

## Monitoring mental health of Sri Lankan youngsters during COVID 19 with passive mobile sensing

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**Abstract:** Smartphones are the key things that offer the collection of behavioral data without knowing the users because it is the most closest and frequently used accessory of daily life. The youngsters in Sri Lanka who are suffering from mental illnesses are not aware of their disease as well as the symptoms. In this article, our main aim is to monitor the behavior of the young people in Sri Lanka at the time of COVID 19, and come up with an analysis of the mental health status and about the symptoms of mental disorders that they are showing. Data can be collected in various ways like, from the default sensors and questioners. Mobile phone usage patterns like the duration of time spent at various locations are the factors that may provide evidence for their behavior. In addition, the daily activities like physical activity and sleep are also affected by these defined mental disorders in this pandemic time. We hope that we could provide the sufficient remedies for those who suffer from mental disorders during COVID 19 with the use of data collected through the sensors and surveys. We ensure the security features when receiving the sensitive data. We think through smartphone sensing, we could contribute to avoiding obstacles in behavioral studies specially in the area of mental health detection.

**Keywords:** Smartphone sensing, mental health, Behavioral Science

### Introduction

During this pandemic of COVID 19, most of the people have changed their living patterns. Set of them are alone because of social distancing. The mental health issue of society will surely take place at this pandemic. Moreover, technology for mobile sensing is now evolving at an incredible pace. The mobile provides a healthy range of sensor choices for social environment sensing. Different location and context-related sensors and network technology are integrated into mobile phones such as GPS, WLAN, cellular network antennas, Bluetooth, accelerometers, magnetometers, gyroscopes, barometers, proximity sensors, humidity sensors, temperature sensors, ambient light sensors, cameras, microphones, and so on. With this variety of input or stimulus choices, combined with capable computational and networking capabilities, the smartphone becomes an enticing "cognitive" medium with great potential for achieving sufficiently high intelligence to answer social context issues such as "Where are you?" "What do you do?" "What do you feel like?" "Who is with you?" "What's going on?"

Typically, built-in sensors of a smartphone such as an accelerometer, magnetometer, and gyroscope can be utilized to calculate the smartphone's speed, heading, orientation, or motion mode. Also, the camera in a smartphone is a potential positioning sensor. In general, human physical activity recognition using Microelectromechanical

system sensors has been extensively applied for health monitoring, emergency services, athletic training, and navigation.

The convergence of IT with the human lifestyle has improved the quality of human life. This emerging technology has resulted in a digital transformation of management, diagnosis, and treatment in the health sector. In this transition, smart device technology is one of the main facilitators. Taking advantage of the ability of smart devices to track different human activities such as tracking sleep patterns, daily water consumption, weight loss reporting, and heart rate monitoring to improve people's lifestyles and health conditions.

Specific implementations for these purposes have been suggested. The World Health Organization (WHO) defines health as “a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity” defined health. Smart devices, for patients with anxiety or depression, have been widely used to monitor mental health. Mental health refers to the well-being of people who cope with stress, who are more successful in their lives, and who contribute positively to their community. Anxiety is an emotion characterized by an uncomfortable state of inner turmoil, frequently accompanied by anxious behavior, such as back and forth pacing and somatic complaints. Depression is a chronic mood disorder that results in severe symptoms that affect the feelings of people and their daily activities, such as working, eating, or sleeping. About 300 million people worldwide suffer from depression, 4.4% of the world's population. WHO has ranked anxiety disorders as the sixth cause leading to global disability (3.4% of people with disabilities in 2015); while depression has been ranked as the single major cause of global disability (7.5%). Also, during this COVID 19 time, it may raise.

Depression is also the main contributor to deaths from suicide, almost 800,000 cases a year. Depressed people share common symptoms with anxious people, such as increased heart palpitation, feeling lonely most of the time, and losing energy at various levels. Scores generated by surveys such as Patient Health Questionnaire (PHQ), the Center for Epidemiologic Studies Depression Scale-Revised (CES-D), and Beck's Depression Inventory (BDI) are the standard approaches for diagnosing and screening anxiety and depression. Different health applications have been proposed, especially for mental health, to help many people with symptoms of anxiety or depression use smart devices as an alternative to sustaining or improving their mental health. Developed countries have built some applications for evaluation purposes using algorithms that implement a series of user-submitted questionnaires to obtain possible diagnoses.

