MANTECH Publications

Journal of Embedded Systems & Its Applications
Volume 4 Issue 2, July-December 2019

Design and Implementation of a Rescue Rover

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Abstract

Rescue rover is a robot that can assist at any disastrous situation by sharing information of the whole area. Due to its small size the robot can fit into any place. Thus, it can go to eventually anywhere immediately and fetch us information about the number of human stuck in the situation, their physical situation and their exact location. This paper is aimed to design such robot to conduct any rescue operation. The robot is consisted of sensors like ultrasonic sensor, passive infrared sensor (PIR), light detecting resistor (LDR), thermal sensor, gas sensor and flame detector. Each sensor can be associated with different tasks. A logical map can be made up using ultrasonic sensor which can be helpful for the rescue team. The other information like any movement can be detected by PIR motion sensor detection. Other sensors like LDR, Gas sensors, and flame sensors are used for several detections. GSM module is used here to send information at the end part. A performance study has been investigated based on accuracy, costing and delay.

Keywords: *Rescue rover, Sensor nodes, PIR, LDR*

INTRODUCTION

Today we are living in a world where natural disasters can happen any time. During these incidents many people get stuck in the affected areas. Sometimes it becomes very hard for the rescue team to get access to that particular point where any human got stuck and counting his last breath. It is very important to have all the necessary information about the area of the disaster so that they can take necessary precaution about the situation and make plan for the further rescue operation. So it is highly recommended that all the necessary information of environment of the particular area and number as well as situation of the injured persons should be gathered as fast as possible. The aim of

this work is to develop a rescue robot more reliable source for fetching information from the affected area.

WORKING PROCEDURE

The robot consists of various sensors for different purposes. All the sensors are equally important for bringing us the information of the whole area. At first let's talk about Passive Infrared Motion Detector. It is a sensor that can detect any kind of motion by object. This sensor can help us finding any human movement especially if the survivor is severely injured and can make limited movements, it can detect that person and can inform us. Then there is a sonar sensor which is used to measure the exact location in between the sensor and the object. We have also added the temperature sensor which helps us to sense the environmental condition at that spot. The temperature sensor also helps to identify the presence of any human body by detecting body temperature. After that there is a light dependent resistor (LDR). This sensor is added to know about the inner condition of any infrastructure whether the area is in dark or not. Flame sensor helps the robot to identify any smoke/fire at any place. And finally there is a gas sensor which helps us to recognize the presence of any poisonous or flammable gas like CO.

We have placed a speaker and a microphone at the robot which will create a two directional communication link to between outside and affected area. These sets of information are assembled together and then forwarded to rescue team via GSM module.

DESIGN AND IMPLEMENTATION OF RESCUE ROVER

3.1 Connection Setup between Motor driver L298N and Arduino

In figure 3.1 we have shown the connection setup among two motors, motor driver, and Arduino Uno board where Red wire is used for +5v power supply and black one is for grounding. There are 4 pins for controlling motor driver which we connected with the Arduino board. Two more pins besides the control pins are known as Enable A and Enable B, can be used to control the speed of the motors. The motors are connected both side of the motor driver.

