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DEVELOPMENT OF PATIENT MONITOR USING WIRELESS AND TOUCHSCREEN TECHNOLOGY

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Abstract

The project aims to create a Patient Monitor using wireless and touch screen technology. The idea is to transmit data faster at a high-speed wireless technology. Meanwhile, the current patient monitors in the market provide less convenience in accessing menus, keyboards, or functions because they still rely on button features. The objective of the project is to change the cable technology by replacing it with wireless technology. The project also uses a touch screen display to provide a faster and more efficient selection of menu options. Furthermore, this product also aims to track patient data history via an IoT application. This project uses Wemos D1 Mini and NodeMCU ESP8266 to send the data wirelessly from the device to the smartphone. The project also uses a Thin Film Transistor (TFT) LCD to make the screen touchable. This project used the MAX30102 sensor to find heart rate, temperature, and oxygen concentration parameters. The Wemos D1 Mini provides the internet connection between the device and the database because this microcontroller is already built in the Wi-Fi inside its components. The data will store on a cloud storage system via the internet. IoT apps securely store user data online, which can be accessed via a phone app. The application can monitor patient health and analyze the data to recommend treatments or generate alerts.

Keywords: Patient Monitor, wireless, touchscreen, Wemos D1 mini, NodeMCU ESP8266, TFT LCD, MAX30102.

1.0 Introduction

A patient monitor is a medical instrument that monitors a patient's vital signs. A typical operating room patient monitor includes ECG, Respiration, Non-Invasive Blood Pressure (NIBP), blood oxygen level, temperature, and invasive blood pressure (IBP), which measures carbon dioxide levels from the patient's respiratory system. Patient monitor parameters include ECG, respiration, blood pressure, temperature, and blood saturation. These include electrocardiogram (ECG), respiratory rate and oxygen saturation, temperature, and invasive blood pressure (IBP), which monitors carbon dioxide levels in the patient's respiratory system. This equipment is the most important medical tool in hospitals and clinics, according to several studies. A Patient Monitor is essential in every household, not just hospitals. This study focused on portable patient monitors with touchscreens and wireless cable technology that were connected to an IoT system.

The most common Patient Monitor issue is the cable. On one hand, there are technical issues with the cable, like disconnected cables and bent or damaged plugs. All medical equipment encouraged to have a touch screen interface for dependable and effective data collecting. At the same time the touchscreen application also makes launching data and outcomes easier. The developing of the Patient Monitor with IoT and mobile apps may solve this issue. Today's technology is essential to develop wireless patient monitors that are simple and quick to respond. Touch screen technology is ideal for this purpose.

Several studies have concluded that the most significant medical gadget in hospitals or clinics is the Patient Monitor device. Not just in hospitals, but in every home, a Patient Monitor gadget is required to monitor health. This research focused on portable Patient Monitor devices that had been modified with a touchscreen monitor and wireless cable technology that was integrated with an IoT system.

1. Methodology

This chapter describes the process and methods to implement this project successfully. Designing and developing the Patient Monitor using Wesmo D1 mini and NodeMCU, drawing operating system block diagrams, making operating device flow charts, and making the device wireless are all stages of this research. Data collection was collected to analyze the error of the output. This method is used to achieve project objectives that achieve perfect results.

This project combines software (systems) and hardware (device) to develop an IoT system for patient data monitoring. Using MIT App Inventor for Graphic User Interface (GUI) on the smartphone, the Arduino platform's software has been developed. This application controls and monitors the patient's historical data. The application became the output for the data of the overall project.

1.1 Developing the hardware and IoT implementation of the Patient Monitor

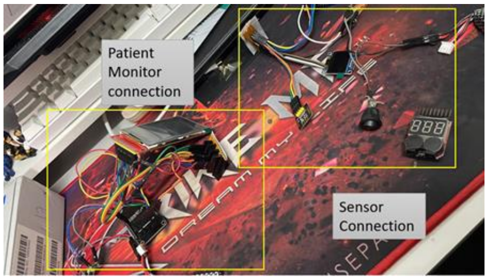

Figure 12 Circuit Connection

Figure 1 shows the circuit of the Development Patient Monitor using wireless and touchscreen technology. All hardware installations follow the schematic circuit made in Fritzing software. Wemos D1 mini is the microcontroller used in this project, on which programs may be loaded using the Arduino IDE software. Next, NodeMCU is an open-source firmware and development kit that aids in the prototyping and developing of Internet of Things (IoT) products. In addition, a MAX301022 sensor is used to find the patient's heart rate, blood oxygen concentration, and temperature. This device required the smartphone to turn on the internet data and the personal hotspots to take the data. The polystyrene was used to prevent the component from getting too close due to a short circuit. The casing is made of plastic, so it is strong and not easily broken.

