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STRESS DETECTION IN PREGNANT WOMEN THROUGH HEART RATE

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ABSTRACT

During pregnancy, there are changes because the fetus begins to grow and develop in the pregnant woman's stomach. Physiology greatly influences its development, especially in hormonal and metabolic changes that affect the psychological stress level of pregnant women. This study aims to determine the initial action to detect heart rate by looking at stress levels in pregnant women. The results of stress measurements are not normal when the heart rate is less than 60 bpm and more than 100 bpm, while in conditions of more than 60 bpm and less than 100 bpm, the results obtained are normal conditions. This study uses a hardware programming approach with the stages: Project Planning, Research, Component Testing, Mechanical System Design, Functional Test, Functional Test, Overall System Functional Test, System Optimization. The results show that this tool has worked well in monitoring heart rate when stressed in real-time using a pulse sensor displayed via telegram notifications in the form of total data. Still, because it is only in the form of notifications, there is no storage in the form of a database.

1. INTRODUCTION

Pregnancy is a period of intrauterine growth and development of the fetus that begins at conception until the beginning of labor. When a woman finds out that she is pregnant, a pregnant woman causes anxiety and creates stress, especially if the pregnancy occurs without

a pregnancy program plan; conditions during pregnancy experience physical and mental changes. Pregnancy is an important phase in a woman's life that can change a woman physically, psychologically, socially, and spiritually. These changes can trigger feelings of anxiety. When a pregnant woman feels anxiety and stress, the body will produce stress hormones that can affect the fetus by blocking blood vessels, reducing oxygen supply, and causing abnormal activity or movement (Rahmawati, 2019). One way to increase spiritual adaptation and reduce anxiety is to provide spiritual support. This study analyzes the relationship between spiritual support, spiritual adaptation, and anxiety levels of pregnant women at the Mother and Child Hospital Cempaka Putih Permata Surabaya (Nahar, 2019). Anxiety in pregnancy is an emotional reaction that occurs in pregnant women related to the mother's concern with the welfare of herself and her fetus, the continuity of pregnancy, childbirth, the post-natal period, and when she has played a role as a mother (Schetter & Tanner, 2012). These stressful conditions affect the heart rate during pregnancy so that detection can be made through the heartbeat of pregnant women. During pregnancy, there are many physiological changes in the body of pregnant women as a form of maternal adaptation, namely physical changes, organ function, hormonal system changes, metabolism, and psychological conditions related to prenatal stress (Manuaba et al., 2007). Stress increases the risk of congenital abnormalities, cesarean section, device delivery, premature birth, low birth weight babies, low birth weight (LBW), and long-term disorders related to emotional behavior disorders in children (Widiani & Noviani, 2020). The decreased anxiety level of pregnant women by 2.6. The average level of anxiety before self-hypnosis was 52.19 (moderate anxiety), and the average level of anxiety after self-hypnosis was 49.59 (mild anxiety) (Sehmawati & Permatasari, 2020).

A growing body of research shows that prenatal stress can significantly affect pregnancy, maternal health, and human development across the lifespan. These effects may occur directly through the influence of prenatal stress-related physiological changes on the developing fetus or indirectly through prenatal stress on maternal health and pregnancy outcome, which, in turn, affect infant health and development (Coussons-Read, 2013). Pregnant women commonly experience prenatal stress and anxiety during pregnancy which can be at risk of preterm birth, fetal growth restriction, and low birth weight (LBW) (Septianingrum, 2015).

Anxiety in pregnancy is an emotional reaction that occurs in pregnant women related to the mother's concern with the welfare of herself and her fetus, the continuity of pregnancy, childbirth, the period after childbirth, and when it has played a role as a mother (Schetter & Tanner, 2012). The prevalence of anxiety and depression in developed countries is around 7-20%, and in developing countries, it is more than 20% (Biaggi et al., 2016). Based on research results, Astuti et al. (2000) showed that 46% of mothers experience mild anxiety, 50% moderate anxiety, and 4% severe anxiety of 50 pregnant women. Anxiety during pregnancy can be caused by physical changes, fear of childbirth, and transition parenting role (Varney et al., 2010). According to Rahmi (2010), various factors can affect anxiety during pregnancy, including maternal age, level of education, family support, and husband's support. Based on Bidjuni & Kallo (2014) research results, gravidity and work-related anxiety in pregnant women in labor.

