

**A SURVEY ON MONITORING SOCIAL DISTANCE USING WEARABLE OR IOT
SENSOR DEVICES**¹Dhanya G Nair, ²Dr. K. P. Sanal Kumar, Dr. S. Anu H Nair³

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ABSTRACT

Coronavirus has infected millions of individuals around the world, and the number of sick persons keeps growing up. The virus is passed from person to person via direct, indirect, or close contact with infected individuals. This research survey introduces a smart social distance system that allows individuals to maintain social distances between others in both indoor and outdoor contexts, preventing COVID-19 exposure and limiting its spread locally and throughout the country.

Also difficult to identify the Covid-19 patient activities such as symptom prediction, identification and monitoring of isolated people. Due to its deeply entrenched sensing capability and easy communication, the Internet of Things (IoT) platform is recommended for achieving this goal. Smart healthcare, smart homes, and smart cities are all utilising IoT technology to create a more convenient and intelligent community. This survey gathered how the Internet of Things (IoT) could be integrated into an epidemic prevention and control system and

Keywords: *Social distance, wearable sensor, IoT sensor, Coronavirus and disease.*

1. INTRODUCTION

The Internet of Things (IoT) has played a vital role in a variety of healthcare applications during the current COVID-19 tragic situation. In general, IoT networks are made up of a variety of small, low-cost, and low-power devices that can be attached to anyone or incorporated in any object. People who are at a higher risk of COVID-19-related severe sickness need to keep their distance from others. To prevent the virus from spreading, keep a safe distance of at least 1 meter between yourself and other people in both indoor and outdoor places. It also restricts close contact with others in both outdoor and indoor environments, because people can transfer the virus before they realise they are infected [1, 2].

Recently, social distance has been shown to be a successful strategy for limiting COVID-19 spreading. As a result of the social distance, researchers and engineers have been prompted to build technological methods to combat the transmission of the COVID-19 virus [3-5]. To combat the spread of COVID-19, several mobile applications and Internet of Things devices have recently been developed. The current outbreak of COVID-19 has imposed drastic changes to different sectors of society and demonstrated the impact that diseases respiratory infections impose in a world intimately connected. Unprecedented containment and mitigation policies have been implemented in an effort to limit the spread of COVID-19, including travel restrictions [6], isolation, and quarantine [7] and closure of shared spaces [8].

The remainder of the survey is defined as follows: Section 2 is gathered a survey of research literature over the recent years in this area of social distance monitoring, as well as related efforts, with an emphasis on image classification techniques. Section 3 discusses about what are the sensor or devices required for monitoring and maintaining the social distance. Section 4 is focused to current research related to social monitoring system, and Section 5 is focused to conclusions and future scope of this research.

2. LITERATURE SURVEY

To prevent COVID-19 from spreading, many digital tools are being researched and created. The current social distance monitoring and warning methods are discussed in this section. Wearable social distance systems and standalone social monitoring systems are the two types of solutions now available, as shown in the Figure 1.

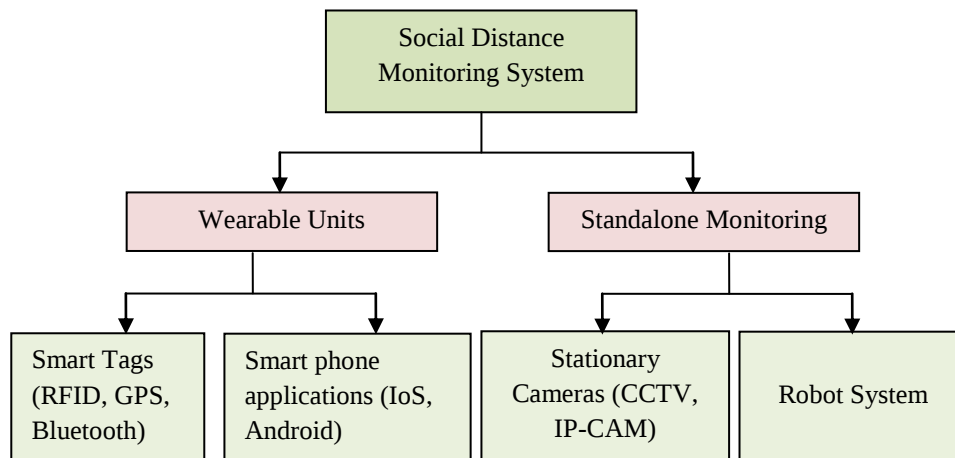


Fig. 1 Social distance monitoring types

The existing research attaching a tag to a person (user) in order to calculate the distance between them and the individuals in their immediate surroundings. On the other hand, the latter is based on image processing methods and uses stationary or mobile equipment to monitor social distances between people in a given region. To begin, wearable-based systems are evaluated using one of two approaches: smart tags (RFID, GPS, or Bluetooth) and smart phone applications (IOS or Android). These methods must be associated to a user in order to make distance measurements and send out warning notifications when that user enters a busy area.

