Portable Pilgrim Tracker

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Abstract. In a huge congregation, a number of pilgrimages went missing because they got lost or other causes. Cases like panicking due to getting scatter around from the group or getting lost and cannot find the way back happens daily during the holy seasons. To accommodate this problem, Portable Pilgrim Tracker is proposed in this paper to overcome those missing pilgrimages cases. Portable Pilgrim Tracker is a monitoring and tracking device designated to be able to detect the user's location and heart rate on a real-time basis. By using wifi technology as the medium of data transmission, the data is collected from the GPS module, and pulse sensor Arduino and the information such as real-time location and heart rate of the user and will be sent to the guardian's Blynk mobile application. With the usage of this portable pilgrim tracker, it is expected that this will be able to assist the mobile application user (guardians or travel agency staff) with the screen of live maps about pilgrim's location and their heart rate in order to avoid any unwanted consequences such as missing pilgrim and health compilation.

INTRODUCTION

The Hajj is the annual pilgrimage to Mecca that Muslims are expected to make at least once in their life when they are physically and financially capable of undertaking the journey. Every year about 2-3 million people from across the world gather in Mecca for the Hajj. With that huge mass number of people gathering at one place, the missing cases of a pilgrim, especially a senior pilgrim, are most likely to happen. During the journey, they run over a lot of harsh and extreme condition, physical problem, and mental pressure. Because of the difficulty of movement, the vacillation of climate, constant strolling during a strict ceremony at an explicit time and site, numerous pilgrims feel drained, wiped out and depleted. These environments may create complications and overburden the physiological functions, including heart and chest, of those who suffer from chronic disease.

Heart health issue amongst senior pilgrim is most likely to happen. A normal heart rate is 60 to 100 beats per minute (bpm); slower than 60 bpm is called bradycardia (slow heart); faster than 100 bpm is tachycardia (fast heart); ideal resting heart rate is closer to 50 bpm to 70 bpm, but it will vary depending on the situation.

This project will be a help to the travel agency of Hajj and umrah to encounter the problem of missing pilgrim while performing their Hajj or umrah routine. Smart Movement Tracker had been studied before in [1-3]. In [1], a Low range Radio Frequency Wide Area Network (LoRaWAN) testbench project consists of Arduino Microcontroller, Dragino YUN Shield, and LoRa Shield to operate as the LoRa Gateway had been presented. LoRa Client requires Arduino Microcontroller and LoRa/GPS Shield. This LoRa Client will power Lora/GPS, and it will send the GPS location information to the LoRa Gateway, where the location received will be recorded in its DataLog periodically. The LoRa Client will be mobile while Gateway Server will be at static mode during the experiment. In a suburban scenario, the communication between two devices has a better performance compared to the urban scenario. These findings inspired the usage of LoRa in [2]. In this paper [2], a prototype for an animal movement tracking system had been developed for Smart Agriculture 4.0. The system collects the data from the

GPS module to determine the animal's location, particularly farm animals. While in [3], a tracker for bus's movement had been proposed. A Bus Stop module consists of an RFID tag, and a card reader will be placed on the bus and at the bus stop. This Bus Stop module will be installed at every bus stop and LCD and interfaced to a Microcontroller-Arduino Mega 2560 and Uno R3. This module receives and sends information of the current, previous and next stop of the bus. The Real-Time Clock (RTC) indicates the ETA of the bus at the next stop.

Travel agency staff and family members get to monitor the user's movement location, which is the senior pilgrim, through their smartphones by using the mobile application as in [4-6]. The system is being developed to assist the pilgrim's guardian by having these objectives, which is to detect the GPS location of missing senior pilgrim and monitor the user's heart rate. The additional heart rate monitoring features is the novel feature in this project.

METHODOLOGY

The prototyping method that has been chosen is the iterative waterfall model. The iterative waterfall model describes a development method that is linear and sequential, but it can be a loop back to other phases when there is a correction needed in certain phases. It has clear and distinct goals for each phase as shown in Fig. 1.

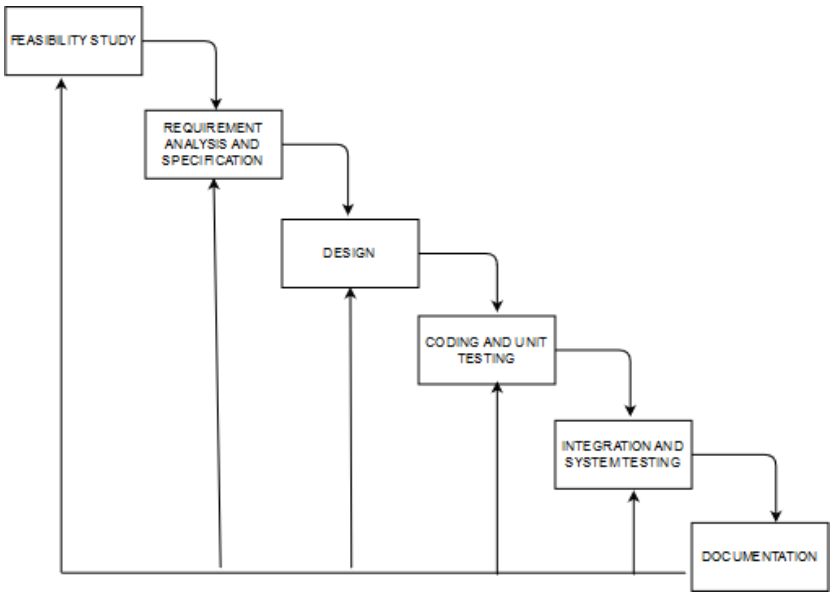

FIGURE 1. Iterative Waterfall Model

Figure 2 below shows the system design of how exactly the project supposed to work in a real-time situation. First, the data such as location and heart rate will be collected from the devices and will be sent to the Blynk application via the ESP32 Wifi module. The data will be illustrated on Blynk mobile application.

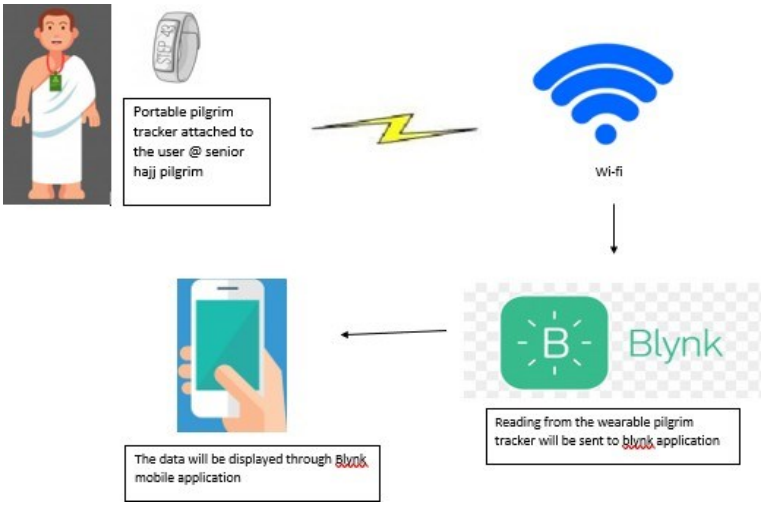

FIGURE 2. System Design

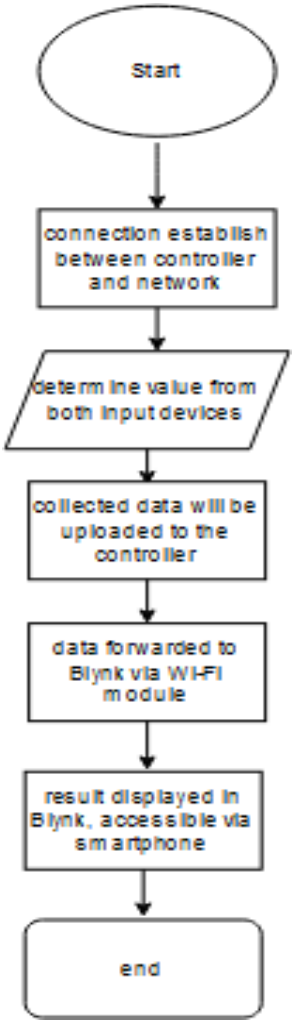

FIGURE 3. Project Flowchart

PROJECT REQUIREMENTS

3.1 Arduino IDE

In this project, Arduino Integrated Development Environment or better known as Arduino IDE has been utilized as the main platform to write and upload programs to Arduino compatible boards such as ESP32 that is being used in this project. This platform uses C++ and C language, which makes it's easier to write programs. The figure below shows the initial coding page of the software used to write and modify the programs.

