Multidisciplinary Applied Research and Innovation Vol. 4 No. 4 (2023) 192-198

MARI

Homepage: http://publisher.uthm.edu.my/periodicals/index.php/mari
e-ISSN :2773-4773

Heart Rate Data Collector for Covid-19 Patient using IoT and LoRa Network

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DOI: https://doi.org/10.30880/mari.2023.04.04.027
Received 01 September 2023; Accepted 15 October 2023; Available online 1 December 2023

Abstract : Patients with covid 19 symptoms were previously monitored by the doctor or nurses. Patients' data were collected directly. Because of the virus can spread from one individual to another, health staff need to wear full personal protective equipment (PPE) to gather patient health data. They had to move from one patient to the next to gather information.The main objective of this project is to collect the heart rate data wirelessly using LoRa and IoT by using MAX30100 sensor to intergrate the pulse oximetry and heart rate monitoring. The presented work is to reduce the use of medical workers and provide online access for medical personnel. This low cost device will help the medical assistant to record patients' data effectively.

Keywords: Heart Rate, IoT, Wireless Sensor Network

1. Introduction

Since the early 2020 Covid-19 outbreak, health has received a lot of attention. The virus spreads in small liquid particles from the lips or nose of the infected person when they cough, sneeze, speak, sing, or breathe. You can contract COVID-19 if you are close to someone who has it by breathing in the virus or by touching your eyes, nose, or mouth after coming into contact with contaminated surfaces. The virus spreads more quickly indoors and in crowded areas. It is imperative to separate covid patients due to the disease's high contagiousness, yet doctors must also monitor their well-being. As the number of occurrences rises, it becomes increasingly challenging to keep track of the health issues of many other isolated people.

Shortness of breath and loss of taste and smell are two early signs of Covid-19 infection that are frequently observed. It can be transmitted from one person to another by bodily fluid droplets from an infected sufferer. Consequently, it is necessary for health professionals to wear personal protection equipment (PPE). The outbreak poses a serious risk to healthcare professionals. Additionally, applying

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PPE to medical staff is challenging and is dependent on the patient's amount of exposure to the Covid-19 virus. Due to the disposable nature of PPE, this will raise the price of PPE purchases.

According to [2], one of the primary issues facing hospital administrators nowadays is continuous monitoring of patients' health metrics. Using a multiple patient monitoring system rather than a single patient monitoring system would be more cost and energy efficient and would allow healthcare workers to monitor numerous patients at the same time in the event of a pandemic. There will be a significant cost and power savings if several patients are served by a single system. If necessary, the data collected might be used for future study. It also gives doctors more freedom in the event of a doctor's absence.

1.1 Wireless Sensor Network

The wireless sensor network (WSN) technologies discussed in article [3] differed in their capacity to transmit data over great distances while using little power and at high data speeds. Network protocol advancements are to blame for the efficiency of long-range transmission technology to a variety of devices with lower energy consumption and relatively cheap cost. A special-purpose WSN called WBAN (wearable body area network) is frequently used in healthcare settings to track physiological signals that might improve quality of life and, as a result, health and wellbeing. Because WSN is scalable, it can take on any extra node or device at any time.

1.2 LoRa Network

According to [5], LoRa is a wireless modulation that allows data to be sent across long distances and low-power communications. There are LoRa gateways spanning a large surrounding region and connected to local or cloud servers on the side of hospitals and public spaces. Mobile cellular or Wi-Fi networks might be used as communication medium between these devices. The patient's position data is captured by the GPS sensor, and the Wi-Fi/cellular modules create a direct link to the local or cloud server.

In [4], LoRa may operate at frequencies between 137 to 1020 MHz in both permitted and unlicensed bands. Direct data transmission from the sensor to a receiver connected to the Internet and a server is used to transmit data. End-devices utilise wireless communication to connect to one or more gateways, whereas gateways perform regular IP connections to connect to the network server. Communication between end devices and gateways occurs via a range of frequency channels and data rates. They used this research to evaluate LoRa wireless connectivity between tests conducted indoors and outside. Before the test, researchers decided the parameters they would use. There have been five instances of this surgery. With different gaps between them, the indoor experiment was done again. The transmitter and receiver were in the same room for the first test, which was conducted at a distance of 7 metres, while the second test was performed at a distance of 75 metres with the sender in a different building.

