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Cholesterol Checking Tool and Blood Type Prototype with Telegram Notification System

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ABSTRACT

The blood, which is divided into groups A, B, O, and AB, is a vital organ. Furthermore, the body needs cholesterol as a lipid, and the amount of cholesterol is a sign of health. A cholesterol level of 200–239 mg/dl is considered healthy. If it is very high, though, cholesterol can accumulate in the blood vessels and obstruct blood flow. This research built an Arduino Uno-based system to counterbalance the technical improvements in the use of LDR and Photodiode sensors that monitor blood type and cholesterol automatically without injections and send notifications to Telegram. This study sheds light on a significant advancement in medical sensor technology. The created device can check blood type and cholesterol levels with high accuracy and greater user convenience than prior technologies that required invasive procedures. The selection of LDR and photodiode sensors was based on their capacity to identify differences in blood samples and their sensitivity to light fluctuations. Medical teams can more effectively monitor patient symptoms thanks to the system's real-time notifications to the Telegram app. Programming and sensor integration are made flexible and simple by using an Arduino Uno in this setup. The primary conclusions of this study demonstrate that this technology can offer a useful non-invasive method for assessing one's health, increasing diagnostic precision and efficiency. The primary output of this research is the creation of a prototype for medical applications that integrates digital communication and sensor technologies, potentially lowering patient risks and expenses. Additionally, this finding opens the door for the advancement of non-invasive diagnostic tools that are more convenient and safer.

1. INTRODUCTION

Blood is one of the most vital components of the body. The kinds of antigens and antibodies found in blood can identify a person's ABO blood type [1-3]. By directly watching the serum droplet reaction, anti-A and anti-B sera are routinely dripped into the blood to be detected and utilized to identify the blood type [4, 5]. Additionally, cholesterol [6], a yellowish lipid, is produced by the body, mostly in the liver [7]. Human cholesterol levels are typically less than 200 mg/dL, and cholesterol is mostly used to form the walls of the body's cell membranes [8, 9]. Conversely, overindulgence may result in hypercholesterolemia, a rise in blood cholesterol, and ultimately may be lethal [10].

A notification system is any device that alerts or cautions its consumers when something occurs [11]. A notification system can be used to keep track of an object's status. Numerous notification systems have been put into place, such as SMS, alarms, LEDs, and messages in the form of pictures and videos [12].

The challenges with using these medical devices are in the manual processes of checking blood type and cholesterol. Blood groups still rely on humans to read the results of agglutination [13] using the slide test method [14], and cholesterol is still checked using test strips with low density readings (LDL) [15]. Another challenge is that the results of the check are still communicated to the user visually [16]. As a result, a notification system is required for the prototype of a blood type and cholesterol checking tool in order to help detect blood type and cholesterol, the results of which can be communicated to the user automatically via telegram. The prototype research of blood type and cholesterol checking tools with microcontrollers is aided by photodiode sensors [17], LDR [18, 19], and red LED [20] as parameter material for additional checks conducted by users. The check results are visible on the LCD [21] that is built into the microcontroller, as well as through the internet-connected Telegram notification [22]. Additionally, the results can be viewed through an Ethernet shield module [23, 24], and by utilizing the open Application Programming Interface (API) facilities made available by Telegram through bots [25, 26], and the universal Telegram library in Arduino programming, which can be used to set up automated message sending [27].

Blood type and cholesterol were the subject of several studies prior to the study using LDR and Photodiode Sensors. These studies included those by Dany Pratmanto and colleagues on the design of an Arduino Uno-based blood type detection device, which used both an Arduino Uno and LDR sensors in the study by Shamila et al. [28], Banar Dwi Retyanto and colleagues on the design of an Arduino Uno-based human blood type measurement prototype, which uses an LDR sensor as a blood type measurement tool [29], and Farras Nabila and his colleagues on Internet of Things-based human blood type detection devices, which use an LDR sensor in the system [30], research on blood type detection devices with voice output and SMS from Mustaziri and his friends used text messages as the output, while research on blood type detection device design and blood sugar, cholesterol, and uric acid measurement from Sinta Jufri used LDR sensors, photodiode sensors, and Arduino [31].

