Real Time Stress Monitoring

Team: Yhui Khuu, Taran Furnell, Muhamad Wazien Rumaiz
School of Computer Science, Software Engineering Research Project
Industry Partner: Adelaide Health Simulation & Skills Centre

Introduction

People experience varying levels of stress in their everyday lives which can affect their behaviour and thought process. This can have a significant impact on their lives and the lives of the people around them. Research has shown that high stress levels can result in affected people making careless and uncharacteristic mistakes. This can potentially result in the injury or death of themselves or people nearby. For example, if a surgeon is experiencing high stress levels, they may be liable to make a mistake during surgery, which could potentially cost the patient their lives depending on the severity.

In the ideal scenario, a person would be able to monitor their own stress and take actions to maintain their stress levels. Unfortunately, the human ability to measure their own, or other people’s stress level is very limited, not to mention wildly inaccurate. This makes it extremely difficult to prevent these situations from occurring.

Currently the best and most accurate method of measuring this stress is by taking and analysing a saliva sample taken from the person in question. This is obviously not very convenient, and not particularly useful in most working environments.

In an effort to help people easily monitor, and subsequently control, their stress levels, we have developed a software solution that is capable of monitoring and measuring stress. Our solution can detect a person’s stress in real time, allowing actions to be taken sooner, thereby substantially reducing the risk of careless mistakes occurring. It is also significantly less intrusive than the standard method of taking samples of saliva.

What is our solution?

Bio-wearables, such as those developed by Empatica, are becoming increasingly popular in our society. These devices are non-intrusive, lightweight and are capable of measuring human biological signals to a reasonable accuracy.

Our solution utilises the measurements obtainable from bio-wearables to approximate the stress levels of the user. The calculated stress values are presented to the user via a web interface which can be accessed via any device with an internet connection, including laptops and mobile devices.

This allows users and/or supervisors to monitor their stress easily, and preventative measures can be taken should their levels exceed a certain threshold.

How it works?

We have collected data from various people while they were experiencing different levels of stress, and analysed the data for consistent changes that occurred at each level. From this, we determined that there were a few major factors that were affected by the user’s current stress level and we have developed an algorithm based on our analysis. Our algorithm calculates the current stress level of a user based on their biological markers. The signals that we used include their Heart Rate Variability, Skin Conductance, and Temperature.

Heart Rate

The time between each individual heart beat is known as the Heart Rate Variability. We have found that a person’s instantaneous heart rate varies more while they are stressed than in normal circumstances.

Skin Conductance

This value is the conductivity of the user’s skin. Sweating is one of the main factors that contributes to the change in this value. This can be tied to a person’s emotional state as people tend to sweat more under certain emotional conditions including when they are stressed. This causes a noticeable change in this value when they are stressed.

Temperature

Body temperature varies slightly under different conditions, for example, the temperature may rise during anger or embarrassment. On the other hand, when people are stressed, it is possible for their body temperature to increase due to the body’s natural response to stress. The change in temperature is not large, but can be an indicator of stress.

We gather the values that we are interested in from the bio-wearable, and pass them to our software. These values are combined in our software, processed through our algorithm, and a stress level is generated as an output which can be displayed in graphical form.

Baseline

One important aspect of our algorithm is the concept of a ‘baseline’ for the values from the watch. We have found that the ‘normal’ measurements for each individual person will inherently differ from person to person due to various factors including health, normal stress levels, and simply due to their bodies being different. This means we cannot use the same values for each person when calculating stress, as the values will differ for each person.

To address this, we take initial measurements from users while they are relatively unstressed, and use this as a baseline for all subsequent measurements. This allows us to consider all values as being relative to their normal state, and allows our algorithm to determine the stress levels for different users. We also normalise the changes using the mean and standard deviation. This gives us a standardised measurement so that we can use the same relationships between the variables when calculating the stress for all cases.

What are the applications?

Research has shown that people perform optimally at a medium level of stress, and their effectiveness drops significantly towards either end of the spectrum.

People who are overly stressed have a tendency to make careless and easily avoided mistakes due to the pressure they are under. This can potentially be disastrous in life threatening situations, and is particularly applicable to the medical field. Doctors live stressful lives, and the slightest mistake during surgery could cost patients their lives.

Our solution will allow doctors who are experiencing excessive levels of stress to be found, and allow them to take a break before continuing with their work. This will help minimise the likelihood of any mishaps occurring due to stress.

On the other hand, people who experience very low levels of stress are likely not performing optimally. A good example of this is in education. A complete lack of stress in students has been shown to be an indication that the curriculum is not challenging enough for them, and they are therefore not learning efficiently. Our solution would allow for these cases to be detected and rectified, and these students can be placed in more challenging classes to optimise their learning.

Future Work

Our algorithm is still in its infancy, and there is plenty of room for improvement in the future with the investment of more time and work. Moreover, technology continues to advance at an incredible rate, and the obtainable measurements from bio-wearable devices will no doubt improve substantially in accuracy and variety in the coming years. This will inherently improve the accuracy of our system due to its dependency on these devices.

In fact, we have designed our system specifically with future improvements in mind. Our system has been designed to be modular, allowing for improvements and changes to be made to any of the components without the need to alter the entire system.