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IOT BASED (BLYNK) DIGITAL TENSIMETER AND BEAT PER MINUTE

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ABSTRCT

In the current industrial era, developments in the electronic aspect are so advanced, for example in the health sector. Currently, there are many new medical devices that allow people to easily find out their health conditions, one of which is checking blood pressure and heart rate. Blood pressure and heart rate are one of the vital signs of humans. Blood pressure is the pressure exerted by the blood against the walls of the arteries. In measuring blood pressure there are two values used such as systolic (when the heart beats) and diastole (when the heart is relaxed). Heart rate usually refers to the amount of time the heart beats per unit time, generally represented as BPM (Beats Per Minute). The purpose of writing this Scientific Paper is to make an IoT-based digital tensimeter and bpm which aims to be able to easily measure blood pressure and heart rate that can be accessed from the internet. The IoT-Based Digital Tensimeter and BPM (Blynk) can measure blood pressure and heart rate (bpm) through the IoT system in the Blynk application on andrioid smartphones and LCDs properly. The device can read blood pressure with an accuracy of 99.58% systolic and 97.75% diastole. Then the BPM can read with an accuracy of 98.29%.

Keywords: Digital Tensimeter, BPM, Heart Rate, Blood Pressure

BACKGROUND

In the current industrial era, developments in the electronic world are so rapid, for example in the health sector. Currently, there are many new medical devices that allow people to easily find out their health condition, one of which is checking blood pressure and heart rate. Blood pressure and heart rate are one of the human vital signs. Heart rate is an important sign in the medical field that is useful in the medical field to quickly check one's health or fitness.

Blood pressure is the pressure felt by the walls of the arteries when blood is pumped by the heart throughout the body. In measuring blood pressure, there are two important values used, namely systolic and diastolic (Amiruddin, Danes and Lintong, 2015). Blood pressure is very important for humans because high blood pressure or what is commonly called hypertension is a dangerous disease if not treated immediately so that later it can cause strokes, heart disease, and increase the risk of developing diabetes. So for that, routine blood pressure checks are needed because hypertension can attack anyone. To check this blood usually use a tensimeter (Sholihudin Dwi Prihatono Tanjung, 2017).

Tensimeter is a tool in the medical world that is used to check blood pressure in humans. Generally tensimeter is divided into two, namely analog tensimeter and digital tensimeter The analog tensimeter works using the korotof method which determines the patient's systole and diastole through the sound of the heartbeat (korotof sound) with the help of a stethoscope. While the digital tensimeter works based on the oscillometry method where to determine the patient's systolic and diastolic pressure sensors are used as transducers that will detect blood pressure and changes in heart rate oscillation signals (Sholihudin Dwi Prihatono Tanjung, 2017). Pulse oximeter is a tool to find out the heart rate beats per minute (bpm) this is a parameter to show heart conditions, and the way to To know the condition of the heart is to know the frequency heart rate (Ketut *et al.*, 2018). The purpose of this study is to develop previous research by adding BPM parameters and using the Android display on the Blynk application. This tool is designed to be based on IoT (Blynk) that can measure blood pressure and heart rate (bpm) through the IoT system in the Blynk application on Android smartphones and LCDs properly (Afriansyah Yovi, Arifuddin Rahman and Novrianto Yusuf, 2018).

As time goes by, technology is getting more sophisticated and developing rapidly. One of them is the Internet of Things technology or what is known as (IoT). The Internet of Things is a technology concept tat aims to expand the benefits of continuously connected internet connectivity. The Internet of Things (IoT) in the health sector makes use of the continuous internet connectivity function for people working in the health sector. One way that can be taken to be able to access data with the Internet of Things (IoT) system is to use wifi (Tatilu, Sompie and Wuwung, 2022) .Blynk is a free downloadable application platform for iOS and Android that lets you control Arduino, NodeMCU, Respberry Pi, and the like over the internet. Blynk was designed for the Internet of Things with the goal of remotely controlling hardware, displaying sensor data, storing data, visualizing, and doing other advanced things. The Blynk application has 3 main components, namely Blynk App (Application), Blynk Server, Blynk Library. Blynk server serves to handle all communications between smartphones and hardware (Tatilu, Sompie and Wuwung, 2022)

Therefore, this study will design a digital tensimeter that is different from what has been done by previous researchers. The digital tensimeter in this study is equipped with measurements of heart rate per minute by utilizing Wemos D1 R2 as a microcontroller to process data from sensors (Roushul, 2022). This study also added a display with the internet (IoT) through the network which will also be seen by doctors in monitoring patients before examination and during treatment.

METHOD

Planning stage

At the planning stage of making the module to be made. This aims to facilitate the manufacture of modules so that the results achieved are as planned.

The planning stages in making the module are as follows:

1. Prepare tool and component specifications.
2. Design block diagrams and wiring diagrams of the modules to be made based on the desired way of working.
3. Designing program flowcharts from the modules to be made.
4. Designing the casing according to the tools that have been made.
5. Determine the components used in the manufacture of tools.
6. Determine the measurement point (Test Point) for data collection and circuit analysis.
7. Testing and repairing the modules that have been made.
8. Compile results in the form of scientific papers based on relevant theories and module data collection results.

Block diagram system

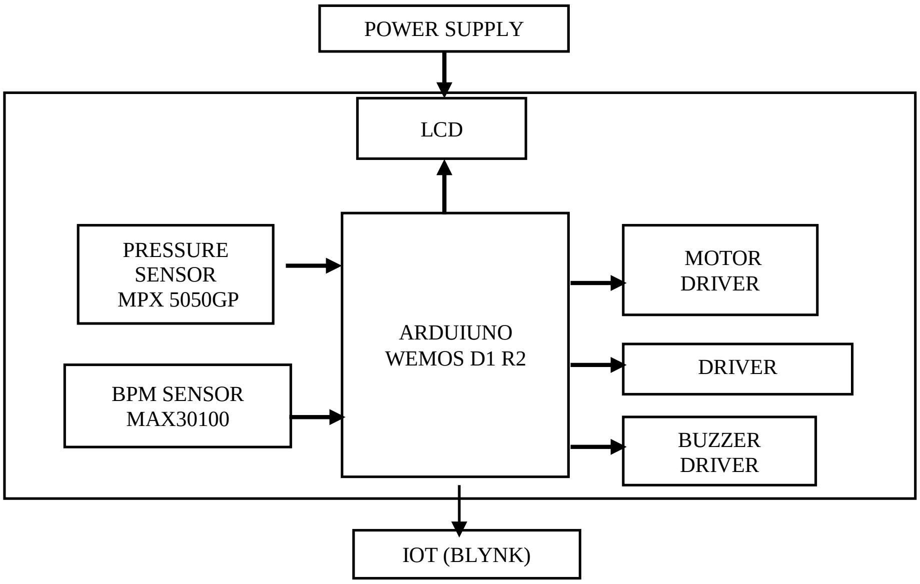

Figure 1 Block Diagram System

Block diagram description

1. *Power Supply*

   Converts AC voltage to DC and outputs 5VDC voltage as a voltage source. From the power supply circuit the transformer receives an AC voltage of 220 V and will lower the voltage to 12VAC. After the circuit is lowered, the voltage will be rectified by the diode bridge to become VDC voltage. The output from the diode will go to the capacitor which will reduce the noise voltage in the circuit. After that from the capacitor, then the voltage will enter the 7812 IC and will be used as an output voltage of 12VDC (Fegi Nisrina *et al.*, 2022).

2. *Pressure* Sensor (MPX5050GP)

To measure the incoming and outgoing air pressure. The MPX5050GP pressure sensor is a piezoelectric transducer made of monolithic silicon. This sensor is made of non-toxic and environmentally friendly materials which is very important in producing medical devices. This sensor is designed to be used for applications that utilize microcontrollers or microprocessors with Analog or Digital inputs. This sensor is known to be accurate because it has two poles, and gives a high level output signal that is proportional to the applied pressure (I Putu Widi Ardinata 06 Kadek Agus Hari Pratama 26, 2020).