1.2 Heart Rate Monitoring

According to [7], their study about people health in a rural area, due to poor infrastructure and long distances to the nearest hospital, only a tiny percentage of the population has access to health services. The disadvantaged population thus confronts rising health hazards and unmet medical demands. However, having access to internet infrastructure in outlying areas creates several opportunities for conducting automated screening checks. In the envisioned scenario, people in rural areas would collect medical data using low-cost point-of-care devices.

2. Materials and Methods

The waterfall approach was used to carry out this project's methodological framework as shown in **Figure 1.**

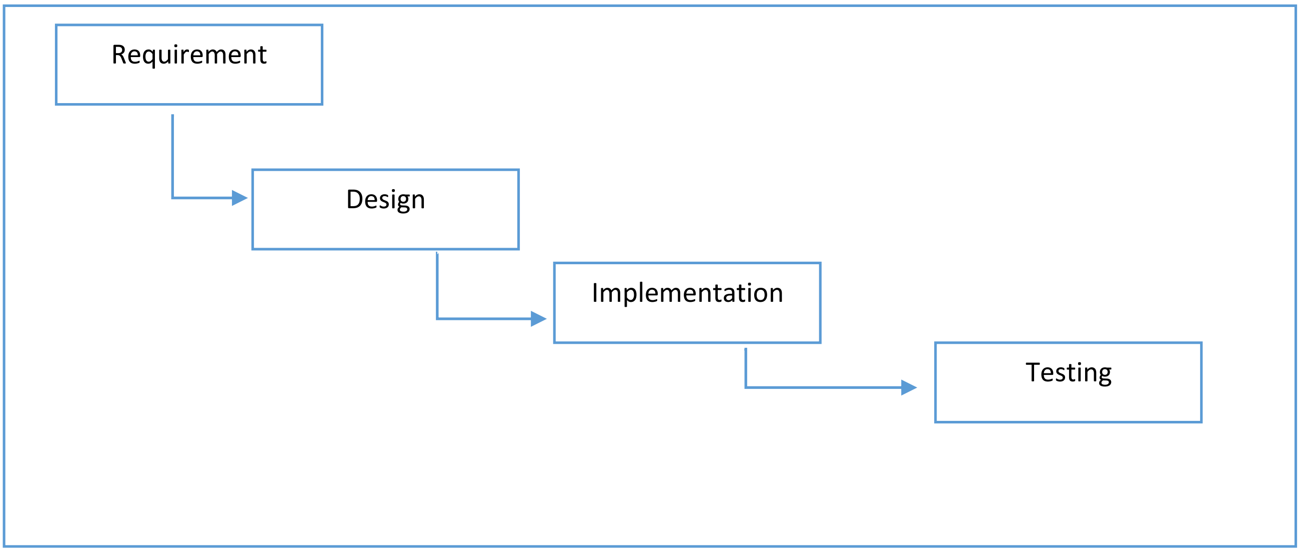

Figure 1: Waterfall methodology

2.1 Materials

- Requirement

Material and Equipment for experimentation and testing that required for Heart Rate Data Collector for Covid-19 Patient using IoT and LoRa Network are as follows:

- ESP32
- Arduino Uno
- LoRa Shield with antenna
- LED
- LCD
- Potientiometer
- Pulse Sensor
- MAX30100
- Resistor
- Jumper Wire

2.2 Methods

Research methodology or involves specific techniques used in the research process is to collect, organize and evaluate data. Methodology refers to the tools used to gather information relevant in our research study. Research methodology is used to study a particular theory and its application in a set certain standard. The method we use is as follows:

- Flowchart (**Figure 2**)
- Block diagram (**Figure 3**)

