K. L. E Society's

KLE TECHNOLOGICAL UNIVERSITY

HUBBALLI-580031, KARNATAKA

KLE Tech. CREATING VALUE LEVERAGING KNOWLEDGE

A Course Project Report on

"SURVEILLANCE AND DEFENCE SYSTEM"

Submitted by

335	01FE18BME183	ANIRUDH.G
318	01FE18BME165	VISHAL.P
305	01FE18BME355	VENUGOPAL.K.P
336	01FE18BME184	SUPREET.M

Mechatronics

(19EMEC202)

SCHOOL OF MECHANICAL ENGINEERING

2019-2020

CONTENTS

CHAPTER 1.INTRODUCTION

The quest for information and intelligence to provide strategic advantage has also provided a catalyst for the development of surveillance technologies ranging from the utilization of aerial balloon reconnaissance in the nineteenth century through to the development of radar and signal interception, global positioning systems, thermal sensors, unmanned aerial vehicles and satellites. Along with developments in the survelliance technologies it has been seen that defence technologies also has been improving over time.There are several ways to assess a technological lead, but in defence the most important indicator of technological advantage-perhaps the only one that ultimately matters—is the technological lead in fielded military equipment.Due to the increase in terrorism and the need for better border security , India is currently engaging its defence systems using the quadrotor mission plans function using a survelliance operavtive and an auto pilot function using gps signals.The question comes to is it effective? . Well the answer is complicated , Because the current defence program runs on a lot of manual survelliance which is prone to have errors or mistakes at some point.How do we avoid it? What if the survelliance operatives fail to make instant decisions ? the answer to these questions is fully automated defence system. A visual feedback control is considered so that the system can automatically recognize the existance of an object in images or moves acquired by quadrotor with a survelliance camera and this enables the quadrotor to track the object with the operational environment without using GPS signals.the visual feedback control is realized by automatic object recognition based on techniques of computr vision , in which the center of gravity position in the image coordinate system can be obtained from color or shape information . In this extract the defence has two parts:- detection and targeting system. The detection can be carried out with computer vision or deep neural networks and the targeting mechanism works on the algorithm created for non linear tracking of target keeping the motion of the quadrotor in mind. recent object detectors like FPN and retina net usually involve extra stages the task of image classification to handle the objects with various scales.object detection need not only needs to recognize the category of the object instances but also spatially locate the position.

CHAPTER 2.NEED ANALYSIS

India shares its borders with its neighboring countries like China, Pakistan, Bhutan, Myanmar, Bangladesh and Nepal. Such extensive and porous borders that run through different kinds of terrains – mountains, hills, planes, valleys, forest, desert and swamps. Sometimes are difficult to monitor especially with different territorial disputes and security troubles still exists in large parts of Indian borders. Because of that very large area is porous for a variety of irregular and illegal cross border activities.the border is used as a route for smuggling of drugs, illegal immigrants crossing the borders, illegal entry of terrorist etc…Due to this a controversial target on site policy has been enforced by the Indian borders patrols. This was initiated with the repost of violence between the migrants and Indian soldiers.But during such disputes with illegal terrorists, smugglers many of our Indian soldiers loose their life fighting these like the URI base attack. Hence we find our project will be of extreme use and may save life of our soldiers

1.2 PROBLEM STATEMENT

To design a automated launching system which can detect the proximity of the target in the field range and shoot it with minimum offset in the required direction at a specific time interval for the purpose of monitoring illegal activity and terrorism along the international borders.

CHAPTER 3.OBJECTIVES

Objectives or goals are expressions of the attributes and behavior that the client or potential users would like to see in a designed system or device.

1. To detect the object within the area.
2. To detect the position of the object.
3. To target only when the line of tress-passing is crossed.
4. To reduce the time of positioning the defence mechanism.
5. Durability of the prototype.
6. Repeatability of the prototype.
7. Time needed to position.

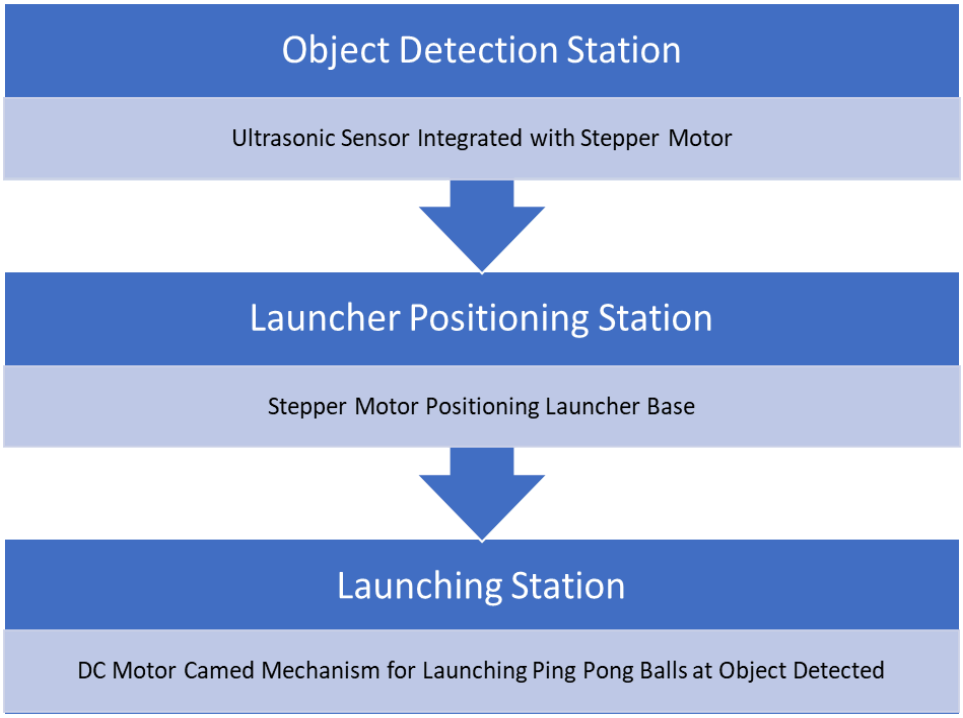

Figure 2.1. : Flow Diagram Structure for the Automated System

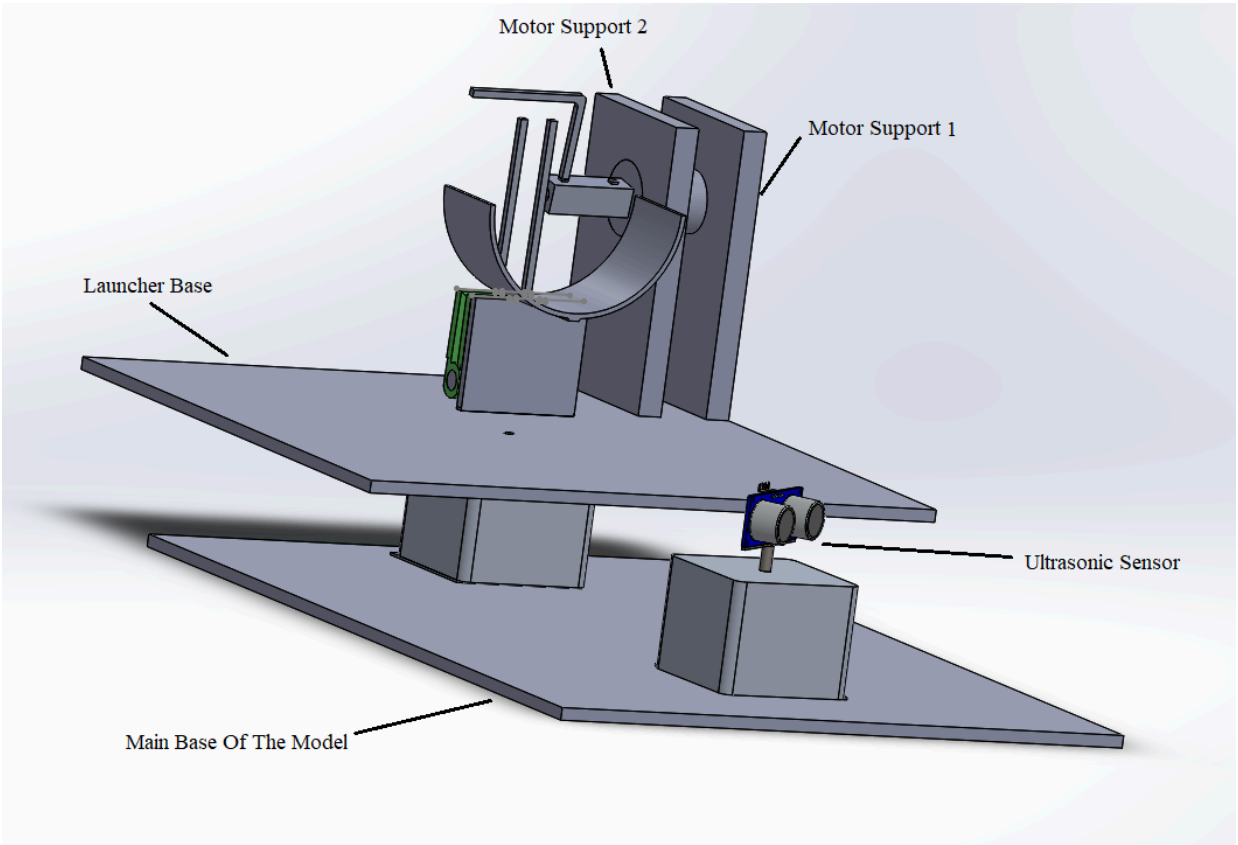

Figure 2.2.1: Model of automatic survelliance and defence system.