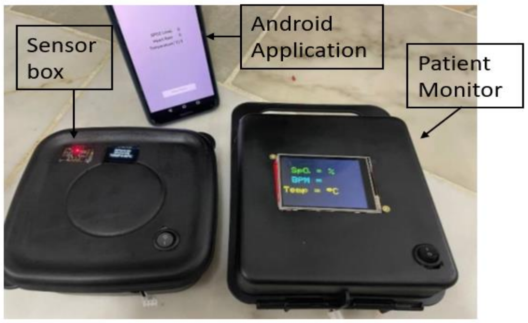

Figure 13 Project's Device

Figure 2 above shows the complete product of the project. The left box represents the sensor the user will put their finger to the MAX30102 sensor. The data will be shown on the OLED display. The left box represents the Patient Monitor device with a TFT touchscreen display. The data shown on the sensor will be transferred to the Patient Monitor device wirelessly through Wi-Fi. The data is also displayed on the smartphone so the user can track the data history after using it.

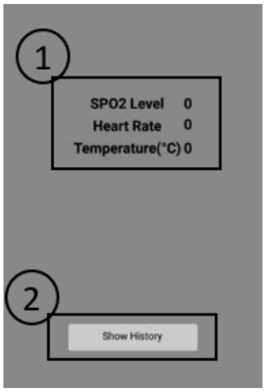

Figure 14 Application on Android smartphone

The interface of IoT implementation using the MIT App Inventor application for collecting the data from the sensor is shown on figure 3 above. The MIT App Inventor application is easy to download for android smartphones. The user can track their health record easily by using the application.

No.	Button
1	Output data
2	History button

Table 14 Function button on the MIT App Inventor application

Table 1 above shows the function of each button of the MIT App Inventor application. No. 1 is will shows the data taken from the sensor. No. 2 is the history button. The user can track their history by pushing the history button.

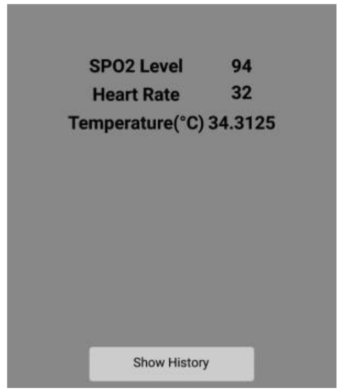

Figure 15 Value appears

The figure 4 above shows the example data when the user touches the MAX30102 sensor. The data that comes out is data from the Patient Monitor device.

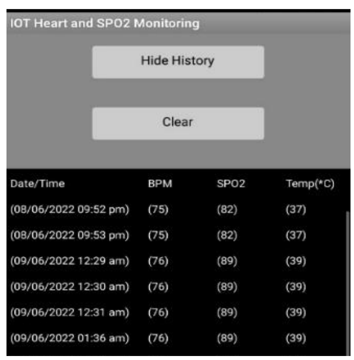

Figure 16 History data

Figure 5 shows the history data when the user puish the history button. The application will record and save information such as date and time, BPM, SP02, and temperature. This record is saved as private and confidential files to keep the privacy of patient information.

1.2 Block Diagram of the Operating System

This project's hardware and software will be combined to create the project "Development of Patient Monitor Using Wireless and Touchscreen Technology".

Furthermore, the device will have an application that will allow users to pick the mode, receive alerts in the form of alarms, and receive updates about the health monitoring system through IoT. A 7V rechargeable battery will serve as the circuit's power source. The output from the device will be displayed on the OLED displayand TFT display. Below shows the block diagram of the MAX30102 sensor, TFT display, and collecting data block diagram.

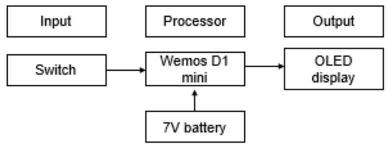

Figure 17 Block diagram (MAX30102 sensor)

Figure 6 shows the block diagram of MAX30102 sensor. The Wemos D1 small will process the MAX30102 sensor's data. A 7V rechargeable battery will serve as the circuit's power source. The output from the MAX30102 sensor will be displayed on the OLED display.

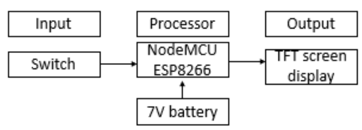

Figure 18 Block diagram (TFT display)

Figure 7 shows the block diagram of TFT display. The NodeMCU ESP8266 will process the data collected from the Wemos D1 Mini and display the data on the TFT screen.

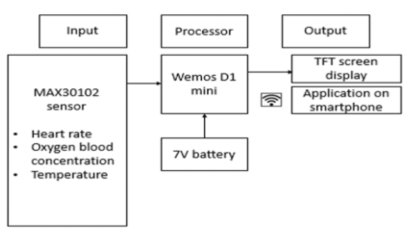

Figure 19 Block diagram (Collecting data)

Figure 8 shows the block diagram of collecting data. The NodeMCU ESP8266 will process the data collected from the Wemos D1 Mini and display the data on the TFT screen.

1.3 Making Flow Chart of the Operation Device

Flowchart in Figure 9 displays a process that begins with users turning on the device and then choosing to change a setting on the device or the user's smartphone. The user has selected the parameters heart rate, oxygen blood concentration, and temperature as his or her preferences. All the device's characteristics can also be customized by the user. After that, the device will begin monitoring and displaying the data collected. The information will be displayed on the touchscreen display of the device or smartphone.