Pregnancies and infants at elevated risk of impaired fetal iron accrual may be identified according to observed synergism between maternal stress and obesity and differential associations with fetal iron status by infant sex (Campbell et al., 2020). Several factors cause pre-eclampsia, including stress levels and physical activity (Elsanti et al., 2016). In this research, detection is done in real-time using a microcontroller. The use of the microcontroller and its circuit is a media base for taking input, processing data, and displaying the results on

the web as an output viewer. Wemos D1 R1 microcontroller as process and Blynk application and database as output (Wahyuni & Maulana, 2021).

Detection of stress levels of pregnant women only detects the stress level of the expectant mother, using the heart rate and monitoring heart rate during stress in real-time continuously. The system processes and displays history on the telegram application in pregnant women's heartbeat data, while the pulse sensor is a heart rate detector when stressed.

2. METHODS

The methodology used in this study uses a hardware programming methodology where the stages can be seen in the following flowchart:

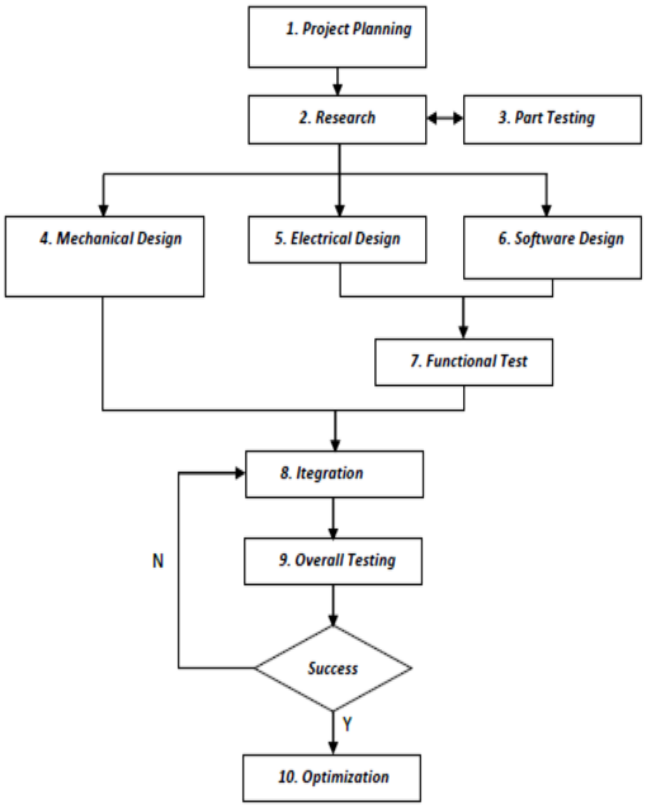

Figure 1 Hardware programming methodology

Note:

1. Research Project Planning (Project Planning): At this stage, research planning is carried out; there are several things, namely previous research, the need for tools and materials, costs, and implementation/application of the application to be designed.
2. Research: At this stage, components (tools and materials) are selected and tested.
3. Component Testing (Part Testing): In component testing, the work function of the components used is based on the system design.
4. Mechanical System Design (Mechanical Design): Mechanical system design is carried out by considering the shape and size, resistance and flexibility to the size of the two fingers, placement of electronic modules, and testing the designed mechanical system.
5. Electrical System Design designs are made for circuits connected to the stress detection component for pregnant women. Using a pulse sensor using a heart rate connected to the placement of ports connected to each part of the electrical design system, made using Fritzing software.
6. Software Design: The software design in this study is shown by a flowchart. System Design is a schematic design of a circuit based on a block diagram.

7. 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 eliminating errors (Bugs) from the software.
8. Integration or Assembly: The electrical module that has been integrated with the software in the controller, is integrated into the mechanical structure that has been designed. Then do a functional test of the whole system.
9. Overall System Functional Testing (Overall Testing): The functional test stages of the entire system carry out tests of the whole research system.
10. System Optimization (Optimization): Improve the performance of the tool that has been designed.

3. RESULTS AND DISCUSSION

3.1. Result

The results obtained from this study have been assembled with an Arduino microcontroller and programmed NodeMcu to control an Android-based Stress Level Detection Tool for pregnant women with Heart Rate Using Telegram Notifications. Integrated heart.

