Portfolio

Radif Uddin Ahmed

143, East Paikpara, Brahmanbaria, Bangladesh.
Email: radifuddinahmed@gmail.com, Cell-Phone: +8801709797113, linkedin ID: RadifUddinAhmed

Research Works Done

1. Design and Implementation of a Low Cost Modern CNC LASER Cutter:

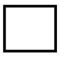
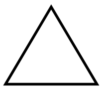
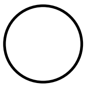
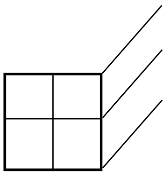
A CNC LASER cutter was designed and fabricated. It had a bed size of 1square feet and a LASER diode of 2.5watts was used for cutting. Whole body was designed in solidWorks.

Fig: Design of the LASER Cutter.

Fig: Fabrication of the LASER Cutter.

Result:

The fabricated machine was tested upon various shapes.

Shape	Difference(mm)	Error (%)	Accuracy (%)
	0.2mm 0.2mm	1%	99%
	0.0mm 0.2mm	1%	99%
	1.0mm 1.1mm 1.5mm	5%	95%
	0.2mm	1%	99%
	0.0mm 0.0mm 0 Degree 0 Degree	0%	100%

2. **Industrial Camera Inspection System (Embedded Machine Vision):**
This System offers more compact solution to detect pharmaceutical tablet defects using deep learning. Its hardware is composed of a NVIDIA Jetson Nano as the processing unit, Raspberry Pi HQ camera as the main image capturing device, an I/O board for receiving camera triggers and sending rejection signals, a 12V 5A power supply and lights made out of LED strips for proper image exposure. The software portion of the system is consisting of a Convolutional Neural Network (CNN). The network is trained with about thousands of images. After training the neural network learns to distinguish between good and defective tablets. While the packaging machine is running the system will receive camera trigger via I/O board, take a snap of the Area of Interest (AOI), feed it in the CNN, find a decision and finally feed the decision to packaging machine via the I/O board.

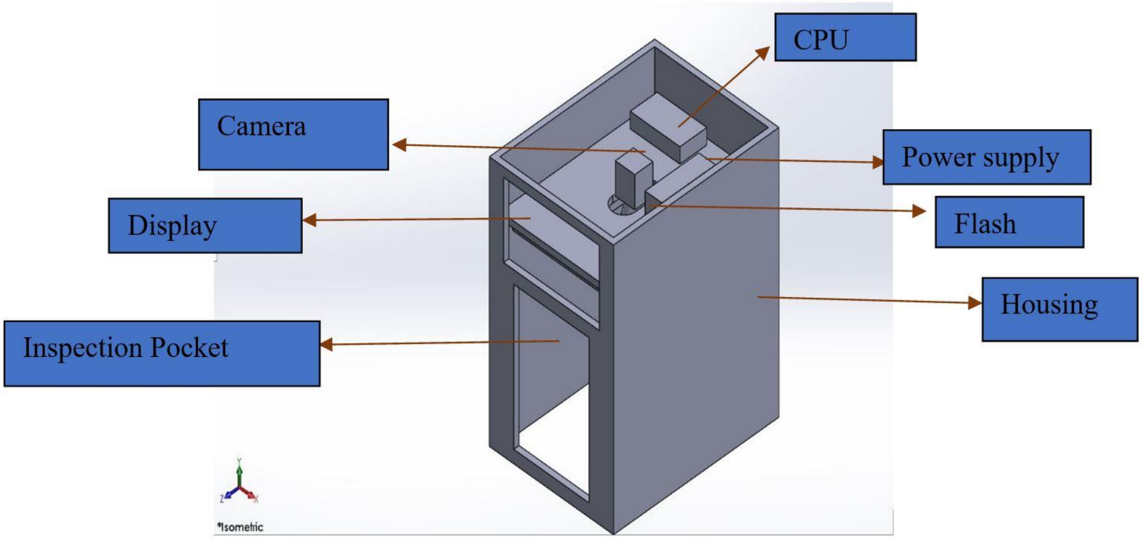


Fig: Hardware setup of camera inspection system

For operation of the system 3 steps needs to be followed:

Step 1: Data Preparation

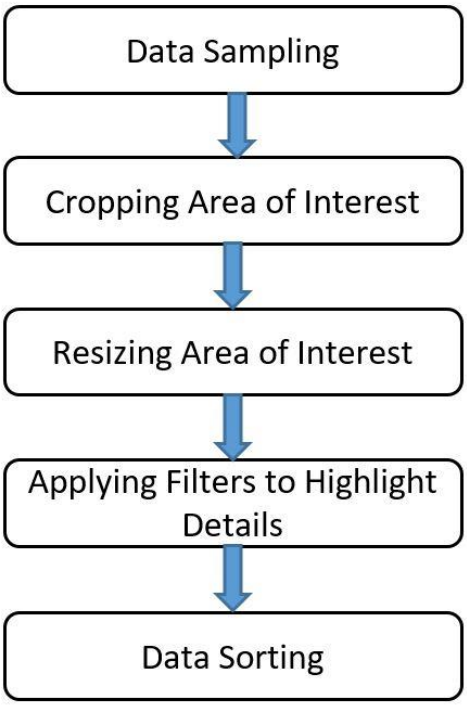


Fig: Data Preparation Flow Chart

Step 2: Model Creation, Training & Saving

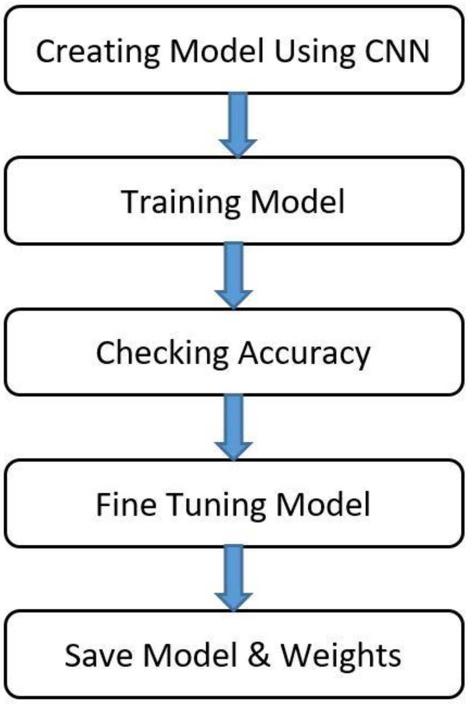


Fig: Model Preperation Flow Chart

Step 3: Application

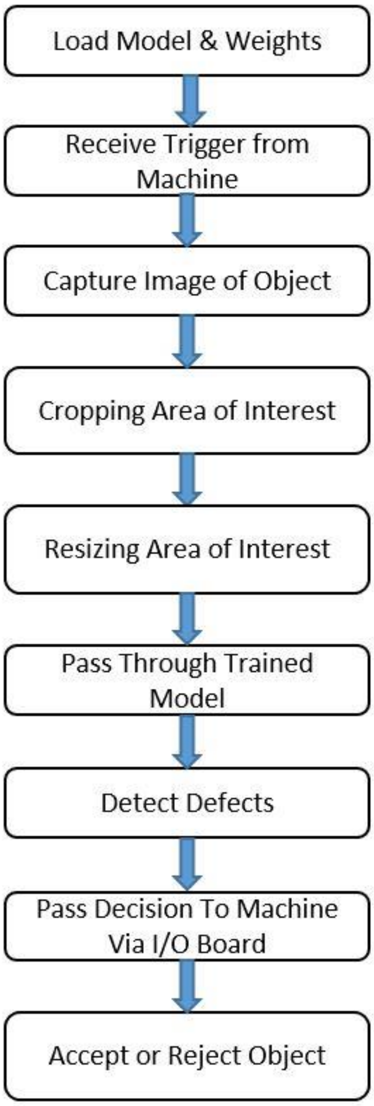


Fig: Application Flow Chart

Fig: Final Fabricated Hardware

N.B.:This research was funded by Renata Ltd.

3. **Industrial Camera Inspection System (Machine Vision):**
   This System was developed using deep learning for detecting pharmaceutical tablet defects before primary packaging. As for the hardware a basler GigE (aca1300 - gc) camera has been used with a 12mm lens. LED panel light has been used to illuminate the Area of Interest (AOI). An I/O board has been used to establish communication between the packaging machine and the camera inspection system. The hardware portion itself is equipped with a 12V 5A power supply. The camera was connected to a separate computer via Ethernet cable for image data processing. The computer received hardware trigger from the packaging machine via the I/O board. Upon receiving a trigger the computer shot an image of the AOI and processed the image using a Convolutional Neural Network (CNN). The neural network would give the decision of whether a tablet should be accepted or rejected based on the quality of the tablet manufactured. The decision was transferred back to the packaging machine via the I/O board. The packaging machine would then reject the defective tablet strip.

Fig: Industrial Camera Inspection System

N.B:This research was funded by Renata Ltd.

4. Design and Fabrication of a Low Cost Assistive Leg Exoskeleton:

This system was developed for assisting motion of human leg. It had an IMU to measure the angle of the limb requiring assistance. The system was trained using the data obtained from the IMU. The assisting effort was delivered using stepper motors and a supporting structure for the affected limb.

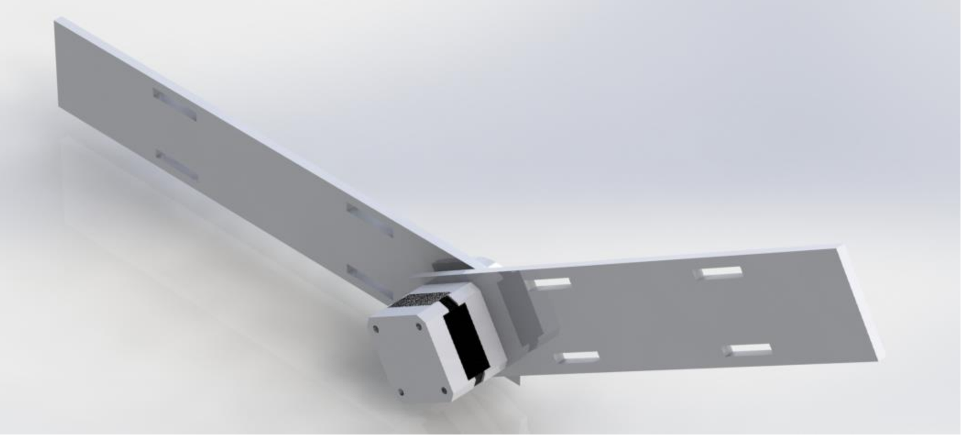


Fig: Design of a Portion of Leg Exoskeleton.

Fig: Angle Measurement of Leg Movement

The exoskeleton had to be trained in order to execute its assistive operations. Hence angle data was obtained from the IMU.

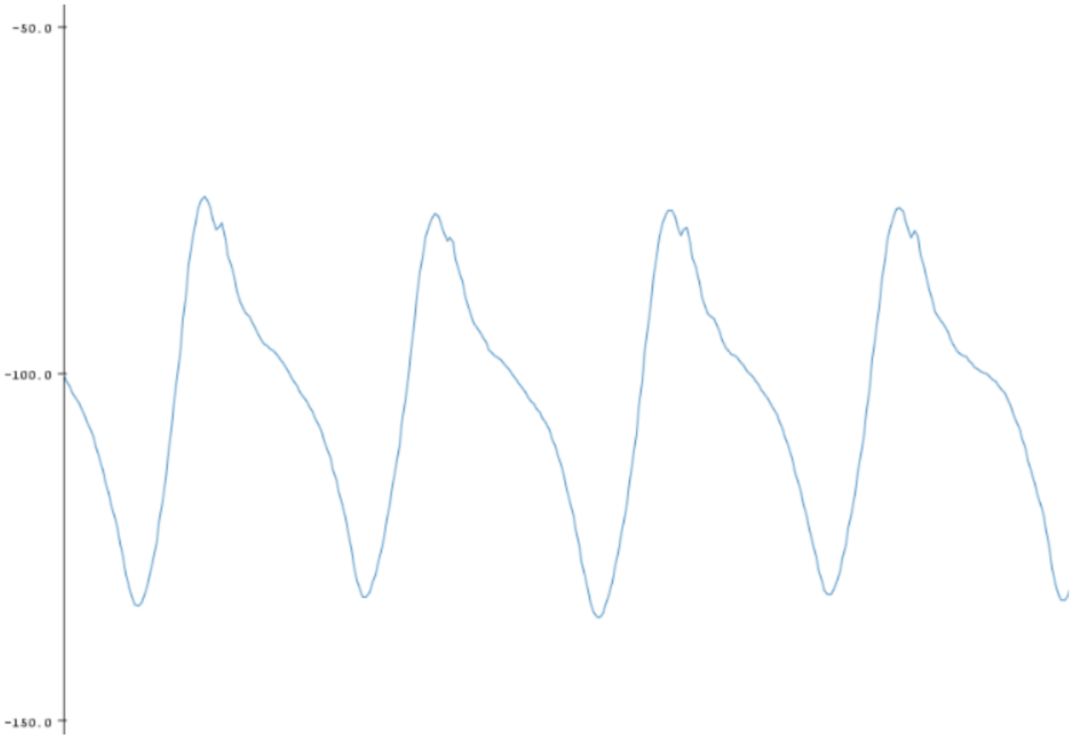


Fig: Angular position data acquired from IMU.

Fig: Leg Exoskeleton Parts.

5. Design and Implementation of a Dual Axis Solar Tracker for Maximum Power:

This system was developed to control the position of the solar tracker automatically in order to gain maximum solar power. It was designed to have two degree of freedom and it was achieved by using a combination of servo and stepper motors. The position of maximum solar power was determined using 4 LDR sensors.

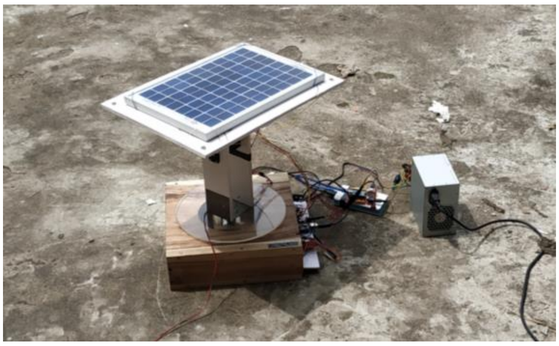


Fig: Two Axis Solar Tracker.

The solar tracker was tested alongside with a single axis and test results were compared in the table below.

Time of the day	Single axis Power(watt)	Dual Axis power(watt)	Percentage of power gain
9.00am	5.312	7.293	38%
10.00am	6.438	7.913	23%
11.00am	7.449	10.176	36%
12.00pm	8.282	10.633	28%
1.00pm	8.901	10.105	14%
2.00pm	8.036	9.159	13%
3.00pm	6.956	8.651	25%
4.00pm	5.611	8.112	45%

Table: Power Comparison between Single Axis and Dual Axis Solar Tracker.

6. Performance Analysis of a Nylon Made Vortex Tube:

This study was done on a vortex tube fabricated out of nylon. Compressed air of different pressure was pushed through inlet port. Then temperature was recorded from the hot and cold end.

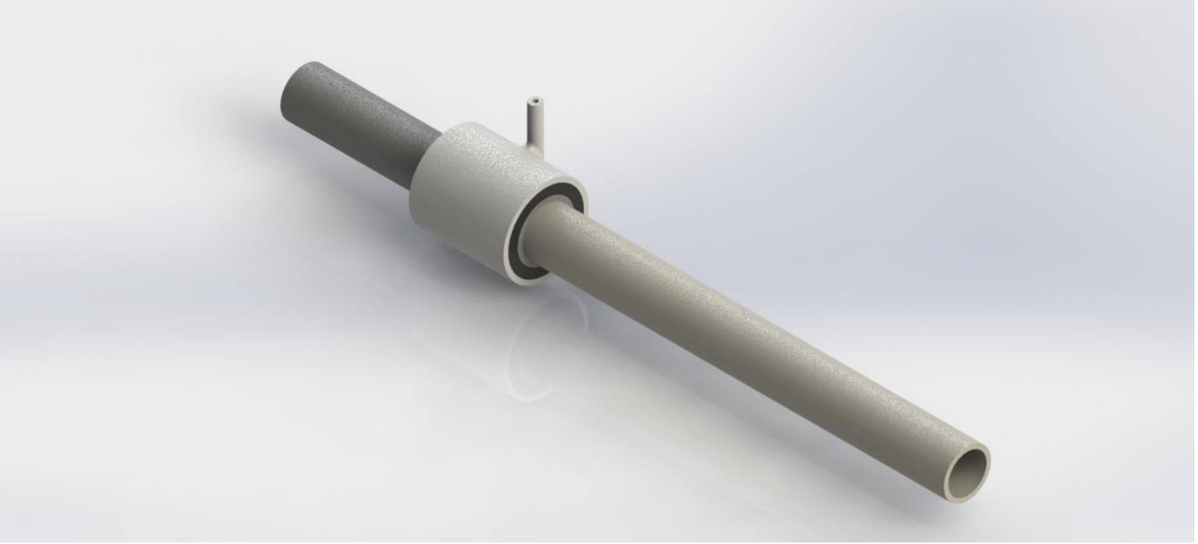


Fig: Design of a Vortex Tube.

Fig: Fabrication of a Vortex Tube.

Results:

Pressure of the inlet compressed air and temperature of inlet, hot end and cold end was analyzed. The analyzed data is given in below table.

Inlet Pressure (bar)	Inlet Temperature (^oC)	Hot End Temperature (^oC)	Cold End Temperature (^oC)
2	26.9	33.4	23.5
3	26	37.5	18.3
4	21.8	40.1	10.1
5	18.1	43	4.9

Table: Data Obtained from Vortex Tube.

7. Performance analysis Hydroxy Gas Generator:

This study was done on producing hydroxy gas analysis its performance under varying conditions. For the fabrication process stainless steel sheets of 20 gage was used. A PVC enclosure was used holding electrode, electrolyte and produced gas. The produced gas was later passed from the PVC enclosure. A car battery was used for the electrolysis process. Potassium Hydroxide was used as electrolyte.

Fig: HHO Production

The production rate was tested under three conditions:

a. Effect of electrolyte concentration:

Concentration of KOH (M)	Production of HHO Gas (ml/min)
0.01	30
0.1	200
0.2	400
0.3	610

b. Effect of time at 0.1M KOH:

Time (min)	Production of HHO Gas (ml/min)
1	200
2	300
3	400
4	430
5	450

c. Effect of temperature 0.1M KOH:

Temperature (K)	Production of HHO Gas (ml/min)
300	450
328	510
355	650
403	690

8. **Design and Fabrication of Cost Efficient Arduino Solar Charge Controller:**
This study was done upon an arduino based charge controller with low cost. Later on its performance was tested.

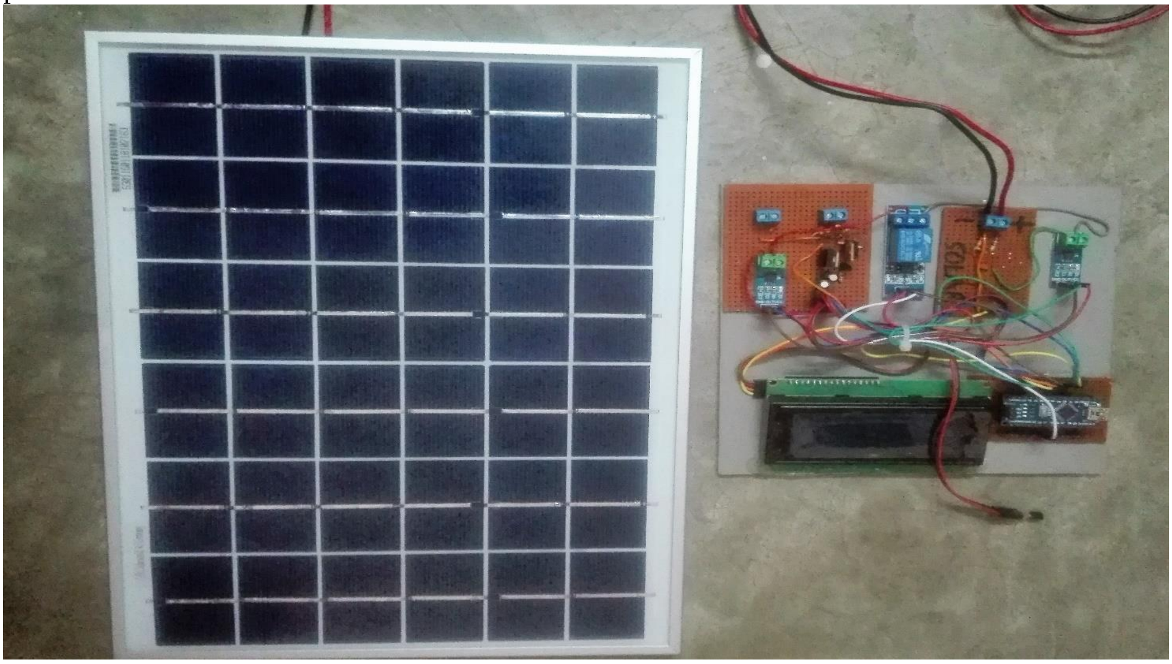


Fig: Solar Charge Controller.

Time	Solar Supply Voltage, V	Solar Supply Current, A	Temperature, Celsius
08.00AM	21.02	0.54	36
08.30AM	20.22	0.54	36
09.00AM	20.96	0.53	37
10.00AM	19.97	0.53	39
11.00AM	21.94	0.54	40
11.30AM	21.96	0.46	41
12.00PM	21.08	0.45	42
12.30PM	19.97	0.54	44
01.30PM	19.67	0.54	48
02.00PM	19.79	0.54	42
02.30PM	20.02	0.51	40
03.00PM	19.64	0.54	40

Table: Solar Panel Supply Voltage with Different Time Period.

Time	Battery Input Voltage, V	Battery Input Current, A	Temperature, Celsius
08.00AM	14.74	0.56	36
08.30AM	14.79	0.58	36
09.00AM	14.60	0.56	37
10.00AM	14.79	0.59	39
11.00AM	14.89	0.58	40
11.30AM	14.97	0.59	41
12.00PM	15.67	0.58	42
12.30PM	15.97	0.59	44
01.30PM	15.77	0.57	48
02.00PM	15.79	0.58	42
02.30PM	15.64	0.58	40
03.00PM	15.64	0.58	40

Table: Battery Input Voltage with Different Time Period.

9. Tilt Operated Wheel Chair:

This system was developed for patients unable to drive a wheel chair by strength. To aid the patient a wireless controller was attached to the hand or head of the patient. Based on the tilting of the patients hand the wheel chair would move. The tilt was measured using an IMU and data was transmitted via a pair of Bluetooth modules. For prototyping the wheel chair four wheeler structure was made. Gear motor was used for movement of the prototype wheel chair.

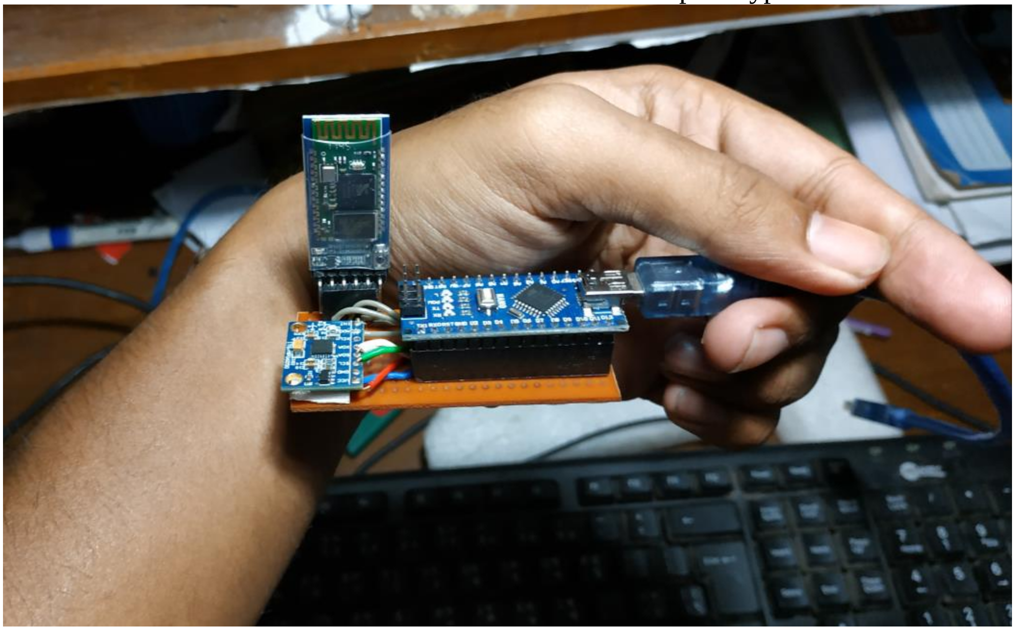


Fig: Bluetooth operated controller.

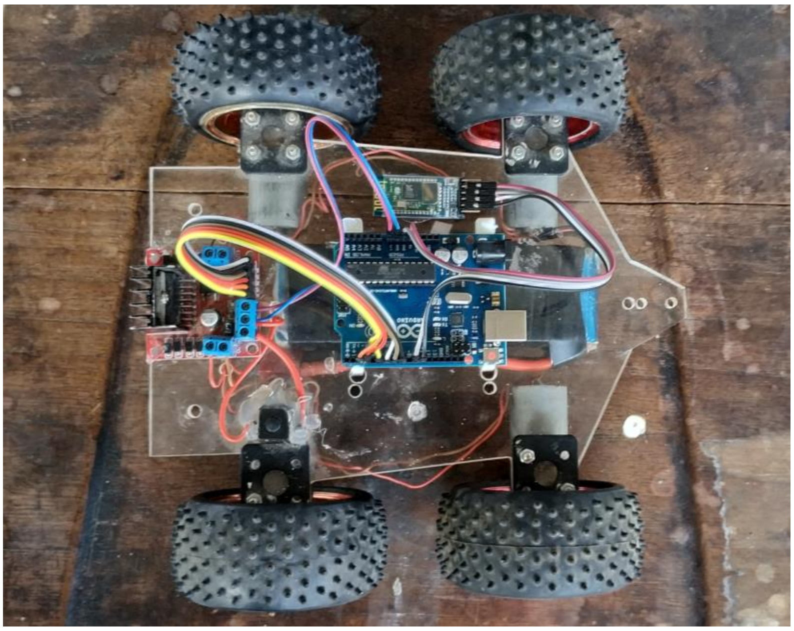


Fig: Wheel chair model.

10. Mine Sweeper Robot:

A robot designed for navigating mine in a minefield. Mine navigation was done using a pair of metal detectors on both side of the robot.

Fig: Design of Mine sweeper robot.

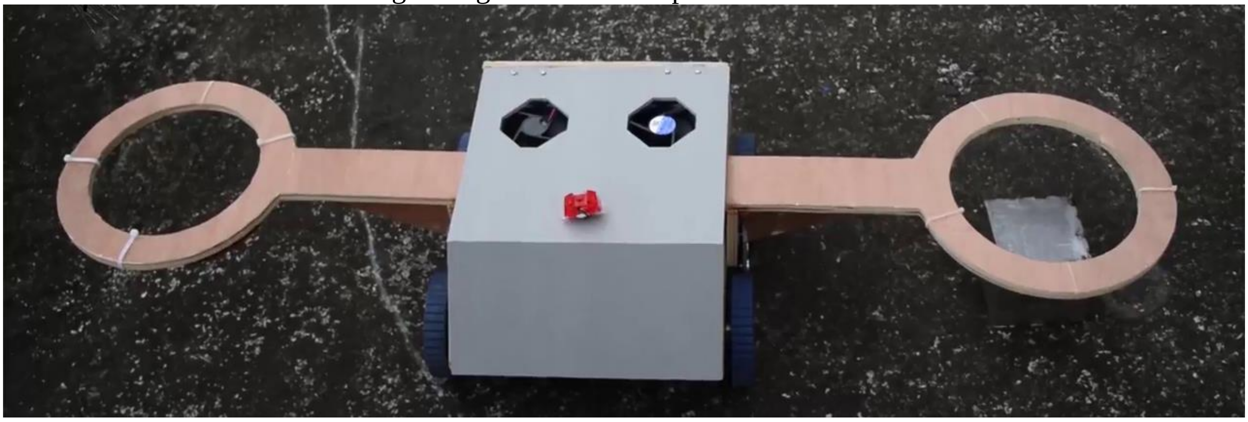


Fig: Fabrication of Mine sweeper robot.

11. Maze Solver Robot:

A robot designed for solving line maze. The development of this robot continued for three consecutive versions. The final version was the most accurate one in terms of solving the line maze.

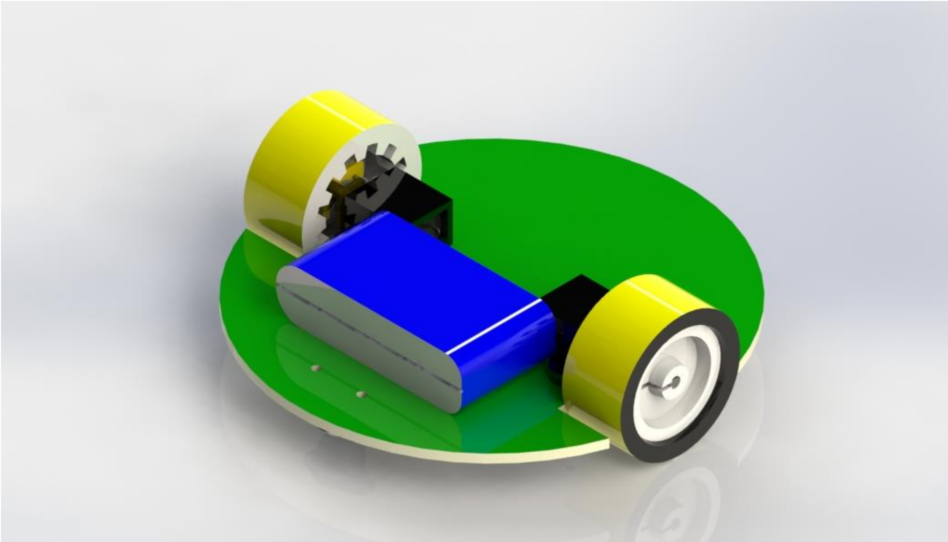


Fig: Design of maze solver robot

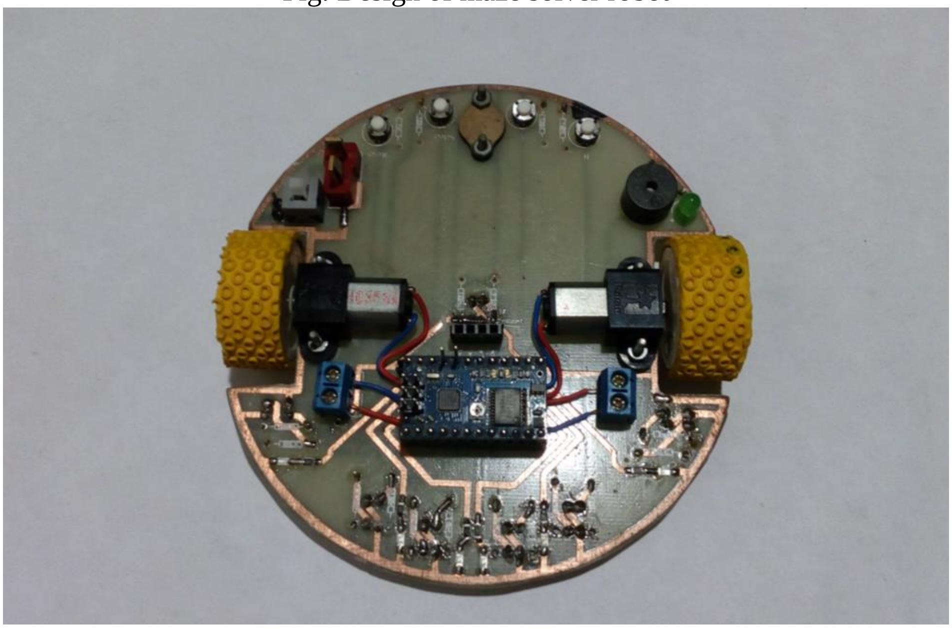


Fig: Fabrication of maze solver robot.

12. Line Follower Robot:

A robotic system that is designed to follow a line using a PID controller. This task was achieved using IR sensors as input devices, microcontroller as processing unit and wheel mounted in motors as output of the system.

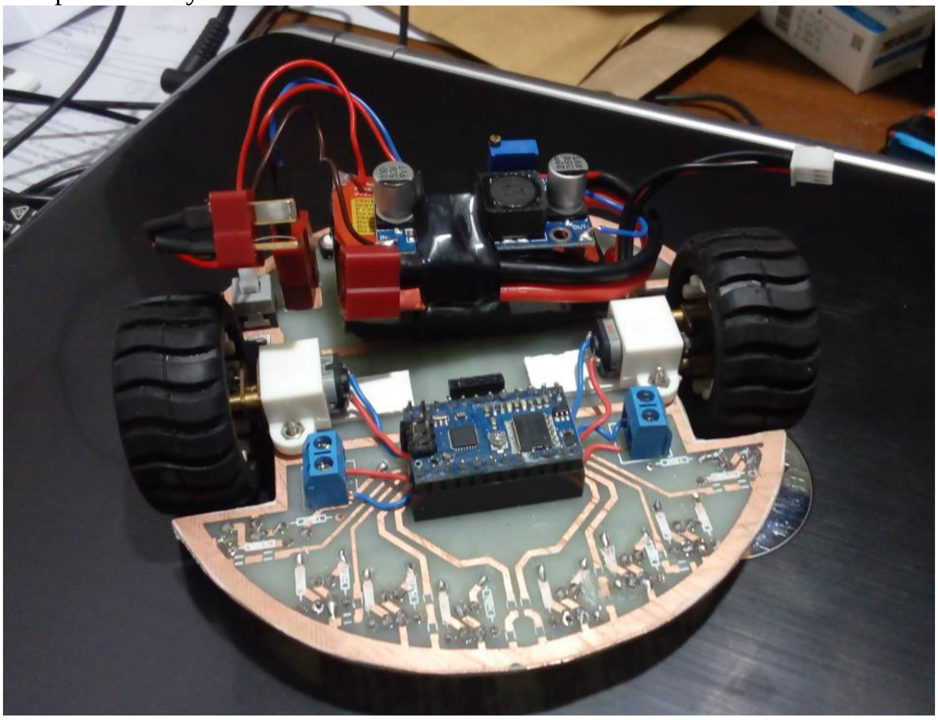


Fig: Line Follower Robot.

13. Unmanned Aerial Vehicle:

This drone was built on a 450mm frame with 980KV brushless DC motors. This drone had CC3D controller as its brain and sensing unit. A 9 channel radio was used to operate it.

Fig: Quadcopter.

14. Accident Detection and Prevention System:

This system had a subtle approach of traffic signal detection using RFID technology. It would help to resolve traffic collision in four way lanes and places where traffic signal is not visible. Besides it involves a collision detection system.

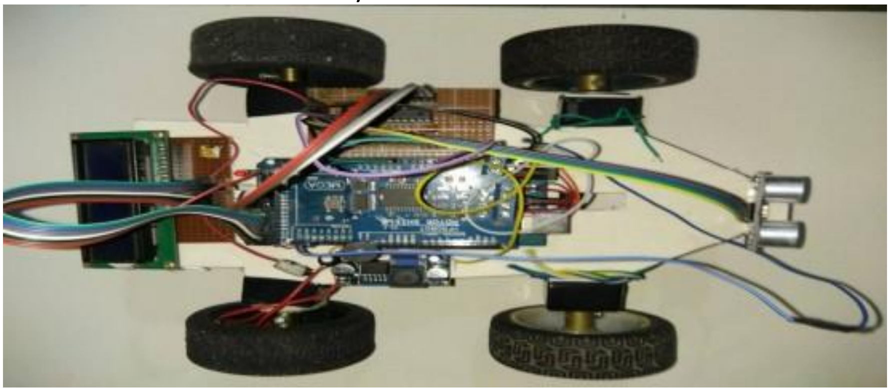


Fig: Car Prototype with Sonar.

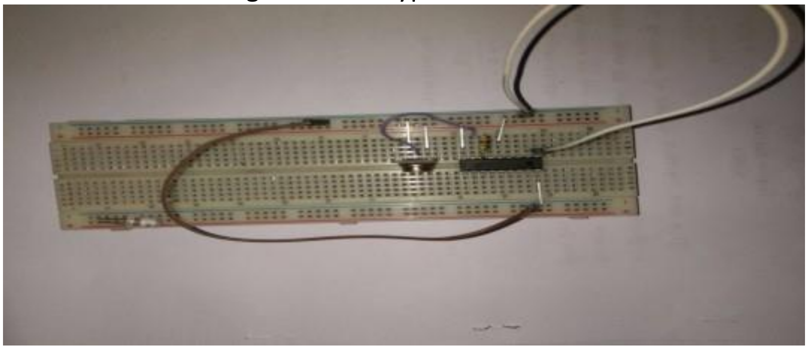


Fig: RF Receiver Circuit.

15. Soccer Robot:

A wireless robot designed and fabricated for a soccer robot contest. The robot was controlled using a custom made wireless controller using Bluetooth technology.

Fig: Internation Soccerbot Competition.

16. **Realtime Online GPS Tracker:**

This system was developed in order to track the location of a vehicle real time online. For this GPS module was used to gather location data then this data was transferred in a web server for online tracking.

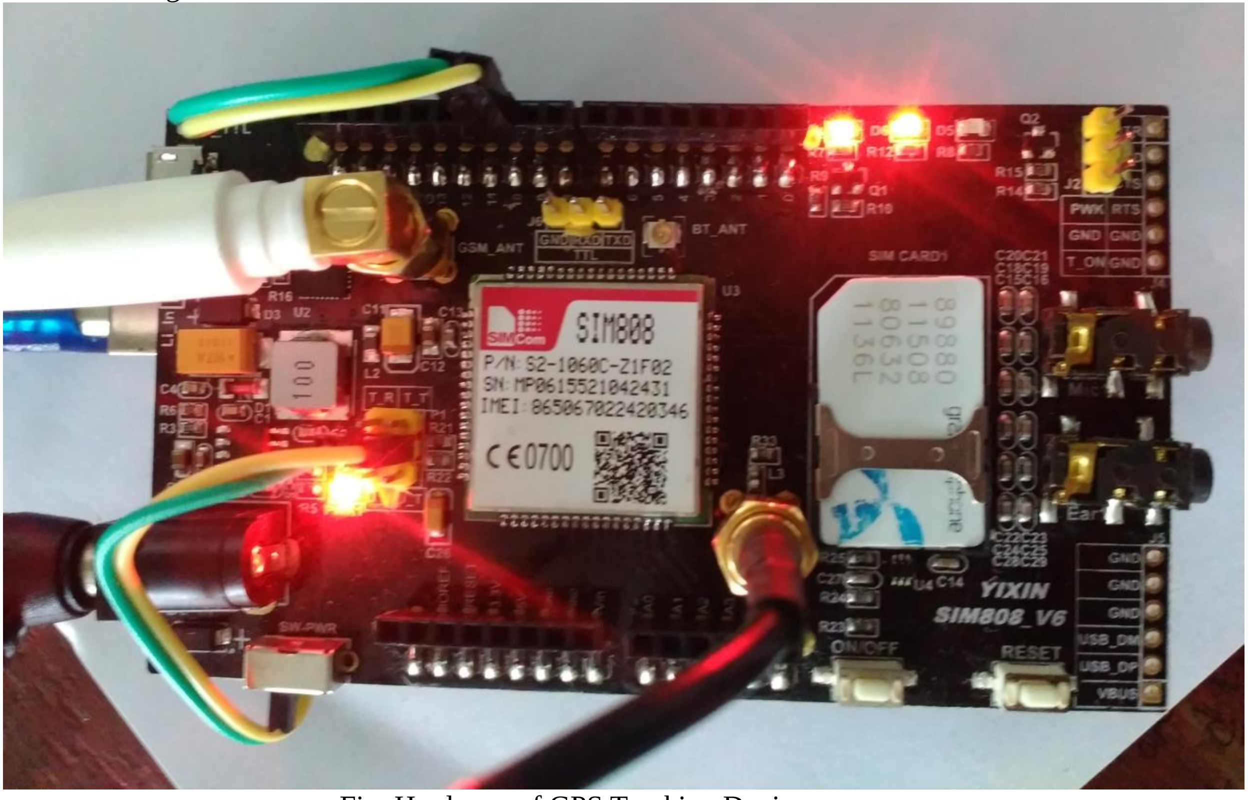


Fig: Hardware of GPS Tracking Device.

17. **Shadow Arm:**

A 5 DOF robotic arm was developed to pick and place object of various shapes. This arm was controlled wirelessly using a pair of Bluetooth and flex sensors were used to obtain angular data from the user.

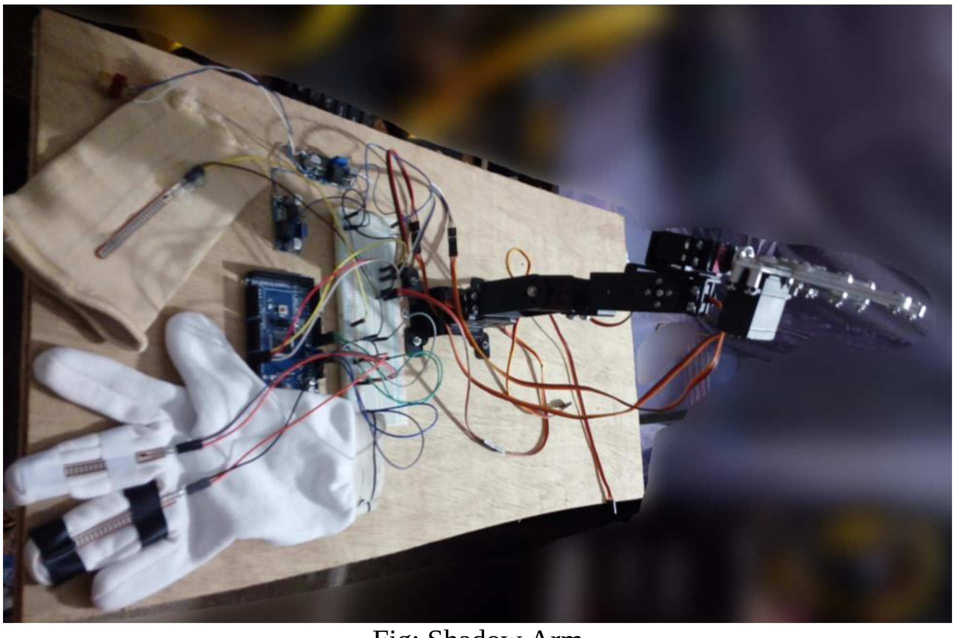


Fig: Shadow Arm

18. Propeller Display:

This was a low cost implementation of propeller display using the persistence of vision of human eye.

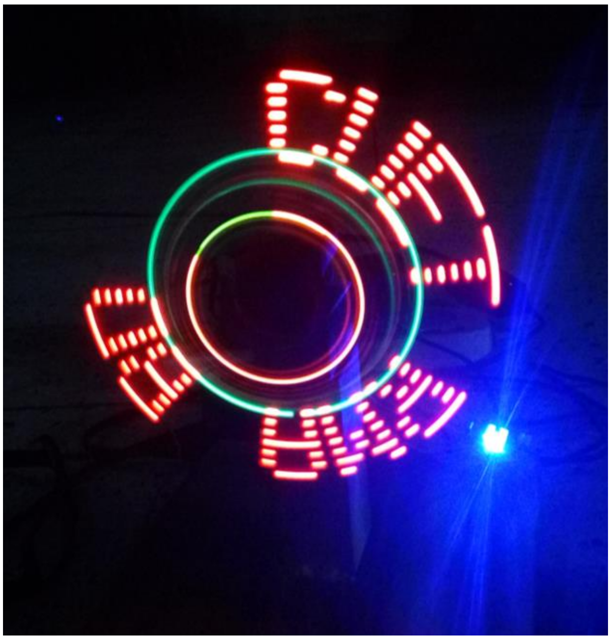


Fig: POV Display.

19. Study of Peltier Cooling Effect on a Computer CPU:

This study was done to determine the cooling effect of a 154W peltier module has over a computer CPU. For generating heat a 50W electric heater was used.

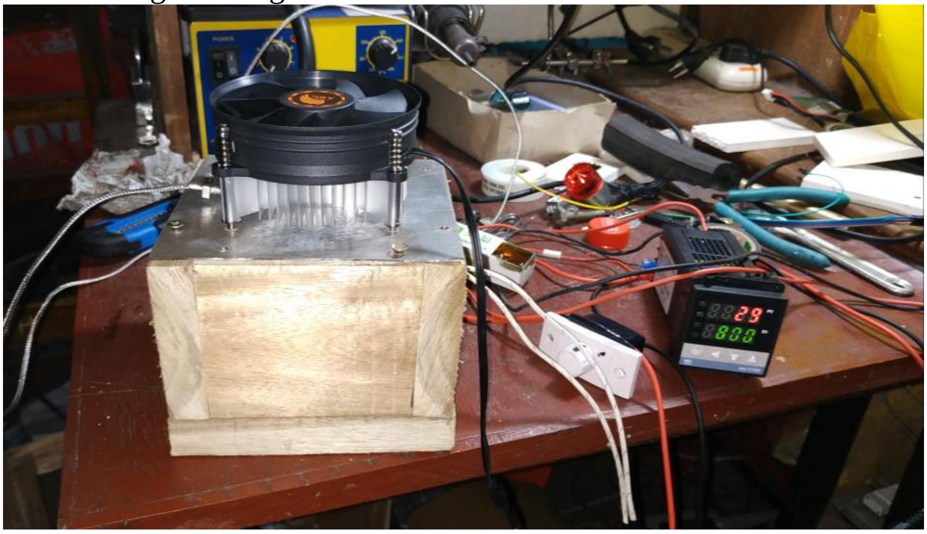


Fig: Study of peltier cooling effect on a CPU.

20. Footstep Power Generator:

This project was developed based on the concept of generating electricity from footstep. For generating electrical charge a series of piezo electric ceramics were used.

21. Door Security Using Face Recognition system:

This project was done using OpenCV. Using open source library face detection was accomplished then dataset was created by training the system to recognize the face. Face recognition system was combined with a microcontroller based system in order to door security.

22. **Biometric Attendance Monitoring System:**
This system was developed to monitor student attendance using fingerprint. Attendance data was uploaded to a web server to monitor. A pair of zigbee radio was used to communicate between field device and a computer to upload data.

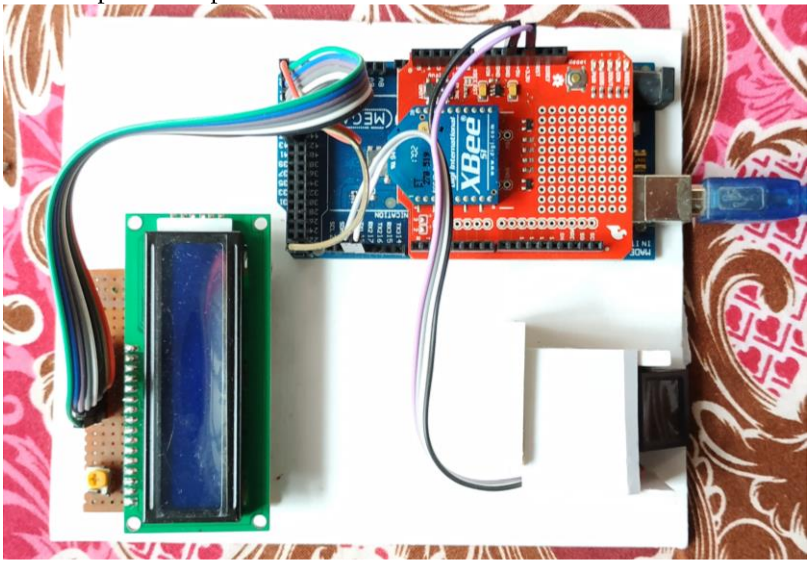


Fig: Biometric Attendance Monitoring System.

23. **Energy Monitoring System:**
This system was developed in order to monitor voltage, current and power factor online and in real-time.

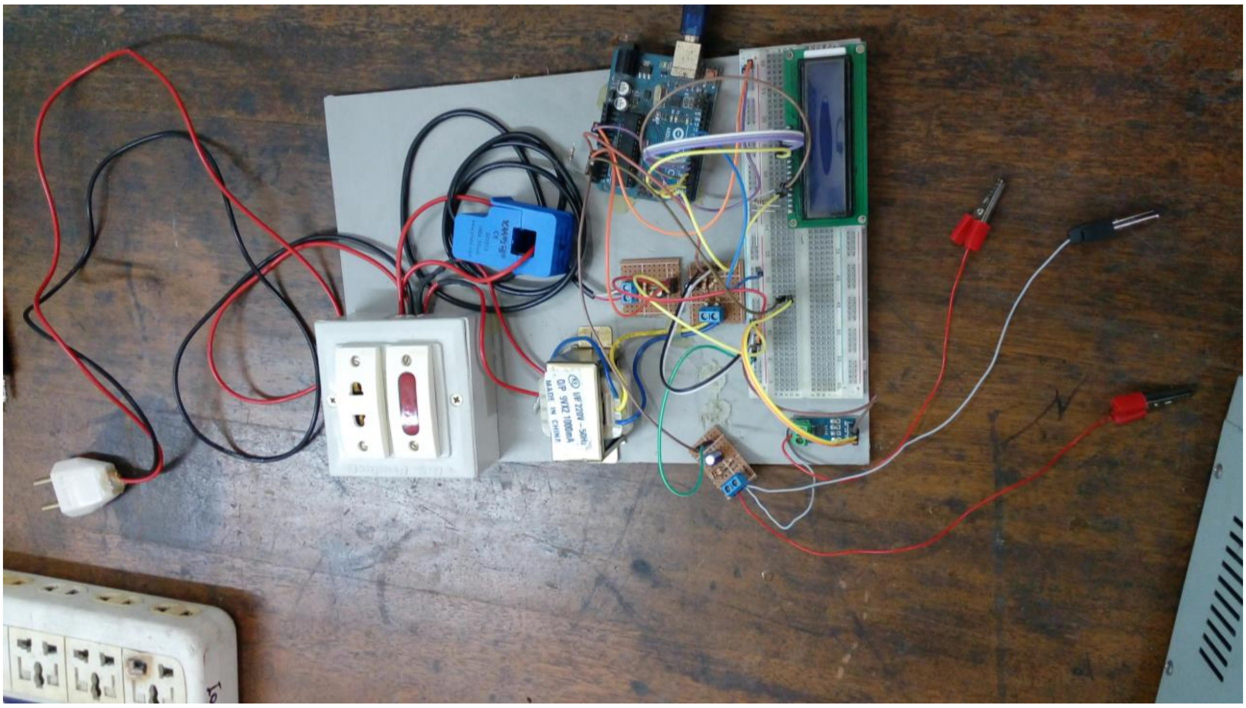


Fig: Energy Monitoring System.

24. **Design and Fabrication of Hover Craft:**
This is a low cost implementation of a hover craft. The body of it was build using thermocol sheet reduce weight. Side skirt was fabricated using polythene. A dedicated BLDC motor (980KV) was used to lift the craft up. In the back of the craft another BLDC motor was used to provide thrust. For directional control a rudder is installed at the back of the craft which is being controlled via a servo motor. For controlling the craft a 6 channel radio was used.

Fig: Hovercraft.

25. **Agricultural Field Data Monitoring System:**
This prototype was developed in order to monitor data of an agricultural field. This would monitor field moisture level, temperature, humidity, CO2 level and log these data to an SD card. Along with that it would upload data to a cloud server. If any data goes out of limit it would notify user with SMS.

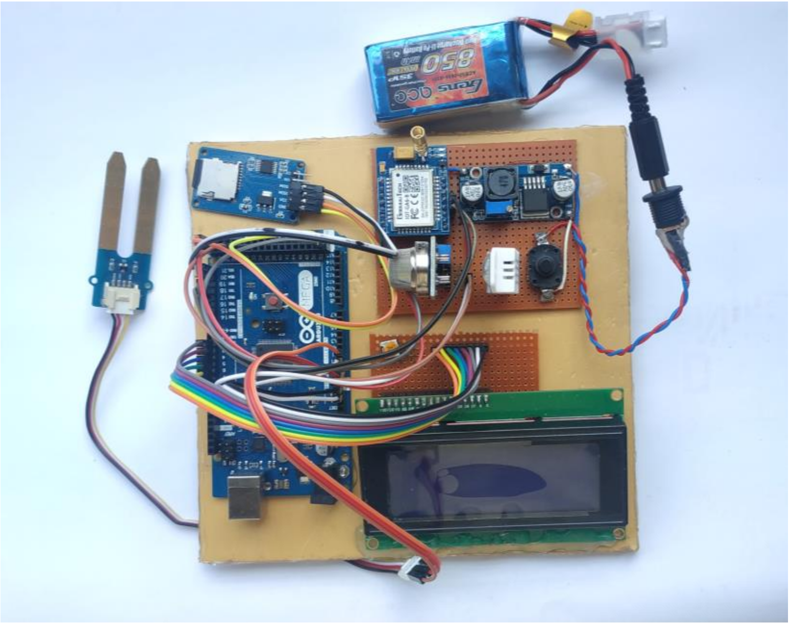


Fig: Agricultural Data Logger.

26. Object Sorting Using Robotic Arm:

This system was developed in order to sort and object from a conveyer belt and place it in a desired box according to its shape. The system had two parts one is its image processing unit and the other is the object sorting robotic arm.

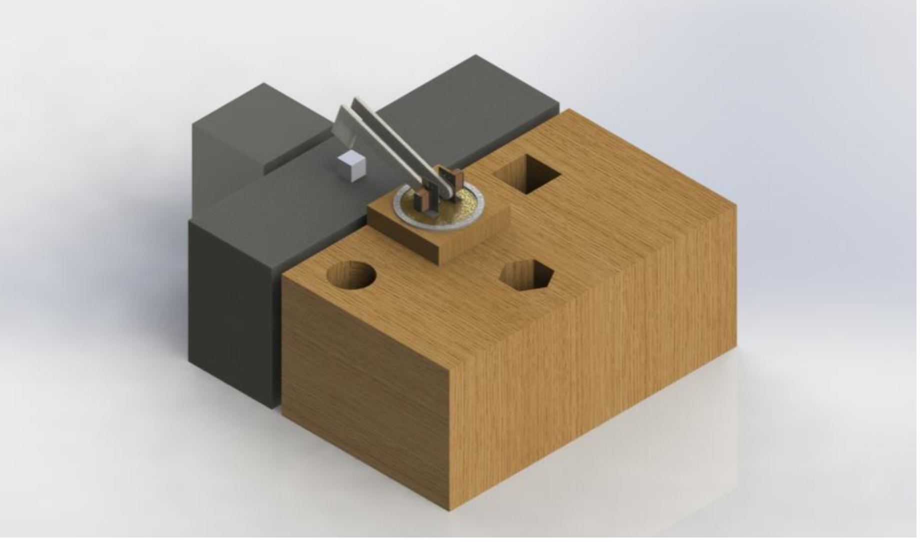


Fig: Object Sorting Using Robotic Arm.

Mechanical Design

I have been working with mechanical design with a plenty long time. During this time I have used solidworks as my main designing software. These are the area that I am confident in:

- Solid Modeling.
- Surfacing.
- Sheet metal.
- Plastic molding.
- Machine Design.

Some of my significant works have been mentioned below.

1. **Six Cylinder Petrol Engine:**

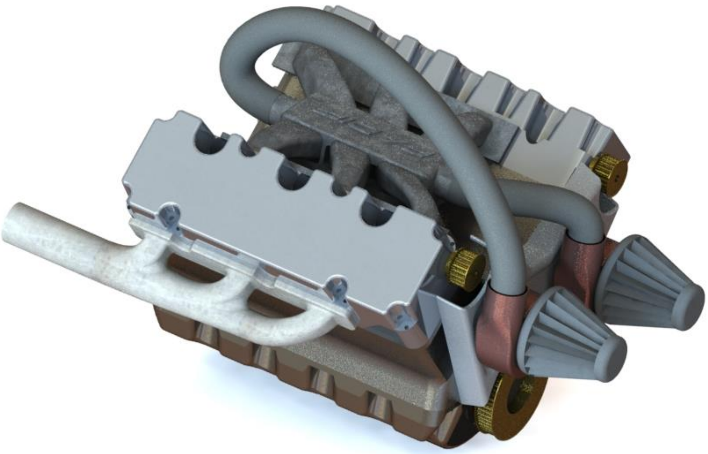


Fig: 6 Cylinder Petrol Engine.

2. **Five Cylinder Radial Engine:**

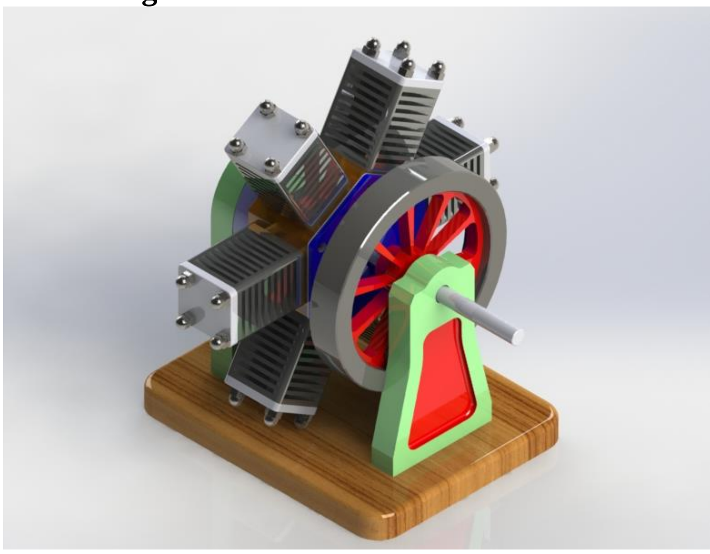


Fig: 5 Cylinder Radial Engine.

3. **Wind Mill:**

Fig: Wind Mill.

4. **Quick Return Mechanism:**

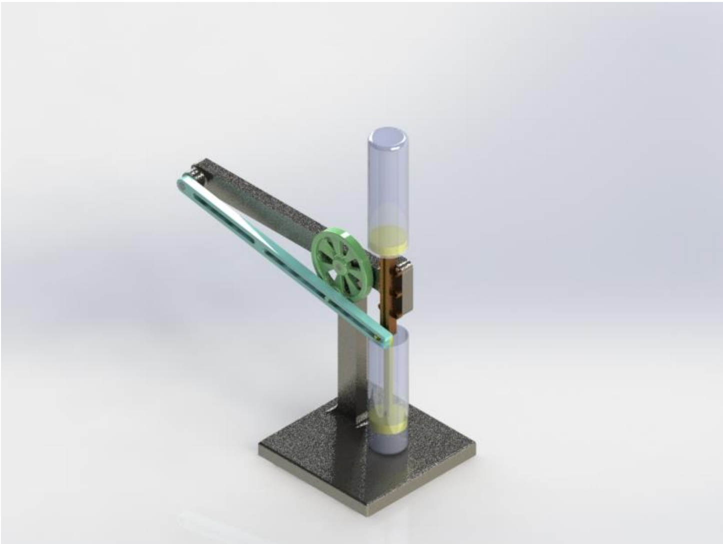


Fig: Quick Return Mechanism.

5. **Racing Robot:**

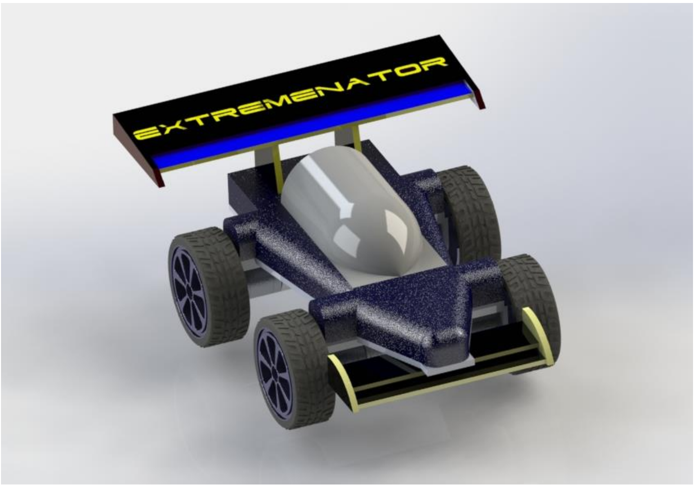


Fig: Racing Robot.

Here is my <u>GrabCAD Link</u>: grabcad.com/radif.uddin.ahmed-1.