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SOCIAL DISTANCE ENCOURAGER AND MOTIVATION SYSTEM

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ABSTRACT
This paper details the development of a wearable device that would encourage and motivate people to maintain social distancing, thus also ensuring the safety and health of individuals. React Native, Redux and, Async storage has been used for the front-end development whereas NodeJS, ExpressJS and, MySQL have been used for the back-end. The distance is monitored with a smartphone's in-built geo-location sensor, warning the user to maintain a distance of six feet. To obtain higher accuracy, ultrasonic sensors are used in conjunction with the mobile application. The band is tethered with the mobile to alert the user once the six-feet norm is violated.

Keywords: Social Distancing, Ultrasonic Sensor, Geolocation, Wearable Device, Health

INTRODUCTION
The COVID-19 pandemic has caused the world and humanity to face a severe global health crisis. Since the SARS-CoV-2 emerged, the virus has spread quickly to other parts of the world. It was found to be highly transmissible which led to a large number of cases and deaths. Even after considerable research and work by scientists, governments, and healthcare managers, little is known about the methods of transmission, specific treatment options, and the care required. In such a case, non-pharmaceutical methods were implemented to curb the spread of the virus, improve health care facilities and avoid deaths. Several countries implemented and encouraged activities such as good hand wash hygiene, use of masks at all times, and social distancing norms. However, the impact of these measures depended on the discipline, care, socioeconomic and cultural activities of individuals [1].
Social Distancing means increasing and maintaining the physical distance between individuals in a social setting such as a school or workplace. This will help in declining the number of cases by mitigating virus transmission. It was also used to reduce the impact of influenza-like diseases in 2009. Social distancing, in addition to other parameters, can result in a more profound impact [2]. However, there is still considerable ambiguity and apprehension towards the term 'social distancing'. People still misunderstand its definition while also asking the question regarding its importance and impact. Hence, this project will help motivate and encourage individuals to maintain social distance.
The number of cases has crossed five million globally and continues to rise. The count of people that have recovered from the disease is also increasing. However, the SARS-CoV-2 affects the entire respiratory system, especially the lungs [3]. Hence, the post-recovery process becomes equally important. Social distancing is one of the tools that can help the patient remain fit, healthy, and safe.
We have developed a wearable device that has an in-built sensor to detect the distance between the user and other individuals (obstacle). It aims to educate and motivate people, especially students in schools and colleges about the importance of social distancing through extrinsic motivations such as discount coupons, free online courses, etc.

LITERATURE SURVEY
To curb the effects of COVID-19, certain measures need to be implemented by the policymakers and followed by the public. Several factors such as age, race, and gender need to be considered before these policies can be implemented. Televisions and radio can be used as a medium to spread awareness about the importance of

COVID-19. It also became important to consider who the present and future non-compliers were and how they can be persuaded to maintain social distancing [4]. This project and initiative use a combination of technology and external incentives to motivate people to follow the rules diligently.

The amount and impact of social distancing remain unclear concerning the seasonal changes. Some studies have suggested that it has a more profound impact during summers whereas it remains insufficient during autumn and winter [5]. Nevertheless, it continues to be vital and must be maintained under any circumstances. The benefits, as well as the costs of social distancing, have been examined in detail in [6]. Upon comparing the results, it has been concluded that in a controlled scenario, the peak of the infection curve can be reduced by nearly 50% thus, avoiding the health care system from being overwhelmed and decrease the mortality rate. An age-structured SIR model has been analysed to observe the COVID-19 progress in India in [7]. The efficacy and duration of non-attendance in the workplace, closure of schools, and the lockdown have been taken into consideration. The mathematical model is structured according to age and social distance as both are important parameters to reduce the effect of COVID-19. However, maintaining a distance from loved ones can harm one's mental health [8]. It could potentially lead to depression and anxiety. Hence, engaging individuals in a competition to maintain social distancing could help them cope with such effects while also ensuring the highest level of safety for themselves and their loved ones.

METHODOLOGY

Survey and Analysis

Before starting our project, we surveyed to realize the problems people face in understanding, maintaining, and following social distancing rules. The survey was conducted for students of various schools and colleges (below the age of 35) and the responses for some of the questions indicated a need for a social distance encourager system. Hence, we developed the project to solve this pressing issue and implement the social distancing rules. The survey gave us some valuable insights. The first question indicated what percentage of people followed the social distancing norms diligently. Social Distancing is the most effective tool to curb the spread of COVID-19. However, only 56% of the young adults and teenagers followed it at all times as shown in Figure 1.