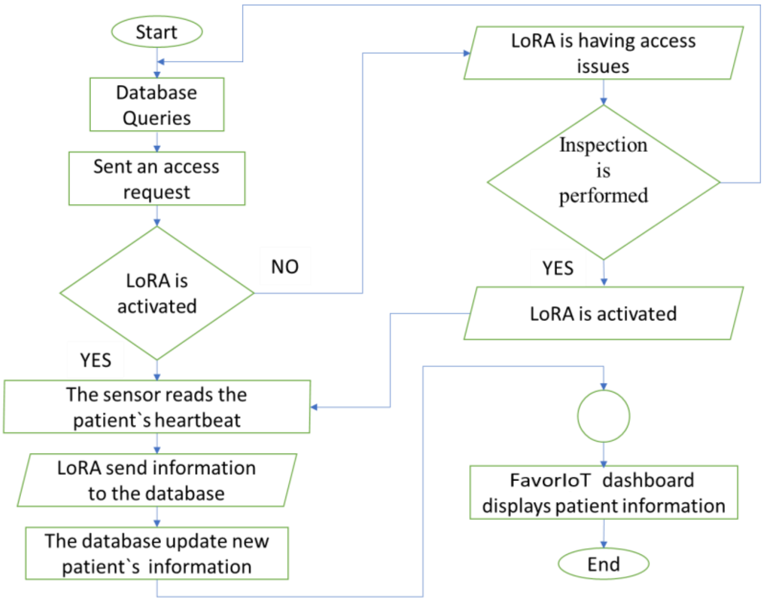

Figure 2: Flowchart

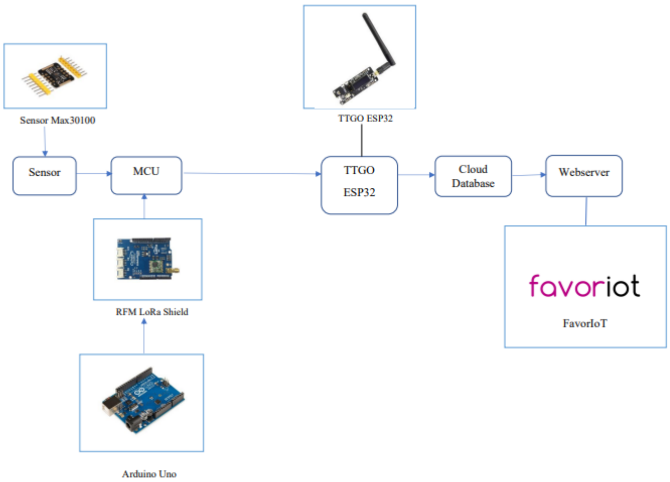

Figure 3: Block diagram

2.3 Implementation

The Heart Rate Data Collector for Covid-19 Patients using IoT and LoRa network will be installed and tested first. The intended Heart Rate Data Collector for Covid-19 Patients using IoT and LoRa network will be modeled using TinkerCAD where the encoding will be checked and utilized in the program.

2.4 Testing

The Heart Rate Data Collector for Covid-19 Patients using IoT and LoRa network prototype will be tested using Arduino Uno that has been combined with Arduino Shield. A variety of supervisory suggestions will be looked at in order to enhance the Heart Rate Data Collector for Covid-19 patients using IoT and LoRa network. After the prototype functions successfully, the ESP32 will be used to replace the Arduino Uno with the Shield.

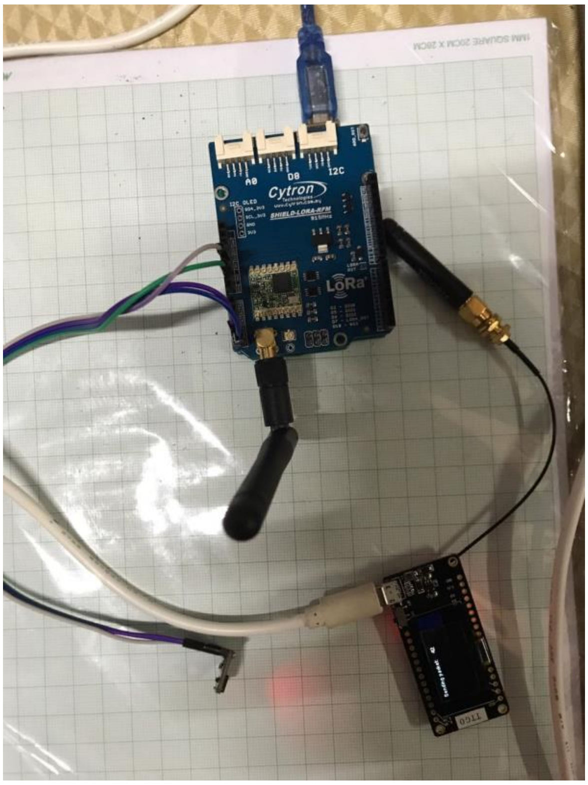

Figure 4: The layout of the whole project

3. Results and Discussion

In this project, the heart beat rate and SpO_2 level will be observed and tabulated in **Table 1**. Value readings are recorded at the time period as in **Table 1** because the following is the time period that the patient is active.

A. Results

Table 1: Results

Item	Time	Heart Beat Rate (bpm)	SpO_2 (%)
1	8.00 a.m.	141.19	96%
2	2.00p.m.	63.71	95%
3	4.00p.m.	146.16	94%
4	10.00p.m.	170.70	95%

According **Table 1,** these are the value that produced different values of heart rate beat and SpO_2 with different time. The heart beat rate at 4.00 p.m. recorded the highest value at bpm among others. At 5.00 p.m., it was found that the value of SpO_2 recorded the highest value.

The observed values from Arduino IDE are listed as presented in **Figure 5**. It can be seen that the sensor detects the heart beat changes every minute.

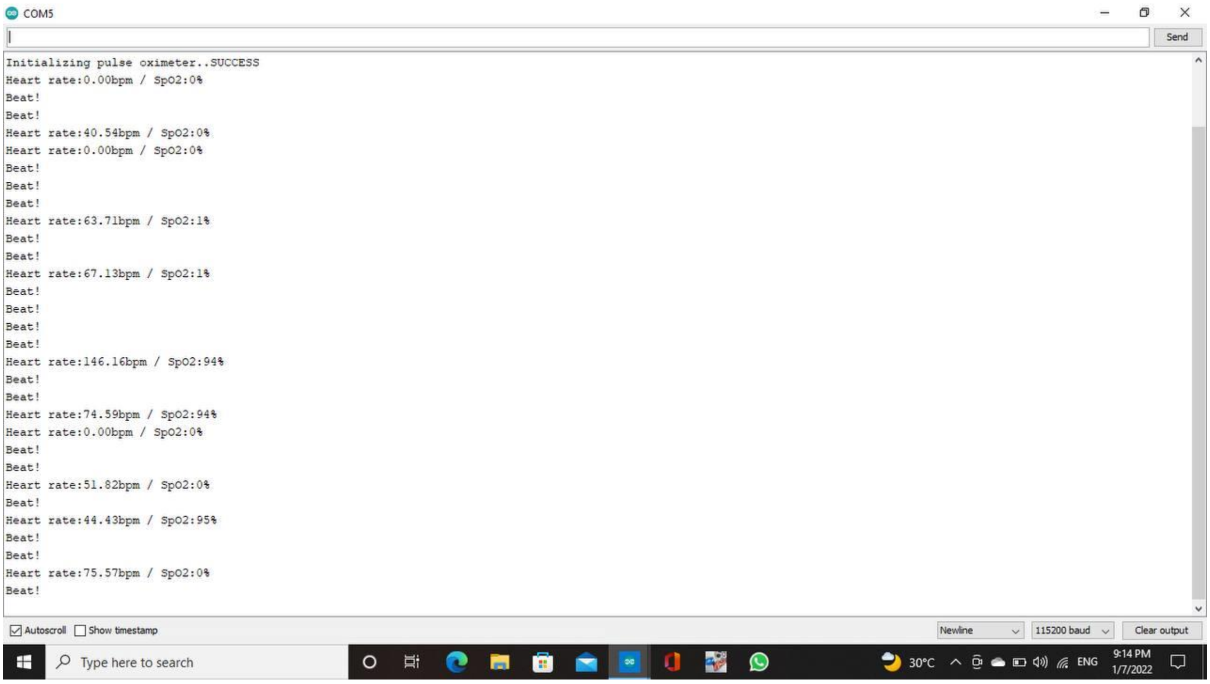

Figure 5: Results on Arduino IDE

3. Conclusion

In conclusion, all the systems worked accordingly to the designed in flowchart. The sensor detect the patient's heart beat rate and SpO_2 it displayed on the Arduino IDE. The data will be transmitted to the TTGO ESP32 before being transferred to the FavorIoT server. When its transferred to the FavorIoT server, the medical assistant can have access to the data accordingly. Furthermore, the readings that have been recorded are in line with the standard of normal readings for an individual that is the pulse rate in bpm is between 40 to 100bpm and the oxygen concentration in SpO_2 is 96% and above.

Acknowledgement

The authors would like to thank the Department of Electrical Engineering, Centre for Diploma Studies, Universiti Tun Hussein Onn Malaysia for its support.

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