SOLDIER'S HEALTH MONITORING SYSTEM

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ABSTRACT

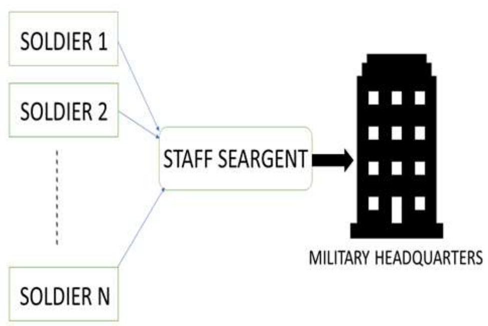
Soldiers are one of the greatest assets of any country. They are crucial for the defense of a country. They are the guardians of the nation and protect its citizens at all costs. Therefore, their protection is of utmost importance and subsequently, technology plays a pivotal role in it.

Many times, soldiers are required to perform operations that require them to venture deep inside forest areas, or some disaster affected areas. Therefore, they require constant monitoring with regards to their health.

Our project focuses on this aspect of technology, wherein we monitor a soldier (including body temperature and heartbeat) using the apt components.

INTRODUCTION

Surveillance of a soldier is a primary requirement during any operation. Owing to this requirement, we have come up with a project that measures the body temperature and senses the heartbeat of the soldier at regular intervals, and transfers this data to the nearest staff sergeant's device, which in turn is sent to the main headquarters. This simultaneous concise data of that group of soldiers (including the staff sergeant's) helps the headquarters to take essential decisions during that operation. Below is a schematic diagram to better illustrate the theory above:



Note that our prototype is designed for just one soldier, but can be used by multiple soldiers.

There are multiple applications of temperature sensors and heartbeat sensors, specifically in the medical field.

Whenever the sensors collect the data, it is transmitted to the sensor head (here, Arduino Uno) in analog waves, which are then converted to digital signals and transferred accordingly.

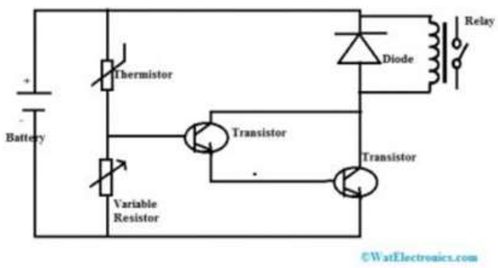
PRINCIPLE

Temperature sensor -

For our project, we have chosen contact temperature sensors, although the non-contact temperature sensors are also available (which detect infrared radiations). Contact sensors include thermocouples and thermistors because they are in direct contact with the object they are to measure. Whereas, the non-contact temperature sensors measure the thermal radiation released by the heat source. Non-contact temperature meters are often used in hazardous environments like nuclear power plants or thermal power plants.

The basic principle of working of the contact temperature sensors is the voltage across the diode terminals. If the voltage increases, the temperature also rises, followed by a voltage drop between the transistor terminals of base and emitter in a diode.

Pictorial representation is given below:



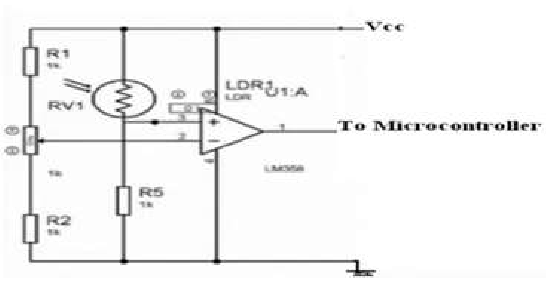
Temperature Sensor Circuit with Relay Switch