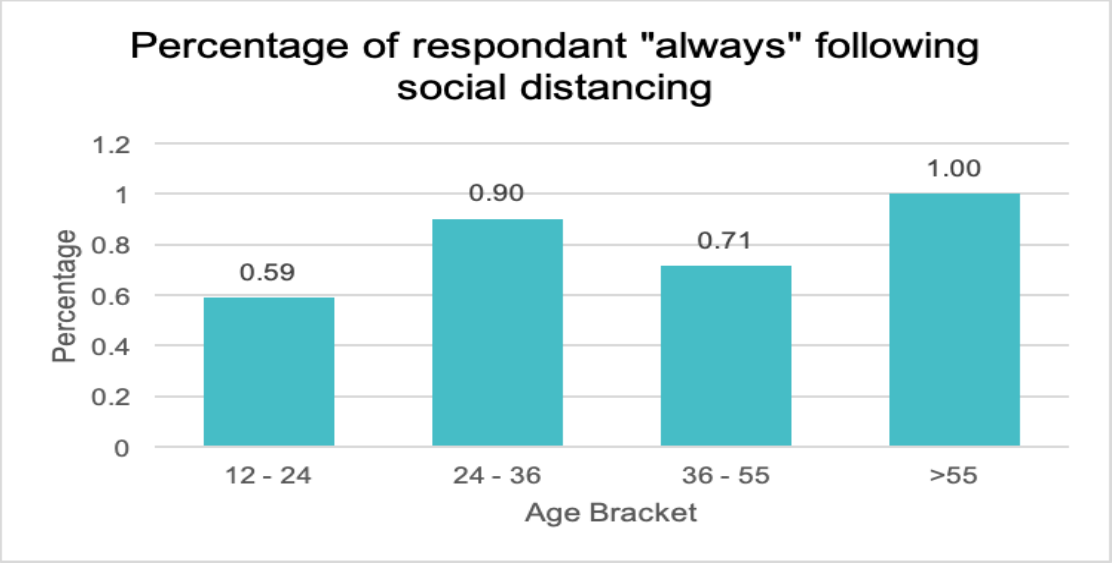

Figure 1: Bar chart of respondents "always" following social distancing

A detailed analysis of the challenges and problems that people encountered was performed. The two major reasons were the lack of motivation and knowledge. People indicated their need to socialise and exercise outdoors. They also believed that using hand sanitizers and wearing a mask at all times were sufficient measures. The results as shown in Figure 2. also depict how people are unaware of the exact distance that needs to be maintained. These results indicated how important it is to educate the general public about the details and importance of social distancing.

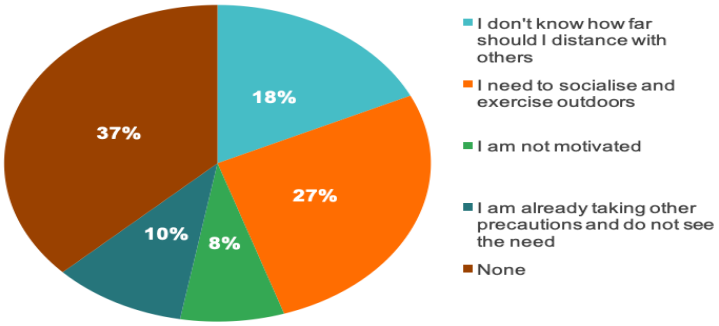

Figure 2: Pie chart of challenges faced with social distancing norms

Block Diagram and General Overview

The ultrasonic sensor is interfaced to the Arduino Uno. This sensor detects an obstacle using ultrasonic waves which are reflected towards it. The data is then stored in our application database which makes it easily accessible and efficient. The data is then used for a point-based system that encourages individuals to maintain social distancing. It also enables Remote Healthcare access, which is extremely important.

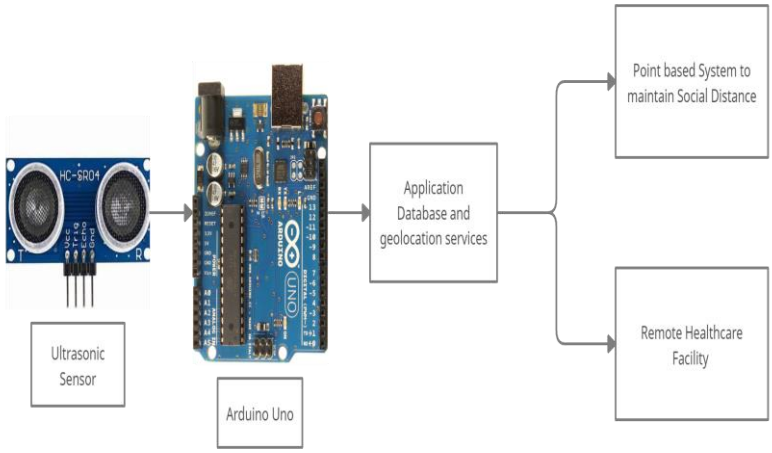

Figure 3: Block Diagram

Hardware and Wrist Band

A wearable health band has been developed which has an ultrasonic sensor embedded in it. It is powered by an Arduino Uno board. The ultrasonic sensor helps determine the distance between the user and other people (obstacles). It emits ultrasonic waves that get reflected by the target obstacles. The time between the emission and reception can be used to determine the distance. The data from the Arduino is collected using the teraterm software.

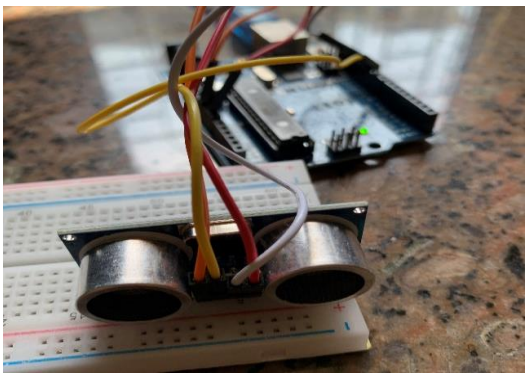

Figure 4: Hardware wristband prototype

App Development

An application is used to interface the data from the wrist band to the geo-location of any smartphone. We have used NodeJS, ExpressJS, MySQL for the back-end development of the app. Upon downloading the app, the user permits to use the geo-location sensor and location using Bluetooth. This allows for an enhanced and precise location to ultimately determine the distance between two users. In the app's database, the current location of the user is defined as "present_location", which stores the user's latitude (Lat) and longitude (Lon) in the cloud. The user's location is updated and stored in the backend every 5 seconds.

When there's a change in the user's location, we write an algorithm to measure the distance between two individuals who are using the app. If the distance between two persons goes below 244 cm, a warning message will be sent to the user's smartphone and the wrist band will also vibrate. This reminds the user to change their path before reaching the 183 cm (6 feet) distance.

If the distance between two persons goes below 183 cm, a specific number of points will be deducted from the user. The new score and ranking will then be reflected on the user's score table.

Distance Calculation Algorithm and Method

The algorithm below is used to find the distance between persons and update the database in the cloud. It also updates the APP's front-end to display the new user information and send the notification to update the user.

SELECT*FROM(SELECT*,(((acos(sin((@latitude*pi()/180))*sin((Latitude*pi()/180))+cos((@latitude*pi()/180))*cos((Latitude*pi()/180))*cos(((@longitudeLongitude)*pi()/180))))*180/pi())*60*1.1515*1.609344) as distance FROM Distances) t WHERE distance <= @distance.

Mobile App User Interface Design

Software such as React Native, Redux and, Async storage has been used to develop the front-end of the project. It consists of user registration and login page where the user enters his details such as name, age, weight, height, previous medical history as observed in Figure 5. The user is also expected to allow permissions to the location services.

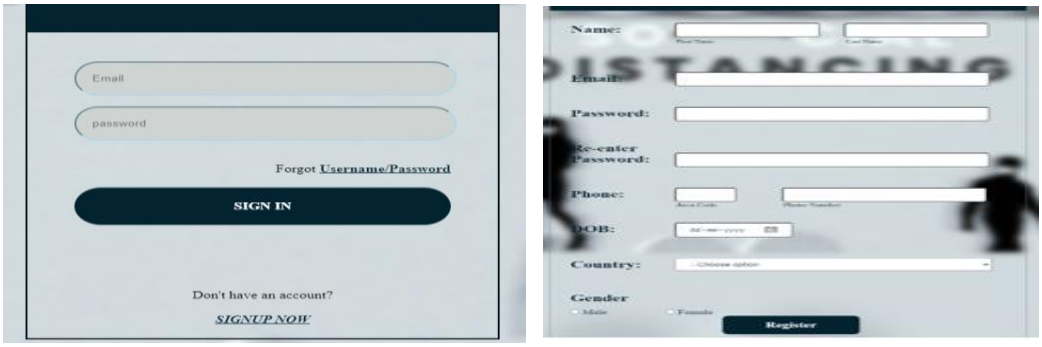

Figure 5: User registration and login page

After the registration is complete, one can gain access to their dashboard, notifications, friends, leader board, profile, and contacts. This will also allow the user to observe their medical history and points that they have gained/lost while using the app. This data is also made accessible to the doctor who can have the medical history of the patient stored and organised in one place.

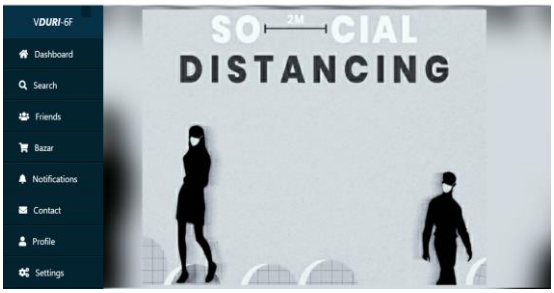

Figure 6: User dashboard

RESULTS AND DISCUSSION

Point based Extrinsic Motivation System

A simple and effective method to motivate individuals to maintain and follow social distancing is through extrinsic motivators. We developed a point-based game to implement the same. According to the rules, a fixed number of points is assigned to each individual at the start of every week, for example, 250. If a person violates the social distancing norm i.e., breaches the imaginary circumference of 6 feet around the other user, a fixed number of points are deducted and the same is updated in their record. In addition, alerts are sent to both the users to continue following the rules diligently.

The data from the Arduino is directly collected as a .CSV file using the teraterm software as observed in figure 7.

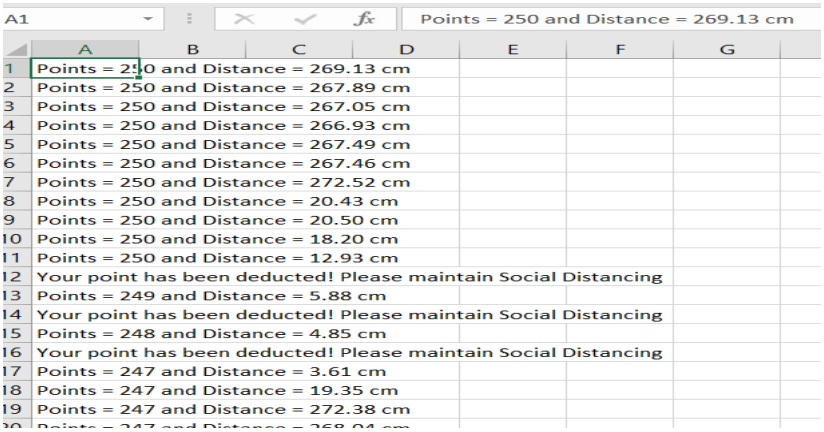

Figure 7: Points update and alert system

An imaginary circle boundary is created around each user with radius of 244 cm as the “red_zone” and another circle with a radius of 183 cm as the “deduction_zone”. If someone enters the user’s “red_zone”, both users will be alerted and the app checks the distance between them infinitely until the distance between them is greater than 244 cm. If someone enters the user’s “deduction_zone”, points will be deducted accordingly.

On the dashboard, one can check their points and have access to the leader board of their area. They can compete with friends and in this way, maintain social distancing and their health in a fun, yet effective way. These points, once collected can be redeemed for various discounts and prizes at their local café, library, or fitness centre. These extrinsic motivators will encourage every user to strictly adhere to the rules.

CONCLUSION

In addition to face masks, regular hand washing, and other effective methods, social distancing is an effective long-term solution to keep every individual safe from COVID-19. However, it continues to remain a novel concept and people are not yet fully aware of its specifications and benefits. Hence, using a point-based system and extrinsic motivators will help encourage and educate people about the advantages of maintaining social distance.

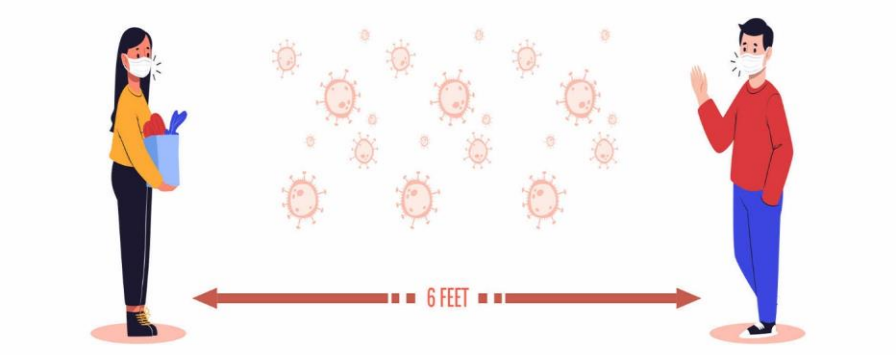

Figure 8: Social Distancing

Remote health care has advanced and its importance has increased tremendously. Fitness bands have become more common and can be used to measure parameters such as pulse, temperature and, oxygen level. This data can then be visualised by the doctor and accurate deductions regarding the health of the individual can be made. This ensures safety to both the doctor and the patient.

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