to driving whilst under the influence of alcohol and can be attributed to a portion of car collisions each year. (Sleep Foundation) There are few visible indications that an individual is getting less sleep than recommended and it's difficult to know if you are deprived of sleep which often makes it more damaging as it may be challenging to identify and then attempt to curb. Similarly, there's no legal limit for sleep deprivation for situations such as driving a vehicle. Sleep deprivation is difficult to measure without the aid of external equipment.

1.2.3 Solution

Our software system aims to reduce fatigue in individuals due to a lack of sleep. EEG have the ability to detect sleeping problems based on brain wave patterns. (Mayfield Clinic) Monitoring and recording the individual user's brainwave data during their sleep allows the system to be tailored specifically for that individual. Implementation of a points system would ensure the user regularly uses the headset. If the system were to be used most nights, the headset would be able to measure and record a large quantity of reliable data for the system to process making results recommendations the system provides likely to be accurate and therefore helpful to the user. If the data were to be displayed in a format easily, this would help the user to better understand their recorded sleep data and allow them to make more appropriate decisions as to how to change their actions.

2 Requirements

2.1 Non-Functional Requirements

1: Software Development Process		
Index	**Description**	**Priority, Dependencies, Source**
1.1	The system must adhere to the Agile/Scrum methodology.	*Priority:* High *Dependencies:* None *Source:* Coursework specification.
1.2	Software development should include at least 3 sprints.	*Priority:* Medium *Dependencies:* 1.1, 1.3 *Source:* Coursework specification.
1.3	Each sprint should last between 1 and 3 weeks.	*Priority:* Medium *Dependencies:* 1.1, 1.2 *Source:* Coursework specification.
1.4	Must review the functional requirements at every scrum meeting.	*Priority:* High *Dependencies:* 1.3 *Source:* Coursework specification.
1.5	Must incorporate risk management into the software process.	*Priority:* High *Dependencies:* 1.1 *Source:* Coursework specification.

2: Expanding Initial Requirements		
Index	**Description**	**Priority, Dependencies, Source**
2.1	The system must expand upon the initial non-functional requirements.	*Priority:* High *Dependencies:* None *Source:* Coursework specification.
2.2	The system must expand upon the initial functional requirements and add additional functionality to the system.	*Priority:* High *Dependencies:* None *Source:* Coursework specification.
2.3	Additional requirements should be established by conducting interviews on potential users, reading articles on Personal informatics and examining existing personal informatics systems.	*Priority:* High *Dependencies:* 2.1, 2.2 *Source:* Coursework specification.

3: Background Research		
Index	**Description**	**Priority, Dependencies, Source**
3.1	Must read and cite 4 articles in the field of personal informatics.	*Priority:* High *Dependencies:* None *Source:* Coursework specification.
3.2	Should read and cite at least eight articles.	*Priority:* Medium *Dependencies:* None *Source:* Coursework specification.
3.3	Citations of core article must be peer-reviewed articles.	*Priority:* High *Dependencies:* 3.1 *Source:* Coursework specification.

3.4	Additional citations may be made to web articles of unknown quality.	*Priority:* Low *Dependencies:* None *Source:* Coursework specification.
3.5	Must classify measurements of stages of sleep (REM cycles).	*Priority:* High *Dependencies:* None *Source:* Tuck (2018), Feinberg et al. (1988)

2.2 Functional Requirements

4: Viewing and Collecting Sleep Data		
Index	**Description**	**Priority, Dependencies, Source**
4.1	The system must be able to interface with the Neurosky headset.	*Priority:* High *Dependencies:* 4.1.1, 4.1.2, 4.1.3 *Source:* Meeting minutes #12.
4.1.1	The system must be able to connect to the Neurosky headset.	*Priority:* High *Dependencies:* None *Source:* Meeting minutes #9.
4.1.2	The system must be able to disconnect from the Neurosky headset.	*Priority:* High *Dependencies:* 4.1.1 *Source:* Meeting minutes #9.
4.1.3	The system must be able to read in raw brainwave data from the Neurosky headset.	*Priority:* High *Dependencies:* 4.1.1 *Source:* Meeting minutes #7.
4.2	The system should permit the manual entering of relevant user data from the last 24 hours.	*Priority:* Medium *Dependencies:* 4.3 *Source:* Coursework specification, British Medical Association (2018), sleep app questionnaire.
4.3	The system must permit the manual entry of information that corresponds to the times when the user went to bed and woke up.	*Priority:* Medium *Dependencies:* None *Source:* British Medical Association (2018), sleep app questionnaire.

3 References

Alhola, P. and Polo-Kantola, P., 2007. Sleep deprivation: impact on cognitive performance. *Neuropsychiatric Disease and Treatment* [Online], 3(5), pp.553–567. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2656292/.

BBC, 2010. *Air india plane crash: 'sleepy' pilot blamed* [Online]. Available from: https://www.bbc.co.uk/news/world-11772562.

British Medical Association, 2018. *Fatigue and sleep deprivation—the impact of different working patterns on doctors* [Online]. Available from: http://bmaopac.hosted.exlibrisgroup.com/exlibris/aleph/a23_1/apache_media/E6Q21YYTL9GF3G9R5B1HDNPA8E51PT.pdf.

Feinberg, I., Baker, T., Leder, R. and March, J.D., 1988. Response of delta (0-3 hz) eeg and eye movement density to a night with 100 minutes of sleep. *Sleep* [Online], 11(5), pp.473–87. Available from: https://www.ncbi.nlm.nih.gov/pubmed/3227227.

Tuck, 2018. *Stages of sleep and sleep cycles* [Online]. Available from: https://www.tuck.com/stages/ [Accessed 27 March 2019].