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Contact Tracing Device for Workplace Using FAVORIOT Platform

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Abstract: The pandemic of COVID-19 has brought serious social and health problems to people in this year. To decrease its negative influence, many contact tracing systems and applications have been identified and implemented by governments of the world rapidly. The BLE tag combines ESP32 TTGO as a microcontroller and uses Bluetooth Low Energy as the sensor to detect close contact. The BLE tag was developed to obtain data from Bluetooth and then transfer the data by internet connection to the FAVORIOT platform. Before the BLE tag is used, it needs to be registered generic name, user ID, and username for the sensor. In the FAVORIOT platform, the received data will be processed and displayed. A dashboard was designed in the FAVORIOT to easily monitor the time interval of close contact with a person and the number of active contacts. This project's result is to easily monitor users to trace close contact at the workplace. As the BLE tag prototype, it works as intended when it is activated, scans BLE around it, and looks for the generic name, which also sensors themselves. The lower the RSSI values, the stronger the sensor's signal strength will scan another BLE tag. The RSSI value that is suitable for use to detect close contact is -55 which is 1.2 meter. The proposed tool may also be used for contact tracing or large-scale monitoring in future health crises. Also, there will be further discussion on the improvement of contact tracing projects, such as adding a haptic buzzer so that the user can be more alert when close contact is identified. In addition, the guard at the workplace can access and print out the employee's database and display it at the main entrance office. This will ensure that employees will be easy to trace without access to FAVORIOT and can be implemented with various applications in the future product.

Keywords: FAVORIOT, ESP32 TTGO, BLE Tag

1. Introduction

Recently, physical distancing was proven to be an effective practice to minimise the spreading of COVID-19, especially in the workplace. Another preventive strategy the government has enforced

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needs to be practiced in the community, such as wearing a mask, scanning the QR code My Sejahtera, washing hands and using sanitizer frequently. Malaysia practices physical distancing of at least 1 meter between each other outdoors and indoors to stay safe from the virus [1]. The Internet of Things (IoT) has played a significant role in various healthcare applications. IoT networks generally consist of several small-size, low-cost, and low-power consumption devices that can be attached to any person or embedded in any object [1]. Regulations restricting social distance, staff gatherings, and sanitary standards will still need to be implemented when companies reopen. Ensure that the workplaces are properly ventilated. This necessitates a purposeful reconsideration of physical workplaces [2]. Nonetheless, the device can make employees feel more protected while working in the offices. Additional weaknesses in manual contact tracing for COVID-19 were that people often had trouble remembering the places and people they had encountered in the two weeks preceding their positive test. This data could be used to supplement the recollection of individuals, reminding them of places they had been so that they could reflect on those with whom they might have had contact [3].

Charuka Moremada et al. [4] discussed that there are no reliable and practical ways to track social interactions or estimate the risk of contracting the disease. This application focuses on user tracking and prediction of the infection probability. The app designed an energy-efficient BLE (Bluetooth Low Energy)-based social contact tracking system and algorithm to predict the chances of obtaining COVID-19. Zouari Karima et al. [5] discussed identifying all the people who have encountered the virus carrier. Wireless healthcare networks, the internet of things, and cloud computing are all topics covered in this application. A federated or hybrid strategy is one option that takes advantage of data medical technology and IoT's strengths while minimising the limitations. Yutaro Kobayashi et al. [6] discussed the system used by the students who were given mobile nodes as entry passes to the campus. Distances between the students are measured by periodically sending and receiving BLE advertising packets between the nodes. Using M5Stick devices and conducting fundamental evaluation between node BLE communications based on a variation of RSSI values. The previous study used M5Stick devices to roughly estimate distances by using average or median RSSI values, that there are variations in RSSI depending on the orientations of persons wearing the monitor, and that sender-node battery power does not affect RSSI.

This project is therefore to design a wearable device for contact tracing in the workplace. As in this project, to develop suitable hardware and software for the proposed contact tracking device. Once the close contact is detected the user can trace close contact and evaluate the user in the FAVORIOT platform. The scope of this project is divided into several phases the contact tracing social distance device will monitor each of the employees at the workplace. The FAVORIOT platform can trace the contact around the user if the distance is less than 6 feet and the TTGO ESP32 will send the data to the FAVORIOT platform by the user.

