Model of a Home Patient Monitoring System With An Alert Systems Using Blynk

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***Abstract*—This paper introduces a home-based health monitoring system tailored for elderly patients who face challenges attending regular physical checkups. Designed for non-hospitalized individuals receiving care at home, the system tracks vital health metrics such as heart rate and oxygen saturation, and includes a push button for emergency alerts. Using a prototype methodology, biomedical sensors capture data that is displayed in real time via the Blynk IoT platform, while simultaneously being stored in an Excel worksheet to maintain long-term patient history. When the alert button is pressed, immediate notifications are sent to the caregiver's smartphone and email, enabling swift response. The system aims to address accessibility barriers in traditional healthcare by offering continuous monitoring, timely alerts, and a reliable data storage framework that empowers caregivers and improves safety within domestic care environments.**

Keywords—Home Health Monitoring Model; Internet of Things (IoT); ESP32; Pulse Oximetry

I. Introduction

In this rapidly improving technology health field, people still struggle to keep themselves strong and healthy amid various diseases. The world is moving faster, and people are working tirelessly without realizing the importance of regular health check-ups. The world is surrounded by different kinds of different ages with various health conditions people. The elderly and disabled people surely want to have a good healthy and safe life too but due to the aging factor for the elderly, and limited movement of disabled people, it might be quite difficult to take care of themselves without any strong companion [1].

The patients will always need to be monitored by doctors for treatment purposes [2]. It is quite bothersome to have doctor checkups regularly to keep updated. The lack of a system offering instant access to current patient health data presents significant challenges for healthcare providers. In the absence of real-time information, monitoring treatment progress becomes difficult, often resulting in delays in recognizing and responding to medical concerns [3]-[5]. Accurate and timely patient data is essential for healthcare professionals to make well-informed decisions regarding diagnosis and treatment strategies [6}-[8].

Previous studies have utilized monitoring systems with wireless communication to track patient health [9]-[10]. More recently, remote health monitoring systems have been developed using IoT platforms, incorporating sensors and ESP32 modules to monitor both patient conditions and locations [11]-[12].

Throughout a few research about IoT in healthcare, there are lots of key features that are important to focus on for this project development. This focus on simple devices that are used on patients and the other key functions for remote communication, data server, and security should be applied on this device. The project uses ESP32 as the microcontroller board and as a Wi-Fi Module for internet connection with the dashboard server that will be used, the Blynk platform. That is chosen as a remote monitor feature because of the wireless connectivity.

II. Methodology

In this project, there are three phases applied to this project. Firstly, the project design as in the conceptual design of the project and its system. The second phase is project development, where all the hardware components will be constructed based on the design in Phase 1, along with software and cloud deployment. The third phase is project testing and troubleshooting to identify any issues and errors thus improving the functionality and accessibility based on the testing progress.

A. Project Design Phase

In this project design phase, lots of rough sketching the ideas from examples, deciding on a few project keys, and combining them into the actual project prototype. Fig. 1 below shows the block diagram of this project system workflow.

Fig. 2 shows the flow chart of the process begins when the patient places their finger on the MAX30100 pulse oximeter sensor, which measures pulse rate and oxygen saturation. There is a push button beside the sensor for the alert function. The sensors are connected to the ESP32, which is the microcontroller. The OLED screen display is connected to ESP32 for output purposes. Once the MAX30100 sensor is measured, the data from the sensors will be displayed on an OLED screen and at the same time will be sent to the cloud, where it appears on the Blynk dashboard as a widget form. As a Wi-Fi module, ESP32 works by sending data after successfully connected to a network and through the correct Blynk Template for security purposes. The push button also sends signals through ESP32 and sends an alert to a smartphone as a notification when patient presses it.

