iJRASET
International Journal For Research in
Applied Science and Engineering Technology

# INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

**Volume:** 10 **Issue:** IX **Month of publication:** September 2022

**DOI:** https://doi.org/10.22214/ijraset.2022.46178

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 10 Issue IX Sep 2022- Available at www.ijraset.com

# On The Way to Complete Automation, Patient Health Monitoring Systems in Rural Area as A Catalyst to National Development

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***Abstract: Many developing countries, including Nigeria, lack adequate patient health monitoring systems, particularly in rural areas. Most adults in this region suffer preventable ailments such as high blood pressure, heart disease/hypertension and heart related diseases.***

***Due to a lack of effective patient health monitoring and the insidious manual system of monitoring that is used in this region, the majority of these patients have suffered various disabilities and, in some cases, have died prematurely. This led to address this issue and aid early detection, monitoring, and treatment of various disorders.***

***This paper, titled " On the way to complete automation, patient health monitoring systems in rural area as a catalyst to national development" proposes a system design that employs long-range (LoRa) radio frequency (Rf) to provide full automation for effective patient monitoring and IoT.***

***It entails reading data wirelessly from sensors attached to patients in real time. This information is sent to a local device via communication channels (Wi-Fi technology) and subsequently to a mobile App. It assists in the monitoring of patients' vital signs with the goal of predicting likely illnesses and reducing acute consequences, as well as giving quick medical access and response when necessary.***

***Keywords: Automation; Patient; Rf; Sensor; Wireless; Monitoring***

## I. INTRODUCTION

Automation is a type of automatic process that is often managed by computers and sensors using software applications, health management systems, and radio frequency (RF) point-to-point and point-to-multipoint communication [1]. The end result should be that patients receive service levels comparable to those found in other industries such as banking and telecoms. The use of automation in service delivery would improve the health sector's image [2].

Almost every process, including health and health-related difficulties throughout the world (Confucius & Amber, 2015), can be automated. Automation in biomedical engineering has solved the bulk of issues around the world. This strategy has long been used in developed countries to improve patient outcomes and longevity.

The adoption of these technologies is limited in developing countries like Nigeria due to a range of variables such as low access, cost, capacity, and trainings [3].

A huge number of patients who exceed the hospital's capacity, as well as a modest number, have been observed at most medical facilities and hospitals in developing countries' rural areas [3]. These patients require critical care at three levels: high, medium, and low. Patients who are extremely ill or in a coma require mechanical ventilation, which necessitates a high level of infrastructure readiness while others require medium and low. As a rule, two or three nurses are needed at this level. Alternatively, resources, such as those with a poor socioeconomic position, a scarcity of human resources, and inadequate infrastructure and medical equipment, this criterion may be impossible to satisfy [4]. To overcome this disadvantage and to supplement the efforts of developed countries' health monitoring systems.

The goal of this study, titled " On the way to complete automation, patient health monitoring systems in rural area as a catalyst to national development "is to raise the standard of patient care." by utilizing automation [5]. It will be important to create a less expensive in-patient monitoring system based on radio frequency, especially in rural areas, to improve patient care quality in the recovery room.

## II. RELATED LITERATURE

The progress of resuscitation is intrinsically linked to the evolution of patient monitoring [6].

The approach was forgotten until it was found by Kouwenhoven, Jude, and Knickerbocker individually (1960). The growth of patient monitoring has been spurred by this innovative explanation of the method, as well as the subsequent rise in interest in resuscitation (Jensen et al., 1966).

The modern health monitor is the pinnacle of technological growth, as it is based on logical vital sign analysis. The systems and periodicals described above have had a significant impact. Health-monitoring devices, on the other hand, were designed specifically for metropolitan environments. Automation in the health sector for patient health monitoring systems in rural areas of most developing countries was found and solved in this article.

## III. METHODOLOGY (MATERIALS AND METHOD)

The research objectives were accomplished using the process outlined in Figure 3.1. The design workflow is divided into stages, each of which include actions that would be carried out repeatedly as illustrated in Figure 3.1's flow diagram until the final intended outcome was obtained. The first stage specifies a comprehensive analysis of the behavioral modeling via a use case diagram, followed by material selection and proposed design techniques, which include designs of the patient health monitoring system for both urban and rural regions as shown in figures 3.2, 3.3, and 3.4, designing the patient health monitoring system for rural regions and creating a database and historian to achieve the research objectives. Then, to complete the system, move to the integration and design of the mobile software application.

