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Early detection model of normal and abnormal blood flow using pulse Oximetry non-invasive of pregnant heart rate

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ABSTRACT

The heart is an important organ in humans as an identification of early examinations in pregnant women carried out by doctors to determine normal and abnormal pregnancies in the fetus. Heart rate or BPM (beats per minute) is a parameter that indicates the condition of a person's heart. The normal human heart rate ranges from 60-100 beats per minute. In pumping blood throughout the body, the heart then holds it back after being cleaned by the lungs and this is closely related to the level of oxygen flowing in the bloodstream. Humans need sufficient oxygen levels in the body to survive. One of the vital monitoring tools for oxygen levels in the human body is pulse oximetry. Pulse oximetry is usually in units or rooms with high and rapid action cases such as the ICU. From these problems, it is necessary to make a research on a diagnostic instrument model for early detection of normal and abnormal blood flow using non-invasive pulse oximetry, a case study of the heart rate of pregnant women which can be identified early through the max 30100 sensor reading in the form of detecting the heart rate and oximeter, then processed by Arduino uno R3 where arduino uno processes data in the form of heart rate and oxymeter readings so that it can be displayed via a 16x2 LCD, the output is the identification of the value of the heart rate and oximeter input so that the normal and abnormal heart rate conditions are known. The purpose of this study is to detect early pregnant women and fetuses with normal or abnormal blood flow using non-invasive pulse oximetry in which case studies are implemented on the heartbeat of pregnant women. The method used in this study uses the hardware programming method by starting with project planning, research, part testing, mechanical design, electrical design, software design, functional test, integration, overall testing and optimization. The measurement results from the MAX30100 sensor are processed on Arduino UNO R3 and displayed on the LCD screen. The system as a whole can work with energy supply from the power supply. After measuring with a comparator that has been calibrated, the average error value of the measurement is 3.32 %.

Keywords: Pregnant Mother, Heart Rate, Fetus, Oximetry, Blood Flow

INTRODUCTION

In a health check on pregnant women, the doctor checks the heartbeat of a pregnant woman or fetus, which is a parameter for the fetal health examination. In the examination, the number of heart beats that occur in a certain time interval is called beats per minute. Fetal Heart Rate is a standard for fetal heart health from a unit that is mutually agreed upon in determining the fetus being examined is normal or not. The main component of a heart rate detector is a pulse sensor with a different design

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and output. Arduino uno as a data processor and detection results appear in graphic form (sarah ayu puspita, 2018).

The heart is one of the organs in humans that functions to pump blood throughout the body and then collect it again after being cleaned by the lungs. As we age, the heart's function will decrease. Heart rate or BPM (beats per minute) is a parameter that indicates the condition of a person's heart. The way to find out the condition of a person's heart is to know the frequency of the heartbeat. The heart rate in normal humans ranges from 60-100 beats per minute (Anugrah et al., 2016). The development of electronic technology is growing rapidly to spread to the field of medical electronics. Medical electronics are made for various purposes including monitoring instruments, diagnostic instruments, therapeutics, instruments, and assistive devices. Oxygen saturation diagnostic tool (SpO2) is a medical device used to determine the ratio between hemoglobin that binds oxygen to the total amount of hemoglobin in the blood. The working principle of this diagnostic tool is to calculate oxygen saturation in percentage units (%) by means of how much light is absorbed by the finger on the finger sensor and the light absorption result is calculated by the SpO2 formula. From the results of oxygen saturation in the blood, it can be determined how much percentage of oxygen can be carried by hemoglobin (Umi Salamah, 2006).

Pulse oximetry is usually in units or rooms with high and rapid action cases such as the ICU. Pulse oximetry is a non-invasive method used outside the body to monitor the percentage of oxygen saturation in the blood. There are many types of pulse oximetry on the market. However, considering the importance of the pulse oximetry function as a tool to monitor the patient's condition, it is necessary to have a priority alarm that functions as a reminder or marker in the event of damage or failure to the device or patient. The priority alarm function in measuring and monitoring patients using pulse oximetry is very important for the prevention of failures with high risk to patients (Amelia Desiana, 2018). Max 30100 sensor is a heart rate sensor and oxygen saturation designed for Arduino uno that detects every heart rate and SpO2. In its use, the Max 30100 sensor uses a strong current of 4 mA and the voltage used is 5 V so that this tool can be carried anywhere. When the heart pumps blood throughout the body, where every pulse there is a pulse wave that moves along the arteries to the capillary network on the Max 30100 installed (Audey, 2020).

From the problems described above, it is necessary to make research into the design of a heart rate detector that has initial identification with a max sensor reading of 30100 in the form of detecting heart rate and oxymeter, then processed by Arduino uno R^3 where Arduino Uno processes data in the form of heart rate and oxymeter readings. so that it can be displayed through a 16x2 lcd, the output is the identification of the value of the input heart rate and oximeter so that it is known that the condition of the heart rate is normal and abnormal. 3 where the input variable from the pulse sensor (Max30100), is processed in the microcontroller (arduino uno R^3), the output is a graphic display on a 16x2 lcd.

LITERATURE REVIEW

Arduino uno as a data processor and detection results appear in graphic form (sarah ayu puspita, 2018). The heart is one of the organs in humans that functions to pump blood throughout the body and then collect it again after being cleaned by the lungs. As we age, the heart's function will decrease. Heart rate or BPM (beats per minute) is a parameter that indicates the condition of a person's heart. The way to find out the condition of a person's heart is to know the frequency of the heartbeat. The heart rate in normal humans ranges from 60-100 beats per minute (Anugrah et al., 2016). The priority alarm function in measuring and monitoring patients using pulse oximetry is very important for the prevention of failures with high risk to patients (Amelia Desiana, 2018).

METHOD

The research phase used in this research is to use a hardware programming approach that is taken through 10 stages. The research stages are shown in Figure 1.

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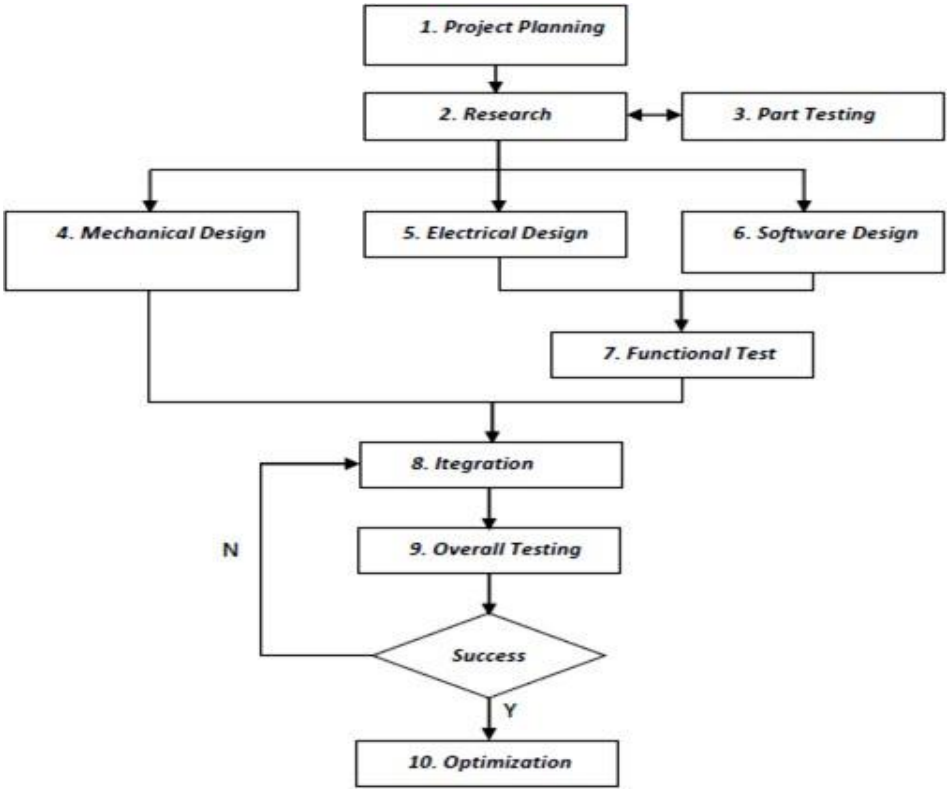

Figure 1. Hardware programming approach method

1. Research Project Planning (Project Planning)
   At this stage, research planning is carried out, there are several important things that need to be determined and considered, including:
   a. Preliminary Research.
   b. Estimated need for tools and materials.
   c. Estimated Budget/funds.
   d. Implementation / application of the application to be designed.
2. Research
   After the planning process, it will be continued with initial research of the application to be made, starting from the selection and testing of components (tools and materials).
3. Component Testing (Part Testing)
   Component testing is carried out on component work functions based on the needs of the application to be designed.
4. Mechanical System Design (Mechanical Design)
   In hardware design, mechanical design is an important thing that must be considered. In general, application requirements for mechanical design include: 1. Shape and size. 2. Resistance and flexibility to the size of the two fingers. 3. Placement of electronic modules. 4. Testing the designed mechanical system.