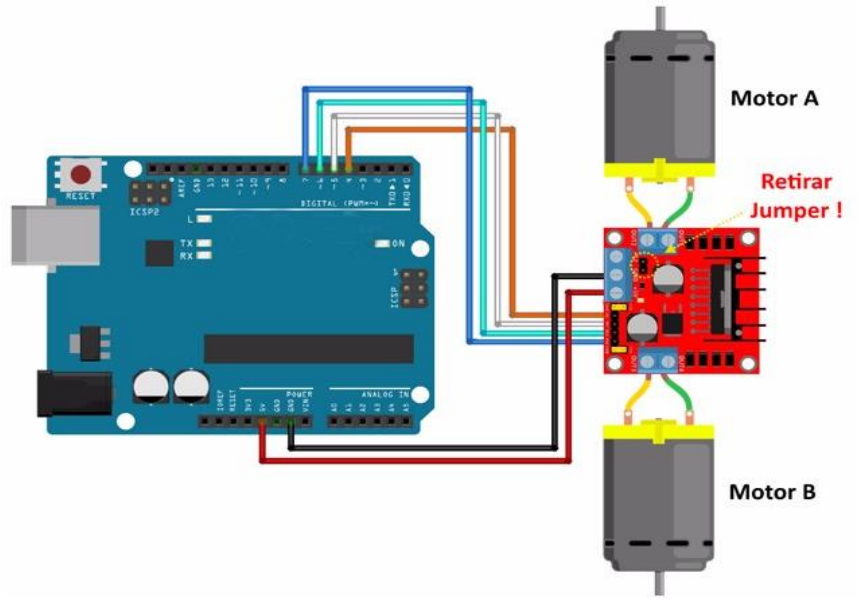

Figure 3: Theoretical setup of Motor driver L298N with Arduino

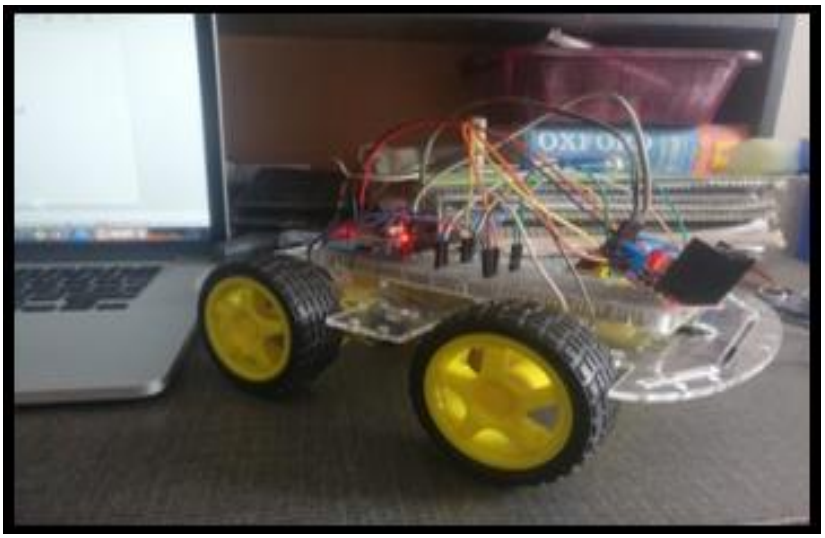

Figure 3.1: Connection setup of Motor driver L298N with Arduino

3.2 PIR Sensor Connection Setup

Connection setup in between PIR sensor and Arduino is shown in fig 3.2. PIR sensor has 3 connection pins, of which we connected the left pin to +5v power supply, the right pin to GND and the middle pin is connected to the digital pin of Arduino board. The middle pin is used for digital output. We have connected an LED that indicates any motion by blinking.