Cunha et al. [9] developed a small and low-cost wearable electronic device that estimates the proximity distance between users based on the Received Signal Strength (RSS) of Wi-Fi signals emitted by other wearable devices of the same type, and then issues a notification when the distance between the users is less than a predefined threshold value. Bian et al. [10] developed a wearable, magnetic field-based proximity sensing system to track social distances between people. The authors built a small-size node that could detect people approaching from a distance of (1.5–2.0 meters), and the nodes were tested in a controlled lab and in a real-life large retail area. The proposed device has a detection range of more than 2 metres and is durable enough for use in everyday situations.

To prevent the transmission of COVID-19 infections, Kobayashi et al. designed a social distance monitoring system for students on a university campus [11]. To give access to the campus, the suggested system consists of ESP32-based microcontroller nodes distributed among students. With the help of mobile Bluetooth and a mobile camera, Neelavathy et al. presented smart social distance (SSD) mobile application-based monitoring that can predict the social distances between two people [12]. To anticipate the social distance, the SSD application has two main components. It does two things: first, it uses deep learning to identify pedestrians in video frames, and then it uses image processing algorithms to determine the distance between the two walkers. The developed programme can also estimate the received signal strength to calculate distance using BLE. A mobile phone application and a wearable device are part of an IoT-based social distance monitoring system developed by Jahmunah [13]. The mobile application comprises of a collection of contact tracking apps that may gather and evaluate data. Lubis [14] proposed a BLE-based proximity-based COVID-19 contact tracing

system that can track and regulate COVID-19 propagation in the local community. The designed device tracks people's vicinity and then syncs the information with their smartphones.

On the other hand, numerous wireless sensor network-based localization and tracking systems developed [15–17], which can be used to measure the distance between persons indoors and hence alerts users in congested regions. The Received signal strength indicator (RSSI) feature can be used to determine the distance between sensor nodes, allowing for the detection of densely populated areas.

Similarly, standalone social monitoring systems based on stationary or mobile devices scattered across the study area have been considered to assess social distances between people by evaluating photos captured by fixed or mobile digital cameras. Digital cameras and robot systems are examples of this. Ahmed et al. [18] suggested a deep learning platform for social distance monitoring based on the YOLOv3 object identification paradigm for recognising persons in video sequences and estimating the distance between people in open-space areas. Al-Khazraji [19] proposed a smart monitoring physical distances system that can track people's physical distances and provide them with appropriate feedback. The proposed technology counts how many people are in a given region and calculates their distances. The system then sends out warning signals to the person who is not keeping to the social distance.

As we described above, various researchers have been undertaken in order to create a better and more effective social distance monitoring system, but no one has concentrated on IoT sensor based social monitoring system. Aside from that, no real-world unit social distance monitoring solution has been discovered. This article primarily focuses on IoT sensor and wearable sensors in order to provide a real-world model social distance monitoring approach that streamlines social distance monitoring chores to aid in this fatal situation.

3. IOT SENSOR AND WEARABLE SENSOR FOR MONITORING SOCIAL DISTANCE

Wi-Fi, cellular, Bluetooth, Ultrawideband, GNSS, Zigbee, and RFID are among the wireless technologies that can be used to enable social distancing. We will go through the basics of these technologies in this part, and then discuss how they can help people practise social distancing by enabling, encouraging, and enforcing it [20–22]. From that, we go over the technologies' prospective uses, benefits, drawbacks, and feasibility. The workflow of social monitoring system using IoT sensor is shown in Figure 2.

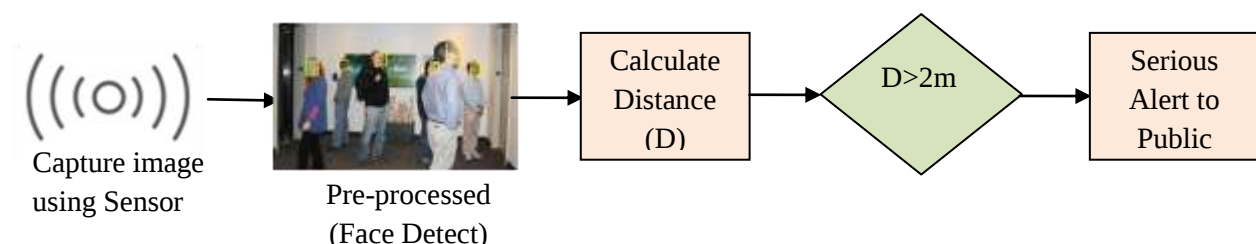


Fig. 2 Workflow of social monitoring system using IoT sensor

3.1. Bluetooth

Bluetooth technology is one of the remedial measures for social distancing in both indoor and outdoor situations, thanks to the increasing rise of Bluetooth-enabled devices. Bluetooth is a wireless technology that operates at frequencies ranging from 2.4 to 2.485 GHz and is used for short-range wireless communications. Bluetooth Low Energy (BLE) was recently released as an extended version of conventional Bluetooth with the

goal of reducing device energy consumption and improving communication performance [23]. In light of the foregoing, BLE localization technology has a number of advantages over Wi-Fi localization. For starters, BLE signals have a higher sample rate (i.e., 0.25 Hz 2 Hz) than Wi-Fi signals. Second, BLE technology consumes less power than Wi-Fi technology, allowing it to be widely deployed in mobile devices.

3.2. RFID

RFID is essential for real-time object tracking and localization. The three major components of an RFID localization system are RFID readers, RFID tags, and a data processing system. RFID tags are often divided into two categories: active tags and passive tags [25]. A passive RFID tag is powered by the electromagnetic field created by the RFID reader and does not require any external power. An active RFID tag, on the other hand, has its own power source, such as a battery, and broadcasts its own signals continually. In most localization systems, active RFID tags are used. As a result, RFID technology can be seen of as a possible tool for social distance. Based on new RFID-based localization technologies, one possible application of RFID technology is locating users in the indoor environment. To that purpose, each user is given an RFID tag, which can be found on the staff ID or member cards. The RFID reader can determine the user's location based on the backscattered signals from the RFID tag. If there are too many people in a given place, the system can alert authorities, who can then take necessary measures, such as forcing people to leave to exercise social distancing.

Similarly, RFID is used to monitoring social distance in public place like super market or building. An RFID reader will be installed at the main gate of a location, and users will be given RFID badges (can be either active and passive tags). When the RFID reader sends RF signals, the users' tags can broadcast their ID (active) or send their ID (passive). The RFID reader may receive a user's ID and increment the counter value when the user enters the location. As a result, the RFID reader can estimate the number of persons present. If there are too many people, the system can alert the local manager, who can then have people line before entering to exercise social distancing. This approach can be used in supermarkets or workplaces where consumers and employees typically have member/staff ID cards with RFID tags.

3.3. GLOBAL NAVIGATION SATELLITE SYSTEMS (GNSS)

In today's outdoor environment, the GNSS system is the most extensively utilised for positioning. GNSS satellites orbit the Earth and transmit navigation signals continually [26]. When a receiver receives navigation messages from satellites, it uses the transmitting time in the messages to determine the distances between its location and the satellites. Essentially, at least three different navigation messages from three different satellites are required to calculate a user's current location. In practise, however, at least four distinct communications from four satellites are necessary to calculate a user's location with good accuracy. Some GNSS systems currently have a precision of less than 1 metre. As a result, GNSS systems are a very promising answer for enabling the practise of social distancing.

GNSS technology is particularly beneficial for tracking people to exercise social distancing because of its remarkable qualities in locating people, especially in outdoor contexts. In particular, most smartphones now include GPS devices that can be used to track the position of mobile users when necessary. People suspected of being contaminated, such as those returning from an infected location, will be obliged to self-isolate in the event of a pandemic outbreak, such as COVID-19. As a result, authorities can ask these individuals to wear GPS-based locating devices to ensure that they do not leave their homes while under quarantine.

4. CURRENT RESEARCH IN SOCIAL DISTANCE MONITORING

IoT, big data, and AI, as well as the creative use of healthcare IoT in smart cities across China, Europe, and the United States, have all contributed in the fight against COVID-19. Continuous monitoring and rapid decision-making are now possible thanks to technology. The basic components of urban intelligence required in the event of a pandemic. Similarly, there is now a stronger commitment to the growth of numerous cutting-edge technologies to address various difficulties associated to the virus pandemic. We presented how several healthcare IoT technologies have evolved to combat and control the COVID-19 epidemic [27].

4.1. Drone Technology for IoT

Drones can be used to track the COVID-19 outbreak, including tracking those who have come into connection with COVID-19 patients. Drones are also useful for enforcing and tracking patients who break quarantine, as well as ensuring that face masks are used. Drones, for example, were deployed in Hubei, as well as Europe and the United States, to guarantee that residents carefully followed lock-down and social distancing restrictions. Residents who were not wearing a face mask or following emergency protocols were also given instructions and warnings by drones equipped with cameras. Drones can also be used to monitor in-home patients or areas that are heavily sick from away. Drones, for example, have been used to carry life-saving supplies to medical personnel and to gather and transport samples for testing at nearby institutions.

4.2. H-IoT based AI

Artificial intelligence can be used to assess the challenge of infection as well as to screen residents [28]. Furthermore, AI may be used to educate computers to recognise, explain, and predict patterns using models based on large data, resulting in actionable awareness. For example, AI apps have been used to track and report residents' travel records from affected locations to the appropriate authorities. This is particularly useful in forecasting the virus's outbreak, as well as decreasing or halting the virus's spreading. Similarly, because there is a lot of misinformation about the virus on social media, AI-based systems can be trained to eliminate incorrect information. Furthermore, AI can be used to conduct more efficient medication and vaccine clinical trials. Additionally, AI has been used to create robots capable of doing online medical examinations/ AI assisted diagnosis on residents, as well as cleansing and sanitising the surroundings.

In China, AI-assisted CCTV cameras with face recognition capabilities were mounted in apartment doorways to guarantee that occupants followed quarantine laws and did not leave their houses. In addition, AI was used to undertake decentralised testing across Chinese cities to identify COVID-19 afflicted residents. Furthermore, companies such as Megvil Technology Limited, Baidu, and Sense Time have all developed AI-assisted contactless body temperature screening systems that may be put in public spaces to detect COVID-19 infection. AI-assisted systems with contactless remote temperature screening, for example, can screen roughly 15 persons per second from a distance of 3 metres. In general, AI systems have aided in the production of equipment needed to combat the COVID-19 epidemic. It has also given respite for overburdened health-care systems.

4.3. Cloud Assisted IoT

Computer system resources, such as databases, networking, servers, and intelligence, can now be given over the internet thanks to advances in wireless and digital technology [29]. Cloud computing enables speedier and more flexible resources, as well as cost-effective and efficient infrastructure management. While most individuals

were isolated from their usual lives during the COVID-19 epidemic, they were able to continue their digital lives thanks to apps like Zoom video, Google Meet, Google Cloud, Slack, Amazon Web Services, Netflix, and Microsoft Azure. Similarly, with healthcare-specific apps like Salesforce Care solution, healthcare staff were able to manage a significant amount of requests coming from the COVID-19 outbreak [30].

Cloud services have assisted H-IoT devices in the field that have limited resources like electricity and computational power. Moving energy and other resource-intensive jobs is now possible due to cloud computing technologies. Sensor nodes are primarily tasked with gathering COVID-19 data and delivering it to the cloud at the end of the day. As a result, these gadgets consume the majority of their energy during antenna broadcast and receive sessions. This, in combination with appropriate energy-saving algorithms, can help IoT devices last longer.

CONCLUSION

In order to avoid the transmission of dangerous diseases like COVID-19, social distance has generally been recognised an essential measure. We have offered a complete overview of how technology can facilitate, encourage, and enforce social distancing in this article. To begin, we gave an overview of social distancing, explained its role in the current COVID-19 pandemic, and presented a number of practical social distancing scenarios in which the technologies can be used. Then we discussed a variety of wireless technologies that can be used to encourage and facilitate social distance monitoring system. We gave an overview of each technology, looked at the state-of-the-art, and explored how it can be used in various social distance scenarios, as well as open issues in social distancing implementation and prospective solutions.

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