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MySD: A Smart Social Distancing Monitoring System

Mohd Ezanee Rusli
College of Computing and Informatics
Universiti Tenaga Nasional
Selangor, Malaysia
ezanee@uniten.edu.my

Salman Yussof
Institute of Informatics and Computing in Energy
Universiti Tenaga Nasional
Selangor, Malaysia
salman@uniten.edu.my

Mohammad Ali
College of Computing and Informatics
Universiti Tenaga Nasional
Selangor, Malaysia
Mohammadali.vip@gmail.com

Ahmed Abdullah Abobakr Hassan
College of Computing and Informatics
Universiti Tenaga Nasional
Selangor, Malaysia
ahmedye33@hotmail.com

Abstract— **Due to COVID-19 pandemic, society need to embrace and adopt new norm that includes practising social distance to break the transmission. The smart social distance application or tracker can help people to be constantly monitored and reminded to adhere to this practice. Direct impact that can be seen from this application will be lower or minimum number of COVID-19 cases due to high level of social distance compliance. This paper will present an innovative solution called MySD which stand for "My Safe Distance" that help users or public to observe social distance advice closely. It leverages smart phone hardware features that typically has Bluetooth transceiver as well GPS to determine safe distance and required level compliance.**

Keywords— Social Distance, Bluetooth, GPS, COVID-19

I. INTRODUCTION

In March 2020, WHO has declared pandemic due to COVID-19. To date, it has been reported more than 10 million confirmed cases worldwide with more than 500,000 death reported [1]. In the presence of contagious diseases such as H1N1 and COVID-19, social distancing is an effective non-pharmaceutical approach which plays an important role in managing pandemic from getting worse [2,3,4]. If implemented properly, social distancing can effectively reduce the transmission and severity of a disease, hence reducing the pressure on healthcare systems and allowing more time for government countermeasures [2]. In addition, the analysis suggests that social distancing initiatives and policies in response to the COVID-19 epidemic have substantial economic benefits.

Many technologies have been deemed to be able to help people or authority to follow and comply to the social distance rules and regulation [5]. For example, wireless positioning systems can effectively remind people to keep a safe distance by measuring the distances between people and notifying them if they are too close to each other. Furthermore, other technologies such as Artificial Intelligence (AI) technologies can also be used to facilitate or even enforce social distancing. By leveraging latest wireless technology in a form of mobile devices such as smartphones, tablet and notebook we can develop a smart application that is capable to notify or alarm people automatically whenever the social distance minimum requirement is not adhered.

In a public environment such as in the university that have many facilities where people convene in a classroom, lecture hall, offices and food court, the requirement to comply to the social distance will be higher and more important. Through smart application, a virtual fencing or wall that surround a person with minimum radius can be established. This can ease the pressure to the management or building owners in terms of their responsibility to create awareness to the students, staff and visitor of the importance maintaining the social distance in campus. In addition, to avoid from being constantly notified the breach of social distance requirement, the app will have a feature where user can set the place where social distance tracker can be automatically disable when the person is at home for example. The application can also be tied up to colour code zone information in real time that can set the level of urgency to comply with the social distance requirement. For example, if the place is considered red, full compliance is required whereas if green zone the requirement can be relaxed automatically. The technology that we have nowadays allows us to monitor the SD.

The rest of the paper is organized as follows: Section II presents related works of this area. Section III introduces the system architecture of the MySD and followed with system implementation in Section IV. The results and discussion of system testing of MySD are discussed in Section V. Finally, conclusion and future work are presented in section IV.

II. RELATED WORKS

Due to the importance of adopting social distance among people to contain the COVID-19 from continuously spreading, some initiatives have been introduced to implement and enforce it. Besides enforcement from authority to ensure people are complying to social distance rules, adopting latest technology such as internet of things (IOT) to increase the level of social distance compliance has also been considered. An Internet of Medical Things (IoMT) enabled wearable called EasyBand was introduced by Tripathy et. al. [6] to limit the growth of new positive cases by auto contact tracing and by encouraging essential social distancing

Advancement of hardware and software especially smart phones with built-in GPS, Bluetooth, LTE and WiFi transceiver, faster CPU and real-time OS such as Android and IOS have given the opportunity for latest mobile application to be developed. For an application such as social distance monitoring system, important modules to enable its main features are required. Module such as distance tracker, location tracker and real time notification are necessary.