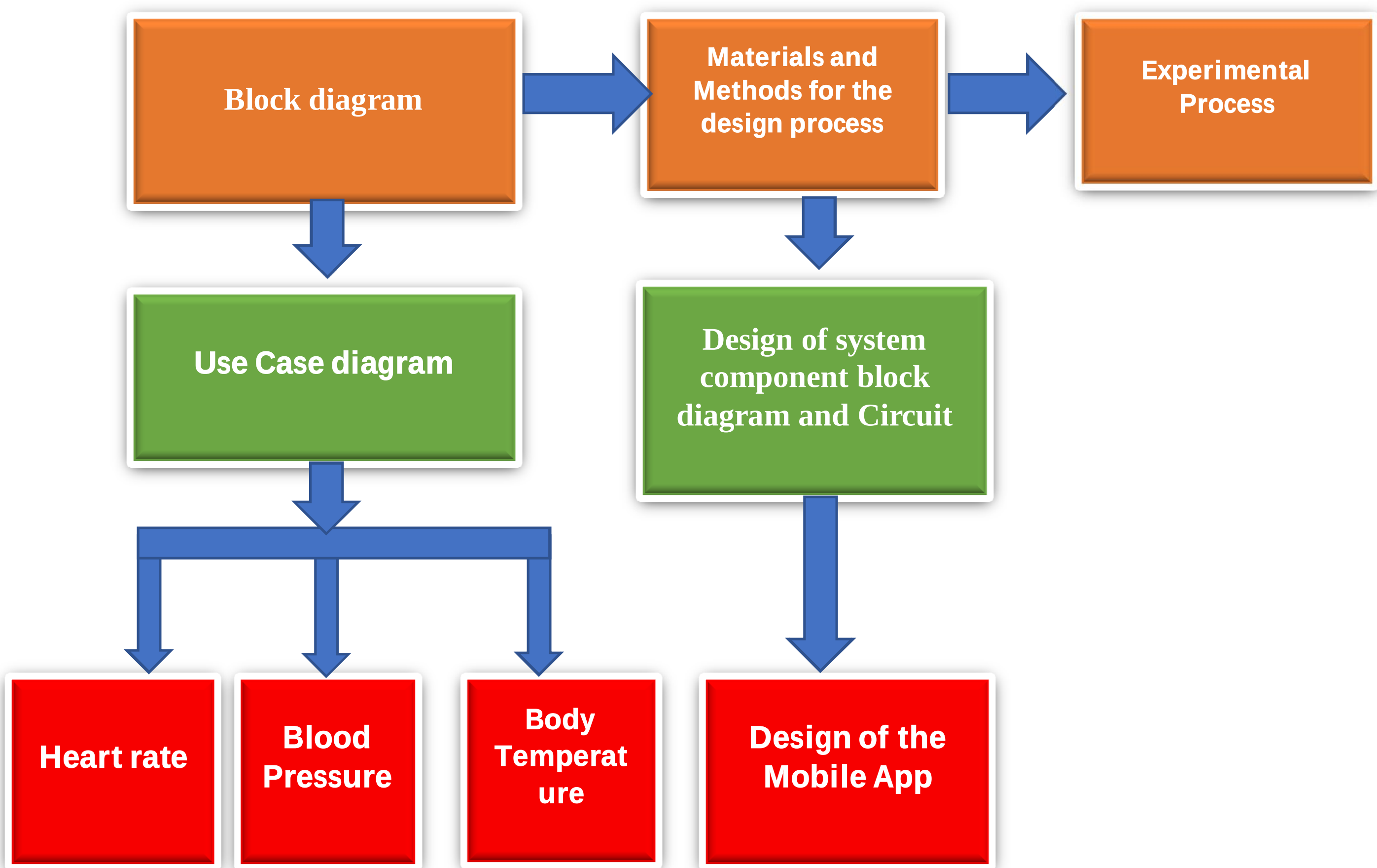