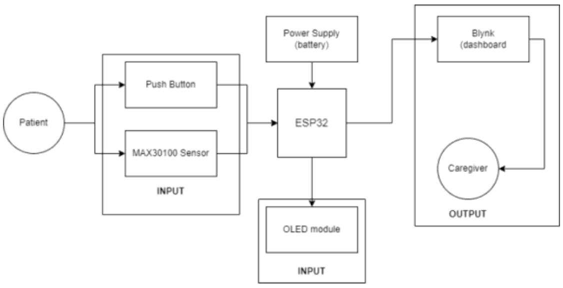

Fig. 1 Project Block Diagram

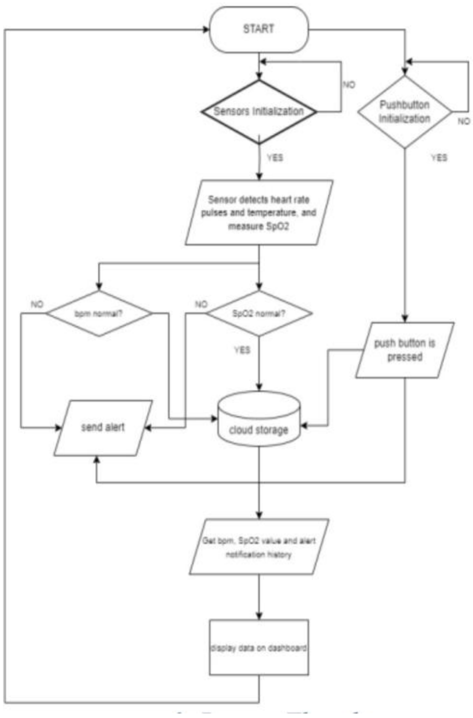

Fig. 2 Project Flow Chart

B. Project Development Phase

In this phase, the components will be built from sensors, jumper wires, and the microcontroller until the software configuration. Figure 3 below is the model of the circuit diagram for this project will be implemented in real life. The components are listed in circuit diagram below.

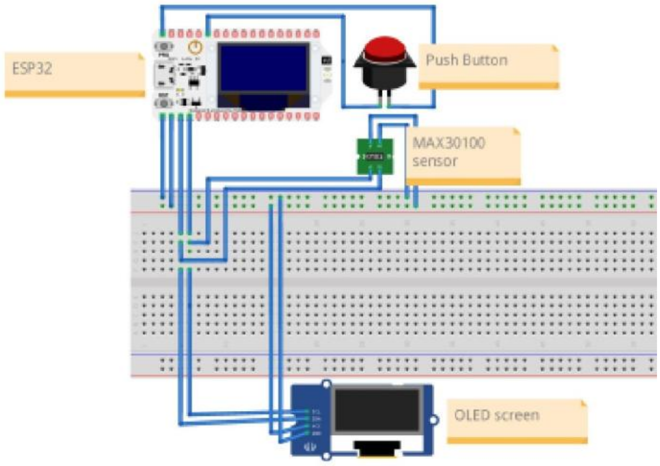

Fig. 3 The Circuit Diagram

C. Project Development Phase

In this phase, the completed prototype will be tested to make sure it is true to its functions. The components building is not always successful in one try, it needs to keep testing and fix any errors that happen either with code configuration in the IDE or the wrong connections. To develop a fully integrated system for this project, we need ESP32 as the microcontroller, connecting with the MAX30100 pulse oximeter sensor and an interactive functional push button for patient usage. Table I and II show the software and hardware components used to develop in this project. The prototype was built and the components were setup according to the prototype design.

TABLE I. SOFTWARE COMPONENTS

Components Description	Component
Arduino IDE The Arduino Integrated Development Environment wellknown as Arduino IDE is a software that contains a text editor for writing code, a message area, a text console, a toolbar for common functions, and a series of menus that connect to the Arduino hardware to upload programs and communicate with them.	ARDUINO
Blynk. Blynk IoT offers an IoT platform specifically designed for IoT projects. It is developed to support the integration of data from sensors and actuators on the Internet, which makes collecting and storing data from IoT devices easier and retrievable with various kinds of output functions and displays	Blynk

TABLE II. HARDWARE COMPONENTS

Components Description	Component
ESP32 Wi-Fi Module is chosen since it is a low-cost and low-power system on a chip microcontroller with integrated Wi-Fi and dual-mode Bluetooth. The standard security IEEE 802.11 also applied on this microcontroller including Wi-Fi Protected Access (WPA) and WLAN Authentication and Privacy Infrastructure (WAPI).	
MAX30100 Pulse Oximeter Sensor. This sensor is an integrated pulse oximetry and heart rate monitor sensor solution, a sensor that combines a photodetector, optimized optics, and low-noise analog processing to detect pulse oximetry and heart rate.	
OLED 4pin 128x64 Display Module 1.3 Inch. This OLED display has 128 columns and 64 rows which make it 8192 pixels, suitable for displaying text, images, and patterns. It needs a supply voltage of around 3V – 5V, can easily interface with any microcontrollers, and can communicate through SPI or IIC.	
Push button 2 pin. A button that allows to make connections for any function to send a signal or any interaction when it is triggered	

III. Result Discussion

The prototype of the project as shown in Fg. 4.