To estimate the distance between users, a model that is based on wireless signal strength has been studied. Lam and She [7] has proposed a distance estimation on Moving Object using received signal strength (RSS) of BLE beacon. In

addition, BLE beacon also has been used by Takamutsu et. Al. in their social graph analysis study [8].

III. System Architecture

The system architecture of MySD can be seen in Fig. 1. MySD application integrates a number of objects or modules such as Bluetooth Distance tracker, GPS module, Google Maps API and COVID-19 Zone indicator. In general, MySD will monitor the distance between users using signal from Bluetooth Low Energy (BLE) transceiver.

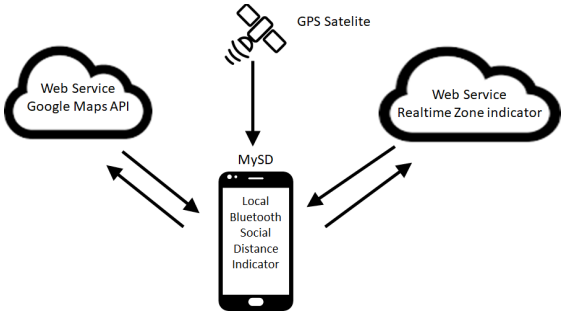

Fig. 1: MySD System Architecture

IV. System Implementation

The first version of the MySD is developed for Android platform. The following section will explain the implementation details of MySD.

A. Social Distance Tracker

MySD leverages the BLE signal to estimate the distance between people based on several advantages that BLE has as compared to Wi-Fi [5]. In general, the BLE signals have a higher sample rate than that of the Wi-Fi signals (i.e., 0.25 Hz 2 Hz), consumes less power than Wi-Fi technology, more signals availability since it can be obtained from most smart devices, whereas Wi-Fi signals can be obtained from only access points and finally BLE beacons are usually powered by battery, and thereby they are more flexible and easier to deploy than Wi-Fi.

Though distance estimation using BLE is possible using the RSSI, its value exhibits significant variation and is subject to factors such as:

- Multipath fading
- Phone placement on a person, e.g. in a hand, in a pocket, proximal or distal to a receiver
- Environmental factors such as surface textures, geometry, and physical layout
- Device-specific characteristics such as chipset, antenna layout, and OS configurations

All these factors introduce random noise in estimating distance. MySD determines the distance between two Bluetooth transceivers using the distance model estimation as shown in Eq. 1.

$$d = A \times \left(\frac{r}{t}\right)^{B} + C \qquad (1)$$

Where:

d = distance in meters
r = RSSI measured by the device
t = reference RSSI at 1 meter

A, B and C are constants which are used to minimize loss factors resulted from signal interference.

To address the issues of the noise in RSSI that affects the accuracy of determining the distance using model, MySD also uses dataset from OpenTrace project [9] that provides the average RSSI value of 2-meter separation for different phone models based on experimental results conducted as shown in Fig. 2.

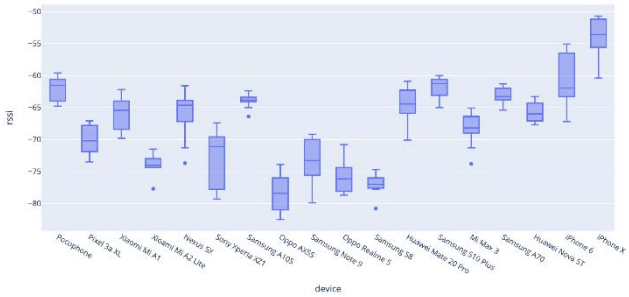

Fig. 2: The Average RSSI of Different Models with 2 meter Apart [9]

Since not all phone models are in the dataset, we have set the threshold value of –55 dbm as a baseline to indicate that social distance is not adhered completely which infers the distance is less than 1 or 2 meter. Therefore, the condition set in MySD to determine the distance is SAFE or UNSAFE is:

(distance > ***0.5*** || avgRssi < ***-55***)

Fig. 3 highlights the overall flowchart of the Social Distance tracker which will trigger an alert or notification whenever a user does not comply to the social distance requirement.