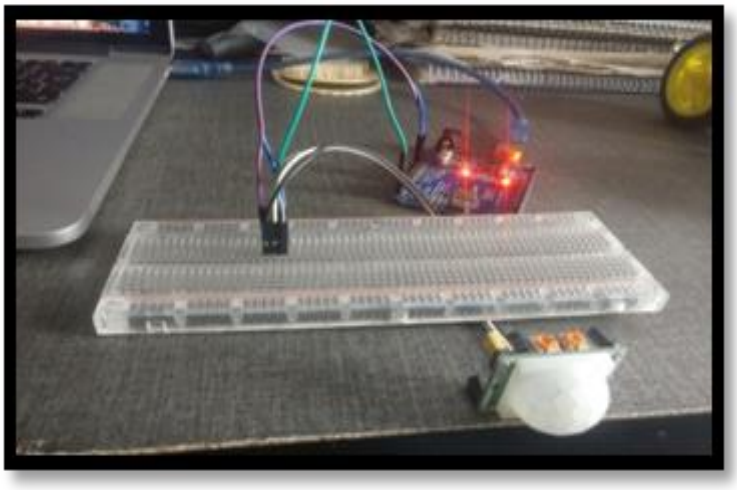

Figure 3.2: Connection setup of PIR motion detector sensor with Arduino

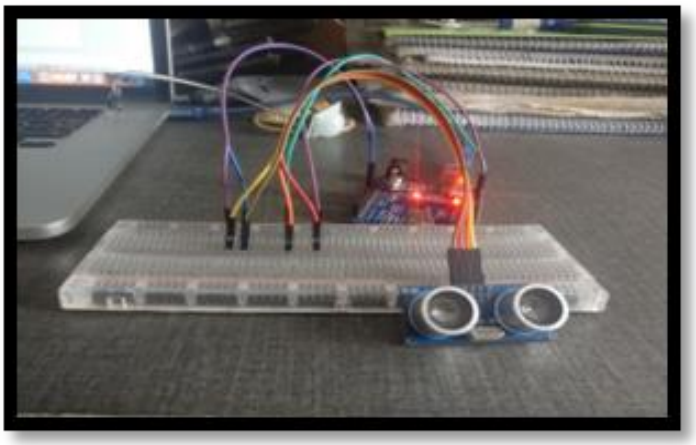

Figure 3.3: Connection setup of Ultrasonic sensor with Arduino

3.3 Sonar Sensor Connection Setup

We have connected the sonar sensor the same way as with the PIR sensor, except it has 4 pins (fig 3.3). The uppermost pin which is connected through a red wire is VCC, responsible for supplying +5V to the sensor. Second pin triggers the sonic pulse which is attached to 12th digital pin of Arduino. The third pin is known as the echo pin which captures the reflected pulse. And the last pin is for GND.

3.4 Temperature Sensor- LM35 Connection Setup

In the setup 3.4 we see there are three pins in the temperature sensor LM-35. We connected the right pin of LM-35 to the ground by black wire. The middle pin of the sensor acts as output which is connected to the analog port of the Arduino board. The VCC of the sensor is connected to the +5V of the Arduino board.

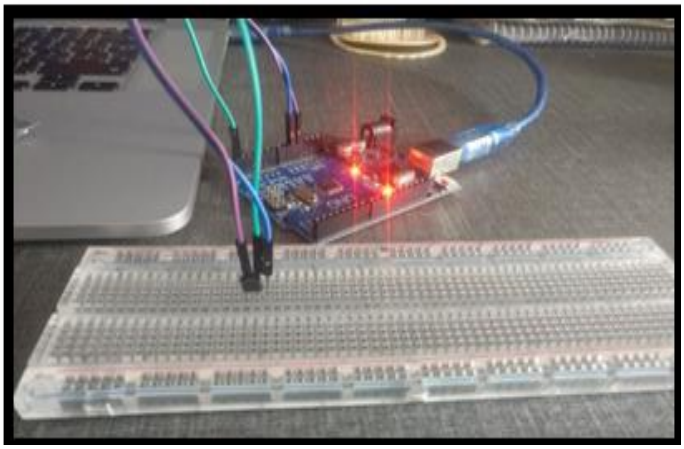

Figure 3.4: Connection setup of Temperature sensor with Arduino

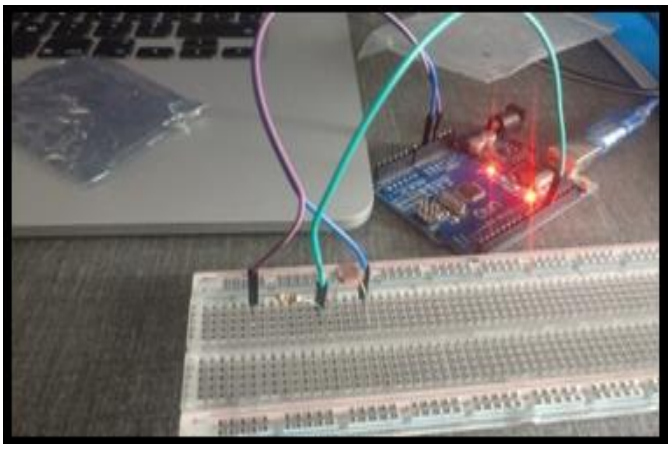

Figure 3.5: Connection setup of LDR sensor with Arduino

3.5 LDR Sensor Connection Setup

At first, we need to connect the LDR to the analog input pin 0 on the Arduino. setup for the connection is in figure 3.5. One pin of the LDR is connected to 5v on the Arduino and the other to the analog pin 0 on the Arduino. A 10K resistor is also connected to the same pin and ground connection is established.

3.6 Flame Detector Connection Setup

From the figure 3.6 we can see the flame sensor has 4 pins and they are connected with the Arduino. At first we attached+5V analog and ground pin of the sensor with the ground and the +5V pin of the Arduino. Then we connected the digital pin of sensor to the digital pin of the Arduino to take the digital output. We connected the led at the pin 12 of the Arduino. When the sensor will detect a flame, the led will light up.

Figure 3.6: Connection setup of Flame Detector sensor with Arduino.