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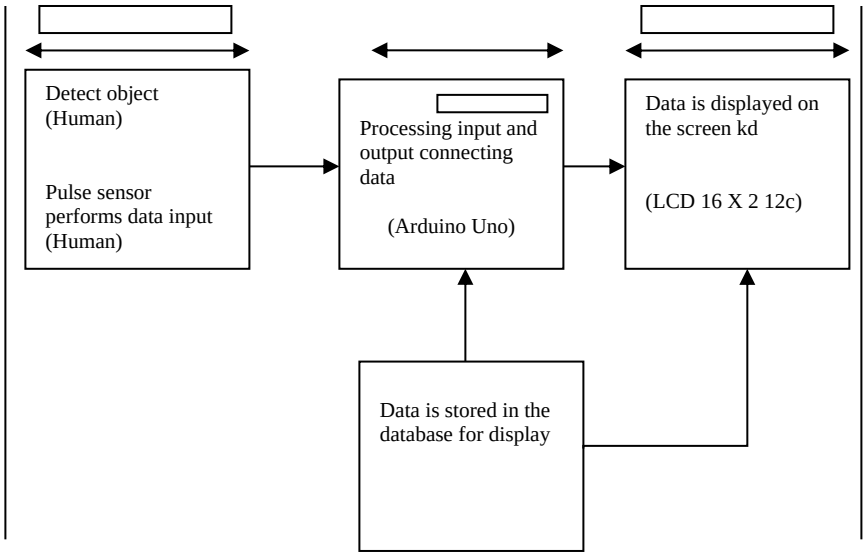

Figure 2. Mechanical system design

In the design of a mechanical system, the tool in the initial state will detect objects, namely humans. The object will be detected by the pulse sensor to get a pulse in the form of blood flow on the fingers or ears of humans. After the data is obtained, the Arduino uno microcontroller will process the data as input, process the data and produce output, then the microcontroller sends the output data to the database. After the data is stored in the database, the output data will be displayed on the LCD screen.

1. Model Design

In the prototype design of the heart rate measuring device for pregnant women based on the Arduino Uno microcontroller, the entire circuit will be made to a minimum so that the device can work optimally. The design of the heart rate model for pregnant women based on the Arduino Uno microcontroller can be seen in the image below:

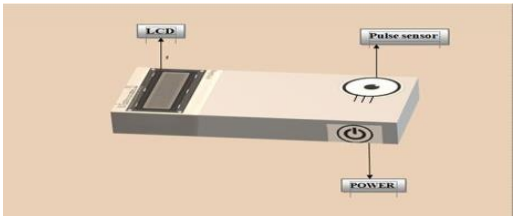

Figure 3. Model Design

2. Electrical Design

This Electrical Design was created to show the circuit connected to the components of the Human Stress Detector Design Using an Android-Based Pulse Sensor, which has referred to the placement of ports connected to each part of the electrical design system made using Fritzing software. As in Figure 4.

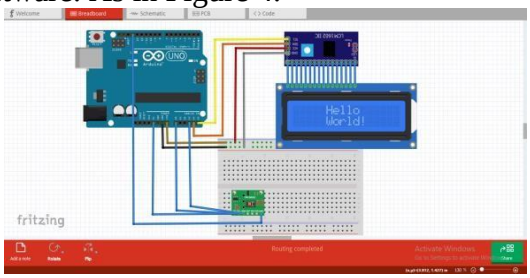

Figure 4. Electrical System Design

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In figure 4, it can be explained that the Arduino GND, 5v pin is connected to the Breadboard which is connected to the Lcd 16x2 i2c and Max 30100. On the 16x2 i2c Lcd the Arduino A5 pin is connected to SCL while the Arduino A4 pin is connected to SDA. On Sensor Max 30100 use pin A0 for analog pin.

a) Design Software

Software design in this study is shown by a flowchart.

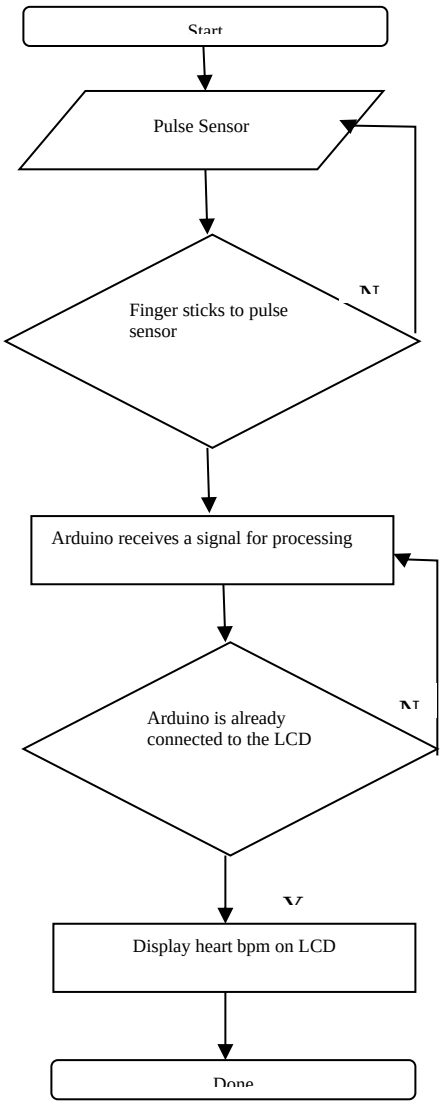

Figure 5. Desain Softwere flowchart

H o w the system works, starting from the pulse sensor it will detect the fingers by placing a finger on the top of the mica box with a range of 5 mm if (yes), if (no) it will return to the pulse sensor, then the sensor will process data if (yes) the sensor is connected to the the lcd will immediately display the heart rate, and if (not) the sensor will not display on the lcd.

b) Functional Test

Functional tests are carried out by integrating electrical systems and software that have been designed. This test is carried out to improve the performance of the software for controlling electrical design and eliminate errors (Bugs) from the software.

c) Integration or Assembly (Integration)

Electrical modules that have been integrated with software in the controller, are integrated into the mechanical structure that has been designed. Then do a functional test of the whole system.

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d) Overall System Functional Test (Overall Testing)

The functional test stages of the entire system carry out tests carried out from the entire research system. System Optimization (Optimization) Improve the performance of the tool that has been designed.

RESULT

1. Tool Test Results

Table 1. *SpO2* measurement

Sp02 Measurement

No	Bedside Monitor / Patient Monitorv(%)	Module (%)	Condition	Difference (%)
1	95	94	Normal	1
2	93	97	Normal	4
3	100	95	Normal	5
4	89	91	Normal	3
5	112	117	Abnormal	5

Table 2. Measurement of BPM

BPM Measurement

No	Bedside Monitor / Patient Monitorv (%)	Module (%)	Condition	Difference (%)
1	100	101	Normal	1
2	90	96	Normal	4
3	90	92	Normal	2
4	96	99	Normal	3
5	123	124	Abnormal	1

Table 3. Measurement of SpO2 and BPM

Sp02 and BPM Measurement

No	1st trimeste	2nd trimester	3rd trimester	patient's condition
1	90	102	110	Normal
2	95	98	97	Normal
3	91	93	100	Normal
4	87	88	92	Normal
5	90	95	101	Normal
6	92	94	99	Normal
7	105	107	100	Abnormal
8	98	94	96	Normal
9	92	94	97	Normal
10	85	86	90	Normal
11	89	92	95	Normal
12	91	93	95	Abnormal
13	101	107	110	Abnormal
14	105	107	112	Normal
15	94	98	103	Normal
16	82	86	90	Normal
17	83	87	92	Normal
18	91	94	97	Normal
19	96	98	103	Normal
20	90	95	98	Normal

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It was explained that data collection for pregnant women was between the ages of 25-40 years, it is clear that the above only shows the results of the patient's heart rate because here the author concludes the relationship between oxygen saturation and heart rate to summarize the existing results because if the patient's heart rate is in normal condition then the patient's heart rate is normal. we can conclude that oxygen saturation will also be normal or vice versa. So that the table above does not show the results of SpO2 but directly on the patient's condition whether normal / abnormal.

DISCUSSIONS

The process for testing the Non Invasive SpO2 tool is equipped with an alarm for abnormal diagnosis based on Arduino Uno R^3 as follows:

a. Connect the appliance to the PLN grid with an electric current, so that the electric current enters the device (SpO2). As in the image below

Figure 6. Device Connected to an electrical outlet

b. Furthermore, when the electric current has been connected to the tool adapter then activate the On/Off switch on the tool so that the indicator light on the tool turns on, if the indicator light on the tool and the circuit is lit, it indicates the tool is active and ready to run as its function.

Figure 7. The Tool Is On Or Active

c. When the tool is on or active it will display writing on the LCD as shown below:

Figure 8. Initial Display on LCD

d. Next, attach the patient's finger to the Max 30100 oximeter sensor module as shown in the image below so that the results of the tool's work are known.

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Figure 9. Patient Finger Attached to Sensor

e. When the patient's finger is detected, writing will appear on the LCD as shown below:

Figure 10. LCD Display When Patient's Finger is Detected

f. If no patient's finger is detected by the oximeter sensor, a text will appear on the LCD as shown below:

Figure 11. LCD Display When Patient's Finger Is Not Detected

CONCLUSION

From the results of the module design for diagnosing blood oxygen levels based on Arduino Uno R^3, the following conclusions can be drawn. In the process of designing the tool, the materials used are: Arduino UNO R3, Max30100 Sensor, 16x2 LCD, 9V, 1A, I2c Adapter, Jumper and Buzzer Cables, Sensors MAX 30100 is a sensor used to detect blood oxygen levels and heart rate. Then the measurement results from the MAX30100 sensor are processed on Arduino UNO R^3 and displayed on the LCD screen. The system as a whole can work with energy supply from the power supply. After measuring with a comparator that has been calibrated, the average error value of the measurement is 3.32%.

REFERENCES

Adiguna, B., Rizal, A., & Hanafi, U. B. (2007). *Aplikasi Pengukuran Denyut Jantung Janin Berbasis Ultrasonic Doppler Fetus Monitor*.

Anugrah D, dkk. (2016). Rancang Bangun Pengukur Laju Detak JantungBerbasis PLC Mikro. Jurnal Electronics, Informatics, and Vocational Education (ELINVO), Volume 1.

Almanjani, F.F., Hasrani, Prihastuti., Ismangil, Agus. (2016). Model Pendeteksi Denyut Janutng Menggunakan Pulse Sensor BerbasisArduino. Universitas Pakuan.

Arthana, I.K.R., Pradnyana, I.M.A (2017). Perancangan Alat Pendeteksi Detak Jantung Dan Notifikasi Melalui Sms.*Seminar Nasional Riset Inovatif 2017*, 889–895.

*Yuli Wahyuni

Bimo, A.M., Anip, Febtriko, Diki, Arisandi. (2017). Alat Pendeteksi Kondisi Jantung Menggunakan Arduino Uno dan Pulse Sensor. Universitas Abdurrab.

Chabibah, N., & Laela, E. N. (2017). Perbedaan Frekuensi Denyut Jantung Janin Berdasarkan Paritas Dan Usia Kehamilan. *Siklus : Journal Research Midwifery PoliteknikTegal*, *6*(1), 195–198.

Fachrul Rozie, Ferry Hadary, F. Trias Pontia W. (2016) Rancang Bangun Alat Monitoring Jumlah Denyut Nadi / Jantung Berbasis Android. Jurusan Teknik Elektro, Fakultas Teknik. Universitas Tabjungpura.

Mangasa A.S Manullang. (2017). Mendeteksi Denyut Jantung Dengan Menggunakan *Pulse* Sensor PadaArduino Uno Berbasis Android. Universitas Sumatera Utara.

Signorini, M.G., Fanelli, Andrea., Magenes, Giovanni., (2014). Monitoring Fetal Heart Rate During Pregnancy: Contributions DromAdvanced Signal Processing and Wearable Technology.

Wibisono, B. M., Setiawan, A., Fitriawan, H., Sulistyanti, S. R., & Purwiyanti, S. (2018). Rancang Bangun Alat Pendeteksi Detak Jantung Menggunakan Pulse Sensor Berbasis Mikrokontroller. *Seminar Nasional Hasil Penelitian Sains, Teknik, Dan Aplikasi Industri*, 1–8.

Wohingati, G. W., & Subari, A. (2015). Alat Pengukur Detak Jantung Menggunakan Pulsesensor Berbasis Arduino Uno R3 Yang Diintegrasikan Dengan Bluetooth. *Gema Teknologi*, *17*(2), 65–71.

Yundra, Eppy., Suyanti., Kartini, UT., (2019). Sistem Deteksi Jantung Menggunakan Hybrid Internet OfThings Based On Pulse Sensor. Universitas Negeri Surabaya,Indonesia.

Arantra Putra, Andrey. (2006). "Rancang Bangun Pulse Oximetry Digital Berbasis Mikrokontroler." Politeknik Elektronika Negeri Surabaya.

R,Yanuardi. (2015). "Rancang Bangun Pulse Oximtry Digital Berbasis Mikrokontroler Atmega 16." Politeknik Tekn Bandung. Y. Sari, "Fungsi pembentukan hemoglobin pada sel darah merah." Frank, "Saturasi oksigen," pp. 1–11, 2010.

N. Townsend, "Pulse Oximetry" Medical electronik. (2001).

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