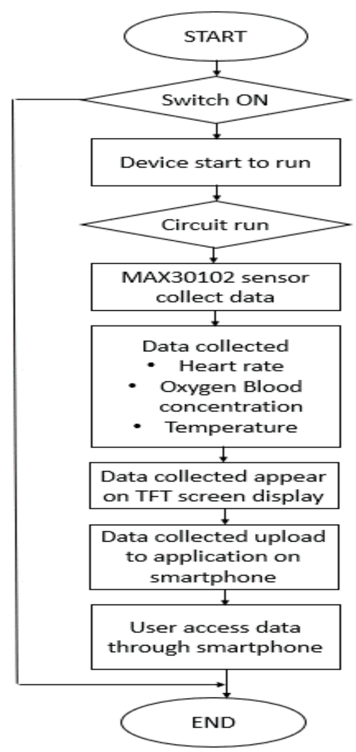

Figure 20 Project's Flow chart

1.4 Data Collection Method

1.4.1 Experimnt on Transmission Data and Connection Test

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Figure 21 Transmission Data and Connection Test

Figure 10 shows the transmission Data and Connection Test. This experiment aims to determine whether the data displayed on the sensor device and the TFT screen Patient Monitor are the same. The user will put finger on the sensor and wait for several seconds. Make sure the internet connection is stable. The user can determine how much error occurred by using percentage error calculation.

1.4.2 Comparison of Product Data and Current Product Data

Oximeter devices were used for comparing heart rate data and oxygen blood concentration data. Using this method, the difference in value between the new and the existing products may be determined. Temperature data also be compared to analyse the temperature data by using infrared thermometer.

1.4.3 Percent error

. Percent errors indicate how significant the errors are when measuring something in an analysis process. More minor percent errors indicate that they are close to the accepted or original value. For example, a 1% error indicates that the user got very close to the accepted value, while 48% means they were far from the true value. Measurement errors are often unavoidable due to certain reasons like hands can shake, the material can be imprecise, or instruments might not be able to estimate exactly. The percent error formula will let the user know how seriously these inevitable errors influenced the results.

$$Percentage\ Error = \frac{Measured\ Value - True\ Value}{True\ Value} x\ 100\%$$

2. Result and Discussion

2.1 Transmission Data and Connection Test

Table 2 shows the table of Transmission Data and Connection Test data. Data Transmission and Connection Test find the percentage error between the data displayed on the TFT display and the data displayed on the Application on the smartphone. The data shows that all data transmission and connection errors are 0%.

No.	**Heart rate**			**Oxygen Blood Concentration**			**Temperature**		
	TFT display	Apps	Error (%)	TFT display	Apps	Error (%)	TFT display	Apps	Error (%)
1	1.16	1.16	0	79%	79%	0	32.44	32.44	0
2	0.53	0.53	0	95%	95%	0	33.69	33.69	0
3	2.13	2.13	0	96%	96%	0	34.12	34.12	0

Table 15 Table of Transmission Data and Connection Test data

2.2 Data Analysis of The Product

Table 3 below shows the error analysis of the product. This data analysis finds the percentage error between the product (MAX30102 sensor) and the oximeter. The first data compares the heart rate data between the two products. To conclude the data, most of the error is 99%, so the heart rate product data is inaccurate compared to the oximeter data.

Next, the Oxygen Blood Concentration data will be taken using two devices: the product and the oximeter. Following the table below, the highest value of percentage error is 18.56%, and the lowest value of percentage error is 1.03%. This data shows that the value of the product and oximeter is approximate.

The last data taken is temperature data. Temperature data were taken using the product and infrared thermometer. The highest percentage error value is 10.41%, and the lowest is 8.35%.

No.	Heart rate		Plus, minus (+ -)	Error (%)
	MAX30102 Sensor	Oximeter		
1	1.16	132.11	130.95	99.12
2	0.53	127.51	126.98	99.58
3	2.13	140.70	138.57	98.49
No.	Oxygen Blood Concentration		Plus, minus (+ -)	Error (%)
	MAX30102 Sensor	Oximeter		
1	79%	97%	18	18.56
2	95%	98%	3	3.06
3	96%	97&	1	1.03
No.	Temperature		Plus, minus (+ -)	Error (%)
	MAX30102 Sensor	Infrared Thermometer		
1	32.44	36.21	3.77	10.41
2	33.69	36.76	3.07	8.35
3	34.12	37.63	3.51	9.33

Table 16 Error analysis of the product

3. Conclusion

The development of the Patient Monitor using wireless technology and a touch screen is a user-friendly device, and it can be used by anyone, especially for hospital needs. Moreover, the Wireless network can be accessed from anywhere, at any time. It will facilitate the work of the hospital in taking patient data. Using the Wemos D1 Mini will act as a web server, allowing any Wi-Fi-connected device to interact with the board and send data wirelessly. MAX30102 sensor is a full pulse oximetry and heart rate sensor module. The sensor is tiny, allowing for data collection without compromising optical or electrical performance. The Arduino 2.4-inch TFT LCD Touch shield makes this project have a touchscreen display. The device will be a low-cost Patient Monitor with wireless and touch screen technology.

4. Acknowledgment

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