3.7 Gas Sensor Connection Setup

From the setup of 3.7 we see there are four pins in a Gas sensor. The most upper pin of the sensor is used for +5V connection from the Arduino board. The second pin of the sensor is used for GND. The DO pin of the sensor is known as digital output which we connected to the digital pin 8 of the Arduino board. The AO pin of the sensor is known as analog output which we connected to the analog pin of the Arduino board.

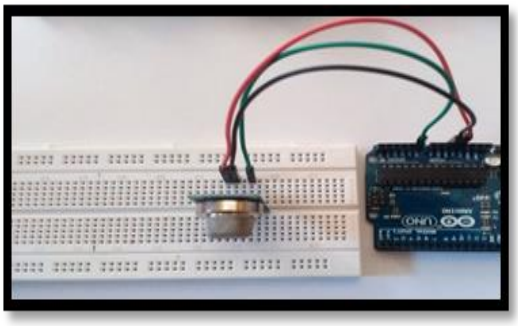

Figure 3.7: Connection setup of Gas detector sensor with Arduino.

3.8 GSM Module Connection Setup

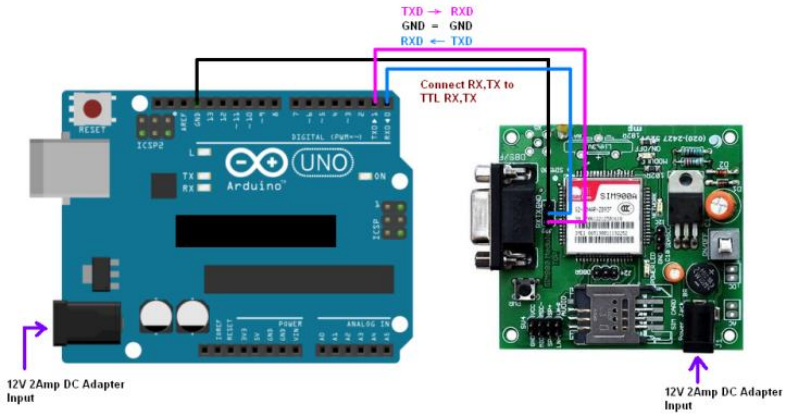

Figure 3.8: Theoretical setup of GSM Module with Arduino

GSM Module consists of 3 pins. The TX pin of the GSM module is responsible for transmitting data; which we attached with RX pin of Arduino board. The RX pin of the GSM module is responsible for receiving data, which we also attached reverse way with TX of Arduino Board. And the other pin is for GND.

RESULTS

Information carrying and assembly robot has different kind of sensors attached to it. The sensors are: PIR Motion Detector Sensor, Ultrasonic Sensor, Temperature Sensor, LDR, and Smoke Detector Sensors. All the sensors work together to give necessary information of any disaster area. These sensors make a database of information that can help the rescue team to know what's going on inside the area as it is sometimes impossible to go to that area by the rescue team.

4.1 Passive Infrared (PIR) Motion Detector Sensor

PIR sensor helps to detect any kind of motion. It generates pulse that reflects from any object standing in front of it. So if the subject makes any movement the sensor can get the variation of signal and thus it knows the subject is making movement. Figure 4.1.1 shown PIR motion detection.

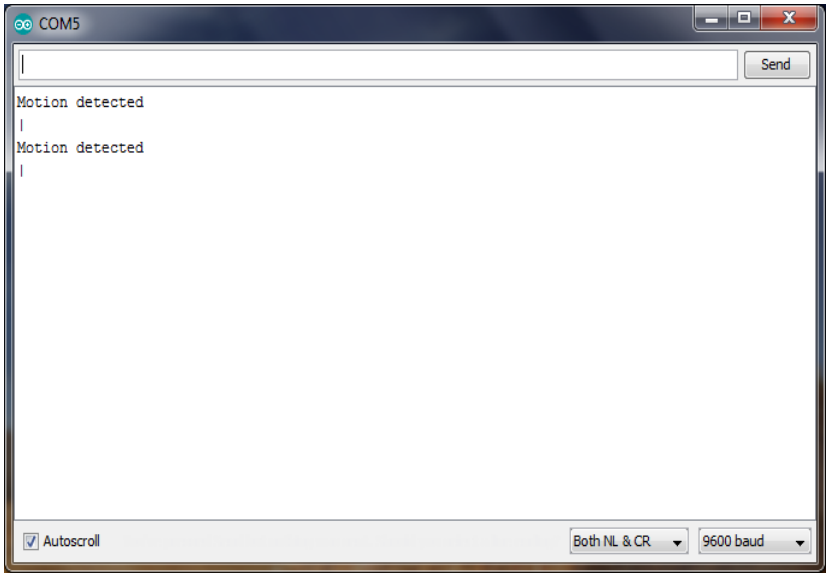

Figure 4.1.1: PIR Motion Detector Sensor reading from the Serial monitor.

