SIDDHARTH RAINA

TEAM G SENSORS AND MOTOR CONTROL LAB INDIVIDUAL LAB REPORT

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1.INDIVIDUAL CONTRIBUTION

1. ULTRASONIC RANGE FINDER SENSOR PLOT:

I worked on finding out the transfer function of the ultrasonic range finder and measured the output voltage of the sensor for different positions of the obstacle in front of the sensor. I plotted the results and concluded that the reasonable range of operation was between 8 inches and 30 inches as shown in Fig.1.1. The ultrasonic range finder outputs a voltage, which is a linear function of the distance of the obstacle from it, when the obstacle is in the given range of operation. The transfer function in the range of operation = Output (mV)/Distance (inches) = **9.1364 mV/inch**

The actual transfer function according to the datasheet of the ultrasonic sensor was **9.8mV/inch**.

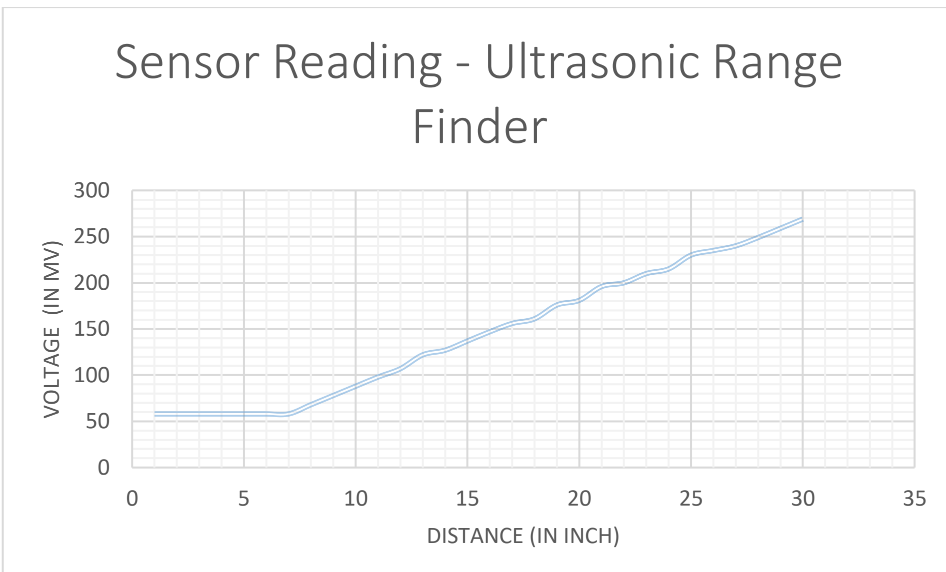

Fig. 1.1 Graph of the sensor voltage vs distance of the obstacle

2.FORCE SENSOR:

I worked on all aspects of the force sensor. Following are the steps, which I had undertaken:

1. Setting up the fixture for the force sensor:

For this step I created a mechanical fixture by sandwiching the force sensor in between two washers and creating a mechanism for driving a screw through the washers into a wooden block as shown in Fig. 1.2.1.

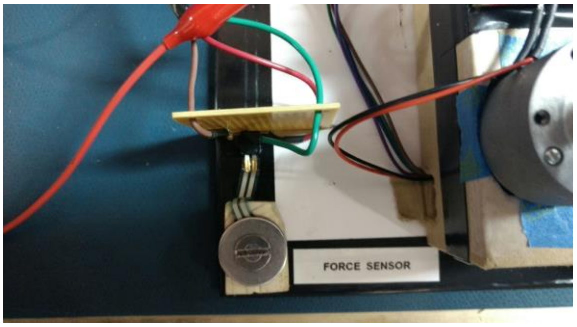

Fig. 1.2.1 A

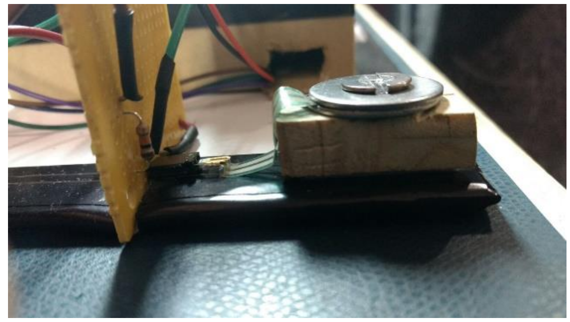

Fig. 1.2.1 B

Fig 1.2.1 Images of the force sensor fixture

As the screw tightens, the contact force between the sensors increases, increasing the voltage across the force sensor. This made it possible to precisely control the force exerted on the force sensor. The input from the force sensor could be used to control the position of the servo as shown in Fig. 1.2.2.

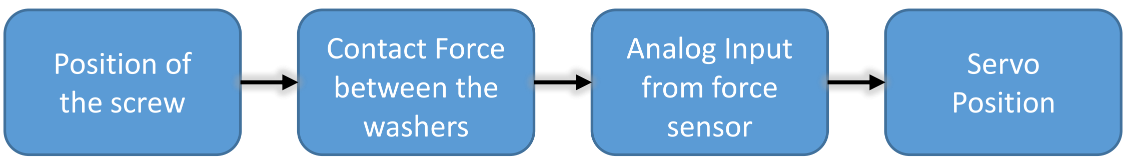

Fig 1.2.2 Block Diagram of the working of the force sensor

2. Circuit Diagram:

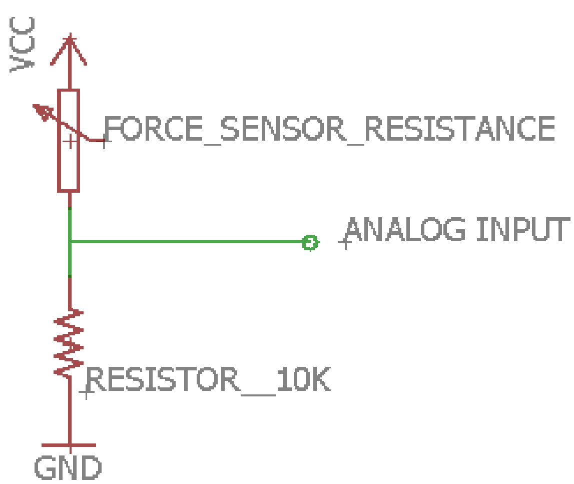

Fig 1.2.3 Circuit Diagram

I created a standalone proto board for the force sensor, which was separate from the main breadboard. This was done in order to secure the sensor and avoid it from passing on noisy analog data. I soldered the components of the force sensor into this proto board according to the circuit diagram shown in Fig. 1.2.3 and Fig. 1.2.1.

The force sensor has infinite resistance when no force acts on it. As the force applied to the sensor increases, the resistance across the sensor decreases, which increases the value of the analog voltage, we get from the sensor. This can be easily interpreted from the circuit diagram as shown in Fig. 1.2.3.

3. Arduino Programming and deriving the transfer function:

Unlike the ultrasonic range finder, the transfer function for the force sensor did not come out to be linear. For deriving the transfer function between the input analog voltage value and the force, I referred to the force sensor datasheet and calculated the conductance.

From the circuit diagram as shown in Fig. 1.2.3

$$R_{sensor} = ((V_{cc} - V_{sensor})*R)/(V_{sensor})$$

Here, R_{sensor} is the resistance across the force sensor,

R = 10K ohm,

V_{cc} = 5V and

V_{sensor} is the voltage across the force sensor.

sensor_analog_value = (V_{sensor} /V_{cc}) * 1024

Conductance = ((sensor_analog_value * 100)/(1024-sensor_analog_value))

According to the interpretations of the graphs in the datasheet, If the value of conductance across the force sensor is less than 1000, the value of force, in Newton, is given by

F = conductance/80.

2.CHALLENGES

1. ULTRASONIC RANGE FINDER SENSOR:

The sensor had noise, which made data acquisition difficult. Due to this the actual transfer function obtained is slightly different from the actual value specified on the datasheet.

The output from the sensor also kept changing with the size of the obstacle size

2. FORCE SENSOR:

For creating the mechanical fixture, I had experimented with multiple designs. In the first design concept, the sensor was sandwiched between a screw and a wooden block. This did not ensure proper force transmission to the sensor, as the pressure was being applied only on limited area of the sensor. The modified design of sandwiching the sensor between washers helped in overcoming this difficulty.

I first connected the force sensor directly to the main breadboard, however it couldn't be secured properly and the sensor terminals kept getting disconnected. In order to overcome this difficulty, I had to solder all components of the force sensor into another standalone proto board. This helped in securing the force sensor into place.

3.TEAMWORK

Our team task distribution was divided as follows:

TEAM MEMBER	CONTRIBUTION
YIQING CAI	GUI
HUAN-YANG CHANG	DC MOTOR PID CONTROL AND ULTRASONIC RANGE FINDER
MAN-NING CHEN	THERMISTOR
SAMBUDDHA SARKAR	STEPPER MOTOR, SERVO MOTOR, POTENTIOMETER, BUZZER AND INTEGRATION
SIDDHARTH RAINA	ULTRASONIC RANGE FINDER PLOT AND FORCE SENSOR

4.FUTURE PLANS

In my project: Calibration of a multi sensor capture system, I am working on capturing images from multiple cameras, given an external trigger. The first step involves calibrating the fixed pattern noise for the cameras followed by calibrating the camera response and camera lens distortion. The final step would be estimating the extrinsic parameters of the cameras.

5.CODE

The following code was used to take the input from the force sensor:

```
int fsrAnalogPin = 0;
int sensor_val;
void setup(void) {
  Serial.begin(9600);
}

void loop(void) {
  sensor_val = analogRead(fsrAnalogPin);
  Serial.print("Force = ");
if(((sensor_val * 100)/(1024-sensor_val))<1000)
 {
   Serial.println(sensor_val*100)/(80*(1024 - sensor_val));
 }
 else
 {
 Serial.println((sensor_val*100)/(1024 - sensor_val)) - 1000)/30;
 }
  delay(1000);
}
```