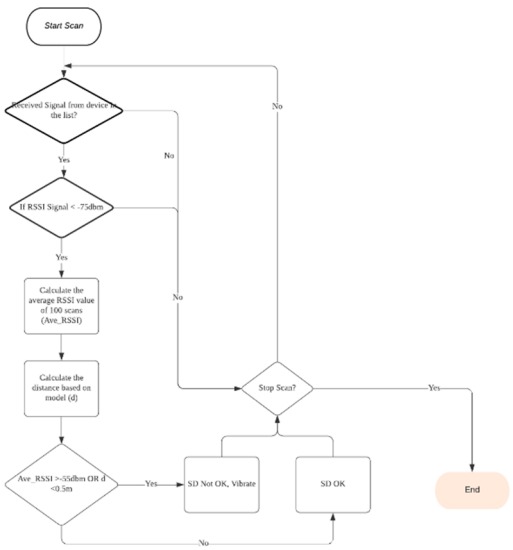

Fig. 3: Social Distance Tracker's Flowchart.

B. *Geo Location and Zoning Notification*

MySD is also equipped with the capability to determine the location of the user. It uses google map API that can inform the city or district the users are currently in based on the GPS information that the phone provides. By using this information, the app will be able to highlight the zone status based on the level set by the authority. In the case of Malaysia, the government has adopted 3-tier zone level as shown in Table 1.

Table 1: Categorization of Zone Based on Number of COVID19 Cases

Zone Level	No of Active Cases
Green	0
Yellow	1-40
Red	>40

The 3-tier zone level will be applied to determine current zone level of a particular district of a state that also consist of multiple cities within it. Table 2 illustrates the list of districts and cities of Selangor which is one of the states in Malaysia.

Table 2: List of Cities within Selangor State Districts

District	Major cities/towns/localities
Gombak	Gombak town, Rawang, Selayang, Setapak, Kepong, Ulu Klang
Hulu Langat	Ampang, Cheras, Semenyih, Kajang, Bangi
Hulu Selangor	Kuala Kubu Bharu, Serendah, Bukit Beruntung, Batang Kali, Ulu Yam
Klang	Klang city, Port Klang, Pandamaran, Meru, Kapar
Kuala Langat	Banting, Jugra, Teluk Datok, Morib, Teluk Panglima Garang, Pulau Carey
Kuala Selangor	Kuala Selangor town, Ijok, Jeram, Tanjung Karang, Bestari Jaya
Petaling	Shah Alam, Petaling Jaya, Subang Jaya, Damansara, Puchong
Sabak Bernam	Sabak, Sekinchan, Sungai Besar
Sepang	Salak Tinggi, Dengkil, Cyberjaya

Based on the latest information that we retrieve from the authority, MySD will notify the user the zone level of their current location. This will let the user to take extra pre caution to comply to social distance requirement as well adopting best practise such as wearing mask and sanitise hand frequently.

V. Results and Discussion

In this section, the observation and the performance of MySD will be presented. By incorporating geo location and zone level status, the user will be notified and reminded about the zone where they are. By enabling GPS tracking as seen in Fig. 4, MySD will check the COVID-19 zone level of the current location.

Fig. 4: MySD with GPS Tracking Enabled

In addition, the notification will be triggered by MySD by displaying the message in the notification list on the phone as shown in Fig. 5 as well as making the phone to vibrate temporarily.

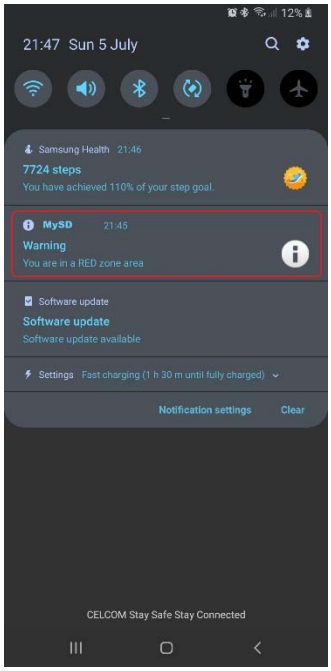

Fig. 5: MySD - Alert and Notification

In Fig. 6, we can also see that MySD will be able to determine different zone level based on the location.