2. Materials and Methods

This focuses on the research method advancing in building the project and achieving the research objective. Several ways need to approach data that will be gained from this project. Further discussion will be discussed in this chapter related to workflow projects from the hardware part to the Internet of Things (IoT) platform.

2.1 Flowchart development

Initially, a FAVORIOT platform is used as a database and must register the same Wi-Fi network to record the close contact sent by the BLE tag with a generic name programmed before use. The signal strength threshold value needs to be set up to determine close contact in terms of user-id, the number of active contacts, the contact's status, whether it is moving away or not, contact ID, and contact name. The sensor will send the data to the IoT hub each time new close contact is detected, and every time is moved away. As the IoT hub puts a time stamp on the data, we can know the length of time contact is exposed each time with the other user.

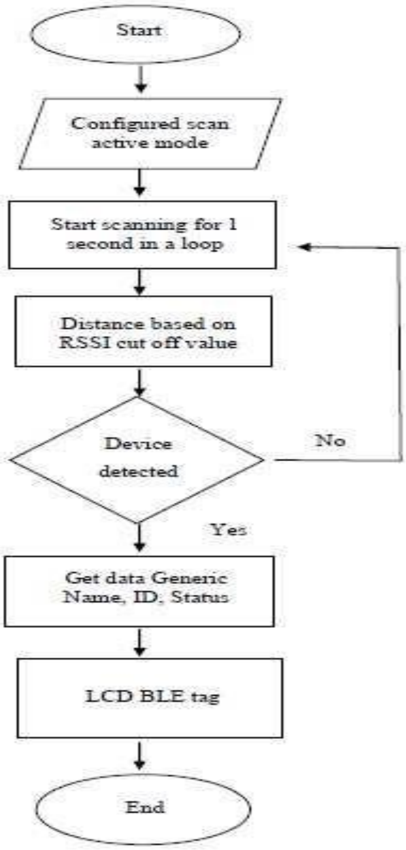

Figure 1: Flowchart of the contact tracing system

2.2 Circuit diagram

With the minimal number of components, the end of this product is compact and easy to bring anywhere. Actual BLE tag module pin connections are shown in Figure 2, it was arranged in a sandwich manner so that the module is compact and also to make sure the product is suitable for the wearable.

Figure 2: Hardware circuit design

2.2 Software development

FAVORIOT is an internet of things platform that allows monitoring, controlling, and automatic any project or system, which helps for better services. In FAVORIOT, several key features will help complete this project's objectives.

Devices menus have Overview, Data Stream, dashboard, and Activity logs. From the previous discussion of Arduino IDE, the DataStream can create close contact information in FAVORIOT. When the devices have powered up and connected to the internet, it will automatically record if there have any close contact. Figure 3 shows the overview system of FAVORIOT.

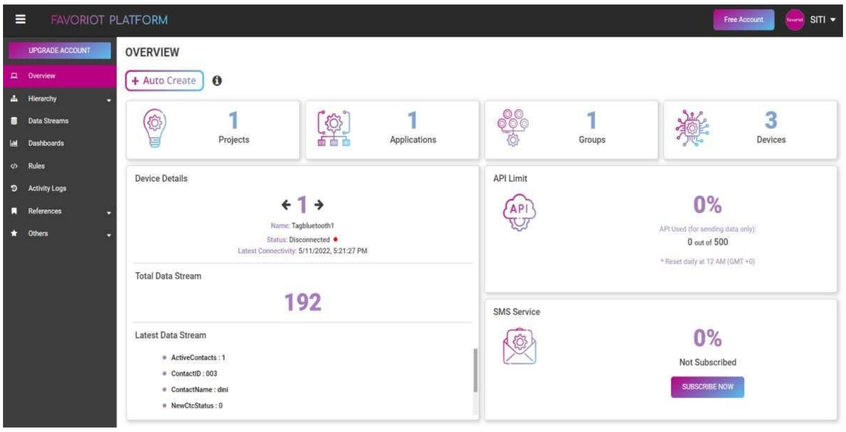

Figure 3: FAVORIOT system overview

3. Results and Discussion

The hardware and the software must be able to be used and run simultaneously. The BLE tag must work properly to scan all the users around them and send the data through the FAVORIOT platform if there is close contact at the workplace. The BLE tag must be detected between the user and other employees through the interface by determining the RSSI value that has been set in ARDUINO IDE. Only one representative monitors this, so it can only work as a demonstration. Once all the hardware coding is completed without any error, the next stage is to acquire access to the FAVORIOT server. The goal is to monitor the behavior between the user and others.