Figure 2 Tool for detecting stress levels of pregnant women

In Figure 2, the overall test of the tool system is running well, starting with input by the Pulse Sensor, Arduino, and NodeMCU, then sent to the telegram cloud server to get notifications in the form of data on the results of the number of BPM and heart rate conditions.

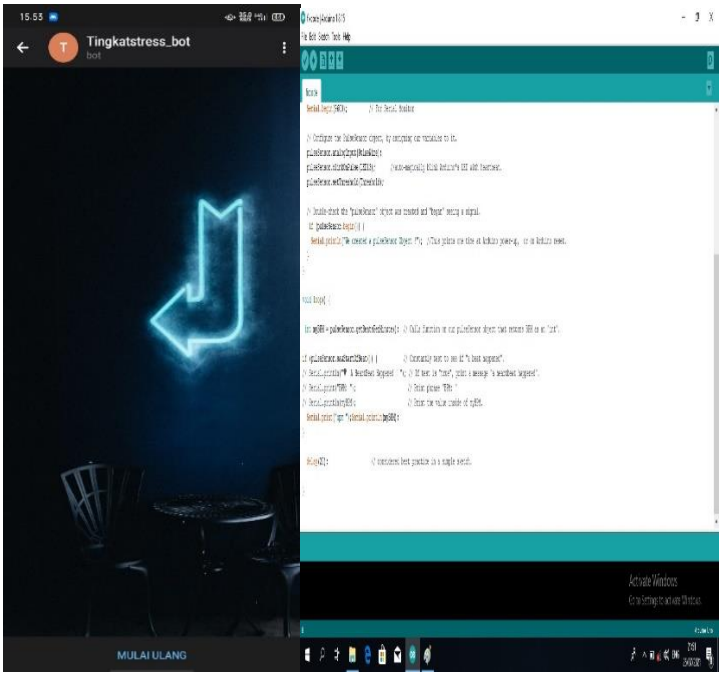

Figure 3 Configuring Telegram and the NodeMCU Program

The program on the Arduino IDE for NodeMCU and setting the telegram application to get the Auth Token is a liaison between NodeMCU and the Telegram application. Can be seen in Figure 3 above.

3.2. Discussion

After all the circuits are assembled and become stress level detectors, we will discuss the working mechanism of an android-based stress level detector for pregnant women using telegram notifications. Starting from a pulse sensor connected to the Arduino Uno to get the value from the sensor, the Arduino Uno itself functions to send data to the NodeMCU via Rx and tx communication. The NodeMCU functions as a data processor and is sent back to the telegram cloud server sending notifications in the form of data on the number of BPM and the user's heart rate. The use of telegram was chosen as a substitute for WhatsApp or similar applications because WhatsApp does not provide an API that the public can access, and its use is paid, so the author uses the telegram application as a substitute for WhatsApp.

This research is strengthened by previous research, namely the research of Faesal et al. (n.d.) regarding the research of heart rate measuring devices. Research by Arthana et al. (2018), namely the Design of a Heartbeat Detector and Notification Through SMS. This study has developed a heart rate detection system and sending notifications using SMS and tested it with a manual sphygmomanometer, which is 1.5 BPM, while the average difference is 1.5 BPM. Between the developed tool and manual measurement of 2.8 BPM, the response to the request for heart rate measurement is around 1.5 minutes. Further research by Mardiansah & Wildian (2019), the design of a patient heart rate monitoring device using a telemetry system with the results of the characterization of the heart rate sensor. Namely, the effect of the sensor distance with a luxmeter on the light intensity, the transfer function obtained is y = 189.91 e-0.162x, and the regression value is R2 = 0.9588. The last is research on the design of automatic trash bins using a microcontroller and ultrasonic sensor with telegram notification. It is equipped with an automated warning system that can detect the capacity of the trash can. If the capacity of the trash can is full, the LED light will light up then a notification will enter through a tool called a telegram which was researched by (Fatmawati et al., 2020).

3.2.1. Structural

Test The configuration and implementation that has been applied goes according to plan and can be appropriately used even though there are still shortcomings. From other aspects or stages, it can be seen from the description below: a. The tool frame is well structured, although there are still shortcomings. b. The configuration in the Blynk application is not a problem at all. c. The program given to NodeMCU to connect to the internet runs well, but when the network is stable.