Heartbeat sensor -

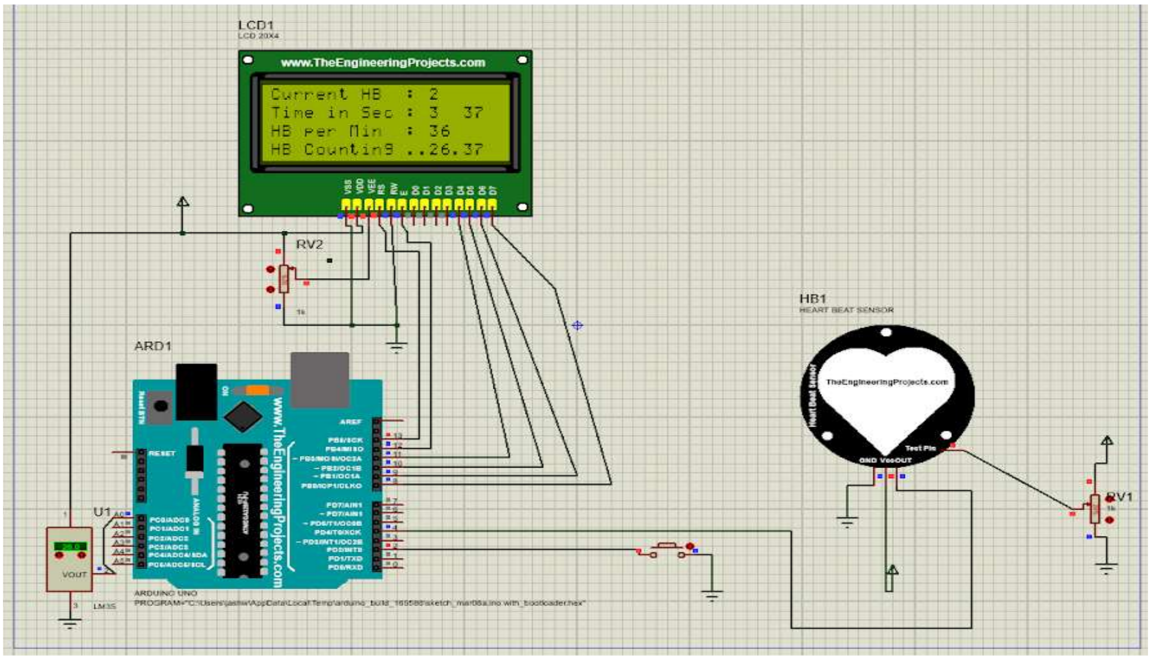
The heartbeat sensor is explicitly a contact sensor and is based on the principle of "photoplethysmography". It measures the change in volume of blood through any organ of the body which causes a change in the light intensity through that organ (avascular region).

In the case of applications where the heart pulse rate is to be monitored, the timing of the pulses is more important. The flow of blood volume is decided by the rate of heart pulses and since light is absorbed by the blood, the signal pulses are equivalent to the heartbeat pulses.

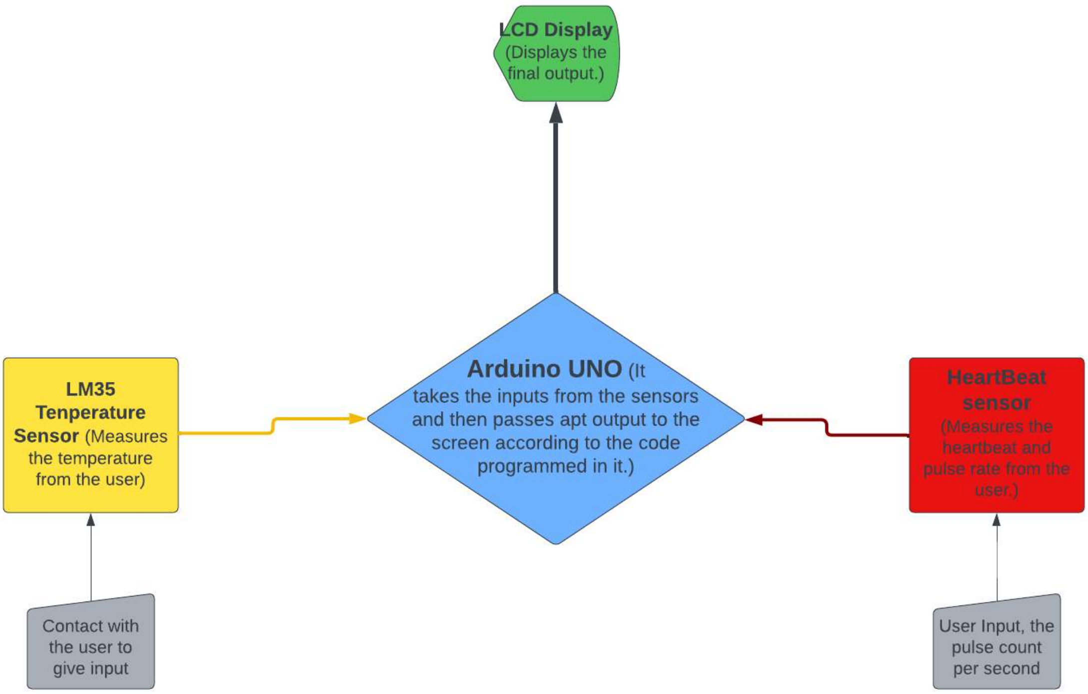
Basic diagrammatic depiction of pulse sensor given below:



SYSTEM DIAGRAM



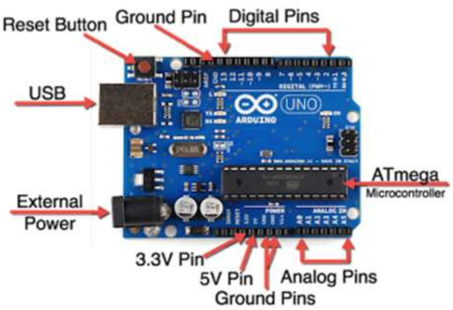
FLOWCHART -



COMPONENTS

Arduino Uno-

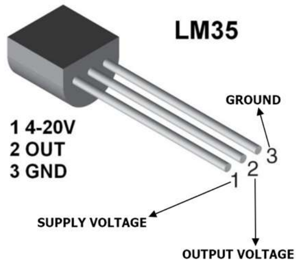
The Arduino Uno board is a microcontroller based on the ATmega328. It has 14 digital input/output pins in which 6 can be used as PWM outputs, a 16 MHz ceramic resonator, an ICSP header, a USB connection, 6 analog inputs, a power jack and a reset button. This contains all the required support needed for the microcontroller.



In our proteus-based project, we have used the Arduino UNO R3 Version (available online with all required libraries). It has an operating voltage of 5 volts, Flash memory of 32 KB of which 0.5 KB used.

LM35 (Temp. Sensor):

LM35 is an integrated analog temperature sensor whose electrical output is proportional to Degree Centigrade. LM35 Sensor doesn't require any external calibration or trimming to provide typical accuracies. The LM35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy.



Features of LM-35:

- Calibrated directly in Degree Celsius (ºC).
- Linear at 10.0 mV/°C scale factor
- 0.5°C accuracy guarantee-able (at a25°C).
- Rated for full -55°C to a 150°C range.
- Suitable for remote applications.
- Low cost due to wafer-level trimming.
- Operates from 4 to 30 volts.
- Less than 60 mA current drain.
- Low self-heating, 0.08°C instills air.
- Non-linearity is only 0.25°C typical.
- Low impedance output, 0.1Ωfor 1 mA load.

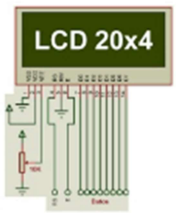
LCD [16*2 and 20*4]:

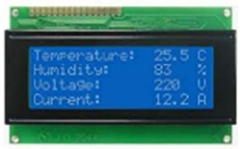
LCD stands for Liquid Crystal Display.
Following are features for 16*2:

- The operating voltage of this LCD is 4.7V-5.3V.
- It includes two rows where each row can produce 16 characters.
- The utilization of current is 1mA with no backlight.
- Every character can be built with a 5×8-pixel box.

- The alphanumeric LCDs, alphabets & numbers.
- Its display can work on two modes like 4-bit & 8-bit.
- These are obtainable in Blue & Green Backlight.