3.1 Results

If the cut of RSSI value is less than -55, which is 1.2 meters, the serial monitor will automatically send the data of close contact to the platform every 1 second. The data will be recorded in the data stream by the generic name of the user. All close contact detection from the BLE tag is recorded in the FAVORIOT platform, as shown in Figure 4. Therefore, the platform had been set to produce a graph for both motion and estimation time. As stated in the previous explanation, the data on “Data Stream” only receive 1(HIGH) output if the user A and user B motion is less than 1meter. The graph produced for the user’s BLE tag estimation time can be seen in Figure 5. The graph also followed the data taken in real-time.

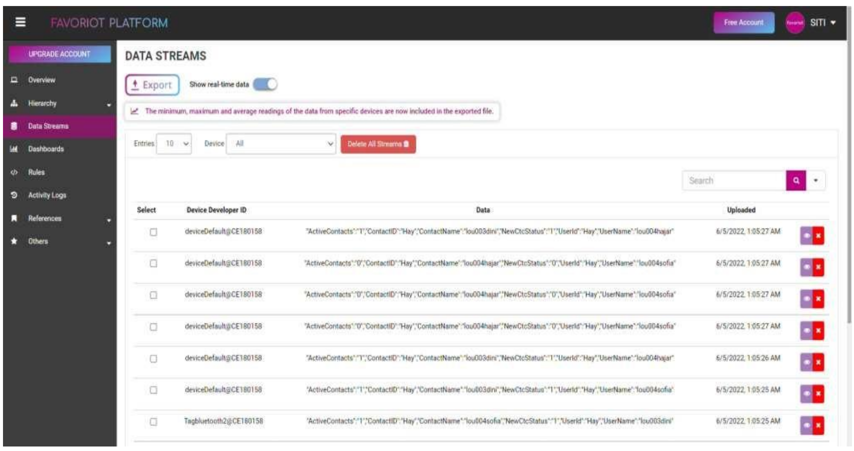

Figure 4: Data collected from the BLE tag of the close contact detection system in the data stream of FAVORIOT

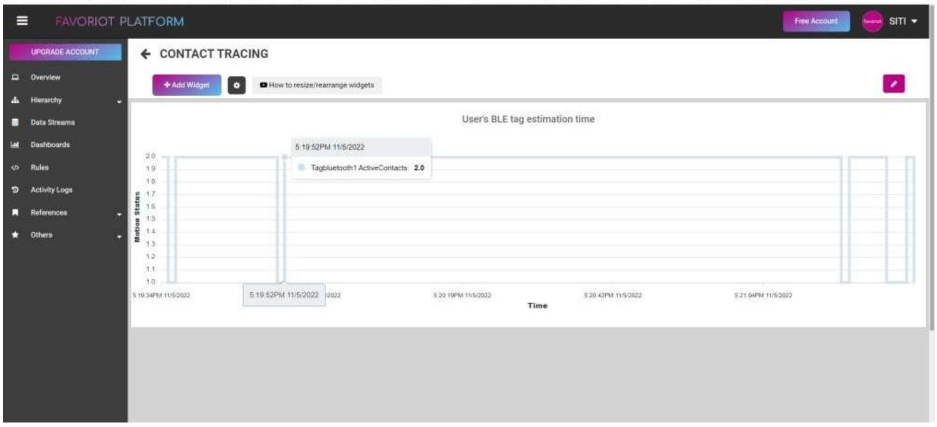

Figure 5: FAVORIOT data analytics platform

3.2 Discussions

The project utilized the FAVORIOT database platform. It is configured to capture all close contacts based on the RSSI value cut-off. This paper focuses on tracing close contact with BLE tags in the workplace. By using the FAVORIOT platform, this strategy will aid in reducing the transmission of the virus in the workplace, especially in the office. The simulation result is inside Arduino IDE and FAVORIOT platform. The data need to obtain from the IoT hub are in close contact. After written code is uploaded inside the module using Arduino IDE, the data can be observed through a serial monitor. The ESP32 TTTGO will have to connect with the Wi-Fi client before it can detect close contact. Each module of ESP32 TTGO needs to do the same steps and rename it as BLE tags. In addition, it shows a successful module connected to the Wi-Fi and ready to work on the serial monitor. Figure 6 shows the information inside the serial monitor during module active time.