4.2 Ultrasonic Sensor (HC-SR04)

Ultrasonic sensor helps to measure accurate distance to the subject standing next to it. The sensor generates ultra-sonic signal; by which it can measure the distance. There is a signal transmitter and signal receiver at the sensor. The Arduino takes the reading from the sensor and calculate the value. The results are shown in the serial monitor.

4.3 Temperature Sensor-LM35

Temperature sensor is used to measure the temperature of that area shown in figure 4.3.1. There is a particular voltage drop for semiconductor device. So we can measure the temperature by measuring the voltage drop of the sensor. For each 10 mV voltage drop there is a temperature rise of 1 degree Celsius. The Arduino calculate temperature from the readings and print it in the serial monitor.

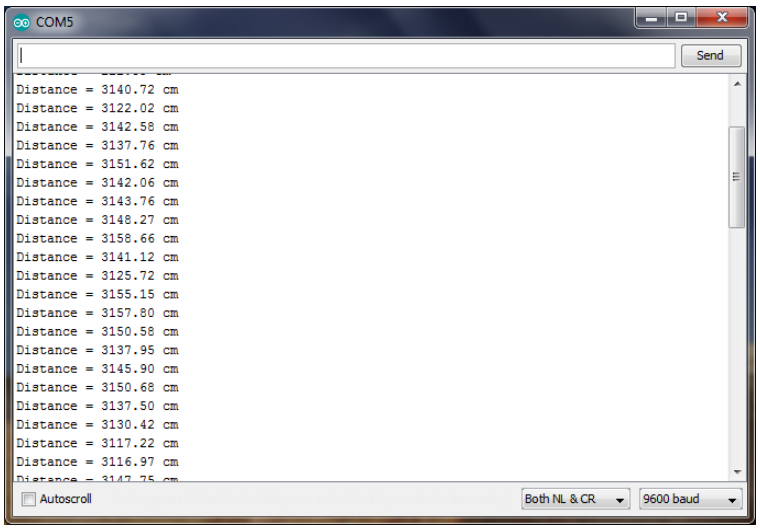

Figure 4.2.1: Ultrasonic Sensor reading from the Serial monitor.

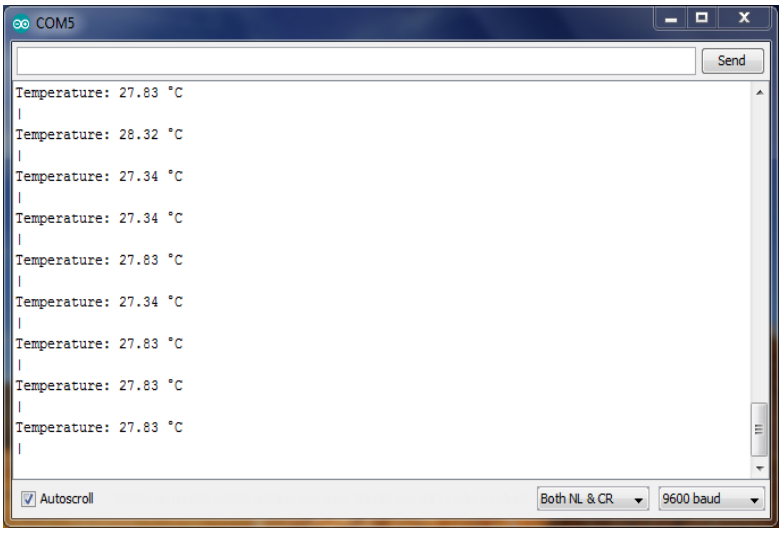

Figure 4.3.1: Temperature Sensor reading from the Serial monitor

Light Dependent Resistor (LDR) Sensor

LDR helps the rescue team to know how much light is present at that area. When there is a light the resistance decreases and when there is no light the resistance raises by this procedure LDR works. So when we get lower value that means the place is dark and if the value is high that means there is enough light in that place.

