Department of Electrical and Electronics Engineering

Third Year B.Tech (ECE/ECE-AIML)

Robotics and Automation

Course Code: ECE3002B

PBL REPORT

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Topic: Blood type & Blood sugar Analyzer

Problem Statement:

Blood type and Glucose level detection are critical for safe blood transfusions and diagnosing anemia. Traditional methods are invasive, costly, and carry infection risks. A non-invasive approach using near-infrared (NIR) light could provide pain-free, continuous monitoring and real-time results. This method involves a wearable device that uses NIR sensors to measure blood parameters through the skin. It aims to improve accuracy and accessibility while avoiding the drawbacks of current methods.

Aim:

To develop a non-invasive and efficient system for simultaneous blood type and blood sugar measurement using near-infrared (NIR) spectroscopy, integrated into a wearable device that provides real-time data and displays results in real-time.

Objectives:

The objective of the work is to decide the blood group of a person swiftly using the kit which should be handy, relatively low-priced, environmentally gentle and long-lasting in addition to the attributes of safety, eco friendly, quick result, flexibility, economy, in-vitro.

Theory:

Non-invasive calibration methods are beneficial due to their pain-free nature and reduction in healthcare costs .These methods enable continuous online monitoring with low contamination risks and allow real-time clinical responses. Near-infrared (NIR) spectroscopy is widely used for non-invasive biomedical sensing, as it can penetrate deep into biological tissues. In the visible and NIR range, the absorption of light by blood is largely influenced by hemoglobin derivatives and water in the plasma. Pulsatile blood volume changes can be tracked by calibrating light transmission or reflection through the blood sample.

Observation table:

Blood group	Voltage level (mV)
A	24-63
B	39.33 - 80
O	14-29.33

Methodology:

-The **proposed model** uses a 940nm NIR light source, chosen for its suitability in measuring blood type.

- The setup involves a **NIR emitter** and a **NIR receiver (photodetector)** placed on either side of the fingertip.

- NIR light passes through the fingertip, and part of the light is absorbed by the blood, while the remaining light reaches the detector.

- The **photodetector converts the received light** into an electrical signal.

- The signal is then **filtered, amplified,** and converted from analog to digital using a microcontroller**.**

- The **digital signal is processed** using second-order regression analysis to predict blood type and glucose levels.

- Results are displayed on an **LCD screen.**

Algorithm:

Initialize Variables and Setup:

- Define necessary variables: `voltage`, `maxVoltage`, `glucoseLevel`, `bloodGroup`, and `validMeasurement`.
- Set `startTime` to the current time.
- Start Serial communication at 9600 baud.

Main Loop:

- Read the Sensor Value from the NIR receiver.
- Convert the sensor value to millivolts and store it in `voltage`.

Error Handling:

- If `voltage` is 0 mV:
    - Print "Error: Sensor blocked", delay for 1 second, and restart the loop.
- If `voltage` is greater than 100 mV:
    - Print "Error: No finger placed", set `validMeasurement` to false, delay for 1 second, and restart the loop.

Measurement Phase (5 seconds):

- If `validMeasurement` is true, track the maximum voltage observed over 5 seconds.
- Print "Current Voltage" every 0.5 seconds to monitor the ongoing voltage.

End of Measurement:

- If `validMeasurement` is true:
    - Determine the blood group based on the recorded `maxVoltage`:
        - Blood Group O: 14-29.33 mV
        - Blood Group A: 24-63 mV
        - Blood Group B: 39.33-99 mV
        - Unknown if outside these ranges.
    - Calculate the glucose level using a predefined formula and print the final results.
- If `validMeasurement` is false:
    - Print "Measurement invalid: No finger detected at some point during measurement window."

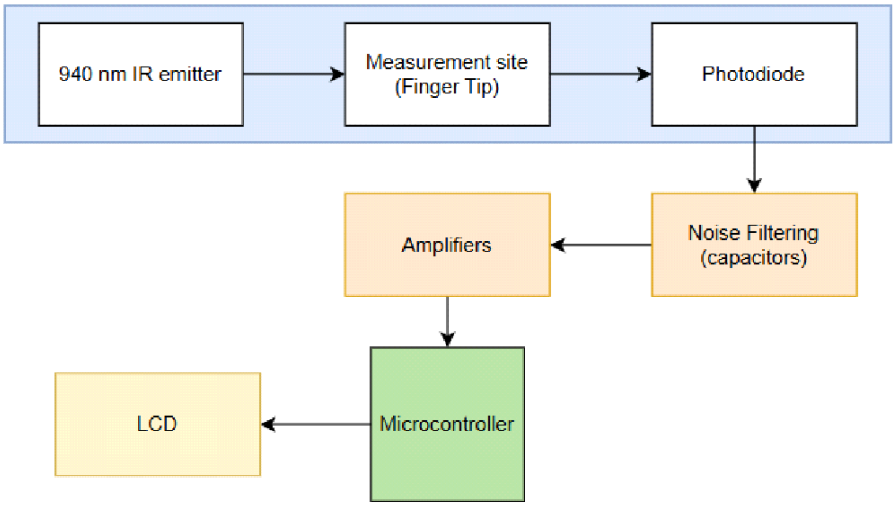
Cooldown Phase (5 seconds):

- Continuously read and print the current voltage every 0.5 seconds to ensure the sensor is ready for the next reading.