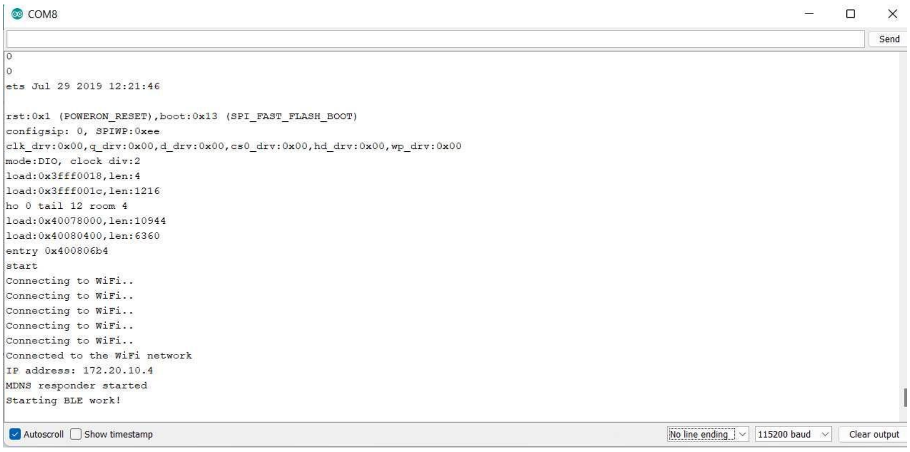

Figure 6: BLE is ready to work

3.3 Analysis

To understand the functionality of the BLE tag, data comparison has been recorded in table form. The distance of BLE tag data collected between other users in the FAVORIOT platform with different values of distance in meters. To understand better, the data is simplified toward its number in different RSSI values with distance and testing BLE tag in 1-meter range. Doing this testing will ensure the limitation of whether the Bluetooth sensor can detect a generic name on the LCD screen or not. The simplified data are shown in Tables 1 and 2.

Table 1: RSSI value testing with distance of BLE tag

Face-to-face	BLE tag/ Distance
RSSI	m
-40	0.2
-50	0.6
-60	1.8
-70	2.7
-80	4.6
-90	8.5

Table 2: RSSI value testing in 1m range

Face-to-face	BLE tag/ Distance
RSSI	m
-50	0.6
-55	1.2
-60	1.8

The analysis has been made where it was found when there are obstacles, for example, other BLE users from another room or behind the wall. The -55 RSSI value cannot be detected by other generic names unless the value of RSSI is high than the BLE tag can detect another generic name for example -80 RSSI value. Furthermore, the maximum distance the Bluetooth can detect is 9.14 meters face-to-face, depending on the obstacles. This can be concluded when the higher the value of RSSI value, the stronger the signal of Bluetooth Low Energy (BLE) can detect the generic name of the user. However, this RSSI value testing range is unsuitable for close contact tracing because the distance range is longer, and it is not necessary to do.

4. Conclusion

As the project title Contact tracing device, for the workplace using FAVORIOT platform, it comes a long way from application contact tracker by using a smartphone, and now TTGO tag with IoT integrated with FAVORIOT platform. The primary purpose was to monitor users to easily trace close contact at the workplace and maintain social distance to help prevent the spread of the Covid-19 virus. As the TTGO tag prototype, it works as intended when activated, scans BLE around it, and looks for the generic name, which also sensors themselves. This prototype is cost-efficient, compact, and able to appear on the list of close contact names on the LCD screen. FAVORIOT was an excellent way to collect as a database and an easy-to-monitor system when the module is switched on. The system is expected to work well as it has been set, is easy to use, and can get the latest data documented. In the future, this project can be upgraded to pack with a suitable design to ensure it is suitable to implement for other applications and put a haptic buzzer so that the user can be more alert at a social distance. The proposed tool may also be used for contact tracing or large-scale monitoring in future health crises.

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