3.2 Blynk Application

Blynk is an IoT platform that allows the researcher to build interfaces for controlling and monitoring hardware projects from mobile devices such as Android and iOS. This platform is being used as a communication medium between the input devices, which are Neo-6m GPS module and pulse sensor, Arduino, to a smartphone via ESP32 wifi module).

3.3 Neo-6m GPS Module

This module is cost-effective and has high sensitivity [7], and also suitable for indoor application. It has a ceramic patch antenna, built-in EEPROM and LED signal indicator.

FIGURE 4. Neo-6m GPS module

3.4 Pulse Sensor Arduino

SO00837PS model is a plug and plays sensor that can be used conveniently to integrate real-time heart rate data into the project [8].

FIGURE 5. Pulse sensor Arduino

3.5 ESP32 Development Board

In this project, the researcher used DOIT DEVKIT V1 as the microcontroller as it has built-in wifi and Bluetooth function. This board can be programmed into several different programming environments, including Arduino IDE [9].

FIGURE 6. ESP32 DOIT DEVKIT V1

RESULT AND DISCUSSION

FIGURE 7. Testing prototype

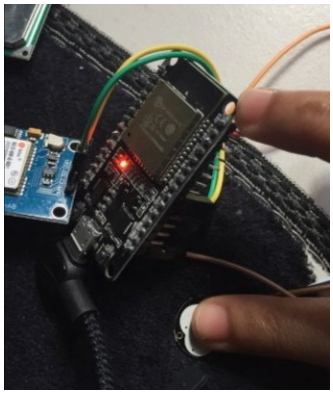

FIGURE 8. Conducting real-time heart rate collection data.

Figure 7 above shows the prototype being outside of the researcher's house to test the functionality and range of the devices. For location detection, the test is being carried out by bringing out the prototype outside and see if it is detecting any location on the Blynk page. As for the heart rate detection shown in Fig. 8, the testing is being done by placing the pulse sensor Arduino on the wrist and fingers and checking if there are any reading, either normal or abnormal rate from Blynk.

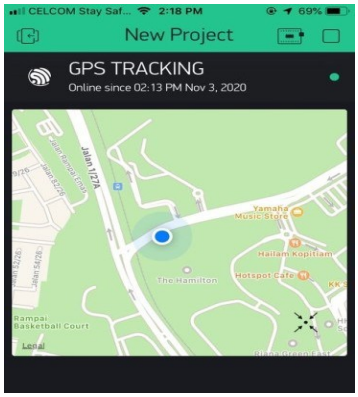

FIGURE 9. Pin-point location of the user

For Fig. 9, the Neo-6m GPS module managed to pinpoint the exact location of the user in a real-time situation. The user will be marked online on the Blynk map widget as long as the device has a connection to the internet.

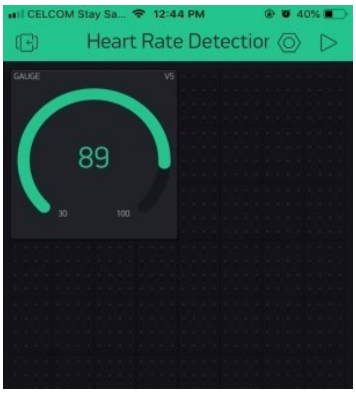

FIGURE 10. Real-time heart rate reading

Figure 10 shows real-time heart rate data collected by pulse sensor Arduino, with an interval set of 15 milliseconds. The data can change accordingly to the condition of the user.

USER TESTING AND DISCUSSION

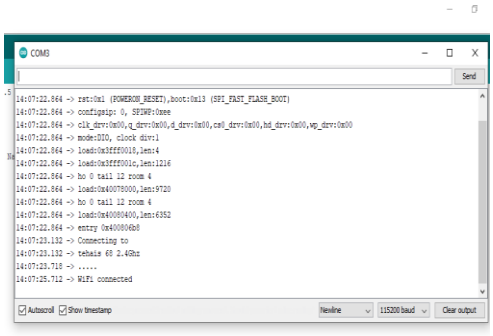

FIGURE 11. Wifi connection status displayed on Arduino IDE.

Figure 11 shows the system successfully connected to the wifi after including wifi credentials such as username and password.

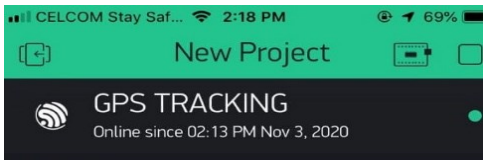

FIGURE 12. Blynk connected with ESP32.

Figure 12 shows the green light at the right indicated that Blynk was successfully connected to the prototype and ready to be used. The prototype was connected using an ESP32 Dev board that has an embedded wifi module.

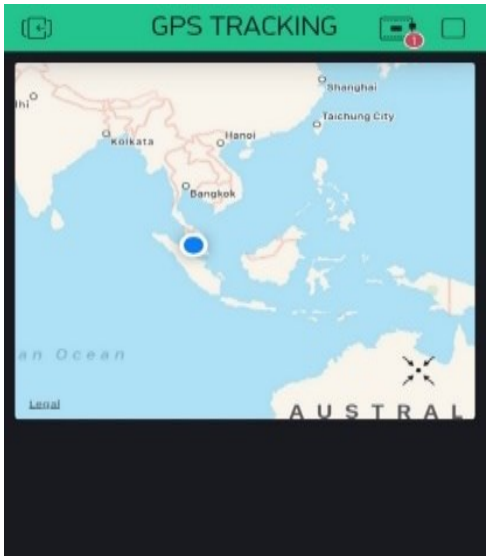

FIGURE 13. Initial map widget

For Fig. 13, the initial map widget managed to send a point to the map with a command; Blynk.virtualWrite(V0, 1, latitude, longitude, "Location").

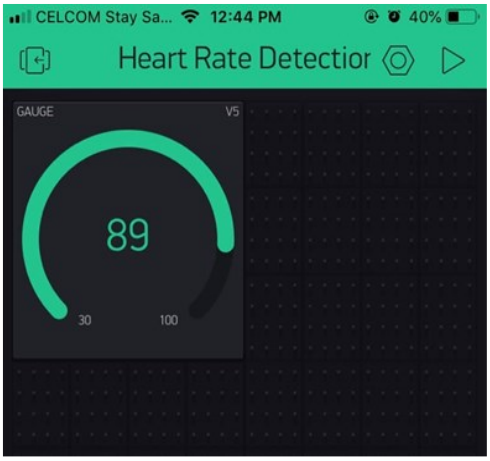

FIGURE 14. Gauge widget for heart rate

Figure 14 shows the gauge widget, which functions to display numerical value and provides real-time reading in a nice and proportional manner. This widget functions in two modes; PUSH mode and Frequency Reading mode. PUSH mode has been chosen because, for this mode, every message that hardware sends to the server is stored automatically on the server. It does not require the application to be online.

CONCLUSION AND RECOMMENDATION

This project's main goals are to be able to detect the location of the user and also, at the same time, have an added value to the project, which is to monitor the heart rate as well. By using the Blynk application, they can track the location of the user using their smartphone as long as both of the parties are connected to the internet. It is quite regrettable that the prototype cannot be merged properly into one prototype due to technical difficulties, but nonetheless, both of the prototypes work well.

For the future researcher that wishes to enhance this project, they can consider by using GSM as the medium data transmission between the prototype and Blynk application. The current transmission is not suitable for long-range communication, and it also prone to interferences. Aside from that, it is advisable to merge the prototype and make them wearable devices to ease the targeted user themselves.

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