Social Distance Detection Using Wireless Signal in Social Networks

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Abstract. Coronavirus disease 2019 (abbreviation: COVID-19) has been a topic of concern in this two years. The number of confirmed cases worldwide has continued to increase. It is a highly contagious and serious virus. In order to prevent the spread of the virus and reduce the infection rate and mortality rate, maintaining social distancing is a very important task. As the mobile phone is indispensable to modern necessities, we considered to use the mobile device to help to detect the social distance. In this paper, we provided an idea about how to use the mobile device wireless signal to detect the social distance.

Keywords: Mobile · Bluetooth · COVID-19 · Social distancing · Wireless signal

1 Introduction

In 2019, the first case of Coronavirus disease 2019 (abbreviation: COVID-19) [1] was detected in Hubei Province, China. The COVID-19 virus spread globally and quickly, and resulting in a persistent infectious epidemic. According to the statistics from the World Health Organization (WHO), as of July 20, 2021 [2]. The cumulative number of cases reported globally is now over 190 million and the number of deaths exceeds 4 million. The COVID-19 is a highly contagious and serious virus.

According to the research of public health scholars, the COVID-19 virus mainly transmitted by droplets and small airborne particles [3]. When people come into close contact with infected person, they will be infected via inhaled droplets and particles that infected people release as they breathe, talk, cough, sneeze, or sing. This is why the WHO suggested that the ways to prevent the spread of the virus are disinfect more, wear a mask, maintain social distancing, and reduce unnecessary contact.

WHO recommended that the social distance is 1.5 m indoors and one-meter outdoors [4]. Maintaining social distancing is a simple and effective way to fight COVID-19. However, it is often not valued by people. And it is not easy to determine the social distancing all the time. In order to effectively maintain social distancing and reduce the virus infection rate, we considered to use the wireless technique to help us to determine the social distance.

Mobile phones have become necessities of our life. Due to everyone will carry their mobile phone when they go outside. We consider to use the wireless technique, such

as Bluetooth, Wi-Fi, RFID (Radio Frequency IDentification), which embedded in the mobile device to determine the social distance.

The remainder of this paper is organized as follows. Section 2 reviews related work. Section 3 illustrates the main idea of detecting social distance using wireless signal. Section 4 is the conclusion and future work.

2   Related Work

The World Health Organization (WHO) has stated that there are two ways in which the spread of COVID-19 virus takes place that are respiratory droplets and physical contact. Thus, one of the research topics of prevent COVID-19 is to detect people wear face mask well or not. According to the World Health Organization (WHO), the right way to wear a mask is by adjusting the mask to cover the mouth, nose, and chin [5]. Sen and Sawant [6] presented a mask detection system that is able to detect any type of mask and masks of different shapes from the video streams for following the rules that are applied by the government. Jiang et al. [7] presented a real-time face mask detection method to detect people wear mask properly or not.

Another research topic is to maintain social distance. As prescribed by WHO, people should maintain at least 1.5 m indoors and one-meter outdoors from each other to control the spread of this disease [2, 8, 9]. Ansari and Singh [10] developed a framework that tracks humans for monitoring the social distancing being practiced. To accomplish this objective of social distance monitoring, an algorithm is developed using object detection method. Rahim et al. [11] proposed an efficient solution for real-time social distance monitoring in low light environments.

Some researchers considered the problem of detecting social distance using wireless technology. Tsai [12] proposes a method that can use wireless signal strength (RSSI) sequence to detect the proximity of movement between people. In [13], Leith and Farrel proposed a method to evaluate the potential of using Bluetooth received signal strength for proximity detection. Narvaez and Guerra [14] explored if a Bluetooth RSSI-based mobile application can be developed to detect if the social distance is met or not. In Taiwan, the Central Epidemic Command Center developed the Taiwan Social Distance app [15]. This app also used the wireless technology.

3   Detecting Social Distance

In the Taiwan Social Distance app, when an app user is confirmed to have COVID-19, the health authority will upload related data after obtaining consent from the confirmed case, and the app will automatically send alerts to app users who have come into contact with the confirmed case in the past 14 days so as to remind them to monitor their health status. This app is help the health authority to find out the coronavirus contact.

