

Project Overview: At one point or another, everyone experiences some form of stress. Routine stress, the most common form, is a product of job-related pressures, family, and a variety of other daily responsibilities. As the source of routine stress is relatively constant, it is substantially harder to notice at first than stress brought on by a traumatic experience or sudden negative change in one's life. A quicker pulse, rapid breathing, muscle tension, and increased perspiration, are all examples of physical manifestations of stress in the human body. In short bursts, these physical reactions often help people deal with stress properly. However, repeatedly experiencing these symptoms over extended periods of time can have a harmful impact by suppressing other important bodily functions. As a result, prolonged stress has the potential to not only weaken one's immune system but also has been shown to lead to serious health problems such as heart disease, high blood pressure, diabetes, depression, and many others.¹

Wouldn't it be great if there were simple activities that an individual could perform such as going on a run, listening to a favorite song, or playing a game that would drastically reduce his or her overall stress level if performed at the appropriate time? This research proposal argues that by using a variety of biometric sensors and machine learning classification, suggestions can be made to help a given individual better deal with routine stress inducing activities or even prevent them all-together. Thus, reducing the likelihood of chronic stress and its damaging impact on the individual's emotional and physical well-being. The proposed research involves actively monitoring a user's heart activity and perspiration levels throughout the day with biometric sensors connected to an Arduino micro-controller and feeding the sensor data via Bluetooth to the user's smartphone. Based on the feedback from the sensors, the system will recognize if the user is "relaxed" or "stressed." The phone app will also monitor the user's physical activity, calendar events, location, and other various smartphone sensors to learn which situations in a user's daily life correspond with his or her most stressful moments. As the system detects such correlations, it will make insightful, personalized, recommendations to the user in hopes of helping alleviate the user's stress or suggest the user avoid similar situations in the future.

For example, say Paul is a hard-working high school student, who makes sure to mark down all of his tests in his phone's calendar – reminding him to study the night before. Paul's sister just started taking drum lessons and enjoys practicing frequently. One night before a test, Paul has trouble concentrating on his test material because his sister is playing the drums for several hours. Paul wakes up the next day and is very stressed out since he did not get much studying done the night before. Not knowing the material well enough, Paul does poorly on his test – only upsetting him and stressing him out further. Paul then decides to try out the proposed stress detection system. Over the course of a few weeks, including another test Paul is unable to study for because of his sister's drumming, the system detects a correlation between an increase in ambient noise levels (sensor data from the microphone in Paul's smartphone) at home the night before and an increase in stress levels the day of a certain calendar event at school. The next time there's an increase in ambient noise at home the evening before Paul has a test, he gets a notification on his phone reminding him he was stressed the last time he was in a similar situation. The app suggests Paul relocate to a quieter environment. Paul goes to the public library where he's able to focus on studying and does really well on his test the next day. Paul is happy about his success.

Intellectual Merit: In order to maximally reduce the amount of routine stress an individual experiences, all contributing factors must first be recognized and understood. The proposed research makes two contributions to this effort: (1) improving the amount of time taken to identify a stressful situation and even be able to predict when they will occur, (2) being able to suggest ways to deal with similar, stressful situations in the future by learning which activities a given person finds "relaxing." The combination of these two contributions may ultimately lead to a deeper understanding of general causes of stress and better ways to treat it.

Broader Impact: The proposed research would allow mental-health professionals make more accurate suggestions to their patients on how to deal with stress. It would also benefit all users of the system by allowing them to better understand what causes them stress and know how they can avoid it – leading to a generally healthier and happier lifestyle.

¹ <http://www.nimh.nih.gov/health/publications/stress/index.shtml>