### **Methodology And Experimental Design**

The main objective is to make a mobile phone application to monitor the behavioral patterns of individuals during this pandemic and monitor their mental wellbeing from the datasets acquired via the developed application. This app may use mobile phone sensors to monitor behavioral patterns. The data sets are the most valuable assets. We are Focusing on Sri Lankan youngsters who have smartphones. Because in this COVID 19 pandemic situation, all of the people are in their houses and smartphones are a good medium to reach them remotely. There are no studies to monitor mental health that can be used by Sri Lankans. It was the main reason for which they do not know about the importance of mental wellbeing. A high percentage of people do not face dangerous mental health issues like Apotemnophilia, Boanthropy, and Capgras Delusion. Most of the time they face general disorders like anxiety, depression, and stress. Therefore, we needed to know the basic behaviors of

people who have these disorders. In those instances, we can collect the relevant information. Through this analyzed data set, authorities can organize events by focusing them to minimize the disorders. Alternatively, we can build a platform among mental health doctors and mental health patients.

We decided to use a smartphone sensing methodology to succeed in this data acquisition. The main problem of unawareness about mental health conditions is the lack of use of ICT based solutions. The smartphone is a successful method to monitor behaviors since it is always in the hands of people. Smartphone sensors replace the unwanted questionnaires that have not effective output and also that will disturb the user's day to day life. We are focusing on passive sensing through smartphones to monitor the movements and activities. It means that this methodology does not need the force of the user. Sometimes this data is obtained without knowing the user. This methodology has a high effect on behavioral science since it can monitor the targeted individual in any amount of days and any amount of hours. Also, every single data recorded. A smartphone has some accessible sensors like Accelerometer, GPS, Light sensor, Microphone, Bluetooth, Antenna, and Proximity sensor. Also, we can access logs such as Call logs, Device activity, SMS patterns, Application usage, and Calendar. Therefore, We plan to access this sensor and manual data through a mobile application developed and analyze. The monitoring process is supposed to be done for about three weeks with a sample.

To measure the depression of any user, the sleep patterns are necessary factors. So that information about the sleep patterns should be very well accurate and reliable. So we are planning to send push notifications to users to get information about their daily sleep

patterns. This push notification will be sent every morning. These push notifications consist of multiple-choice questions that will help to conclude the depression level. It will be a short reliable form that will not consume the user's time in a high manner.

Mainly we focused to access smartphone in-built sensors like GPS and Accelerometer to detect the behavioral patterns of the user. The mobile phone will monitor the movements and activities at equal time intervals all over the day. The IMEI number will be used as the primary key to identify the user. Each data will be sent to the backend with the IMEI of the smartphone.

The next step is to ensure the privacy of the target user. The most common limitations in this type of study are security and privacy issues. To overcome this, I am not using any names of users for any identification purpose. Using the IMEI number of the device is a good solution for this gap. Or else we can get some amount of summarized data without any individual data. We will not record sensitive data like call records, Photos, and others. More sensitive data will not be uploaded separately.

We asked 20 participants from August to September 2020 via online and verbal communication methods. They are good to go with this study if they have a smart-phone which have android 9 or below (Api Level<28), email account, active internet connection which has connection approximately all over the day, have the ability to read and understand Sinhala and English, still in the age range of 20 to 30 years who are representing the young generation. All participants in this study have participated with a volunteering basis with the mindset of contributing to the healthy outputs to the community with the effectiveness of this research. The eligibility of any user has been reviewed with the above-mentioned criteria before the study

with online communication methods and direct verbal communication.

In the first step of this research, participants were requested to install the Activity recognition Application (Described in the below section) and check the working condition of the application for their specific android device. Devices who have special limitations for the sensors were neglected from the study. After installation users are asked to complete a survey that is used to monitor the depression of individuals. This survey consists of questionnaires that are approved by the world health organization and also used by psychiatric doctors in Sri Lanka. So the standards of the survey are in a high place. This also an online assessment in which the user records are recorded online. The user should not reveal any of their identity for the best practices of privacy.