3.2.2. Pulse Sensor Test

Pulse sensor testing is carried out to determine the function of the sensor. The pulse sensor functions as a heart rate detector which will later be processed by the microcontroller and sent via a telegram notification in the form of data from the number of BPM and heart rate conditions.

Table 1 Pulse Sensor Test Table

Test	*Pulse Sensor*	Number Of BPM
1.	97	97
2.	77	77
3.	105	105
4.	87	87
5.	82	82

From table 1 above, this is a heart rate test on a pulse sensor on an Android-based stress detection tool for pregnant women with a heart rate using telegram notifications. It can be concluded that the pulse sensor is working properly.

3.2.3. Data Retrieval

The data collection that the author means is taking data from 10 people who are willing to take their heart rate results. The ten people consisted of 10 pregnant women of different ages. For testing using the fingers of pregnant women who are willing, the fingers used can use any finger because all fingers have a heartbeat but at least use the index finger. The purpose of collecting this data is only to find out that the tool made by the author can function properly.

Table 2 Results of Data Collection

Number	Name	Age	Number Of BPM	Manual Calculation	Heart Condition
1.	Dina	22	136	134	Abnormal Condition
2.	Lina	21	142	141	Abnormal Condition
3.	Mery	20	165	166	Abnormal Condition
4.	Wina	19	122	121	Abnormal Condition
5.	Vida	21	176	175	Abnormal Condition
6.	Lilis	21	155	155	Abnormal Condition
7.	Ani	22	74	73	Abnormal Condition
8.	Nina	19	147	146	Abnormal Condition
9.	Syarifah	18	130	128	Abnormal Condition
10.	Leni	18	85	84	Normal Condition

In Table 2, there is a column for the number of BPM (Beats per minute) and heart conditions. The amount of BPM is obtained from the results of measurements with tools made to get the condition of the heart. The author uses a Pulse Sensor to clarify the age variable and the amount of BPM that is obtained, normal and abnormal conditions here according to Dr. Alexander N (2019). If the heart rate is below 60 indicates the user is experiencing health problems, and if the heart rate is above 100 but less than 200, the user is experiencing initial stress levels.

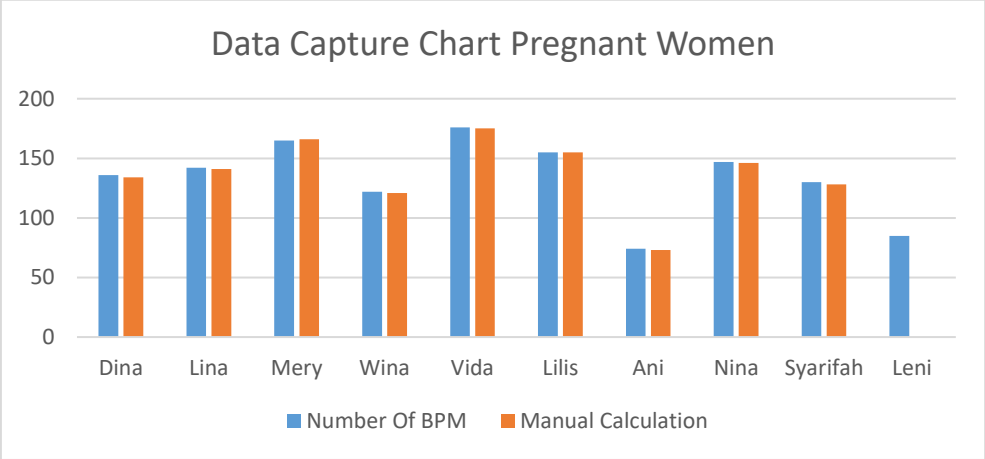

Figure 4 Data collection graph

From Figure 4, it can be seen that the heart rate measurement tool for pregnant women that has been made functions well as a stress detector.