Fig. 4 The prototype

Fig. 5 and 6 shows the message after placing the finger or any pulse point to the sensor. Then it will display the data on the OLED display

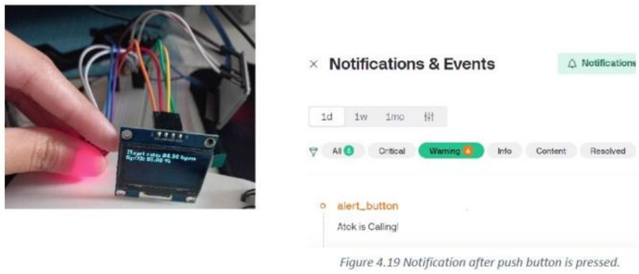

Fig. 5 Testing on MAX30100 and OLED screen display

The data from the user which are Heart Rate (bpm) in red colour, and purple colour for Oxygen Saturation Level (SpO2) graph was showed on the Blynk dashboard on smartphone app. Fig. 7 shown the data for past 15 mins for better visualization since the Live data just showed dotted graph. While Fig. 8 is the graph on web dashboard. Fig. 9 and 10 show the results in Excel for the heartbeat and the history of the alert notification.

The challenges were the unstable Internet connection and the constant need to check the connections, and ESP32 need to press "Enable" button in case the Wi-Fi was still connecting. Sometimes the wires are not tight and it is quite annoying to always fix them and need to tape them up especially when the push button pins are loose and the resultant, the button send a delayed signal.

This system is to implement in the house but instead of monitoring health key measures only, just build one for in-house fast message delivery between siblings' rooms. In the IoT view, this system is good to implement for in-house use in case some sick people do not have the will to speak or get up to walk around. It is also provide data worksheet to keep health key measures stored in data for any treatment references, in case there is any unstable record. Data acquisition is performed through direct contact with the patient's pulse point, and the measured values are simultaneously displayed on an onboard OLED screen and transmitted to cloud-based platforms. The system leverages Blynk for mobile dashboard visualization and Node-RED for backend data handling, ensuring seamless remote access and monitoring. Furthermore, historical data is archived in CSV format, facilitating longitudinal analysis and trend evaluation.

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The proposed system presents a scalable and cost-effective solution for remote health monitoring, specifically designed for non-critical patients in home-care settings. By integrating the ESP32 microcontroller with the MAX30100 pulse oximetry sensor, the system enables real-time acquisition and transmission of vital signs, including heart rate (BPM) and blood oxygen saturation (SpO_2). A push-button interface allows patients to initiate alerts, enhancing caregiver responsiveness. Data is displayed locally via an OLED screen and transmitted to cloud platforms using Blynk and Node-RED, with historical data archived in CSV format for further analysis. Public demonstrations confirmed the system's functional reliability and practical applicability.