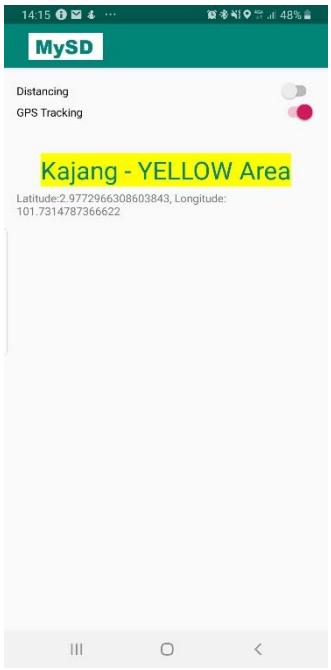

Fig. 6: MySD - Zone Level Notification (Yellow)

When the distance tracker is activated, MySD will start monitoring the distance between users who either carry smart phone or any other devices that can transmit BLE signal. In Fig. 7, we can see that if the distance is more than 0.5 meter or the average RSSI value is greater than -55dbm, MySD will consider the user is categorised as SAFE. Hence, no alert will be activated.

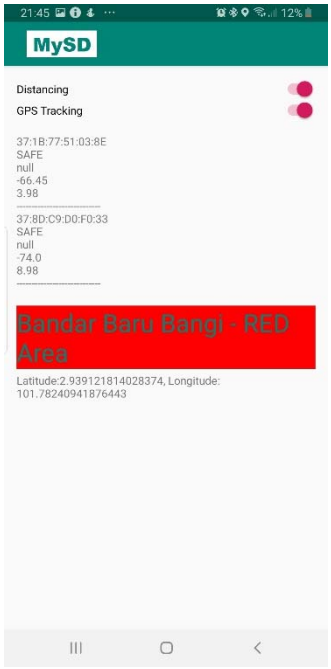

Fig. 7: MySD - Zone Level Notification and Social Distance Monitoring (SAFE)

In a situation that the user is too close and not adhering to social distance requirement, MySD will detect that the user is in category UNSAFE as shown in Fig. 8. When this is detected, MySD will trigger the phone to be continuously vibrating until the social distance requirement is met and the user is back to SAFE category again.

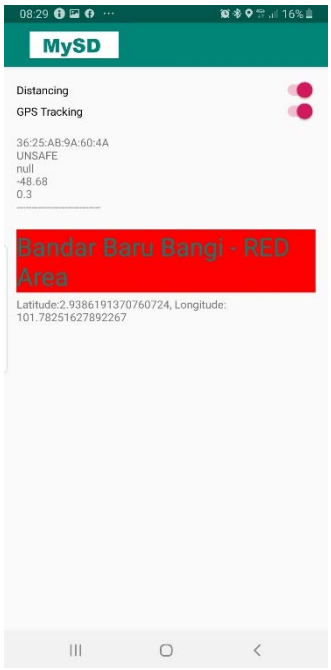

Fig. 8: MySD - Zone Level Notification and Social Distance Monitoring (UNSAFE)

Based on the testing that have been tested, MySD is able to inform and monitor users who installed the application on their Android phones. In addition, all main features of MySD has been tested and are working correctly.

VI. Conclusion and Future Works

Taking into account the importance of social distance in managing and reducing the probability of COVID-19 disease from continuously spreading which can cause the healthcare system to collapse due to high number of patient, MySD can offer a smart solution to public to monitor and remind them to maintain the distance when in public areas. MySD allows the creation of invisible safe zone surrounding the users to minimise the chances of getting infected with COVID-19 in the public or crowded areas. By incorporating the current zone information, user will be more alert to comply to social distance in the high risk areas (i.e. Red and Yellow zones). The alert which are in the form of notification and vibration will help further the user to force themselves to maintain a safe distance.

In the future, additional backend process will be included that allow advanced statistical analysis to be done which can be used by the authority, facilities or building owner to monitor the level of compliance among the people or visitors.

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