However, when people are shopping in a hypermarket, this app cannot alert the app users that they are not maintain the safety social distance immediately. Especially when someone focus on his shopping products, he cannot pay attention on the social distance issue.

In [14], Narvaez and Guerra analyzed the problems of solutions for social distancing using different technologies. In this paper, they used the Bluetooth RSSI signal to detect the social distance. And they claim that people hold their cell phones in front of them horizontally. However, people are not always hold their cell phones as if they were using it. Therefore, we try to solve the problem with the situation.

As we know, the physical obstacles also effect the transmission of Bluetooth RSSI signal. Our idea is adding some Bluetooth devices as base stations on the ceiling. This method can reduce some interferences from the physical obstacles, such as pillar, product display stands.

The customers who are in the hypermarket, the Bluetooth base stations will collect the Bluetooth signal from their cell phone. The system will determine the location for everyone according to the Bluetooth signal collection data. Then, we can evaluate the distance between each two persons met the safety social distance or not, shown as Fig. 1. If the distance is less than one meter, system will send alert to these persons who are not standing safety social distance.
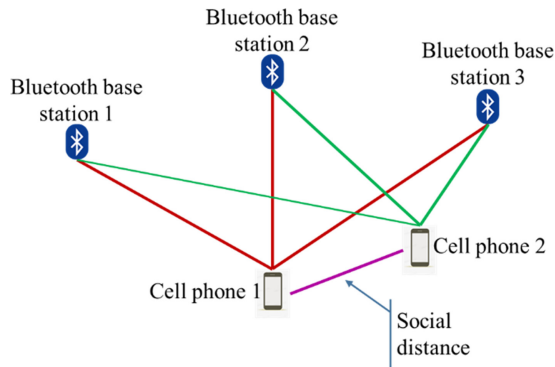

Fig. 1. The illustration of the method how to determine the social distance. The Bluetooth base stations are setting on the ceiling. System will determine the locations of cell phones and then calculate the distance between these two cell phone.

Moreover, Taiwan CDC regulated the number of people allowed in hypermarket. The number was calculated by how many people can stand in one square meter and people can maintain the social distance, shown as Fig. 2. The Bluetooth base stations also can determine the number of people in some area is a suitable number. If some area has too many persons, the system can send alert to these persons who are standing in this area.

During the epidemic, the Bluetooth signal collection data can help people to maintain the safety social distance. In the normal period, this data can help the manager of hypermarket to analyze which area is hot spot. And he can mobilize manpower to hot spot or plan the route.
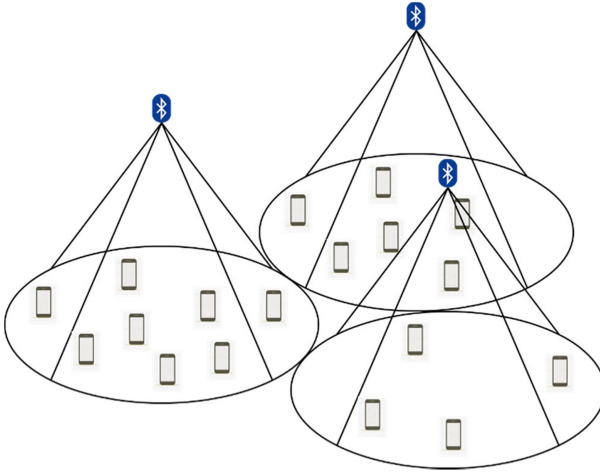
Fig. 2. The illustration of how to calculated by how many people can stand in one square meter.

4   Conclusion and Future Work

In this paper, we considered the problem of real-time social distancing detection. To address this issue, we explored if a Bluetooth RSSI-based mobile application can be developed to detect the social distance. Our method first found out the locations for each user. And then determine the distance is met or not. However, in order to avoid the physical obstacles, we set the Bluetooth base stations on the ceiling. This means that our method is not suitable for outdoors. We only can apply our method in indoor environments, such as hypermarkets.

Other challenges are security and privacy-preserving. Due to the Bluetooth technology, the system must first obtain user authorization. Hence, the security and privacy-preserving is a very important issue. If we cannot provide a safe system to protect the users' data, then fewer people want to use this application. Thus, our next research topic is to present a security mechanism.

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