The development of blood type and cholesterol detection devices has been the subject of numerous studies, but some obstacles remain unmet, including the need for intrusive procedures, expensive costs, and the inability to notify users or medical teams in real time. Patients must often undergo difficult and uncomfortable treatments in order to use current technologies [32].

By creating an automated system using an Arduino Uno with LDR and Photodiode sensors, this research seeks to circumvent these constraints. The photodiode is utilized to detect differences in the blood sample, and the LDR sensor was selected due to its sensitivity to light changes. The medical team can effectively monitor the patient's status and promptly take appropriate action thanks to the system's real-time notification capability via the Telegram app.

The primary goal of this project is to develop a non-invasive, highly accurate blood type and cholesterol checker that is more user-friendly. The primary output of this research is the creation of a prototype for medical applications that integrates digital communication and sensor technologies, potentially lowering patient risks and expenses while also enhancing diagnostic accuracy and efficiency. Furthermore, this study lays the groundwork for the advancement of non-invasive diagnostic technologies that are more convenient and safer.

2. RESEARCH METHODS

This research method found in Figure 1 provides a framework for performing an action or a framework for collecting ideas that are focused and relevant to the goals and objectives [33].

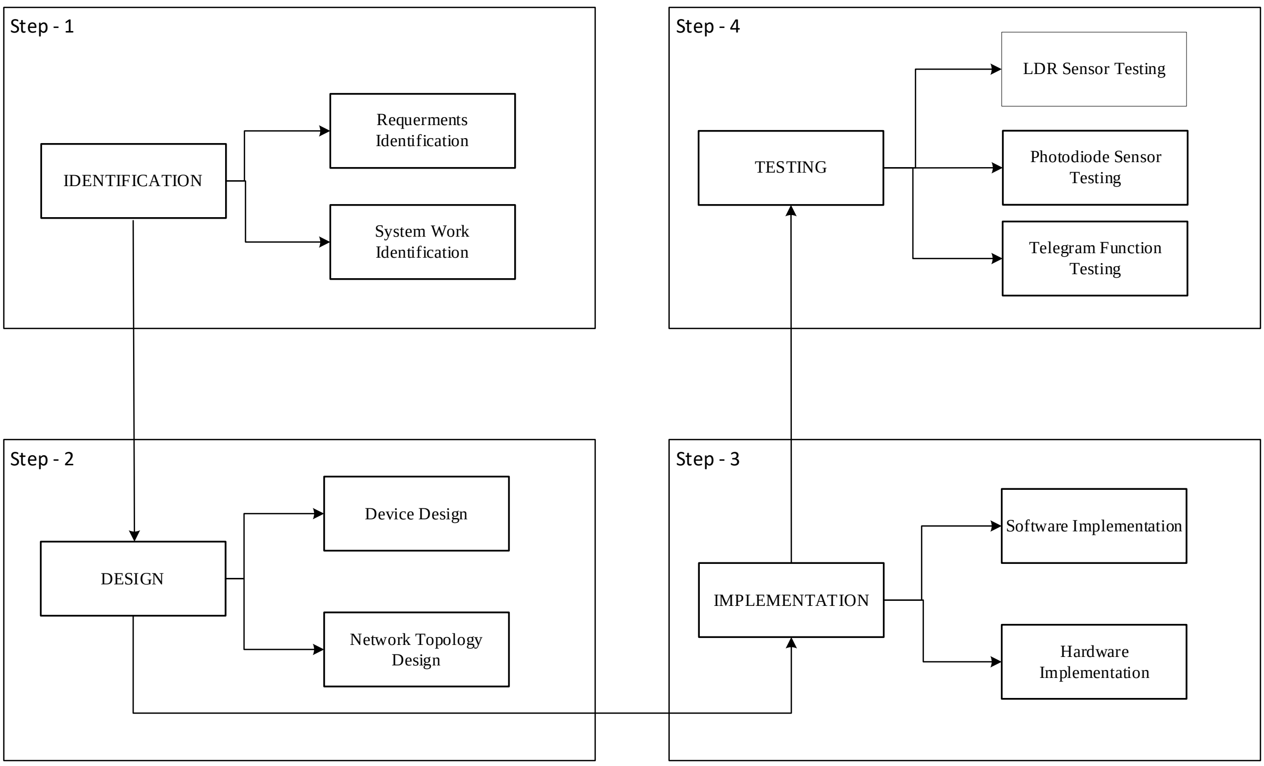

Figure 1. Research methods

2.1 Identification

The requirements needed to develop the system are examined at this first stage [34-36]. Right now, the research's motivation is being examined. The two components of the analysis stage are the identification of needs and the identification of methods of operation.

2.2 Design

In order to help researchers comprehend the flow or function of the design to be developed, this research design includes the construction of the system work analysis phases that are transformed into block diagrams. The phases of this study design are as follows. In order to explain linked devices, block diagrams [37] and schematic diagrams [38] are created as part of the hardware design employed in the study, along with network topology design.

2.3 Implementation

Implementation is done through two steps: (1) Hardware implementation and (2) Software implementation. Everything that has been created, including hardware and network design, is used in the implementation stage of blood type and cholesterol notification tools [39].

2.4 Testing

This phase will see the implementation of several function tests that were conducted during the previous phase. These tests include the following: (1) Testing the LDR (Light Dependent Resistor) sensor as a blood type detection sensor; (2) Testing the Photodiode sensor as a cholesterol detection sensor; and (3) Testing Telegram as a monitoring tool through notification message media.

3. RESULT

The outcomes of the prototype research stages of monitoring blood type and cholesterol using a telegraph notification system via 4 (four) phases, namely the first identification which is separated into 2 (two) components, namely identification of needs and identification of ways of functioning. Second, there is the design step, which is separated into two sections: network topology design and hardware design. Third, the assembly or usage of every component. The test findings are the fourth:

3.1 Identification

3.1.1 Requirements identification

There are a number of hardware devices to enable research at the requirements definition stage to be executed. Arduino Uno supports electrical prototype development with 14 digital input/output pins, 6 analog input pins, and a host of other functions. The resistance of an LDR (Light Dependent Resistor) sensor varies according to the amount of light that hits it. This particular sensor was chosen for its ability to identify variations in light intensity that may arise from chemical reactions in the blood specimen. The principle of operation of an LDR is that the resistance of the sensor decreases when more light hits it, and vice versa. One type of sensor that has the ability to convert light into electric current is the photodiode. The selection of photodiodes is based on their high accuracy in detecting fluctuations in blood samples. Photodiodes function based on the idea that light hitting a diode junction will cause electrons and holes, resulting in an electric current proportional to the light intensity. Sensor Setup: To detect variations in the intensity of light flowing through the blood sample, the LDR and Photodiode sensors are positioned appropriately. LEDs help the LDR and Photodiode sensors to illuminate the object, so that the object can be seen very clearly.

Interface with Arduino Uno: To read the voltage changes caused by variations in light, the Arduino Uno's analog pins are linked to the LDR and photodiode sensors. Data Processing: By analyzing the measured variations in light intensity, the Arduino Uno interprets the data from the sensors to calculate the blood type and cholesterol levels. Real-time Notification: After the data has been processed, it is delivered to the Telegram app by an Arduino Uno-connected communication module, giving the user or medical team real-time notifications.

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3.1.2 System work identification

The functioning of the system in this research will be discussed while figuring out the workings depicted in Figure 2. The identification of this system's operation is explained in the accompanying graphic.

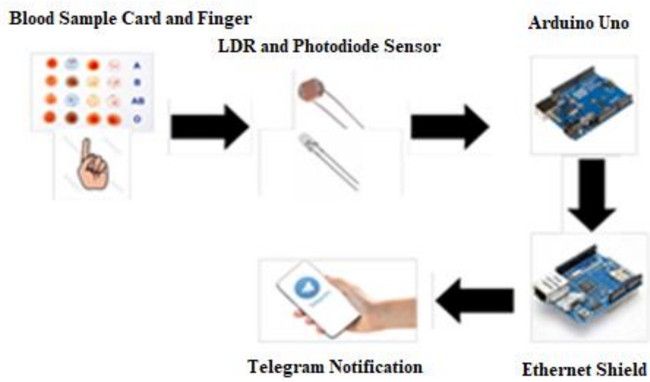

Figure 2. System works identification

Figure 2 explains how the method in this study works. First, a finger is injected, and then blood is dripped onto blood type paper. The sensor will transmit input to the Arduino Uno source code that has been built to transfer data using an Ethernet shield and will send a notice via Telegram when the LDR sensor detects the blood group on the blood group detection paper and the photodiode sensor detects cholesterol.

3.2 Design

At this stage in Figure 3, several designs related to research are carried out. The following are some of the stages of system design in this research.

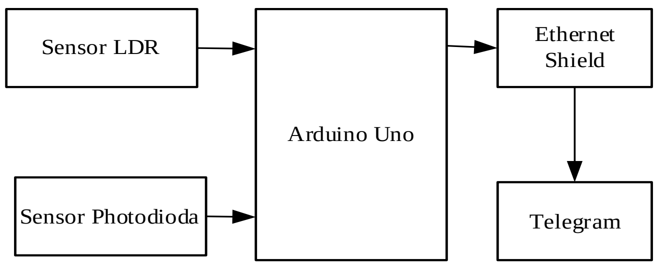

Figure 3. Block diagram

3.2.1 Block diagram

The hardware system design is depicted in the following block diagram

It is clear from Figure 3 that the Ethernet shield serves as a data transmission medium, the Arduino Uno microcontroller is the process, and the LDR and Photodiode sensors are the inputs. The data is subsequently presented in a telegraph as the output.

3.2.2 Hardware design

The hardware system architecture for Figure 4 is illustrated in the schematic circuit below.

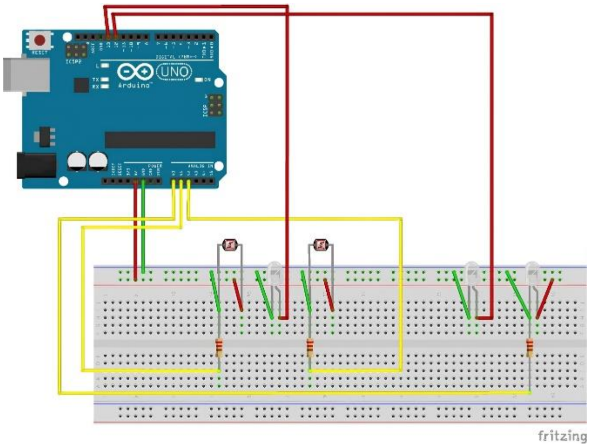

Figure 4. Schematic circuit

The general hardware schematic circuit for the Arduino Uno that will be attached to the monitoring system is illustrated in Figure 4.

3.2.3 Network topology design

Figure 5 depicts the network architecture design showing the connection of the Arduino Uno to the switch. The network topology, as illustrated, employs various technologies. It starts with an internet source linking to the RB CCR 1009-7G-1C-1S+ proxy router at IP address 10.10.0.1/21. This router then connects to the switch at the CSN (Computer System and Network) Laboratory Server. Attached to this switch is the blood type and cholesterol checking device, assigned the IP address 192.168.137.2/24. Subsequently, this device communicates the results of the blood type and cholesterol tests to a Telegram bot.

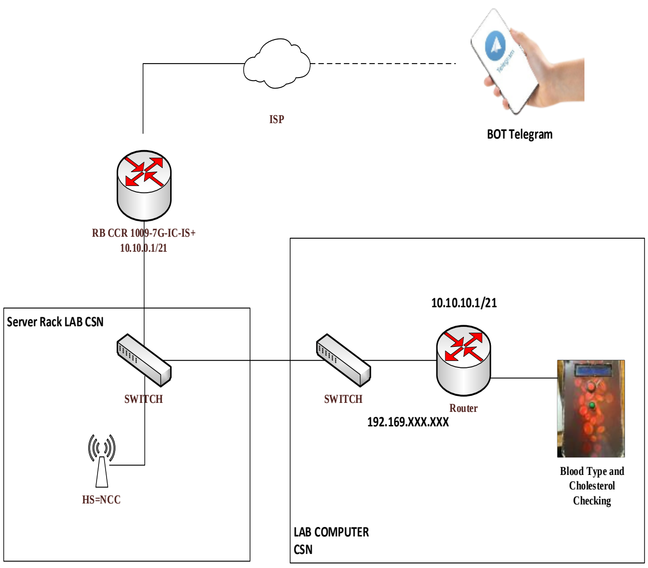

Figure 5. Network topology design

3.3 Implementation

Figure 6 showcases the system being operationalized during the implementation phase, which involves assembling or installing all previously used components. The implementation steps to be executed through the system process are detailed in section. Additionally, the general flowchart displayed in Figure 6 is segmented into various sections, each corresponding to different work processes.

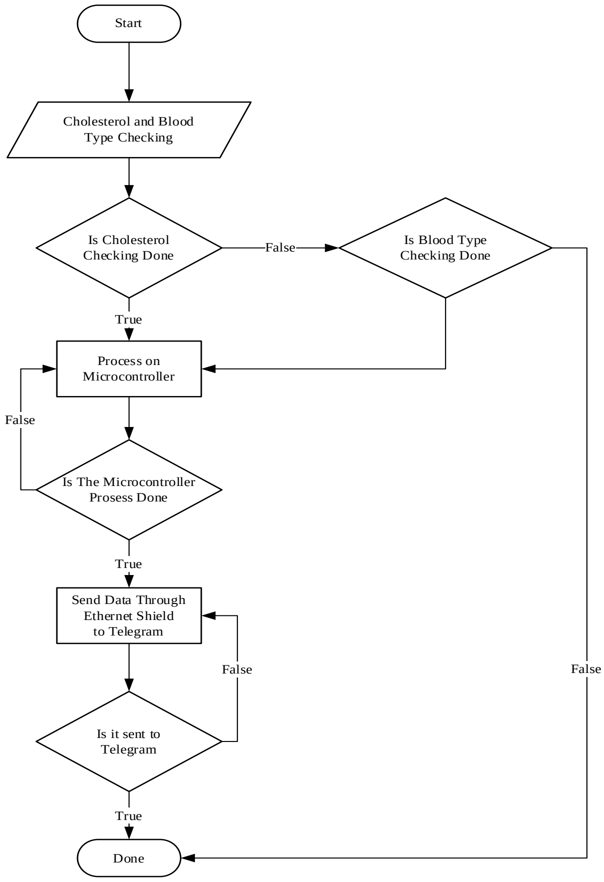

Figure 6. System workflow

3.3.1 Hardware implementation

Figure 7 illustrates the hardware implementation process, beginning with the installation of input sensors, including LDR and Photodiode sensors. Following this, an Arduino Uno is installed to serve as the program processor. Finally, output hardware such as an Ethernet shield is added. The overall configuration of the hardware is depicted in Figure 7.

Figure 7. Hardware Implementation

3.3.2 Software implementation

Figure 8 displays the outcome after the LDR sensor module is connected and the program is executed. It shows an image generated by the LDR sensor, which is used to determine blood type.

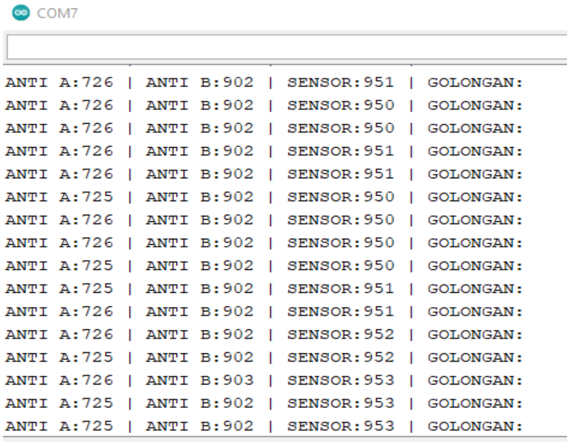

Figure 8. LDR implementation

Figure 9 illustrates the result of connecting the photodiode sensor module and running the application. It provides an example of how the photodiode sensor is used to measure cholesterol levels.

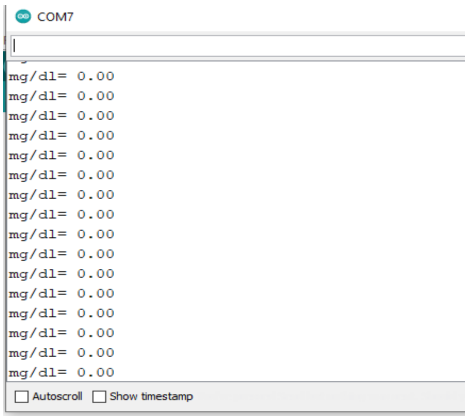

Figure 9. Photodiode implementation

3.4 Testing

3.4.1 LDR sensor testing

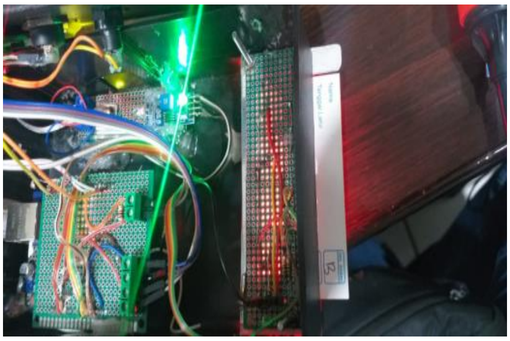

Figure 10. LDR testing with slide test

Figure 10 demonstrates the testing of the prototype notification system, which monitors cholesterol and blood type using a Telegram messaging system. This test is performed to confirm that the system meets its design objectives. Specifically, Figure 10 shows the sensor test conducted with a blood type sample card positioned underneath; the serial monitor displays the output or analog value generated in response to the presence of the sample card.

Figure 11 is some blood type sample card collection done in Cianjur during earthquake natural disaster in order for in order for the people to easily know their blood type.

Figure 11. Blood type sample card testing

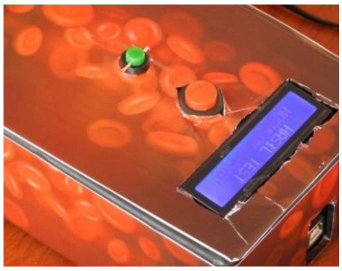

Figure 12. Blood type sample card testing

Figure 12 is the results on some blood type sample card collection displayed on the LED display.

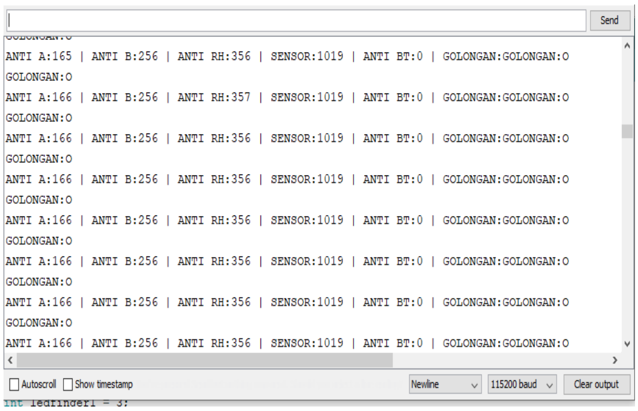

Figure 13. Blood Type LDR Testing Output

The sensor is tested in Figure 13 with an item resembling a blood type sample card beneath. The output, or analog value, is displayed on the serial monitor when the blood type sample card is present.

3.4.2 Photodiode testing

Figure 14 depicts a test of the photodiode sensor used for cholesterol measurement. It demonstrates how an obstruction in front of the sensor module causes the photodiode, which functions as an LED light catcher, to register a high reading due to the finger blocking it.

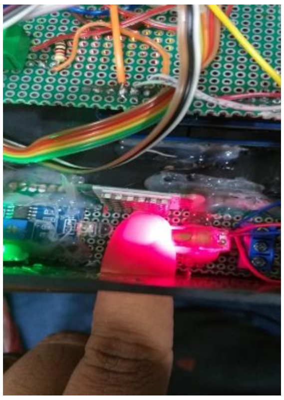

Figure 14. Photodiode testing with finger

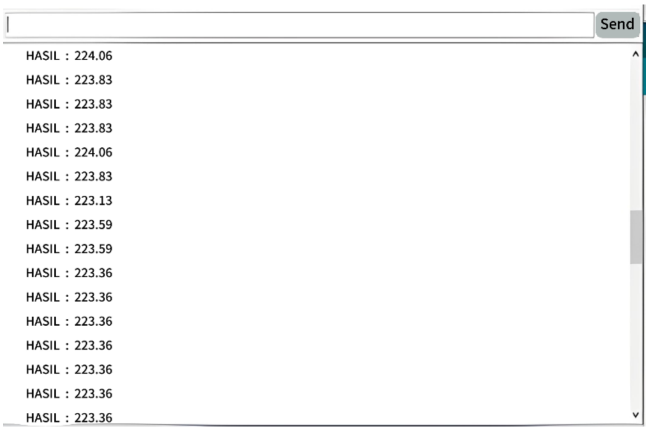

Figure 15. Cholesterol photodiode testing output

Figure 16. Telegram notification testing output

Figure 15 explains how an obstruction to the sensor module causes the photodiode, which serves as an LED light catcher, to be high since the finger is blocking it.

Figure 16 illustrates a test of the telegraph notification system for blood type and cholesterol results. It demonstrates the validation of these findings and the delivery of alerts via Telegram.

3.4.3 Test result table

Table 1 shows the trial results of checking blood type and there are various types of blood types.

Table 2 shows the results of the cholesterol checking trial to several students and there are various cholesterol results.

Table 1. Results of blood group testing

No.	Name	Address	Blood Type
1	Neng Siti Julaeha	Cianjur	O
2	Monika	Cianjur	B
3	Siti Nur Aisyah	Cianjur	A
4	Niesa Zahra	Cianjur	O
5	Siti Subaehak	Cianjur	B
6	Nenti Nuraeni	Cianjur	B
7	Neng Resti	Cianjur	AB
8	Siti Masroh	Cianjur	O
9	Rohimah	Cianjur	O
10	Rismayanti	Cianjur	B
11	Ucu Nurhasanah	Cianjur	O
12	Ai Hasanah	Cianjur	O
13	Ibu Lolis	Cianjur	A
14	Ibu Rosidah	Cianjur	O
15	Juningsih	Cianjur	AB
16	Nanang Ridwan S.	Cianjur	O
17	Dede Firman Kasim	Cianjur	O
18	Azmi	Cianjur	B
19	Zaki	Cianjur	B
20	Muhammad Hamzah	Cianjur	O
21	Nanda	Cianjur	B
22	Reva	Cianjur	B
23	Kevin	Bogor	A
24	Ghani	Bogor	O
25	Fadli	Bogor	B
26	Indri	Bogor	B
27	Puspa	Bogor	AB
28	Seno	Bogor	A

Table 2. Cholesterol check result

No.	Name	Cholesterol	
		Research Tool	Original Tool
1	Kevin	223 mg/dl	216 mg/dl
2	Ghani	218 mg/dl	214 mg/dl
3	Fadli	220 mg/dl	213 mg/dl
4	Indri	226 mg/dl	231 mg/dl
5	Puspa	220 mg/dl	217 mg/dl
6	Seno	192 mg/dl	182 mg/dl
7	Fikri	215 mg/dl	218 mg/dl
8	Brisman	227 mg/dl	229 mg/dl
9	Arif	216 mg/dl	218 mg/dl
10	Kamaludin	208 mg/dl	214 mg/dl

4. CONCLUSIONS

The following conclusions may be made based on the test results and conducted discussions: 1) A system for applying blood type and cholesterol that may send out automated alerts has been designed. The blood type reader is an LDR sensor, and the cholesterol reader is a photodiode. 2) Has the ability to notify Telegram about blood type and cholesterol results.

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