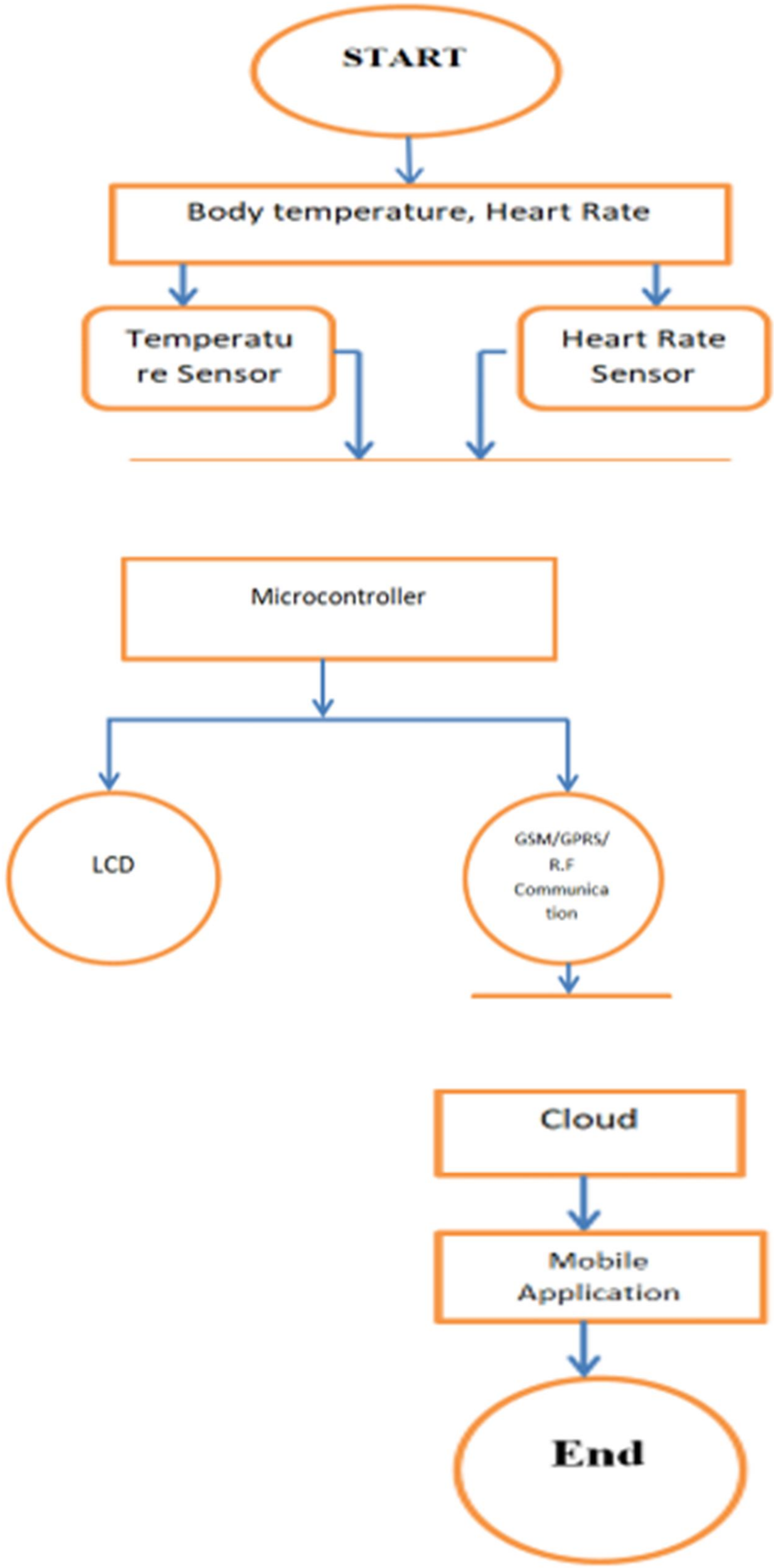