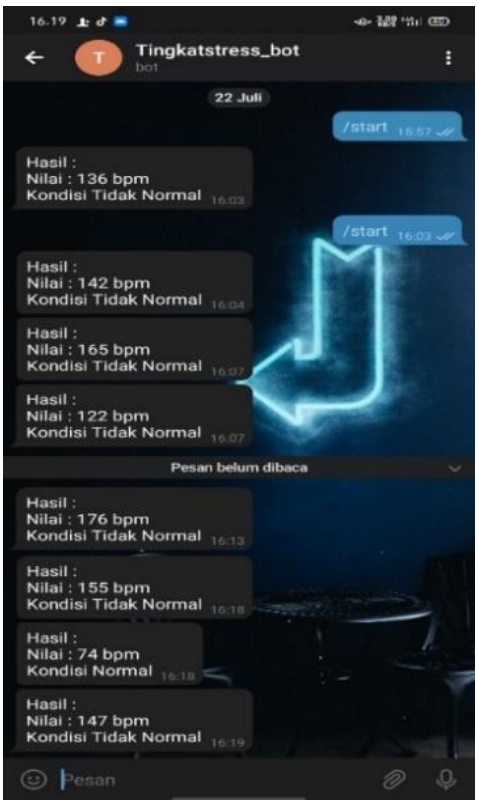

Figure 5 Telegram notification display

Figure 5 pictures of telegram notifications that will be received by the user using an android-based stress level detection tool for pregnant women with a heart rate using a telegram notification that displays data on the results of the number of BPM and heart rate conditions.

Table 3 Distance testing table

Test	Distance	Experimental Result
1.	10 Meters	Succeed
2.	15 Meters	Succeed
3.	20 Meters	Succeed
4.	25 Meters	Succeed
5.	30 Meters	Succeed
6.	35 Meters	Succeed
7.	40 Meters	Succeed
8.	45 Meters	Succeed

In table 3, the distance test of the stress detection tool for pregnant women is carried out to send notifications to telegram. The purpose of distance testing is because the tool made uses the internet to send notifications to users with a note that the tool used is connected to wifi so that it can function and can send notifications in the form of data on the results of the number of BPM to users via telegram.

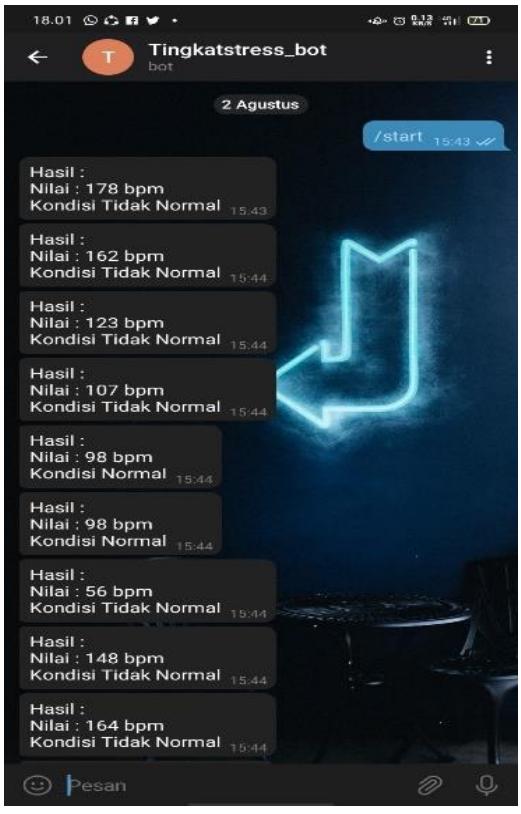

Figure 6 Image of Distance Test Notification Display

Figure 6 above is the result of the notification that appears on the telegram application, and the distance test has been functioning properly.

4. CONCLUSION

Based on the results, process, design, manufacture, and testing of a pregnancy stress level detection tool with a Heartbeat Using an Android-Based Notification Telegram, it can be concluded that this tool uses a pulse sensor as a heart rate input whose value will be displayed in the form of a telegram notification in the form of total data. It beats per minute, but because it's only notifications, there's no storage space (database), so it can be used indefinitely. This tool uses the Arduino IDE program for NodeMCU and sets the Telegram application to get an Auth Token which is a liaison between NodeMCU and the Telegram application. In structural testing, the configuration and implementation that have been implemented went according to plan and can be appropriately used even though there are still shortcomings. The framework is well structured; although there are still shortcomings, the configuration in the Blynk application is not hampered at all; the program provided for NodeMCU is connected to the internet works fine, but when the network is stable.

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