#### A. Activity recognition Application

This is an Android app that we developed to get and process mobile phone sensor data. The app basically gets the data from the accelerometer and GPS location sensor. It tracks the users' behaviors and all the accessing sensors are got used after the user gives permission to track. This application runs in the background and checks for the location in equal time intervals. It will send the location data to a realtime firebase database. In addition, we accessed the accelerometer and got the users' physical activity. This is another perspective we can measure the behavior of the individuals. We can assure the accuracy of the activity since the accelerometer data are processed and returned the activity by the Google activity recognition API. With this sensor data, the application gets the sleep pattern of every user in every morning it is a very simple tickable multiple choice question that reminds the users via the push notification feature in every morning.

This application is completely designed and developed by us and it can be mentioned as contributions to the study. We have made it open source so that any research people or students get used to it in the future.

With the behavioral patterns of mental health patients and random people, we can analyze and provide detailed information about any individual who may have mental disorders or have symptoms based on the behavioral data got from mental health patients. The final idea is to analyze the data and to take immediate necessary steps to raise people's mentality that was affected during COVID 19. Also, to help the doctors to identify mental health patients through the behavioral data coming from this application.

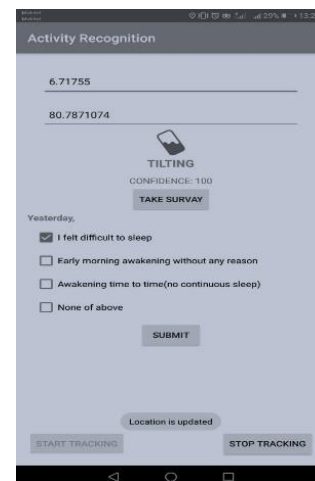


Figure 1. Application overview

### Progress And Expected Results

#### A. Progress

We have built a mobile application for the data collection scenario. we have done the testing of the application. And also the accelerometer is the other most critical sensor available on our mobile phones. It will send us the activity of the user. The activities are mainly driving, still, walking, Tiltin, running, and unknown. It is also included in the application. The sleep pattern and the depression survey also mentioned inside the same application. To maintain these

standards the mentorship of the experts is needed. we can get questions from related websites. But we cannot assure them about their accuracy by 100%. So that I have got supports from doctors who are experts in mental health-related issues in the district hospital Bandarwela. They have given us the WHO-approved depression surveys and scales. These survey data can be used to ensure the mental health condition that will return from the behavioral data.

We have started collecting the data from all perspectives above mentioned. And the study is Ongoing.

### B. Expected results

Accurate, reliable, and analyzed data set of random Sri Lankan youngsters that can be used to overcome the mental health issues during the COVID 19 pandemic. We are looking forward to analyzing the data acquired by sensors and surveys and get the behavioral pattern of individuals. It will be compared with the behavioral patterns of the depressed people and through this study, we will be able to represent critical behavioral patterns that young people in Sri Lanka. Through this analysis, the behavioral patterns of depressed youngsters will be revealed.

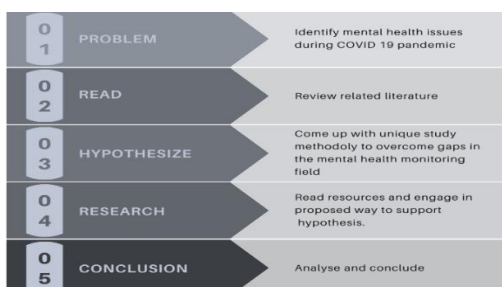


Figure 2. Stages of study

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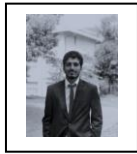
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### Author Biographies



I am K.A.A.B. Gunarathne an undergraduate of Department of Computing and Information system, Sabaragamuwa university of Sri Lanka. I am following Bachelor of Science (Special) Degree in Information Systems. I have experiences in developing mobile applications and I like to expand them and my other skills to do this study during the COVID 19 pandemic.