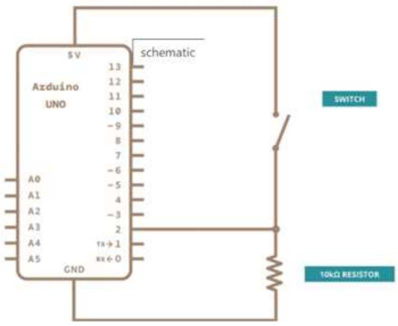
It displays a few custom generated characters.





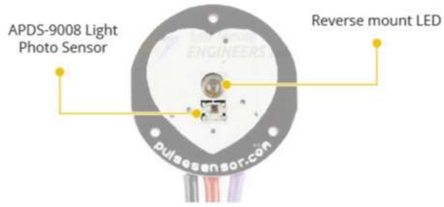
Button:

Push Buttons or switches connect two points in a circuit when you press them. This example turns on the built-in LED on pin 13 when you press the button.



Heart Beat Sensor:

A basic Heartbeat Sensor system can be built using basic components like an LDR, comparator IC LM358, and a Microcontroller.



The module operates from a 3.3-5V DC.

Voltage supply with an operating current of

< 4mA. Here are the technical

specifications:

Maximum Ratings	Wavelength
VCC - 3.0V to 5.5V	LED Output - 565 nm
i_{max} (maximum current draw) < 4mA	Sensor Input - 525 nm
V_{out} (Output voltage range) - 0.3V to VCC	

POT-HG:

POT-HG is a Potentiometer software that is included in the Proteus Software's library. It allows us to change the resistance during simulation run-time.

A physical Potentiometer is a three-terminal resistor with a sliding or rotating contact that forms an adjustable voltage divider.

EXPERIMENTAL PROTOTYPE

Working Principle

Our project works on the principle of temperature measurement and detection. And also on the measurement of heartbeat of the soldier using the heartbeat sensor, which can be further implemented to display the pulse of the soldier.

The working principle of the sensors used are explained earlier. Here, we mainly discuss the implementation of the code on which our entire project is based upon.

As we can't get any physical input in online mode, we have to initialize some default values to our sensors.

First we have to select the pins of the microcontroller which will display the output on the lcd display. Then we use a void setup() function to initialize all our sensors in the working mode, clear the previous output of the lcd display and initialize some default values to the sensors attached.

Then a void loop() function is used which takes output from the heartbeat and temperature sensor inorder to convert them to proper form and also return them to the respective pins of the lcd display for output. Here we measure the heartbeat till a particular time interval and ultimately return the average heartbeat during that interval.

The output from the temperature sensor is directly displayed after some conversions.

Lastly, a void timerIsr() loop is used to set the start of heartbeat measurement.