Figure 3.1. The design workflow


START
Body temperature, Heart Rate
Temperatu
re Sensor
Heart Rate
Sensor
Microcontroller
LCD
GSM/GPRS/
R.F
Communica
tion
Cloud
Mobile
Application
End

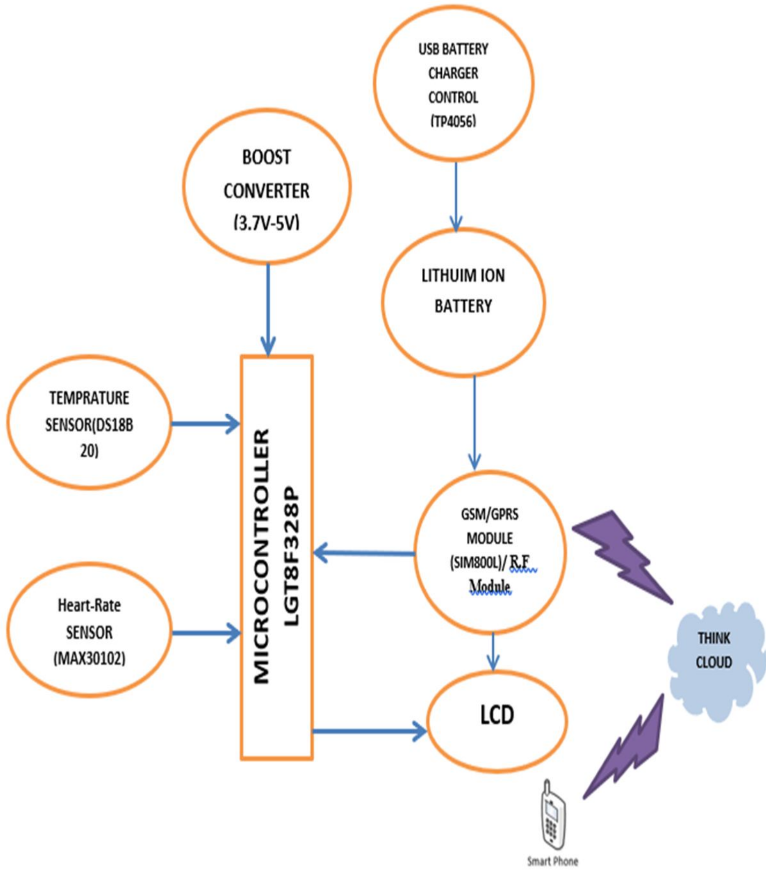
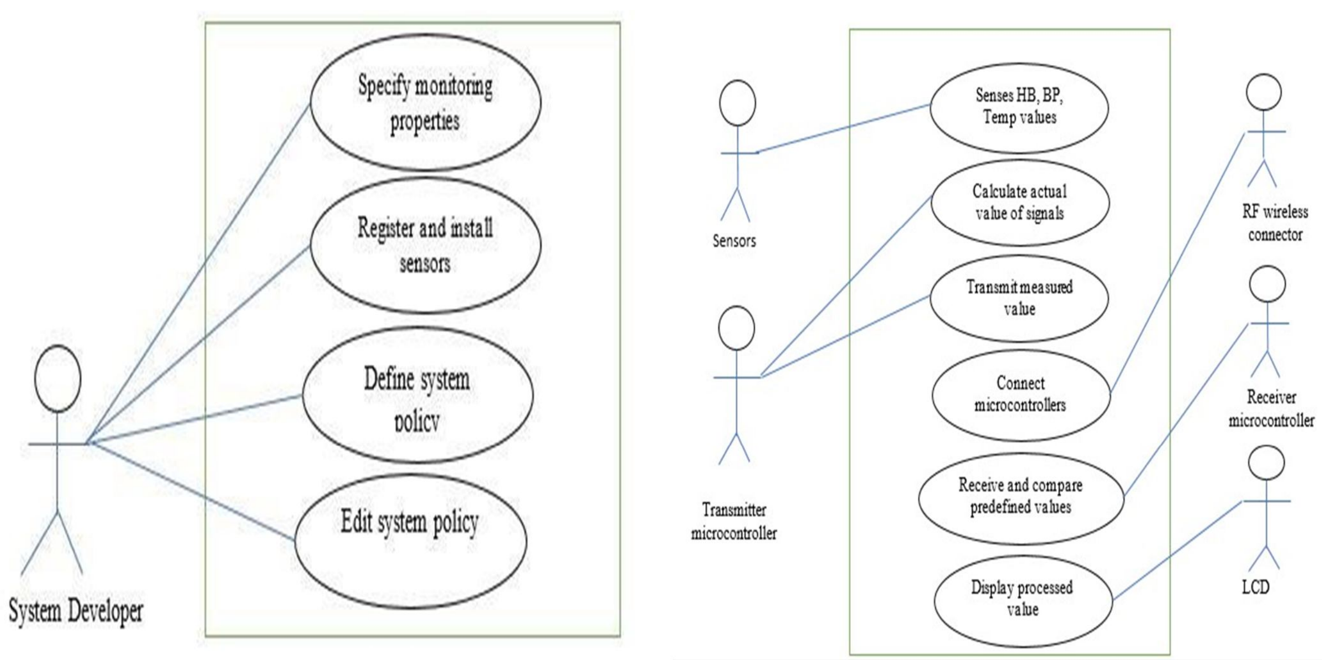



Figure 3.2. The block diagrams of the Patient Health Monitoring system for Urban and rural area




(a) (b)