3. BPM Sensor (MAX30100)
   To measure heart rate per minute. This sensor consists of two LEDs, one emitting red light and the other emitting infrared light and a photodetector. For pulse, only infrared light is needed. The MAX30100 sensor operates from both 1.8V and 3.3V power supplies and can be turned off via software with negligible standby current, allowing the power supply to remain connected at all times (Harianto, Hidayat and Hulu, 2021).
4. Motor Driver
   As a control for dc motors and solenoids. In this motor driver circuit, it is connected to the Wemos D1 R2 pin, namely pin D6, when the cuff is pumped, the motor driver will turn on. The function of the transistor in the motor driver is as a switch so that the motor will inflate the cuff to its maximum point (Ahmad Nur Kholis Suhermanto *et al.*, 2023).
5. Solenoid Driver
   As a control for the solenoid valve. This solenoid valve is a valve that is controlled by an electric current both AC and DC through the coil/solenoid, its function is only to close/open the channel. because it only has 1 inlet hole and 1 outlet hole (Muhammad Abdun Syakur, 2022).
6. Arduino Wemos D1 R2
   As a microcontroller that controls the work of the tool. Wemos D1-R2 is an Arduino compatible development board specially designed for IoT (Internet of Thing) needs. Wemos D1-R2 uses the ESP8266 type WiFi chip. Wemos D1-R2 has 11 digital I/O, 1 analog input with a maximum voltage of 3.3V (Khoirunnisa Sofia, 2018).
7. Push Button
   As a calibration button on the tool. In this Push Button circuit, the pin will be connected to the Arduino Wemos D1 R2 which is used as a microcontroller (Danindra Riski, 2019).
8. On/Off
   To turn on the On/Off switch on the tool. The switch, which in English is called the Switch, is one of the most frequently used electrical components or devices. Almost all electronic and electrical equipment requires a switch to turn on or turn off the electrical device used (Rizki, 2021).
9. LCD
   To display the reading results from the tool that will appear on the LCD. The LCD (Liquid Cristal Display) functions as a data viewer in the form of characters, letters, numbers or graphics which will later be used to display the working status of the tool (Subagyo and Suprianto, 2017).
10. Blynk App
    To display the readings from the pressure sensor and bpm sensor on Android. Blynk is designed for the Internet of Things with the goal of being able to remotely control hardware, be able to display sensor data, be able to store data, visualize and do many other advanced things (Supegina and Elektro, 2017).

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Tool flowchart

Perencanaan flowcart dari alat ini sebagai berikut:

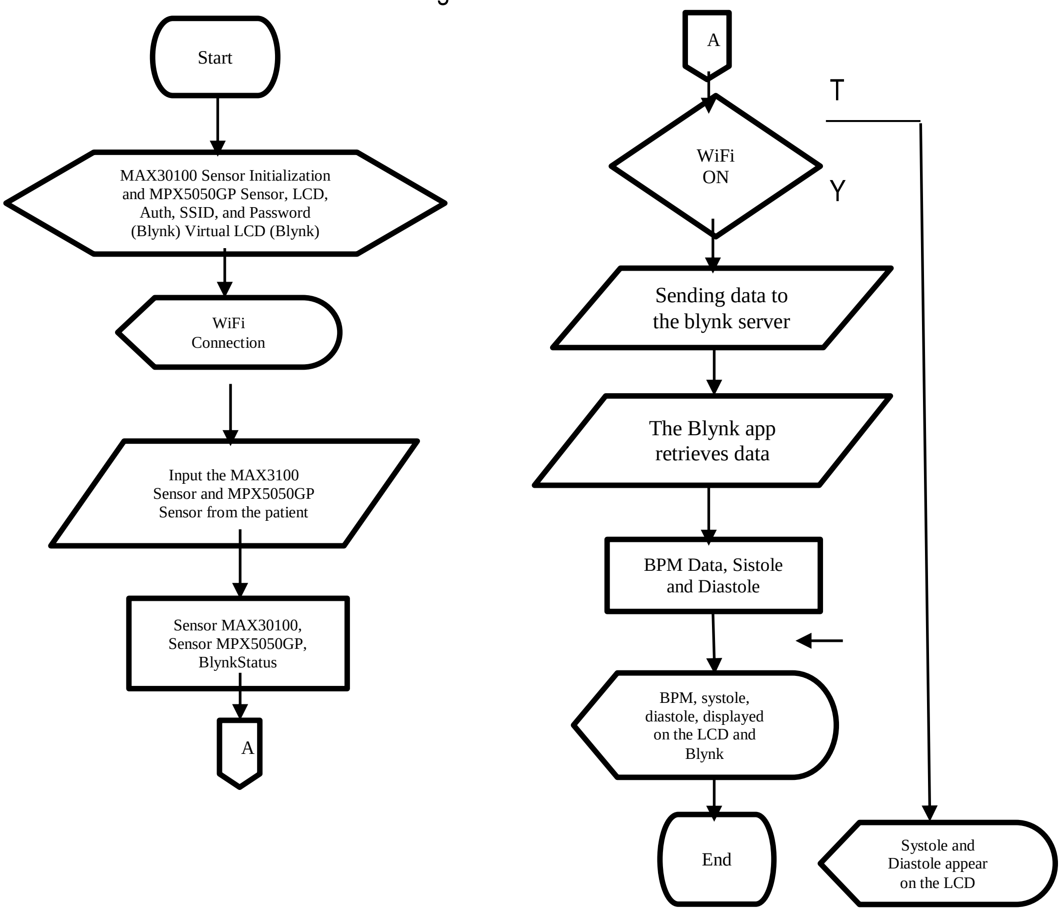

Figure 2 Tool Flowchart

Desain alat

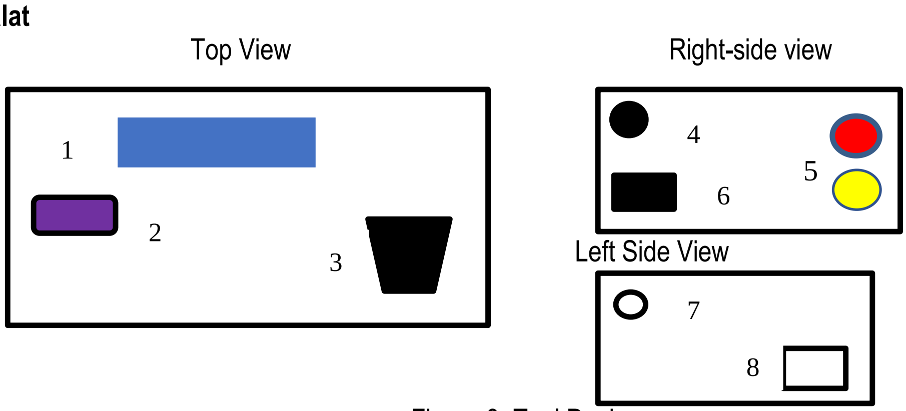

Figure 3. Tool Design

Here is an explanation of its parts:
1. LCD Display
2. MAX30100 Sensor
3. Saklar On/Off
4. Fuse
5. Push button
6. Power Cable Hole
7. Manset Hole
8. *USB Micro*

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Step testing tools

After making the tool, the next step is to carry out tests and measurements that aim to determine the performance of the tool and ensure that the tool can function as planned by the author. There are several stages of measurement and testing, as follows:

1. Prepare the tools needed.
2. Prepare a data table to record the results of the measurements that have been made.
3. Take sensor readings by measuring blood pressure and heart rate on the tool that has been made.
4. Record the measurement results in the table that has been made

RESULT AND DISCUSSION

Measurement results

Measurements were made with an AC voltage source of 220.8VAC. After measuring at each predetermined measurement point, the measurement results are obtained as follows:

1. Measurement Point Results 1

Table 1. Measurement Results At point 1

Measurement point (1)	Measurement Result	Figure
Output Trafo	11,67 VAC	

2. Measurement Point Results 2

Table 2. Measurement Results At point 2

Measurement point (2)	Measurement Result	Figure
Output Power Supply	12,04 VDC	

3. Measurement Point Results 3

Table 3. Measurement Results At point 3

Measurement point (3)	Measurement Result	Figure
a. Output Wemos D1 R2 (5V)	5,01 VDC	
b. Output Wemos D1 R2 (3,3V)	3,376 VDC	

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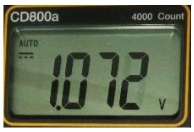
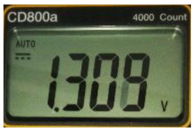
4. Measurement Point Results 4

Table 4. Measurement Results At point 4

Measurement point (4)	Measurement Result	Figure
a. Output Motor DC (Not Work)	5,01 VDC	
b. Output Motor DC (Work)	4,97 VDV	

5. Measurement Point Results 5

Tabel 5. . Measurement Results At point 5

No	Measurement point (5) Output Sensor MPX (Tekanan)	Measurement Result	Figure
1	0 mmHg	0,164 V	
2	20 mmHg	0,359 V	
3	40 mmHg	0,604 V	
4	60 mmHg	0,847 V	
5	80 mmHg	1,072 V	
6	100 mmHg	1,309 V	
7	120 mmHg	1,537 V	
8	140 mmHg	1,769 V	

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9	160 mmHg	2,010 V	

3.2 COMPARISON RESULTS OF TOOL

3.3.1 Results of Comparison of Tool Modules with Tensimeter Digital

Functional testing is carried out by comparing the value of blood pressure readings with a Digital tensimeter.

Table 6. Comparison of Tool Module with Digital Tensimeter

No	Responden	Gender (M/F)	Tool Module	Digital Tensimeter
1	A	M		
				
2	B	F		
				
3	C	M		
				

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4	D	F		
				
5	E	M		
				

3.3.2 Results of Comparison of Tool Module with Pulse Oximetry

Functional testing is carried out by comparing the value of the heart rate reading with the Pulse Oximetry tool.

Table 7. Comparison of Tool Module with Pulse Oximetry

No	Responden	Gender (M/F)	Tool Module	Pulse Oximetry
1	A	M		
				
2	B	F		
				

3	C	M		
				
4	D	F		
				
5	E	M		
				

Data analysis of equipment comparison results

Data Analysis of Comparison Results of Tool Modules with Digital Tensimeter

Tool comparisons were carried out on 5 people with the comparison tool used, namely Digital Tensimeter. Measurements for each person were carried out 2 times. To see the results of the comparison can be seen in the table below:

Table 1. Data Analysis of Tool Comparison Results

No	Responden	Gender (M/F)	Tool Module		Digital Tensimeter		Accuracy (%)	
			Sys	Dys	Sys	Dys	Sys	Dys
	A	M	112,3	71,2	112	70		
			112,3	73,2	114	72		
1	Rata-rata		112,3	72,2	113	71	99,39	98,31
	PK Sys		0,61%					
	PK Dys		1,69%					
	B	F	122,9	81,7	124	80		
			125,1	84,9	125	82		
2	Rata-rata		124	83,3	124,5	81	99,6	97,17
	PK Sys		0,40%					
	PK Dys		2,83%					
	C	M	139,6	82,4	139	85		
			137,3	85,2	137	87		
3	Rata-rata		138,45	83,8	138	86	99,68	97,45
	PK Sys		0,32%					
	PK Dys		2,55%					
	D	F	126,1	80,0	125	78		
			125,1	84,9	125	82		
4	Rata-rata		125,6	82,45	125	80	99,52	96,94
	PK Sys		0,48%					
	PK Dys		3,06%					
5	E	M	132,2	81,0	132	80	99,71	98,89
			134,0	81,8	136	81		

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Rata-rata	133,6	81,4	134	80,5		
PK Sys	0,29%					
PK Dys	1,11%					
Average Accuracy (%)					99,58	97.75

Analysis of Comparison Results of Tool Module with Pulse Oximetry

Tool comparisons were carried out on 5 people with the comparison tool used, namely Pulse Oximetry. Measurements for each person were carried out 2 times. To see the results of the comparison can be seen in the table below:

Table 9. Data Analysis of Tool Comparison Results

No	Responden	Gender (M/F)	Tool Module (BPM)	Pulse Oximetry	Percent Error (%)	Accuracy (%)
1	A	M	71	72	2,06	97,94
			71	73		
	Rata-rata		71	72,5		
2	B	F	75	75	0,66	99,34
			75	75		
	Rata-rata		75	2,02		
3	C	M	76	74	2,01	97,99
			76	75		
	Rata-rata		76	74,5		
4	D	F	81	81	0,61	99,39
			81	82		
	Rata-rata		81	81,5		
5	E	M	76	79	3.18	96,82
			76	78		
	Rata-rata		76	78,5		
Average Accuracy BPM (%)						98,29

CONCLUSION AND SUGGESTION

Conclusion

After making this tool and studying the design literature, testing the tool, and analyzing the tool, the authors conclude that The IoT-Based Digital Tensimeter and BPM Tool (Blynk) can measure blood pressure and heart rate (bpm) through the IoT system in the Blynk application on Android and LCD smartphones properly. The tool can read blood pressure with an accuracy of 99.58% systolic and 97.75% diastolic. Then the BPM can be read with an accuracy of 98.29%.

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