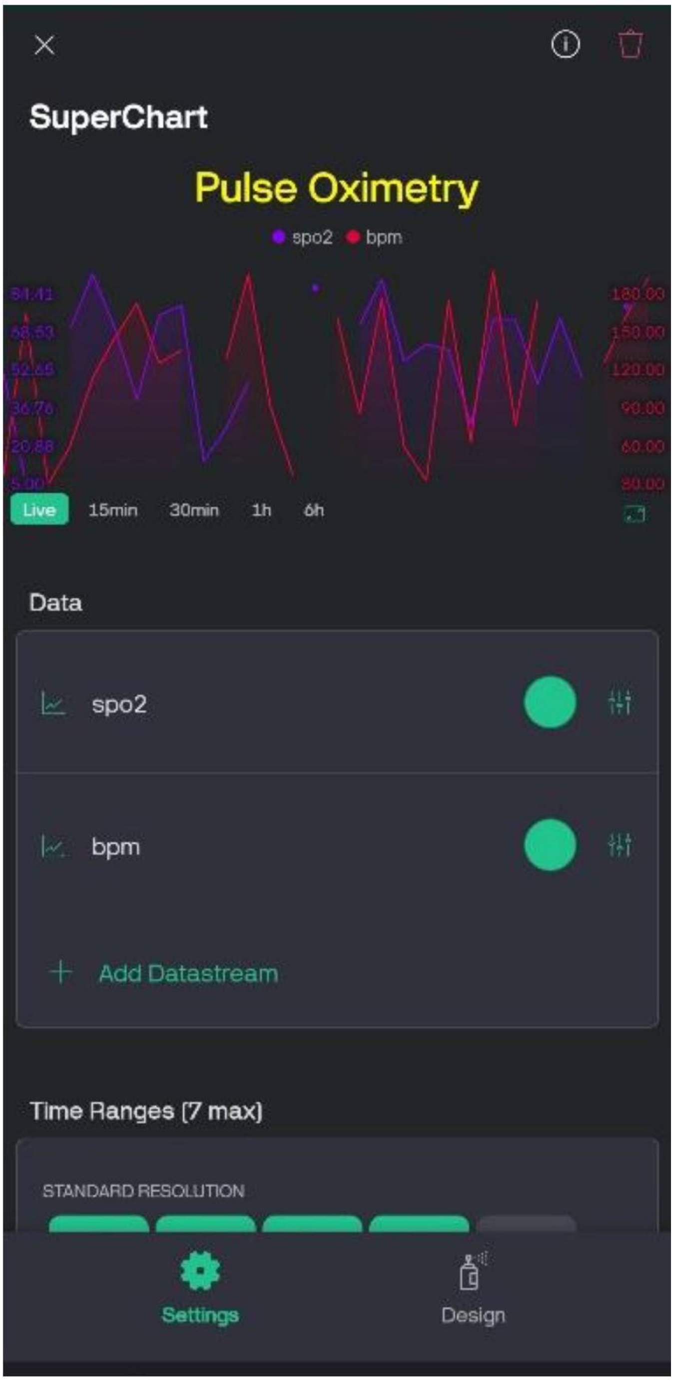

Fig. 6 Heart Rate and SpO2 chart widget

Fig. 7 Measurement display on the Dashboard

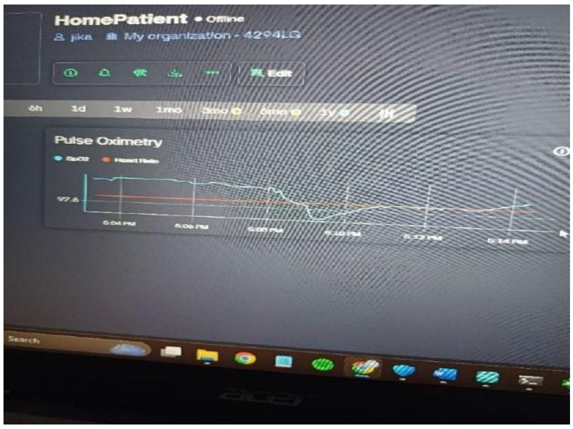

Fig. 8 Graph displayed on the Web Dashboard

	A	B	C
1	Time	Heart Rate	SpO2
2	6/12/2024 17:11	89.62	97.639
3	6/12/2024 17:10	89.8	97.617
4	6/12/2024 17:09	90.24444	97.564
5	6/12/2024 17:08	89.72	97.66889
6	6/12/2024 17:07	89.2	97.728
7	6/12/2024 17:06	89.1	97.74429
8	6/12/2024 17:05	89.14286	97.75143
9	6/12/2024 17:04	89.2	97.76
10	6/12/2024 17:03	89.35556	97.753
11	6/12/2024 17:02	89.22	97.77778
12	6/12/2024 17:01	89.28	97.778
13	6/12/2024 17:00	89.4	97.775
14	6/12/2024 16:59	89.66667	97.74667
15	6/12/2024 16:58	90.62	97.628
16	6/12/2024 16:57	91.74	97.485
17	6/12/2024 16:56	90.3	97.775

Fig. 9 Result of the Heart beat (bpm)

Time	Event Type	Name	Description
6/12/2024 17:08	WARNING	alert_butto	Atok is Calling!
6/12/2024 16:43	ONLINE	Online	
6/12/2024 16:42	OFFLINE	Offline	
6/12/2024 16:37	ONLINE	Online	
6/12/2024 16:37	OFFLINE	Offline	
6/12/2024 16:36	ONLINE	Online	
6/12/2024 16:36	OFFLINE	Offline	
6/12/2024 16:10	WARNING	alert_butto	Atok is Calling!
6/12/2024 15:57	ONLINE	Online	

Fig. 10 The history of Alert Notification from Excel

IV. Conclusion

This study presents the successful implementation of an IoT-enabled biomedical monitoring system designed for home-care applications. Utilizing the ESP32 microcontroller and the MAX30100 pulse oximetry sensor, the system enables continuous, real-time monitoring of critical physiological parameters—namely heart rate (BPM) and blood oxygen saturation (SpO_2). The integration of a tactile push-button interface provides an additional layer of interactivity, allowing patients to signal caregivers when assistance is required.

For future development. First, the implementation of threshold-based alert mechanisms for abnormal heart rate and SpO_2 readings is essential for early detection and timely medical intervention. This recommendation was supported by a case involving a patient with undetected critical blood pressure levels, emphasizing the need for proactive monitoring. Second, the integration of additional biometric sensors, such as blood pressure and glucose level monitors, is suggested to expand the system's diagnostic capabilities. Although current budget constraints limit the feasibility of these additions, their inclusion would significantly improve the system's utility for chronic disease management in home-care environments.

In conclusion, the system establishes a robust foundation for accessible, real-time health monitoring. Future work should focus on enhancing sensor integration, implementing intelligent alert systems, and advancing data analytics to support predictive healthcare models.

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