Figure 3.3: Use case diagram of system administration (a) and functionality (b)

The Proposed Hardware Part

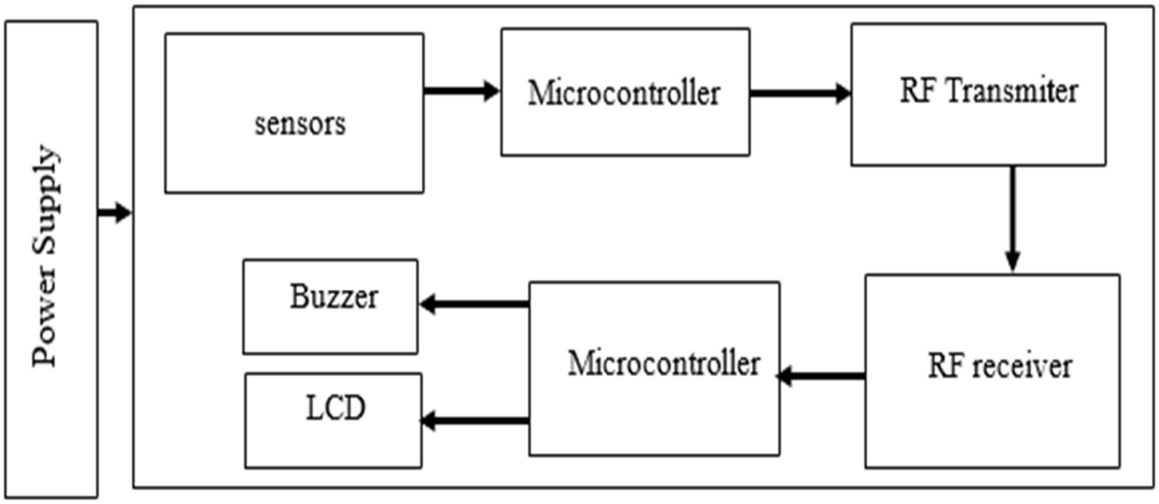
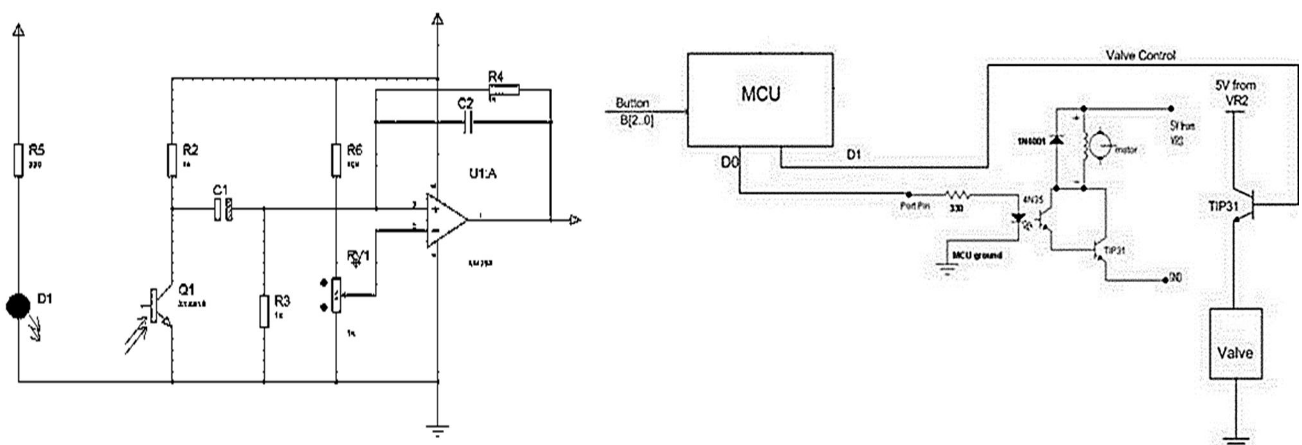



Figure 3.4 System component block diagram

*A. The Source Of The Power, The Heart Rate Sensor, The Blood Pressure Sensor, And The Body Temperature*

There are five main parts that make up the hardware of the system. The power supply unit, different sensors, and RF are all shown in Figure 3.4. It is suggested that you utilize a 5V power supply with a 1A maximum current value. The XD-58C pulse sensor, which has a working voltage of +3.3v or 5V and a current of 4mA with an amplification and noise cancellation unit, features the Light Emitting Diode (LED) and circuitry on opposing sides. This circuitry handles the amplification and noise reduction. The front-facing LED of the sensor is positioned over a bodily vein. It needs be placed on a vein; nevertheless, fingertip or ear tip can be used. The pressure sensor MPX2050. The output voltage is proportional to the pressure transducer. As shown in figure 3.5, the temperature sensor might be anything between -55 and 150 degrees Celsius. Because it is body temperature and unlikely to fall below 0 degrees Celsius. The module sends an asynchronous serial data stream and can connect to any voltage-compatible. Any serial device using a level translator or a Universal Asynchronous Receiver Transmitter (UART) device.




(a) (b)

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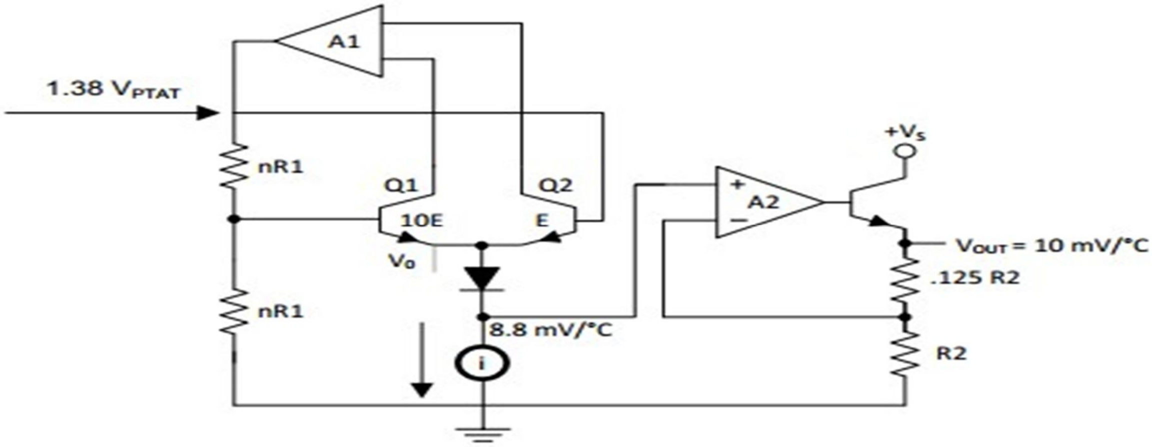


(c)

Figure 3. 5 shows a schematic of the heart rate (a), blood pressure (b), and body temperature (c).

*B. Software For The Microcontroller*

A variety of high-level programming languages are being used to program them. These programming languages are either custom-made or modified versions of general-purpose languages such Micro C Compiler for PIC16F877A is a high-end development tool for PIC microcontrollers, which is written in C. with a lot of features. Its purpose is to make embedded device application development as simple as possible for programmers without sacrificing performance or control.

*C. RF Wireless Transceiver for line-of-sight (los) along Fresnel zone in Rural Region.*

A clear line-of-sight with low-power in wireless communication is very essential for the functioning of long-distance microwave point-to-point links. The line-of-sight passage between the end node and the gateway is surrounded by the Fresnel zone, an elliptical-shaped body. Depending on the distance between the two sites and the frequency channel, the elliptical region immediately surrounding the visual link path changes. For instance, even though there is a direct line of sight between the end node and the gateway, the broadcast signal can be reduced if a hard object in the form of an obstruction, such as a mountain ridge, trees, hilltops, or building(s), is too close to the signal route. This will weaken the radio signal, failing to produce the desired level of received signal: Despite the fact that they do not block the straight view, the obstructions. Therefore, the necessary clearance for the Fresnel zone should be calculated and taken into consideration when planning the link path as shown in figure 3.6.

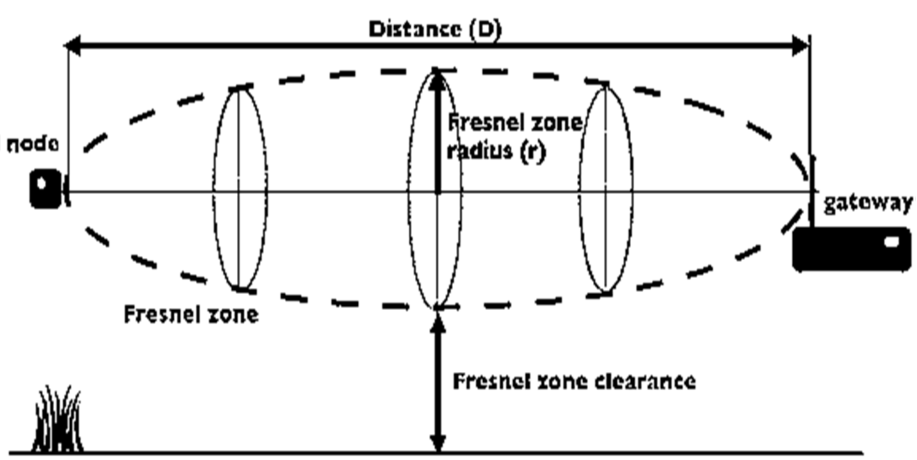


Figure 3.6: Fresnel zone [7]

Equation 1 is used to calculate the maximum radius of the Fresnel zone, which is halfway between the end and the gateway.

$$r = (8.657) \times \frac{\sqrt{D}}{f} \quad (1)$$

where: r is the Fresnel Zone's meter-scale radius.
D = distance (km) and f = frequency (GHz).
The flat earth assumption underlies the Fresnel zone radius. The earth's curvature is not taken into account.

### *D. Software for The App*

The widely utilized Android Studio was used to create the circuit's android application. It was created using JetBrains' IntelliJ IDEA software and is the official integrated development environment (IDE) for Google's Android operating system. The following are some of the features of Android Studio: Support for Android-specific refactoring, Gradle-based builds, and rapid fixes UI components can be dragged and dropped in a comprehensive layout editor, and there is an option to evaluate layouts on various screen configurations. Lint tools are also available to catch performance, usability, version compatibility, and other issues. Assistance with creating Android Wear applications, use of the Android Virtual Device (Emulator) to launch and debug applications in the Android Studio. The app's user interface was created using XML, while the functionality was built using Java. Figure 4.2 shows the GUI for the android application designed for the mobile devices.

## IV. RESULTS

According to results on temperature and heart rate, the sensor detects temperature while the heart rate sensor monitors heart rate. Even when a user only watches their heart rate, as shown in figure 4.2, where it is presented on the Mobile App, the temperature sensor continues to measure the ambient temperature and the average processing time is 25 seconds. Figure 4.1 and Table 4.1 display the findings.

Table 4.1: Patient and Body Temperature

| S/N | BODY TEMPERATURE (degree Celsius) | PATIENTS |
|---|---|---|
| 1 | 24.000 | 1 |
| 2 | 25.000 | 4 |
| 3 | 26.000 | 5 |
| 4 | 27.000 | 3 |