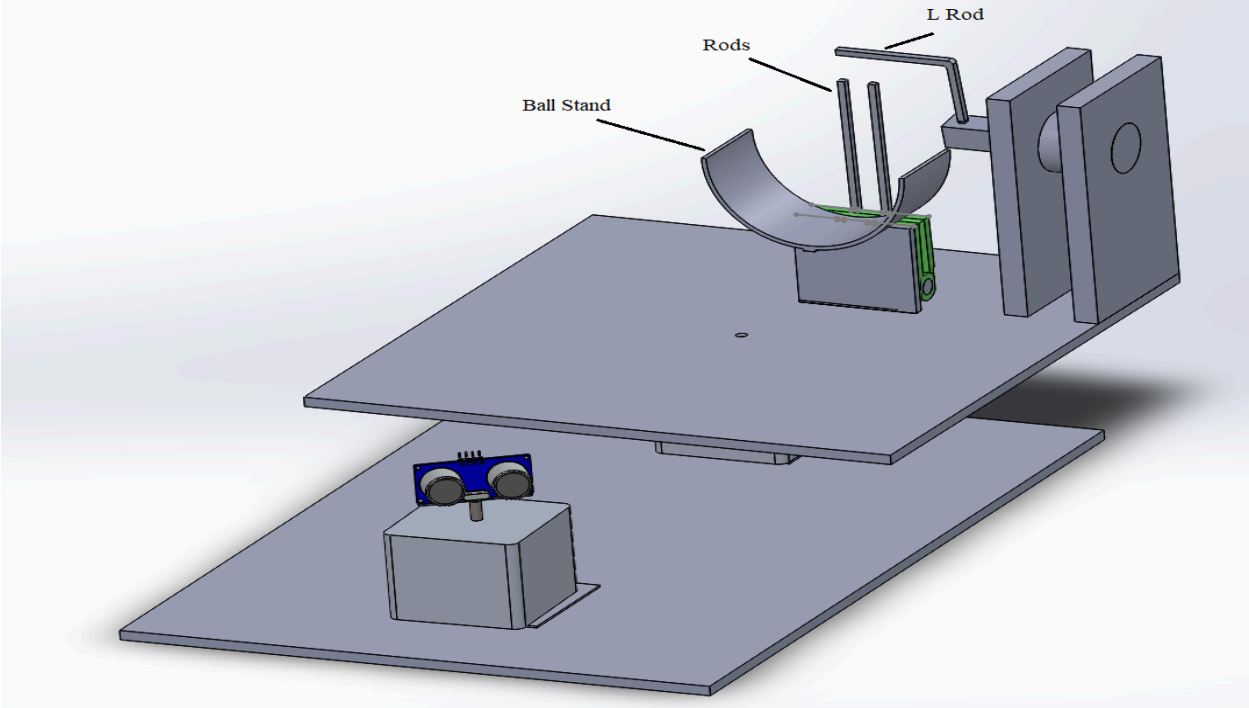

Figure 2.2.2: Model of automatic survelliance and defence system.

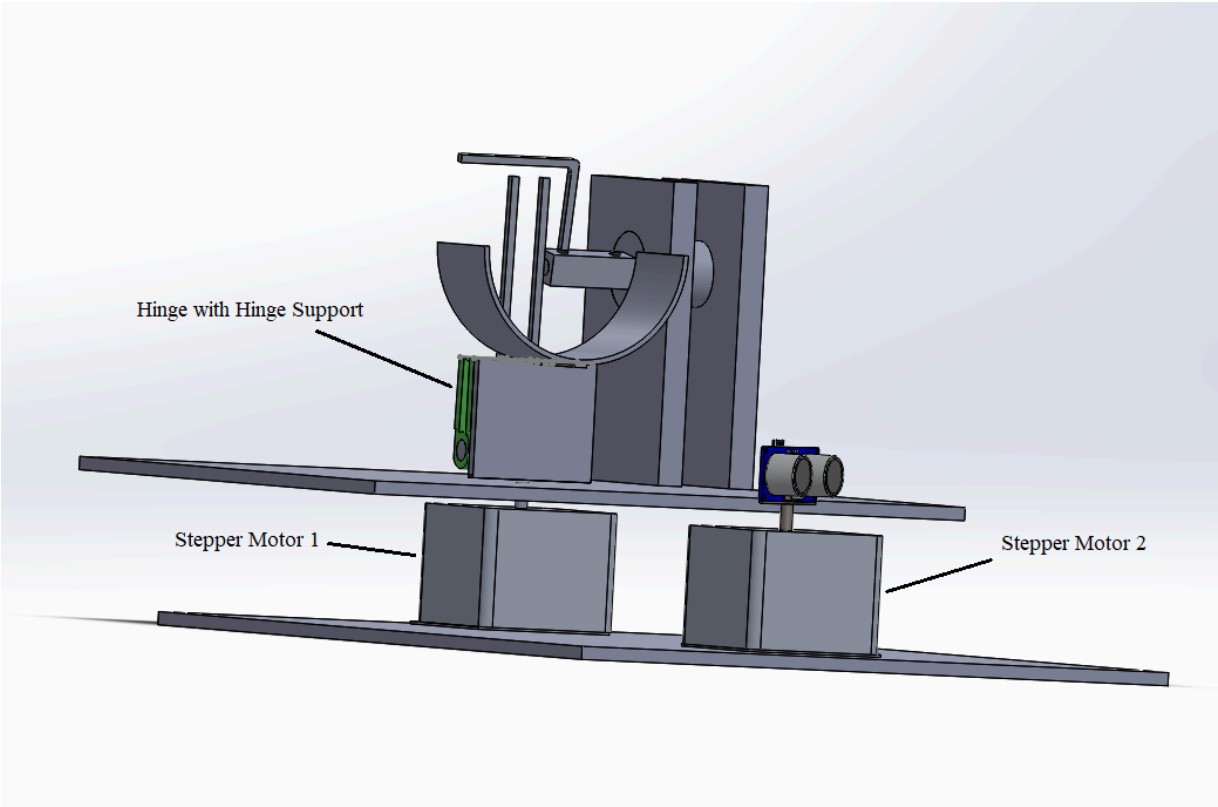

Figure 2.2.3: Model of automatic survelliance and defence system.

CHAPTER 4.METHODOLOGY

Methodology is the systematic, theoretical analysis of the methods applied to a field of study, or analysis of the body of methods and principles associated with a branch of knowledge.

The need regarding the importance of survelliance and defence systems was defined and then gathering pertinent information (literature survey) was carried out in order to collect more data on the subject, the reaserach showed that the is no automated system which integrates both survelliance and defence systems . The objectives were set to integrate both of these systems and make them automated. Automatic survelliance and defence systems would be of great advancement to our military and defence organisations of our country. Based on the objectives a problem statement was framed and according to that different concepts were designed and one was selected among it the the procedure in which the models is going to be build was decide the nsprints were formed so as to build a particular system step by step and then integrate them after the completion of the model test were conducted to ensure proper working .

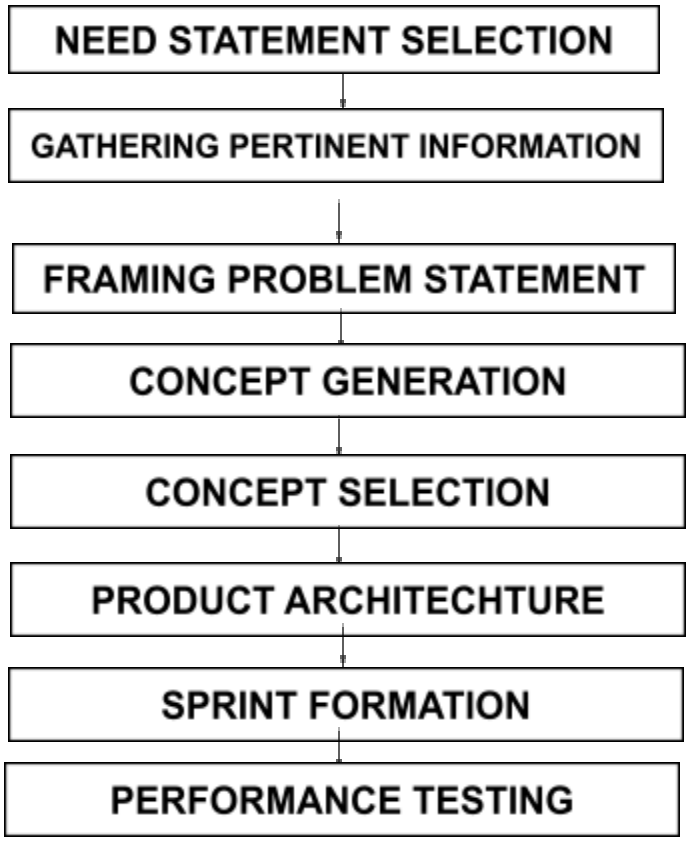

Figure 3.1: Methodology

CHAPTER 5.FABRICATION DETAILS AND DRAWINGS

5.1 DETAILED DESIGN

Detailed design is the phase where the design is refined and plans, specifications and estimates are created. Detailed design will include outputs such as 2D and 3D models. Detailed design of the system is the last design activity before implementation begins. The detailed design should represent the system design in a variety of views where each view uses a different modeling technique. By using a variety of views, different parts of the system can be made clearer by different views. Some views are better at elaborating systems states whereas other views are better at showing how data flows within the system. Other views are better at showing how different system entities relate to each through class taxonomies for systems that are designed using an object-oriented approach.

- An ultrasonic sensor was used to detect the object with in specified range.
- A nema 17 stepper motor was integrated with ultrasonic sensor in ordr to increase the range of detection.
- The ultrasonic sensor is set to detect the object within range of 30 cm .
- The position of the detected object (distance and angle) is read .
- Another nema 17 stepper motor was used to support the laucher base to rotate it in the angle of the detected object.
- A 10 rpm dc motor was used as a part of cam mechanism to launch ping pong balls on the target.
- Catapult mechanism was as the launching system.
- 12 Volt Lead acid battery is used as a power source.
- Motor drives L298 are used to drive the motors.

5.2 FABRICATION

Fabrication has a great deal to do with manufacturing. Fabrication is an industrial term that refers to the manipulation of raw materials (such as steel) for the making of machines and structures. Steel and other metals are cut and shaped during the fabrication process.

Fabrication is a very hands-on part of the manufacturing process. Although a fabrication shop and a manufacturing plant can work independently, it is unlikely that you will find a manufacturing establishment that does not at least have close ties to a fabrication shop. Most

manufacturers have fabricators in-house simply because of the frequency that most manufacturing processes need the services of a fabrication shop.

The fabrication of a working machine or of an entire structure of a building from nothing more than metal requires a lot of skill and planning. A fabrication shop will begin a business transaction by proposing a plan to the purchasing party and trying to win their bid for work. If the fabrication shop is awarded the bid and will be responsible for a specific fabrication job, the specific materials and sub-contractor work will need to be determined. Also, special equipment may need to be used to complete the contracted work.

5.3 MANUFACTURING PROCESSES INVOLVED

5.3.1 Laser cutting

Laser cutting is a technology that uses a laser to slice materials. While typically used for industrial manufacturing applications, it is also starting to be used by schools, small businesses, and hobbyists. Laser cutting works by directing the output of a high-power laser most commonly through optics. The focused laser beam is directed at the material, which then either melts, burns, vaporizes away, or is blown away by a jet of gas, leaving an edge with a high-quality surface finish.

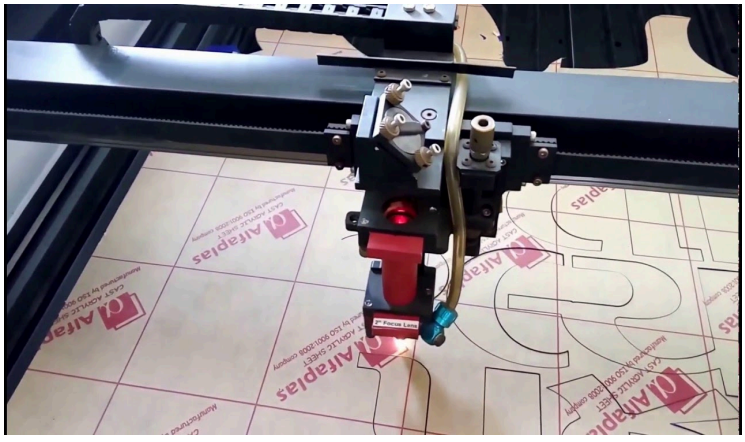

Fig 5.1: laser cutting

5.3.2 Soldering

Soldering is a process in which two or more items are joined together by melting and putting a filler metal (solder) into the joint, the filler metal having a lower melting point than the adjoining metal Electronic soldering connects electrical wiring to devices, and electronic

components to printed circuit boards. Electronic connections may be hand-soldered with a soldering iron. Automated methods such as wave soldering or use of ovens can make many joints on a complex circuit board in one operation, vastly reducing production cost of electronic devices.

Figure 5.2: Soldering

5.3.3 Drilling

Drilling is a cutting process that uses a drill bit to cut or enlarge a hole of circular cross-section in solid materials. The drill bit is a rotary cutting tool, often multipoint. The bit is pressed against the workpiece and rotated at rates from hundreds to thousands of revolutions per minute. This forces the cutting edge against the workpiece, cutting off chips (swarf) from the hole as it is drilled.

Figure 5.3: Drilling

5.3.4 Welding

Welding is a fabrication or sculptural process that joins materials, usually metals or thermoplastics, by using high heat to melt the parts together and allowing them to cool, causing fusion. Welding is distinct from lower temperature metal-joining techniques such as brazing and soldering, which do not melt the base metal.In addition to melting the base metal, a filler material is typically added to the joint to form a pool of molten material (the weld pool) that cools to form a joint that, based on weld configuration (butt, full penetration, fillet, etc.), can be stronger than the base material (parent metal). Pressure may also be used in conjunction with heat or by itself to produce a weld. Welding also requires a form of shield to protect the filler metals or melted metals from being contaminated or oxidized.

Figure 5.4: Welding

5.4 DESCRIPTION OF COMPONENTS USED

5.4.1 DC Geared Motor, 12V, 10 RPM, Torque up to 5 Kg-cm

DC Gear motor, is also called DC Geared Motor, Geared Dc Motor and gearhead motor or gearbox motor. It consists of a electric DC motor and a gearbox or gearhead; these gearheads are used to reduce the DC motor speed, while increase the DC motor torque. Therefore user can get lower speed and higher torque from gear motor.

Specifications:-

Motor Type	DC Motor with Gear box, Metal gears
Base Motor	DC Motor 3000 RPM
Shaft Type	Circular 6mm ϕ with Internal Hole for coupling, 23 mm Shaft length
Maximum Torque	4 Kg-cm at 12V
RPM	10 RPM at 12V
Weight	150 gms
Max Load Current	450 mA at 12V-10 RPM

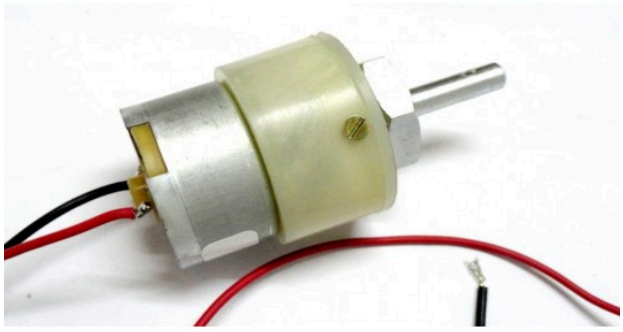

Figure 5.5: dc geared motor

5.4.2 Ultrasonic sensor

HC-SR04 ultrasonic sensor uses SONAR to determine the distance of an object just like the bats do. It offers excellent non-contact range detection with high accuracy and stable readings in an easy-to-use package from 2 cm to 400 cm or 1” to 13 feet.

Specifications:-

Power Supply	+5V
Quiescent Current	< 2 mA
Working Current	15 mA
Effectual Angle	15˚ (Degree)
Ranging Distance	2 cm- 400 cm/l″ - 13ft
Resolution	0.3 cm
Measuring Angle	30 Degree

Figure 5.6: ultrasonic sensor

5.4.3 Microcontroller

A microcontroller is a small computer on a single integrated circuit containing a processor core, memory, and programmable input/output peripherals. Microcontrollers are used in automatically controlled products and devices which controls and coordinates the complete system.

ATmega328P

Arduino Uno is a microcontroller board based on 8-bit ATmega328P microcontroller. Along with ATmega328P, it consists other components such as crystal oscillator, serial communication,

voltage regulator, etc. to support the microcontroller. Arduino Uno has 14 digital input/output pins (out of which 6 can be used as PWM outputs), 6 analog input pins, a USB connection, A Power barrel jack, an ICSP header and a reset button.

Specifications:-

Microcontroller	ATmega – 8bit AVR family microcontroller
Operating Voltage	5V
Recommended Input Voltage	7 – 12V
Input Voltage Limits	6 – 20V
Analog Input Pins	6 (A0 – A5)
Digital I/O Pins	14 (Out of which 6 provide PWM output)
DC Current on I/O Pins	40 mA
DC Current on 3.3V Pin	50 mA
Flash Memory	32 KB(0.5KB is used for Bootloader)
SRAM	2 KB
EEPROM	1 KB
Frequency (clock speed)	16 MHz

Figure 5.7: Arduino Uno

5.4.4 Nema 17 stepper motor

NEMA 17 is a **hybrid stepping motor** with a 1.8° step angle (200 steps/revolution). Each phase draws 1.2 A at 4 V, allowing for a holding torque of 3.2 kg-cm. Stepper motors are generally used in a variety of applications where precise position control is desirable and the cost or complexity of a feedback control system is unwarranted. Here are a few applications where stepper motors are often found.

Specifications:-

Rated Voltage	12V DC
Current	1.2A at 4V
Step Angle	1.8 Deg
No Of Phases	4
Motor Length	1.54 inches
Operating Temperature	-10 to 40 ˚C
Unipolar Holding Torque	22.2 oz-in
wire	4 , 8 inch lead
Steps per revolution	200, 1.8 degrees

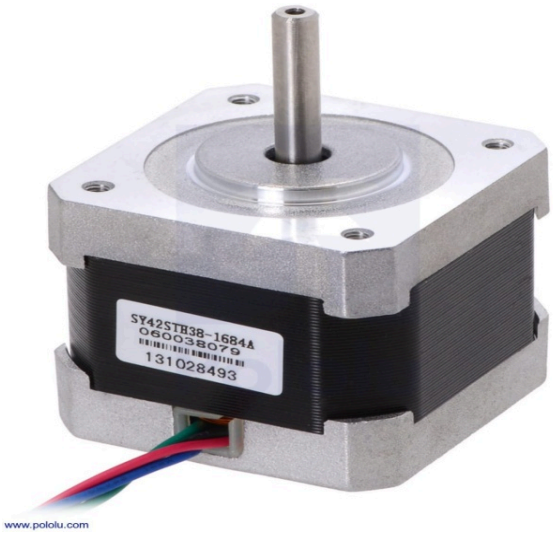

Figure 5.8: Nema 17 stepper motor

5.4.5 L298 Motor Driver

The L298 is an integrated monolithic circuit in a 15-lead Multiwatt and PowerSO20 packages. It is a high voltage, high current dual full-bridge driver designed to accept standard TTL logic levels and drive inductive loads such as relays, solenoids, DC and stepping motors. Two enable inputs are provided to enable or disable the device independently of the input signals. The emitters of the lower transistors of each bridge are connected together and the corresponding external terminal can be used for the connection of an external sensing resistor. An additional supply input is provided so that the logic works at a lower voltage.

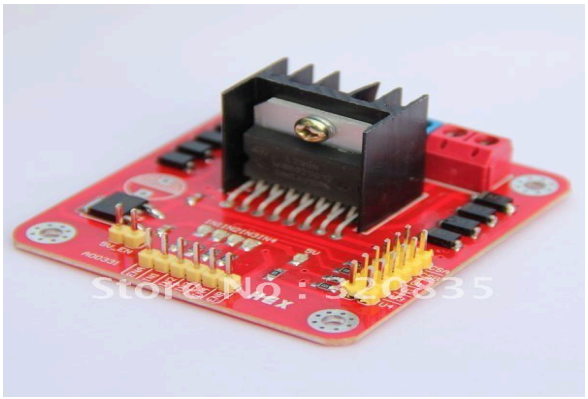

Figure 5.9: L298 Motor driver

5.5 2D and 3D part DRAWINGS

All dimensions are in mm

All dimensions have tolerance of 6mm

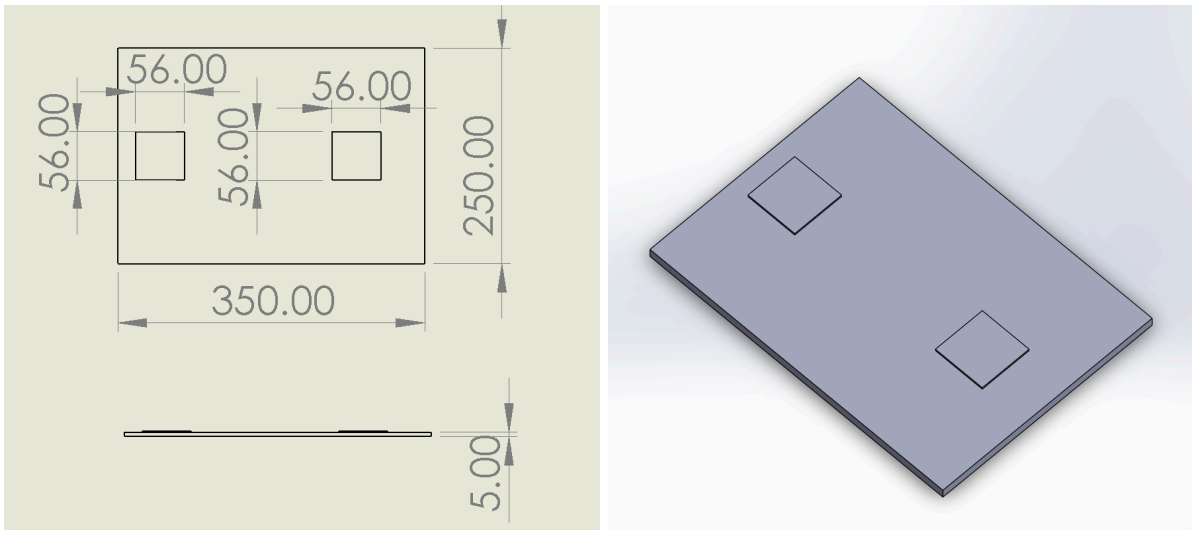

Figure 5.10:Main base

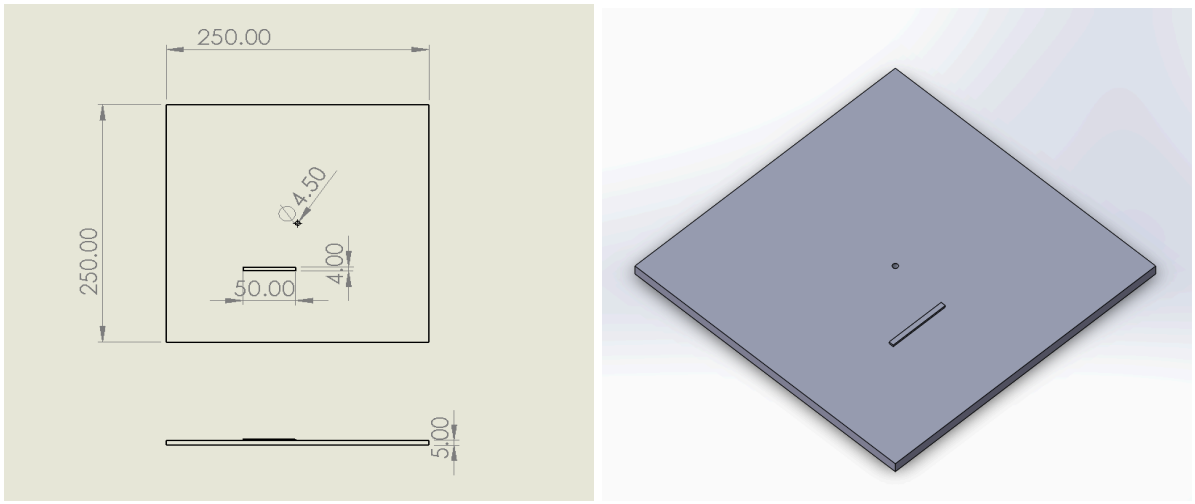

Figure 5.11: Launcher base

All dimensions are in mm

All dimensions have tolerance of 0.5mm

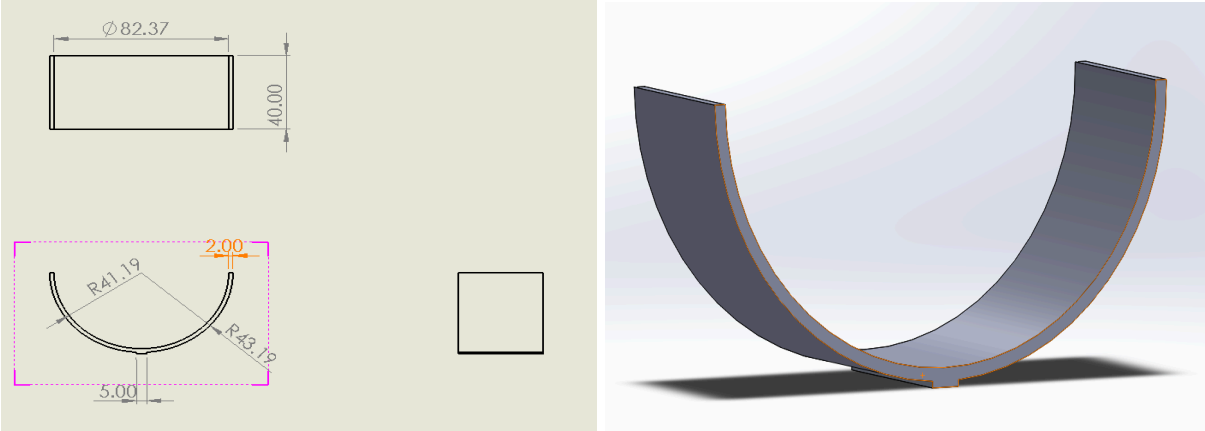

Figure 5.12:Support

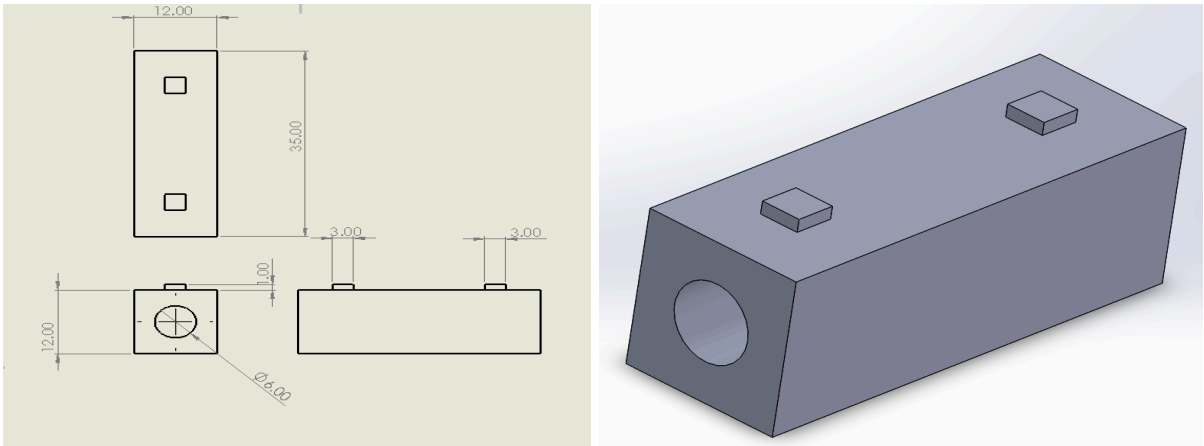

Figure 5.13:Bush

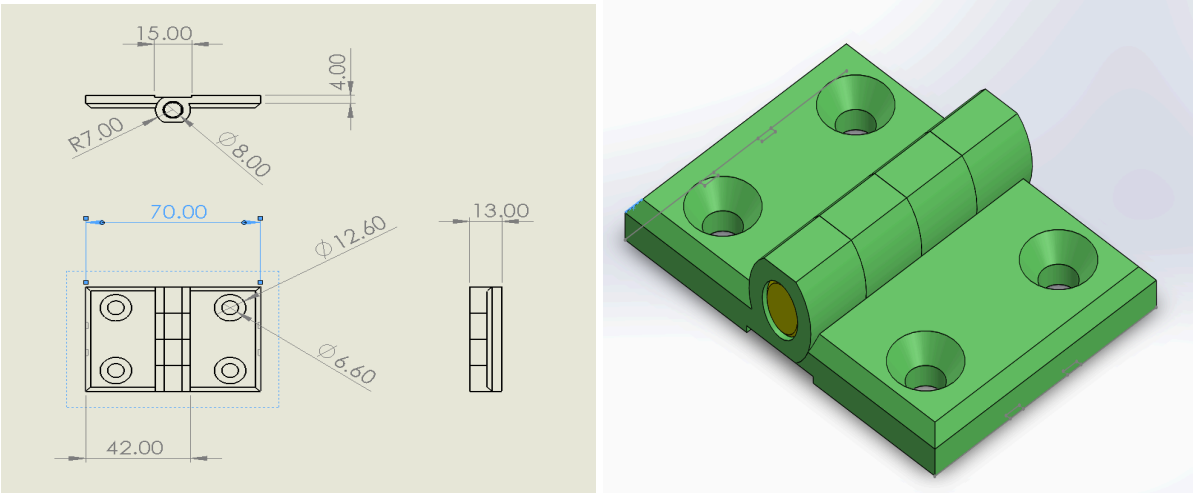

Figure 5.14: Hinge

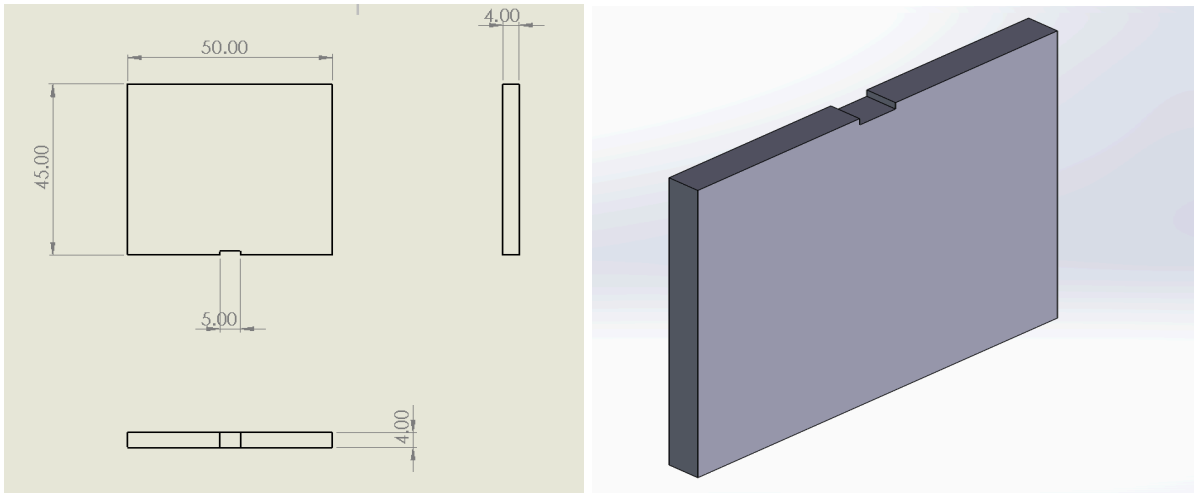

Figure 5.15:Hinge support

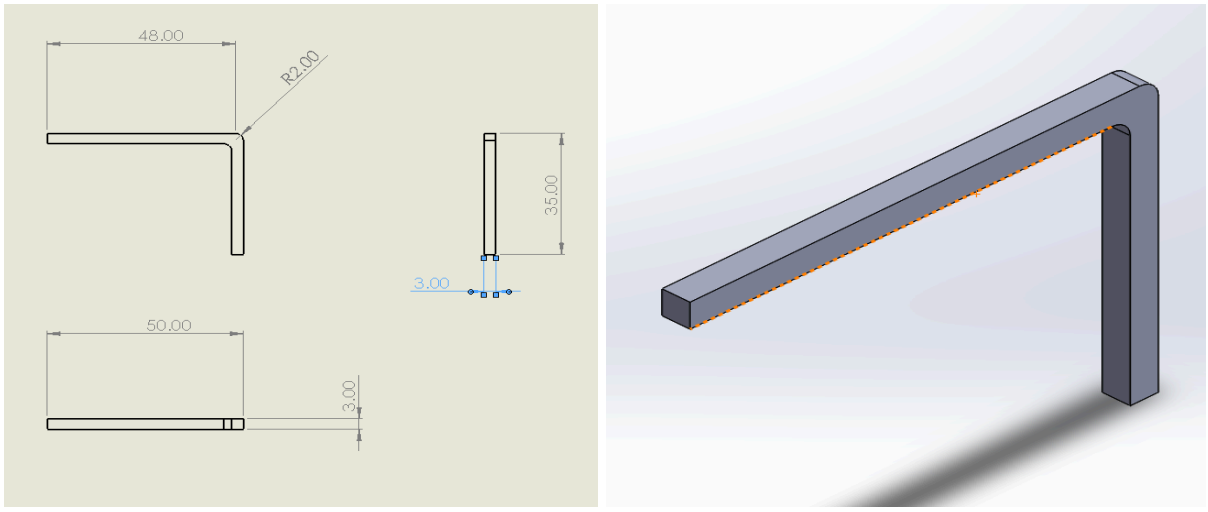

Figure 5.16:L rod

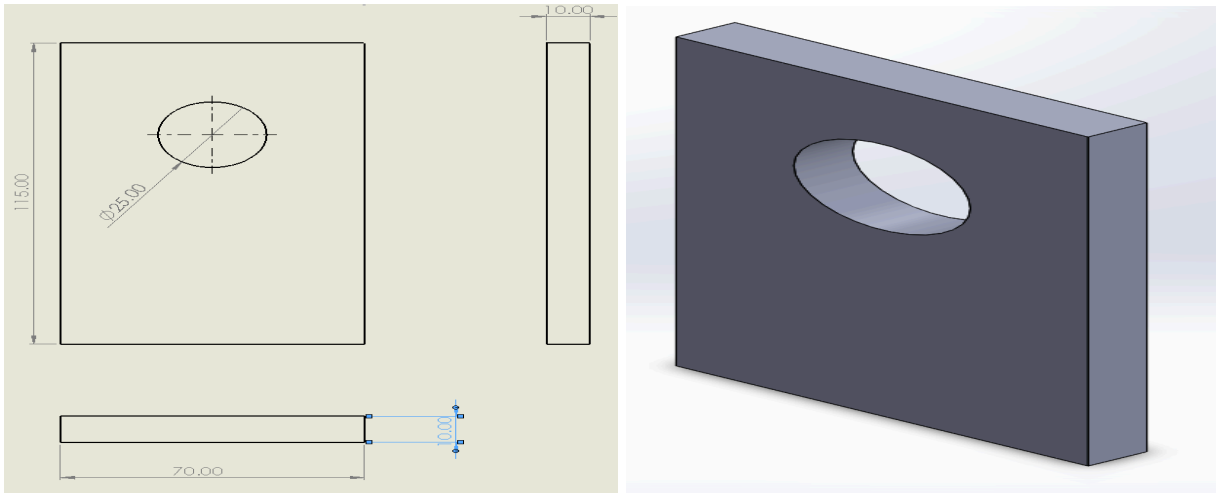

Figure 5.17:Motor support 1

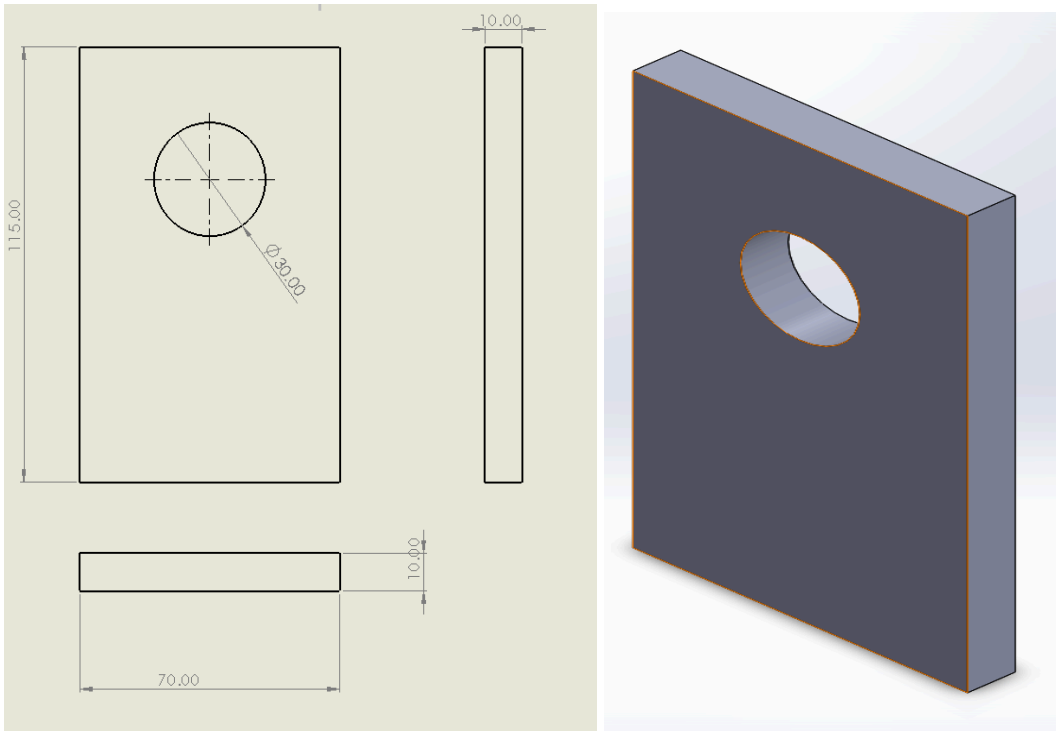

Figure 5.18:Motor support 2

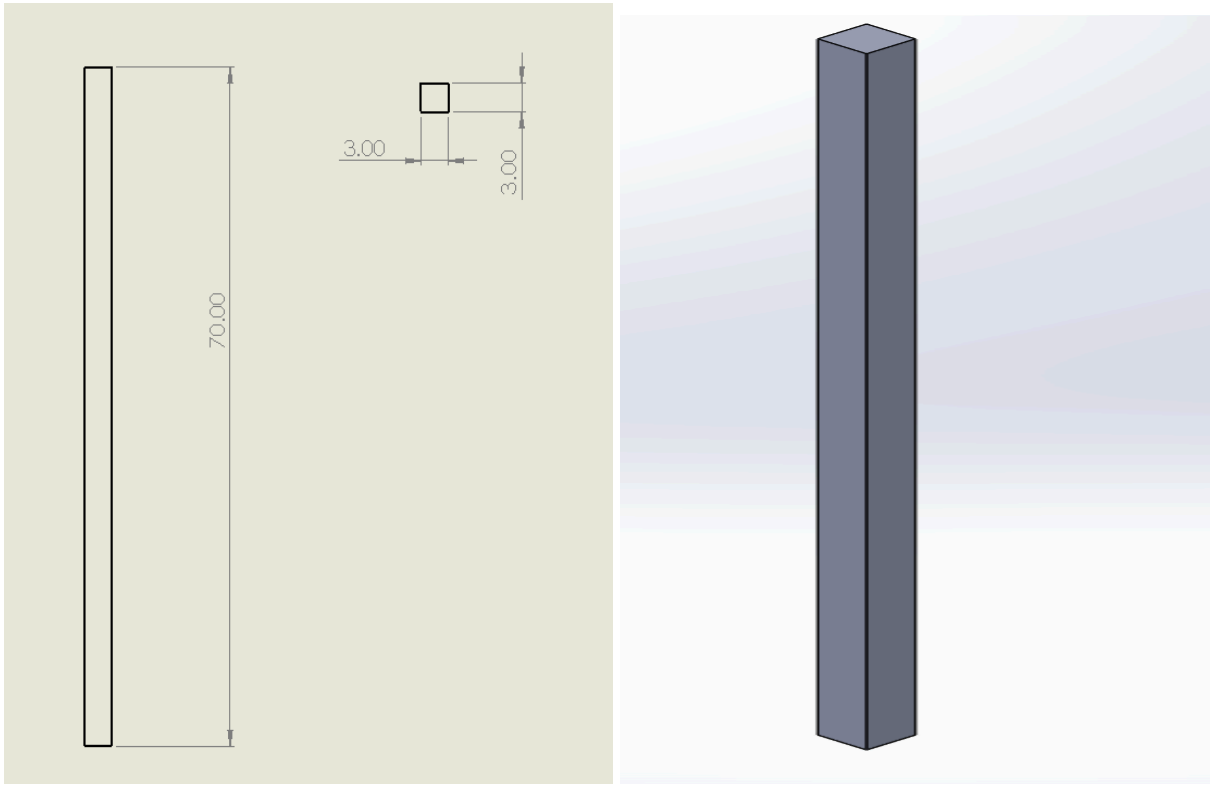

Figure 5.19:Hinge rod

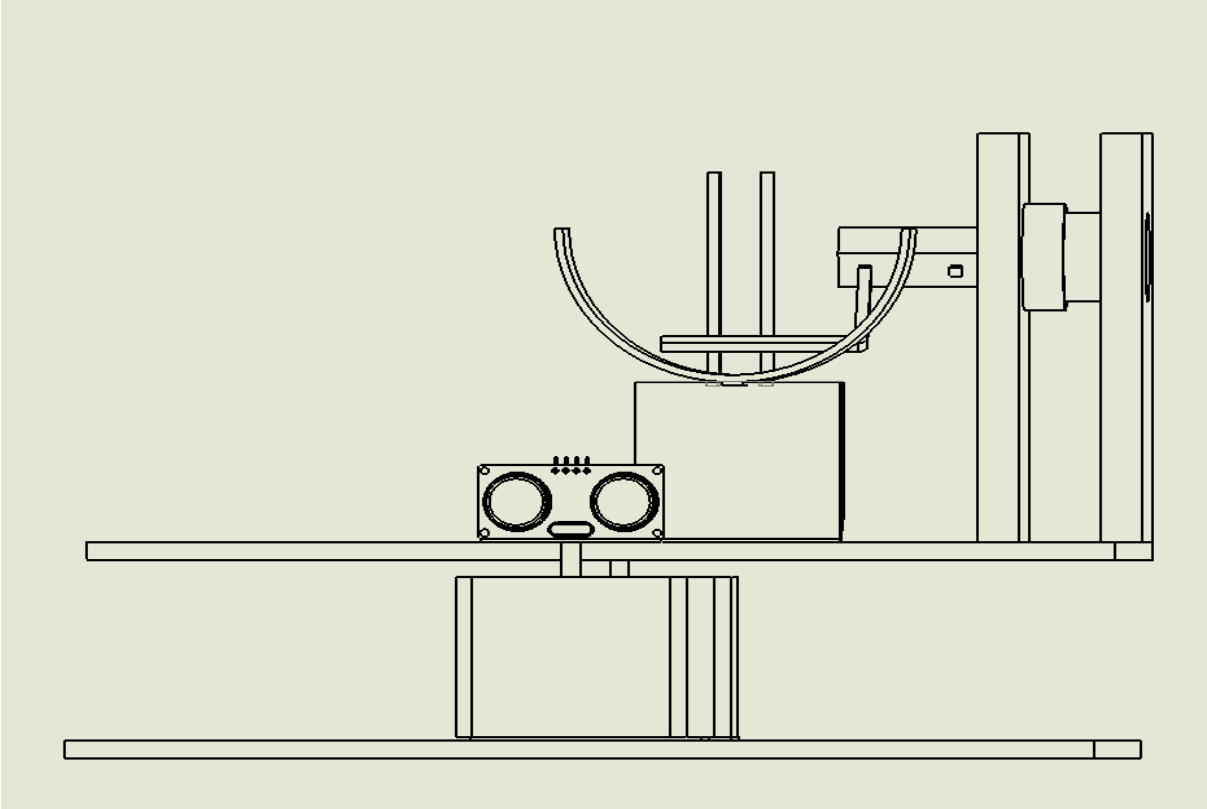

Figure 5.20:Assembly 2d 1

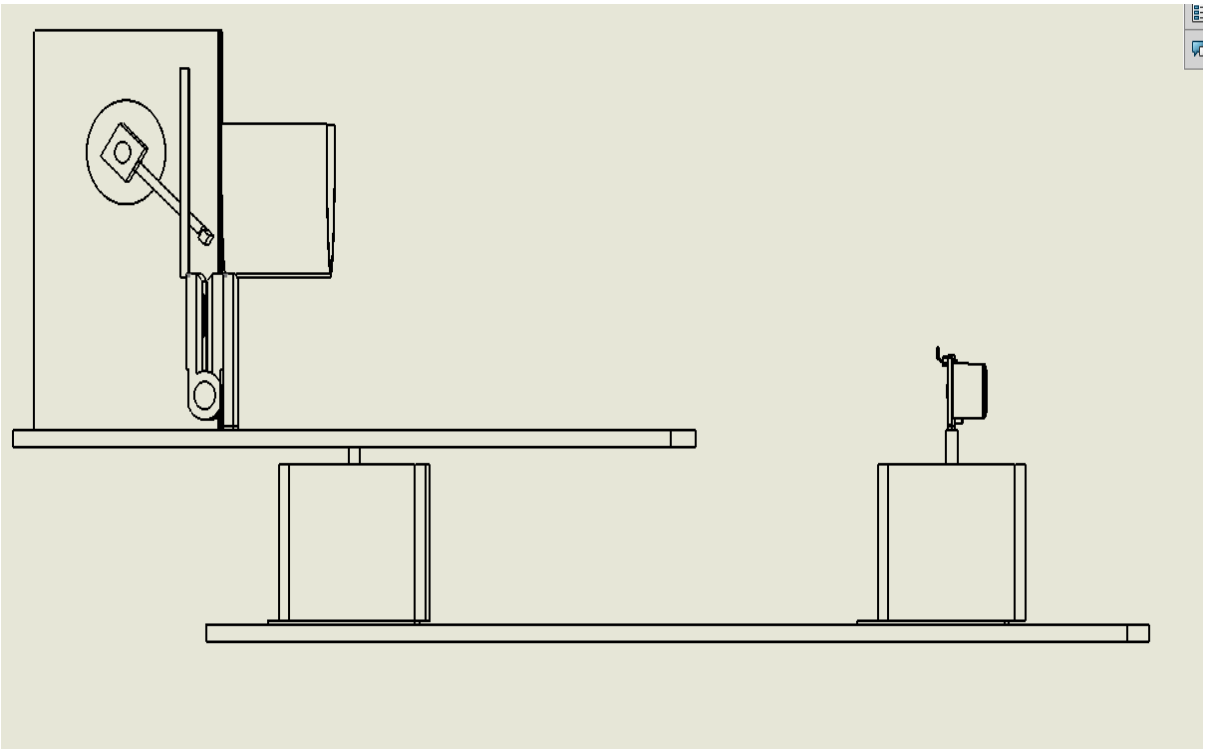

Figure 5.21:Assembly 2d 2

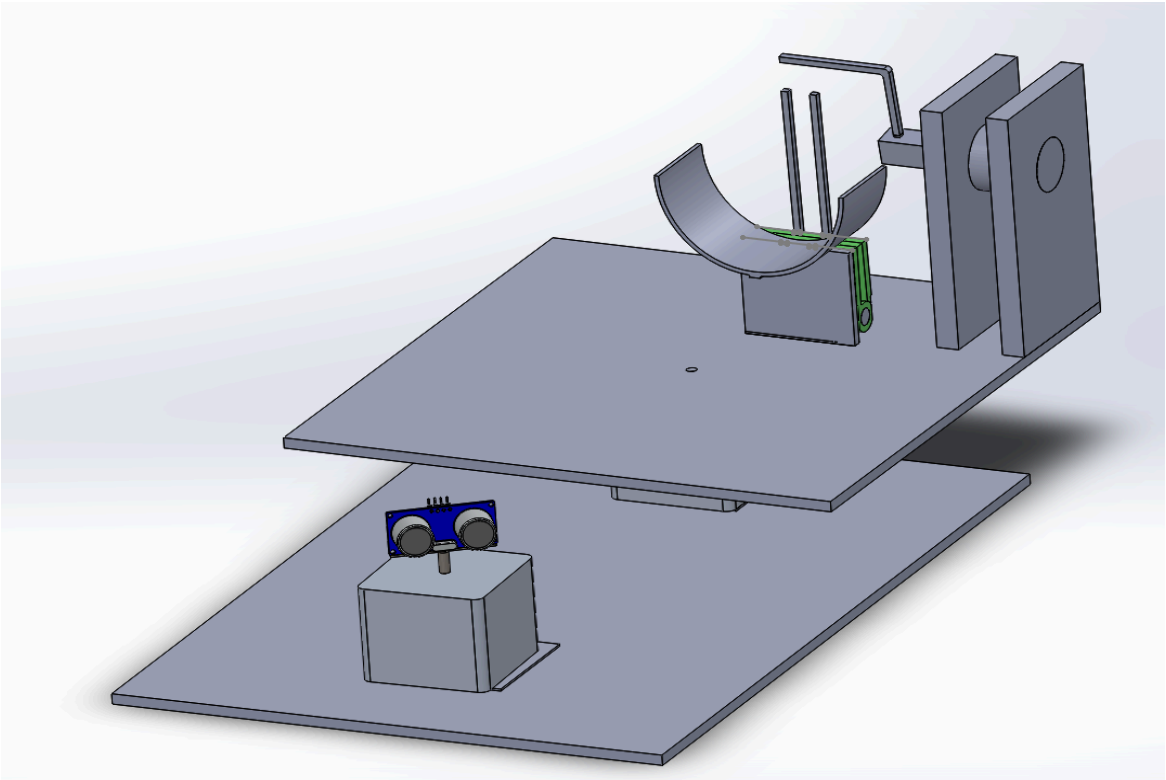

Figure 5.22:Assembly 3d 1

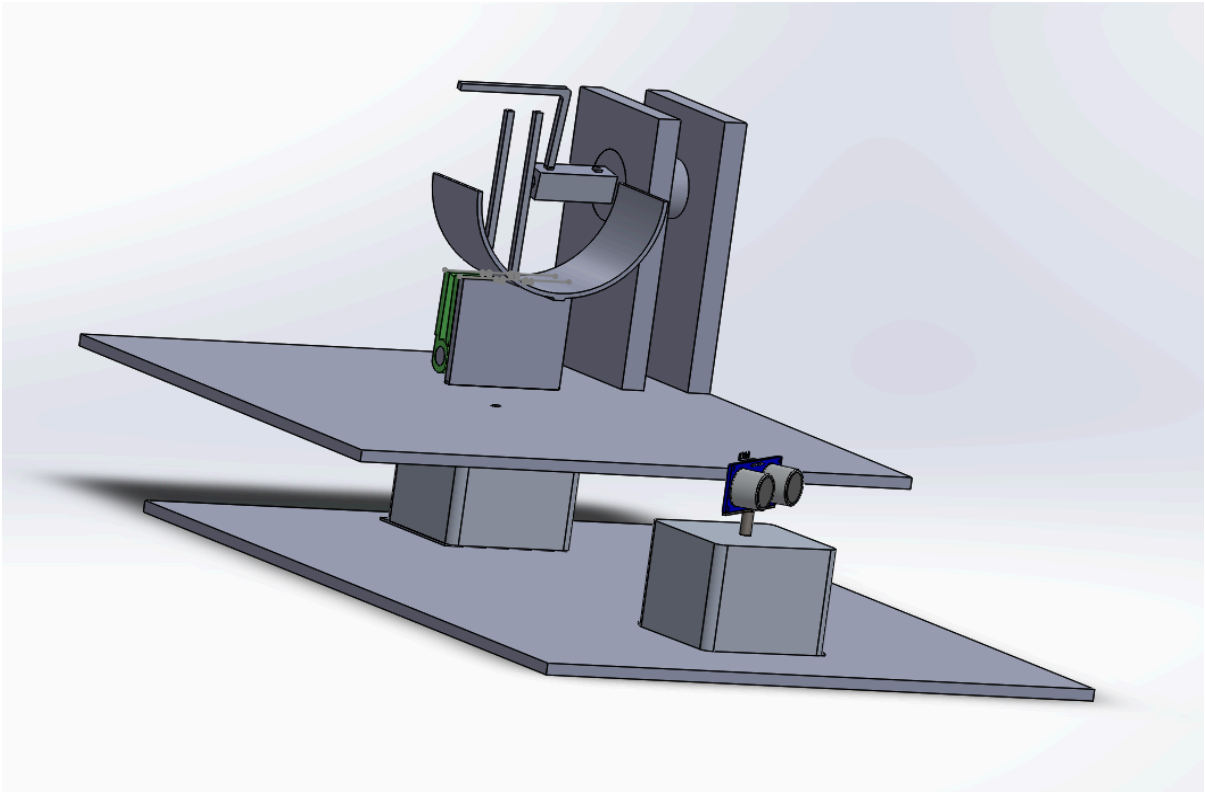

Figure 5.23:Assembly 3d 2

CHAPTER 6.TESTING AND VALIDATION

Verification and validation are independent procedures that are used together for checking that a product, service, or system meets requirements and specifications and that it fulfills its intended purpose.

Initially the ultrasonic sensor connected with stepper motor which will act as our survelliance system, once the system starts the stepper motor will oscillate between an angle of 0 to 180 degree and ultrasonic sensor situated on top of it will also be oscillating and that will act as a radar system for detection . Once the ultrasonic sensor detect the object within the set range or distance it sends the signal to the microcontroller and the microcontroller will send signal to stepper motor to stop at that point. Once the stepper motor at the suverillance station stops . The angle at which the stepper motor has stopped is read by the microcontroller and it commands the launcher base stepper to rotate the laucher base at that angle and then actuate the dc motor at the top of the launcher base to launch ping pong balls in that direction (catapult-cam mechanism). The system is tested in proteus and solidworks software and it gives the required output in a satisfactory manner.

From the research it has been found that all this process without automation could take hours of time and by that time enemy could have successfully exceuted there plan, by this automation the process will take minutes and also can successfully stop enemy attacks. since no sensor is 100% accurate so the test was conducted to check the accuracy of the ultrasonic sensor being used in this system. After the test it is seen that 10 cms of allowance should be provided to the system. The test was conducted to understand what is the distance at which the sensor should be triggered so that the launching should be perfect.

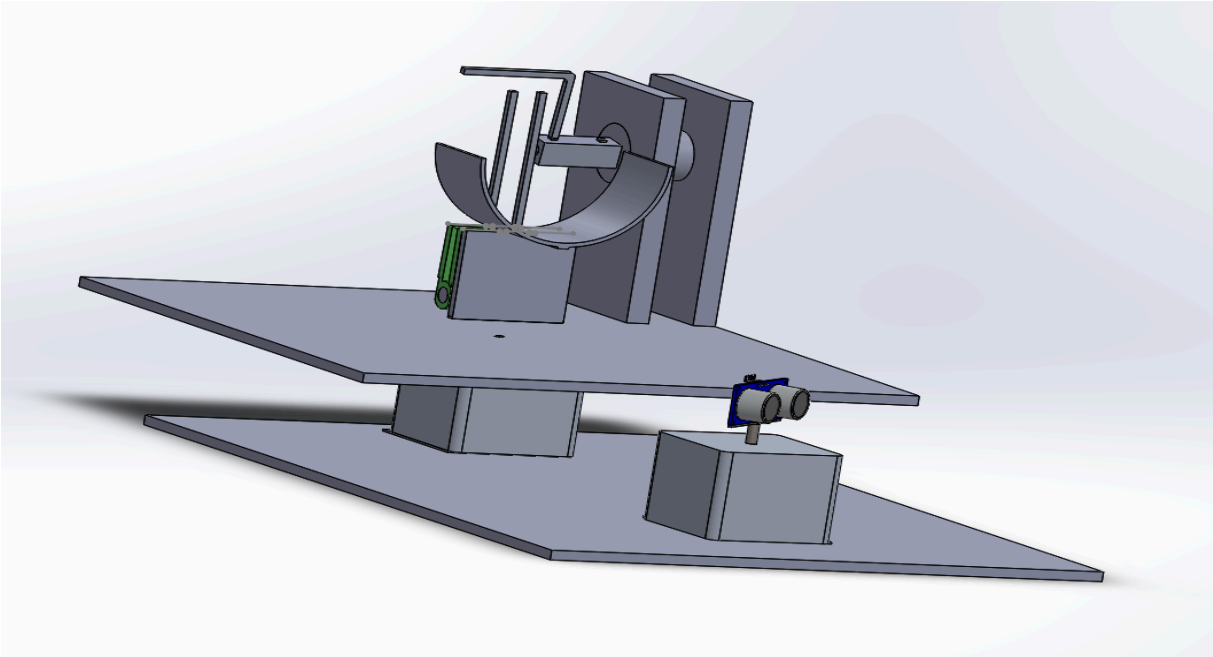

Figure 6.1: Image showing the 3d model of how the actual model will look

1.

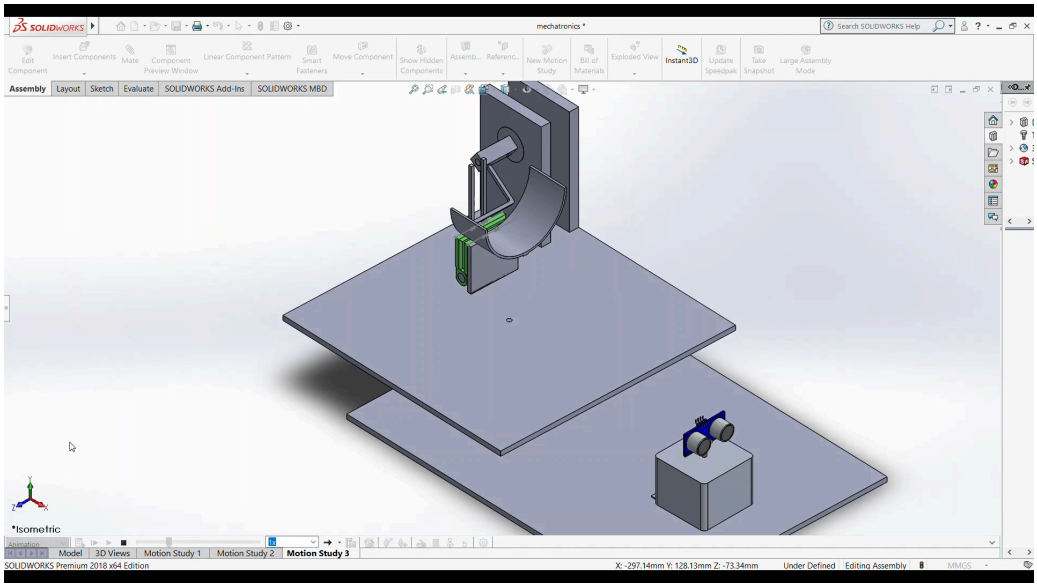

Figure 6.2:Image showing simulation being conducted in solidworks software

https://drive.google.com/file/d/1Gh0IYNDm8UkjebQ1Rx5uqif9z0K6Af1q/view

link of video to show the mechanical simulation in solidworks software.

2.

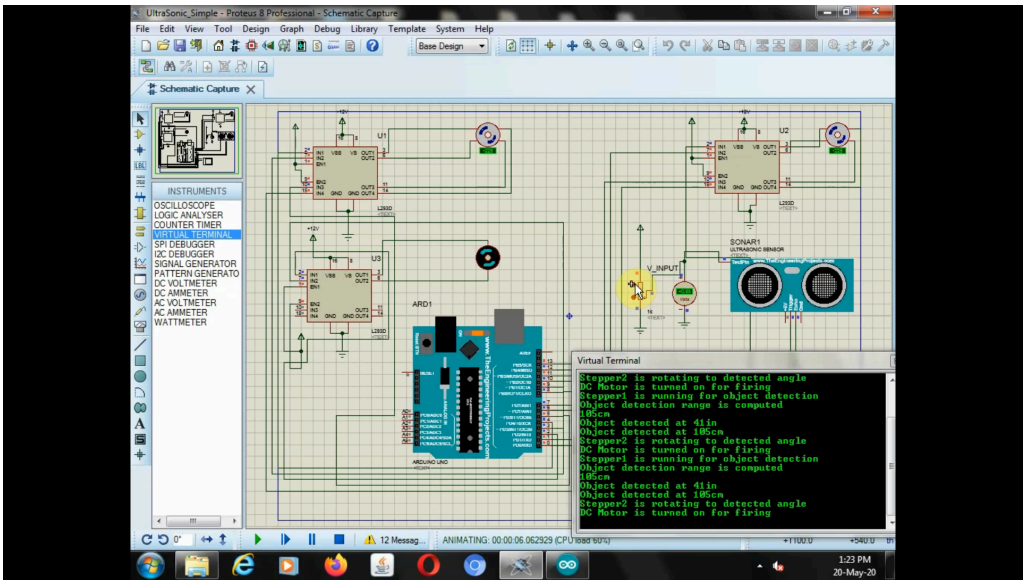

Figure 6.2:Image showing simulation being conducted in proteus software.

https://drive.google.com/file/d/1VV66WxdBFqwAn_0SN1DBKMmG7wVucwHh/view

link of video to show the electrical simulation in proteus software.

CHAPTER 7. CONCLUSION AND FUTURE SCOPE

6.1.1 Conclusion

In order to safe guard a country's borders and protect it against its enemies survelliance and defense system plays an important role, a country's defence system plays an vital role in the power structureof the country and mainly the safety of the citizens inside the borders. But this system not only upgrade a countries defense but also strengthen its fire power.the essence of the project depends on object detection and tracking. object detection is a computer vision technique is a computer vision technique that allows us to identify and locate objects in an image or video with this kind of identification and localization , object detection can be used to count objects in the scene as well as gather other intel using the algorithm to determine and track their precise location , all whith accuracy labelling them as a threat or ally as we need talked about tracking .Tracking is mainly depended on algorithm you use.

The two most commonlyapplied algorithms in object detection -HOG and YOLO. HOG is a feature descriptive that has been proven to work well with svm and similar machine learning models whereas YOLO is employed by deep learning based neural networks.

6.1.2 Future scope

The scope of this system is just not limited to military defence system. This can be used in navy and air defence also. The device here is set to detect only object and with in limited distance but it can also be made to detect any varierty may it be objects like truck, guns, cars, boats, ships etc. or humans, based on one's requirement. The launcher of the system is automatic but it can be made manually so that the controller may take actions wheather the target must be eliminated or any other actions to be taken , which will gives control to the user and not entirely machines. The lauching mechanism used here is catapult mechanism but it can be replaced with actual guns or anti aircraft missiles etc .

REFERENCES

1. https://www.researchgate.net/publication/264310835_Military_Surveillance
   Journal paper "Military Surveillance" by Dean Wilson from School of Law, Politics and Sociology University of Sussex, Brighton, UNITED KINGDOM, july-2007.

2. https://www.researchgate.net/publication/323195352_Border_surveillance_and_intruder_detection_using_wireless_sensor_networks_A_brief_survey

   Border surveillance and intruder detection using wireless sensor networks. a brief survey. Conference paper, uploaded by indu P K, on April 2017 on international conference on communication and signal processing.

3. https://patents.google.com/patent/US3946384

   US3946384A, united states by Thomas A westaway,us secretary of navy. Data provided by IFI CLAIMS patent services.

4. https://en.m.wikipedia.org/wiki/Tartar_Guided_Missile_Fire_Control_System

   Information provided by WIKIPEDIA. Content available under CC BY-SA 3.0, contributed by john.

5. https://www.electronicshub.org/arduino-radar-project/

   Information provided by Electronicshub.org. copyrights claimed by footer_backtotop @ 2020.

6. https://www.researches-app.com

   An energy efficient and reliable scheduling strategy for dynamic WBANs with channel periodicity exploitation. By Xin huang, yueqian Wu, fung ke, kunqian liu,yuehua Ding.

7. https://www.youtube.com

   videos related to programming for Arduino, mechanisms,simulations were reffered .

APPENDIX

Arduino code :

```
#include <Stepper.h>
#define STEPS 32
const int pingPin = 7; // Trigger Pin of Ultrasonic Sensor
const int echoPin = 6; // Echo Pin of Ultrasonic Sensor
const int dc1 = 2;
const int dc2 = 3;
const int st1 = 4;
const int st2 = 5;
const int st3 = 8;
const int st4 = 9;
const int st5 = 10;
const int st6 = 11;
const int st7 = 12;
const int st8 = 13;
int val1 = 50;
int c = 0;
int val2 = 0;
Stepper stepper1(STEPS, 4, 5, 8, 9);
Stepper stepper2(STEPS, 10, 11, 12, 13);
void setup()
{
  Serial.begin(9600); // Starting Serial Terminal
  stepper1.setSpeed(200);
  stepper2.setSpeed(200);
}
   void loop()
{
  Serial.print("Stepper1 is running for object detection");
  Serial.println();
```

```
stepper1.step(val1);
c = c+1;
long duration, inches, cm;
pinMode(pingPin, OUTPUT);
digitalWrite(pingPin, LOW);
delayMicroseconds(2);
digitalWrite(pingPin, HIGH);
delayMicroseconds(10);
digitalWrite(pingPin, LOW);
pinMode(echoPin, INPUT);
duration = pulseIn(echoPin, HIGH);
inches = microsecondsToInches(duration);
cm = microsecondsToCentimeters(duration);
Serial.print("Object detection range is computed");
Serial.println();
Serial.print(cm);
Serial.print("cm");
Serial.println();
if(cm>100)
{
 Serial.print("Object detected at ");
 Serial.print(inches);
 Serial.print("in");
 Serial.println();
 Serial.print("Object detected at ");
 Serial.print(cm);
 Serial.print("cm");
 Serial.println();
 int val=0;
 stepper1.step(val);
 int c1=c;
```

```
    c=0;
    for(val2=c1;val2>0;val2--)
    {
      Serial.print("Stepper2 is rotating to detected angle");
      Serial.println();
      stepper2.step(50);
      pinMode(dc1, OUTPUT);
      pinMode(dc2, OUTPUT);
    }
    Serial.print("DC Motor is turned on for firing");
    Serial.println();
    int i=0;
    for(i=1;i<10;i++)
    {
    digitalWrite(dc1, HIGH);
    delay(100);
    digitalWrite(dc2, LOW);
    }
     digitalWrite(dc1, LOW);
     digitalWrite(dc2, LOW);
  }
   delay(100);
}
long microsecondsToInches(long microseconds)
{
 return microseconds / 74 / 2;
}
long microsecondsToCentimeters(long microseconds)
{
   return microseconds / 29 / 2;
}
```