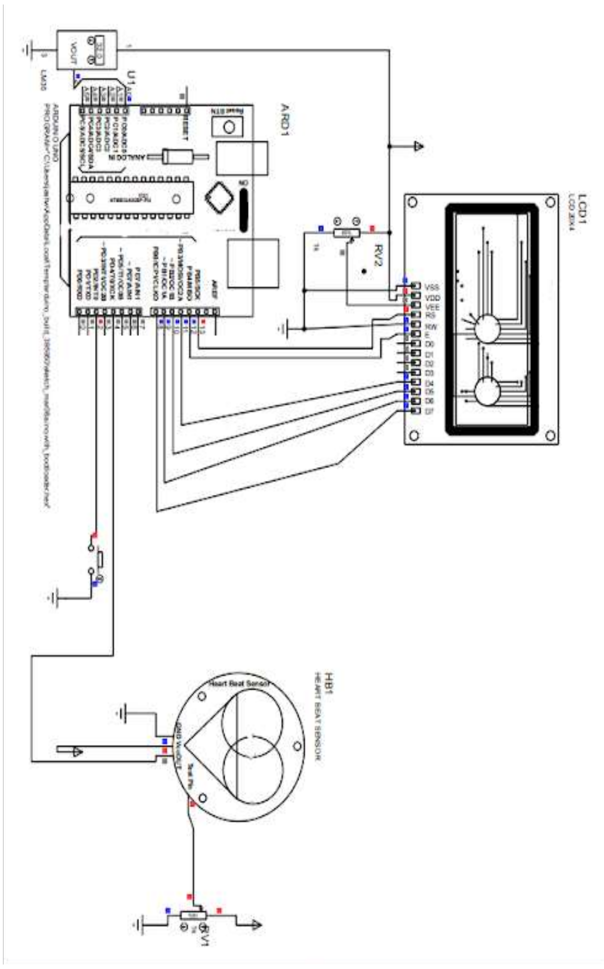
Implementation

The implementation of our project, Soldier's Health Monitoring System, is based on a simulated circuit as we were unable to present it in hardware form in offline mode. It revolves around the proteus implementation of the circuit involving all the components and writing and compiling programs on the arduino ide. Arduino offers an open-source electronic prototyping platform that is easy to use and flexible for people who are beginners in the robotics field.

The **Proteus Design Suite** is a proprietary software tool suite used primarily for electronic design automation. The software is used mainly by electronic design engineers and technicians to create schematics and electronic prints for manufacturing printed circuit boards(PCBs).It was developed in Yorkshire, England by Labcenter Electronics Ltd and is available in English, French, Spanish and Chinese languages.

Nearly all the libraries are available in the proteus software though the library for the heartbeat sensor is downloaded from the internet. All the connections are made using jumper wires. Inputs from the sensors are passed to the microcontroller which then processes the inputs according to the programmed code and displays the required output on the screen.

The circuit diagram of the proteus implementation of our project is depicted in the following image -



Result

Constant health monitoring can be very crucial at all times for a military force. Our project aims for a self sufficient, direct and haselfree measurement of metabolic activities of a soldier which will be quite helpful for earlier detection of any diseases or other physical discomforts.

We have gone for a simple yet efficient and sturdy design as the conditions for rough usage are prominent. It will be easily wearable without any outer discomfort or uneasiness for the soldier.

Ultimately our project has gone for measurement of simple health data from which other helpful data can be derived.

Due to the limitations of the online mode we were unable to integrate many other sensors for better and varied measurement of metabolic activities of the soldier. A working model too would be quite helpful for the visualization of our project and making any other necessary hardware amendments in it.

Specification

The best benefit of our project is its flexibility and scope of enhancement. We have made our model with an open mind in order to further advance in the future. Believing in the concept of simple yet effective we have tried to make our project in such a way that the further addition of additional components and features won’t be too bothersome.

We would further aim to advance our idea by implementing it in a hierarchical model so that the data of a single soldier can be read, recorded and measured by the central unit. Adding further components like the gps and gsm modules is within our sight. Measuring the position and coordinates of a soldier is too valuable of an opportunity to pass up.

CONCLUSION

We built a compact but impactful monitoring system which has a varied amount of use in a variety of fields focusing on military operations but expanding even to medical and areas of daily usage. The measurement of basic activities like temperature and heartbeat is quite helpful.

The main motto behind this model is to develop a self-sustaining and direct model which gives the health details without any fuss. The simplicity of its operation will be quite helpful for the soldiers. This makes them independent for basic medical needs and would help them to analyze their diagnosis in hostile conditions.

The only drawback would be the hardware part in which we have our work cut out for us. Also the addition of various other monitoring devices won't be amiss and connecting it to IOT would also be a main focus for us.

ACKNOWLEDGEMENTS

To begin with, I would like to express my humble and unconditional gratitude to the Almighty God without whose blessings this project would never have been possible.

This project is entirely dedicated to the brave soldiers of our motherland who fearlessly and dauntlessly protect us all from all the threats daring to come near our country. This project is just a little token of our appreciation and gratitude towards them and our duty towards our nation.

We would like to express our sincere thanks to our professor **Dr. Bipin C. Mandi** for giving us this valuable opportunity of learning by doing. We would also like to thank him for being our constant support and source of inspiration during this entire project.

Special thanks to IIIT NR for providing the necessary facilities to implement this project.

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