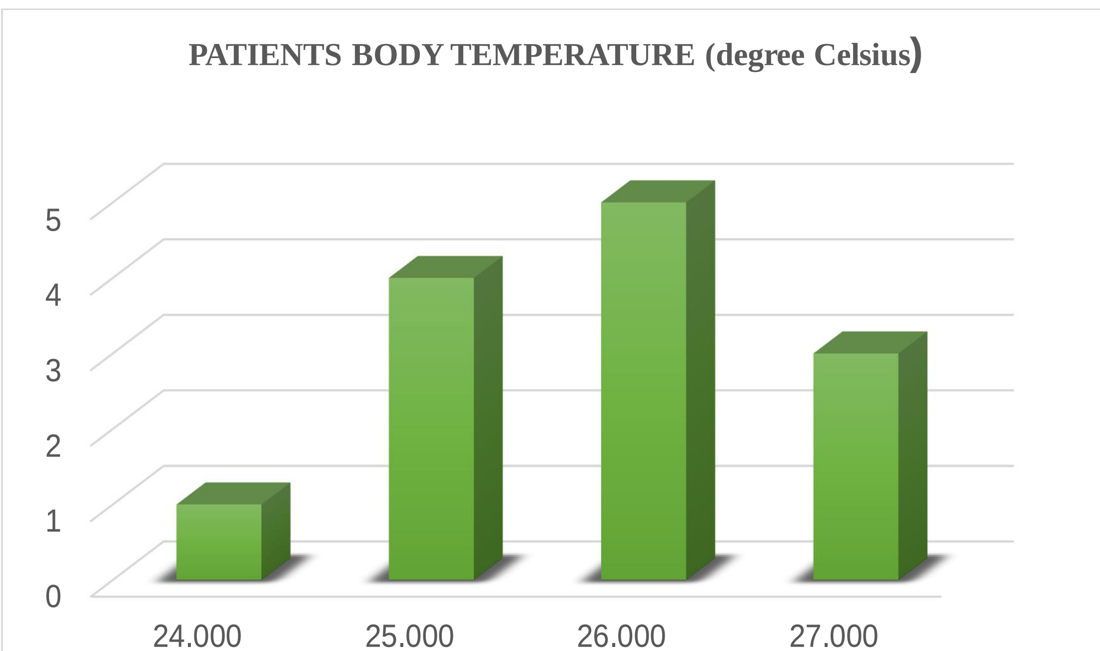


Figure 4.1: Patient body Temperature

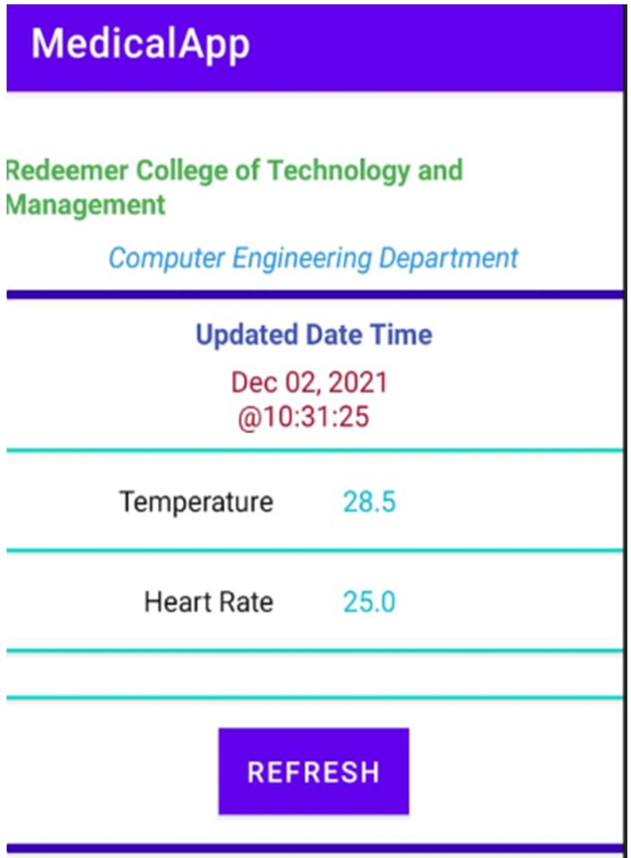


Figure 4.2: The Graphics User Interface (GUI) for the Android Application

The figure above depicts the graphical user interface of a software mobile application designed for patient health monitoring in both urban and rural areas of developing African countries such as Nigeria.

## V. CONCLUSION

This research proposes a less-cost RF-based PHM device for use in low-resource settings to improve patient monitoring settings and overcoming medical personnel shortages. Through the created RF-based in-patient monitoring system, medical centers and hospitals, particularly in rural areas of developing countries in Africa like Nigeria, may make effective and timely decisions about crucial patient treatment. The system employs distributed sensors, programmable microcontrollers, and RF modules that work together to offer real-time to centrally designated nurses, the patient's vital status is communicated and wirelessly sends information to mobile application.

## REFERENCES

[1] Gomez, Chessa, Fleury, Roussos, and Preuveneers, "Internet of Things for enabling smart environments: A technology-centric perspective," Journal of Ambient intelligent and smart environment, pp. 23-45, 2019.
[2] Gomez et al, "Internet of Things for enabling smart environments: A technology-centric perspective," Journal of Ambient intelligent and smart environment, pp. 23-45, 2019.
[3] Sajal et al, "Recent progress, challenges, and prospects of fully integrated mobile and wearable point-of-care testing systems for self-testing," Journal of Chemical Society Review, pp. 322-333, 2020.
[4] Andreas et al, "Review of supplemental oxygen and respiratory support for paediatric emergency care in sub-Saharan Africa," Elsevier, pp. 510-519, 2020.
[5] Kumar et al, "Intelligent Wireless Patient Monitoring and Tracking System(Using Sensor Network and Wireless Communication)’," Journal Biomedical Engineering, pp. 226-234, 2018.
[6] Spyro et al, "European Resuscitation Council Guidelines 2021: Ethics of resuscitation and end of life decisions," Elsevier, pp. 408-432, 2021.
[7] Bor and Roedig, "LoRA transmission Parameter Selection," in 13th IEEE International Conference on Distributed Computing in Sensors System (DCOSS), Ottawa, 2017.
[8] Conficius & Amber, "Healthcare System in developed and developing countries,," Journal of Medical Science, pp. 333-339, 2015.