4.5 Flame Detector

Flame detector sensor can sense the presence of any flame at that area. It can easily detect any flame or fire source at 760 nm ~ 1100 nm wavelength. So if there is a fire, the output of the sensor is high, if there is no fire the output of the sensor is low. Figure 4.5.1shows Flame Detector reading from the Serial monitor

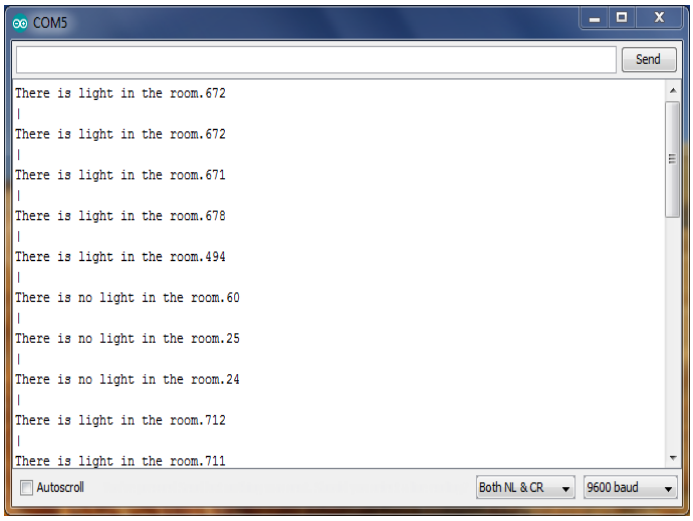

Figure 4.4.1: LDR Sensor reading from the Serial monitor

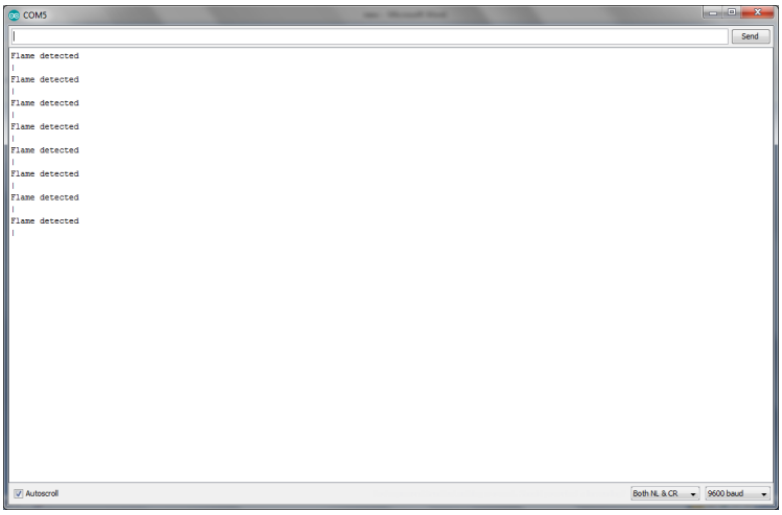

Figure 4.5.1: Flame Detector reading from Serial monitor.

4.6 Power Consumption

Table 1 illustrates total power consumption of the rescue rover.

Table 1: Power Consumption of Components

Name of Sensors	**Voltage Consumption Volt**	**Current Consumption Amp**	**Total Power consumption P=VI Watt**
Motor driver L298N	7.4V	1 Amp	7.4 Watt
PIR motion detector Sensor	5V	0.5 Amp	2.5Watt
Ultra sonic Sensor	5V	0.5Amp	2.5Watt
LDR Sensor	3.3V	0.5 Amp	1.65 Watt
Temperature sensor LM-35	3.3V	0.5 Amp	1.65 Watt
Flame Detector	5V	0.5 Amp	2.5Watt
Gas Sensor MQ-9	5V	0.5 Amp	2.5Watt

4.7.1 Accuracy measurement of Temperature sensor

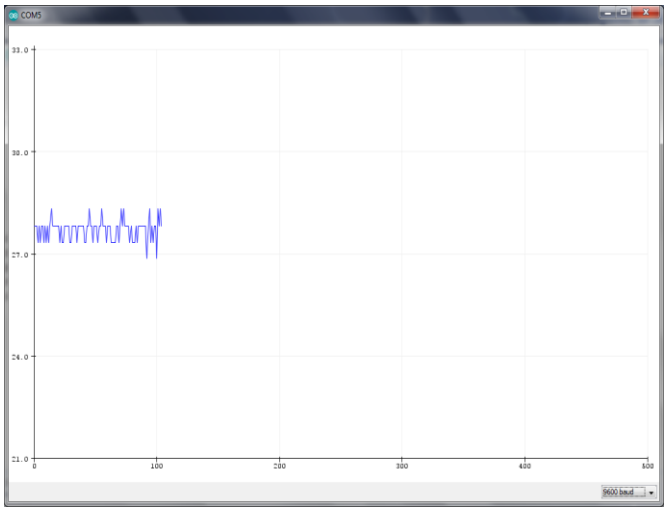

Figure 4.7.1: Temperature Sensor accuracy on Serial plotter.

The Temperature sensor is sensing 28-degree Celsius temperature. 100 readings are taken from the sensor and a graph is plotted by the serial plotter.

4.7.2 Accuracy measurement of LDR

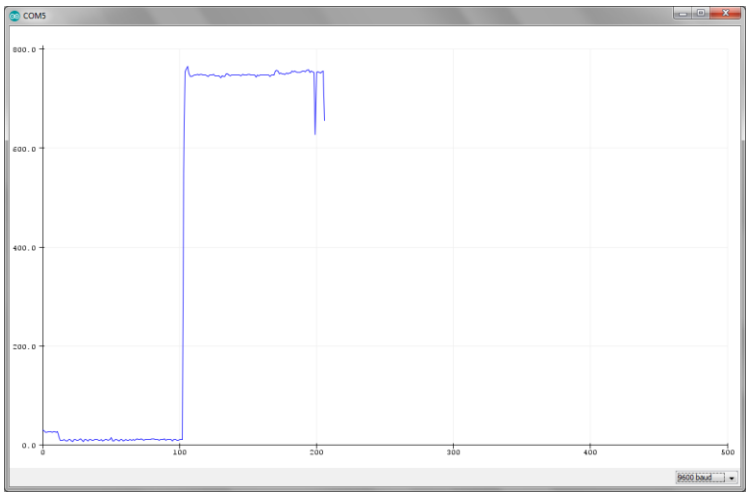

Figure 4.7.2: LDR Sensor accuracy on Serial plotter.

200 readings are taken from the sensor and a graph is plotted by the serial plotter. First 100 readings are indicating the results we got from the dark and the other 100 readings are showing results from the light environment.

4.7.3 Accuracy measurement of Ultrasonic Sensor

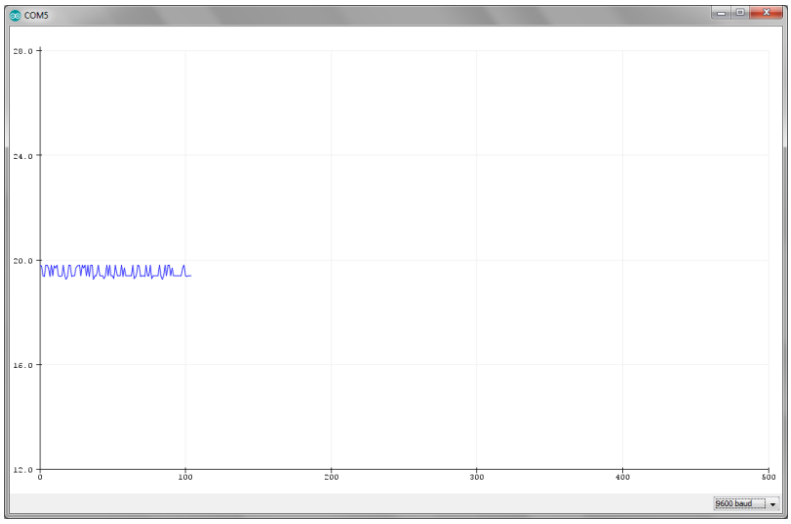

Figure 4.7.3: Ultrasonic Sensor accuracy on Serial plotter

The ultrasonic sensor is showing the distance measurement graph. Sometimes the readings are fluctuating for a little measurement.

CONCLUSION

Information Carry and Assembly Robot is the innovation to work for the benefits of human being at many disastrous situations. This technology can help in the rescue missions. When there is a situation like earth quake, this robot can be the best solution to simulate information around the area. This information is necessary for the rescue team. Because it takes most of the time to figure out the inner situation in earth quake so the delay can be costly. Someone trapped in there may die for this delay. That's why to minimize the loss of human life this robot can play a vital role in that type of scenario for bringing together information of any disastrous area. Out main target was to build such robot for these types of real life scenarios. As it is only the prototype our main target is to make it functional in real time.

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