Reset:

- Reset `maxVoltage` to 0, set `validMeasurement` to true, update `startTime`, and delay for 2 seconds before starting a new measurement cycle.

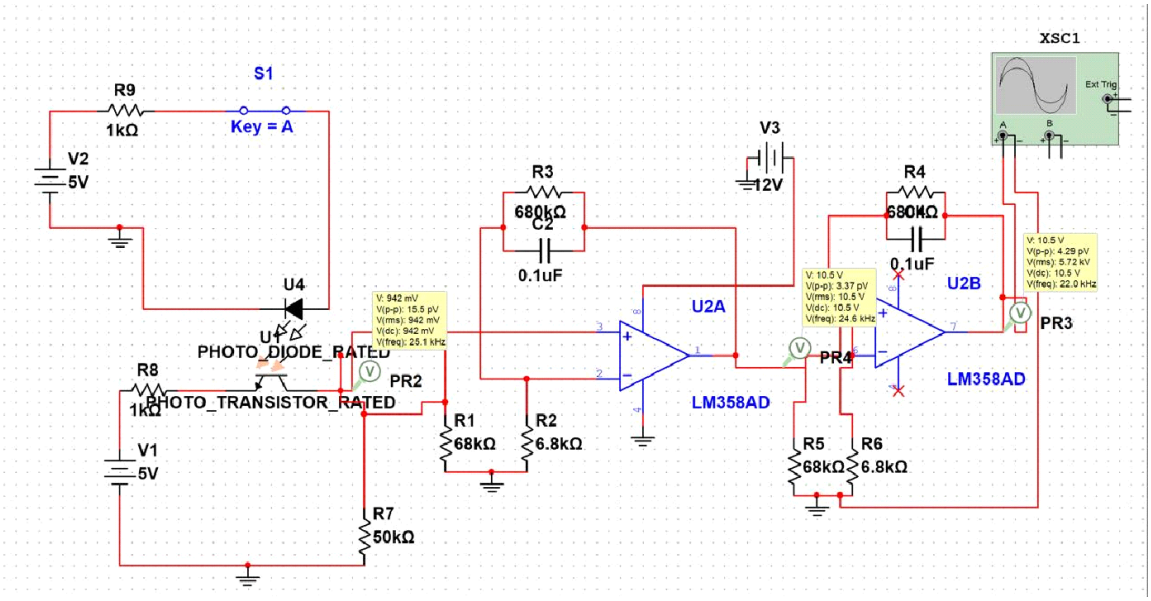
Block Diagram :



Specifications:

- **Light Source:**
  Near-Infrared (NIR) LED, 940 nm wavelength
- **Measurement Site:**
  Fingertip
- **Sensing Components:**
  NIR emitter
  NIR receiver (photodiode)
- **Signal Processing:**
  Microcontroller(Atmega328p / STM32Gxxxx)
  Analog-to-Digital Converter (ADC)
  Signal filtering and amplification(LM358)
- **Display:**
  LCD screen

Simulation :



Conclusion and Future Scope:

Currently, skilled specialists do calibration of blood type and blood sugar level via chemical approaches in clinical test centers, which involves pricking one's finger to acquire a sample of blood. This can be circumvented using the blood type detection using Near Infrared Sensors as specified, a portable device by means of a novel non-invasive method of determining blood type, calibrating hemoglobin concentration and blood sugar level is anticipated. Existing non-invasive models encompass calibration of the system, which may lead to meticulousness errors each time the system is calibrated.

The approach presented in this work, based on Near Infrared Sensors, consents to determining safely, the blood type and blood sugar level of a patient within a short time devoid of the compulsion of taking blood samples, in this manner eradicating the pain of being wedged with a needle. The procedure is advantageous in emergency situations, blood transfusions, etc. as it prominently condenses the time and difficulty of manually.

The error in blood typing is due to the integumentary issues such as thickness of the epidermal layer. The error can also be due to perspiration by the sebaceous glands. Thus, in future, a device or sensor could be designed to consider and overcome the above mentioned factors.

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Signature of Students:

Signature of Guide: