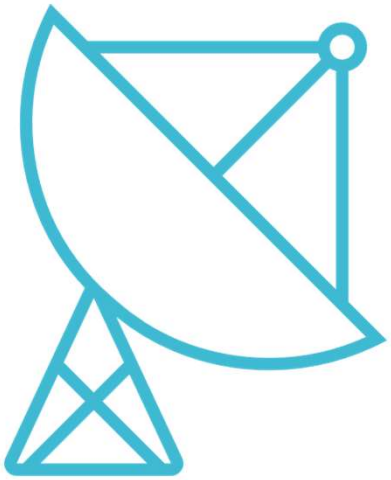
DC MOTOR POSITION CONTROL USING PID



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AGENDA

- Introduction
- Hardware devices used in this project
- Construction and Circuit Diagram
- Concepts involved and Arduino programming
- Working & Conclusion

Introduction

- Our main goal of this project is to control the position of antenna in 3-D space with the help of DC motors and Arduino
- we can control the rotation of antenna in two mutually perpendicular planes after completion of the setup .
- Basic idea of design is provided in the next slide .

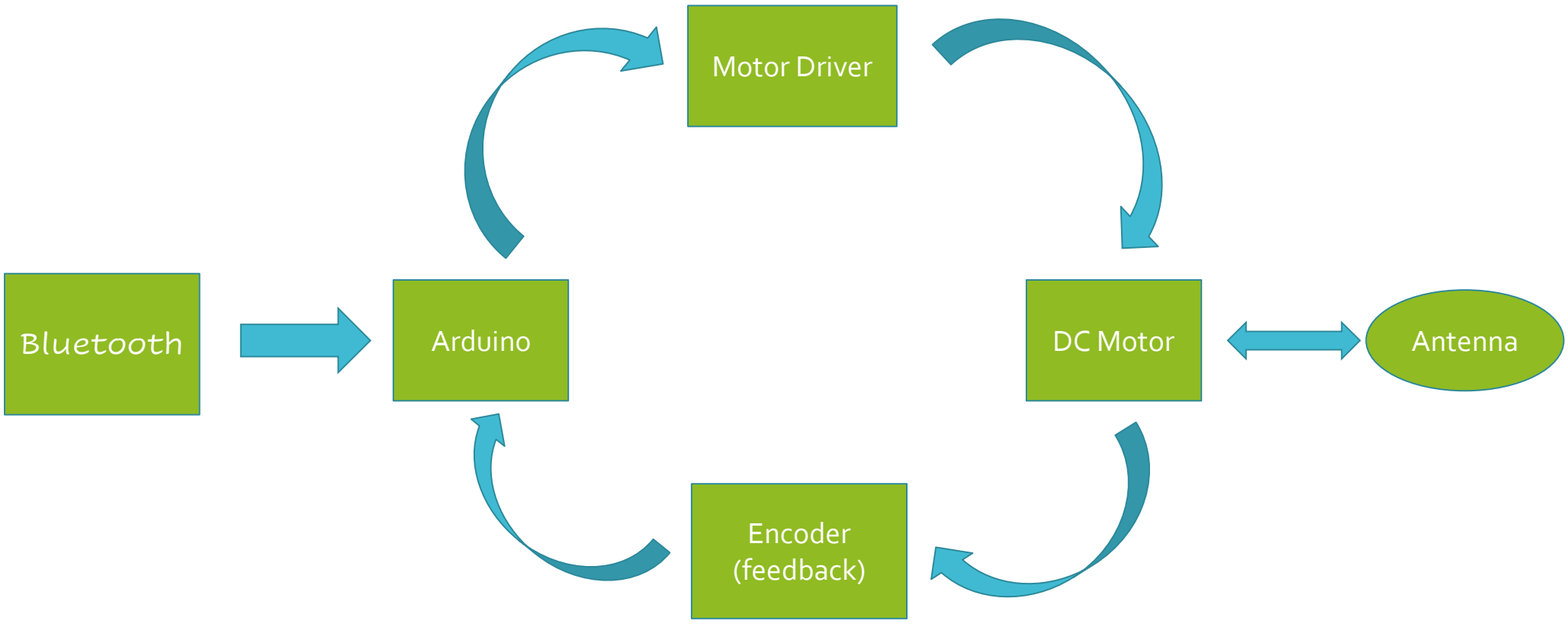

Motor Driver
Bluetooth
Arduino
DC Motor
Antenna
Encoder
(feedback)

Figure *A*.

- Block diagram in figure A shows basic idea of the working of the project.
- Position of Antenna is controlled by input given by mobile phone which communicates with Arduino through Bluetooth.
- Arduino sends signals to motor driver to run the motor.
- Motor rotates as per the instructions given by motor driver CW or ACW.
- Antenna is just mechanically couple with DC motor which rotates along with shaft of motor.
- An optical encoder senses the position of DC motor(So ,The Antenna) and gives feedback about the position of Antenna to Arduino.
- Arduino senses the signal sent by encoder and sends signal to driver accordingly.

Components

1. Arduino Uno

2. DC motor (2 NOS)

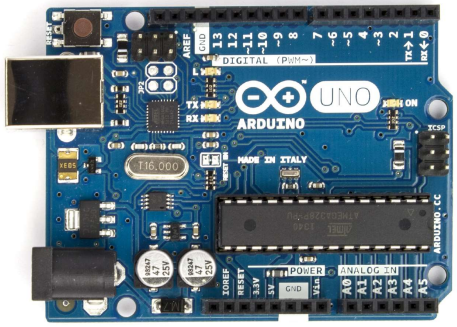
3. Motor driver IC (LM 298N)

4. Bluetooth Module

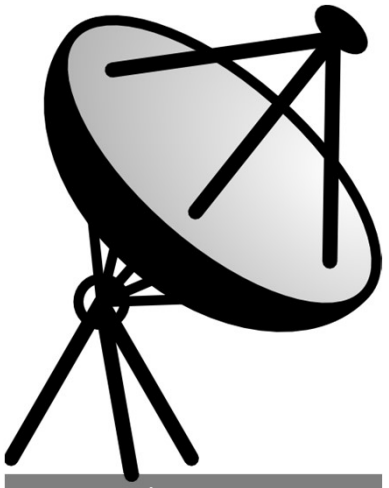
5. Optical encoder

6. Model of Antenna

Optical encoder



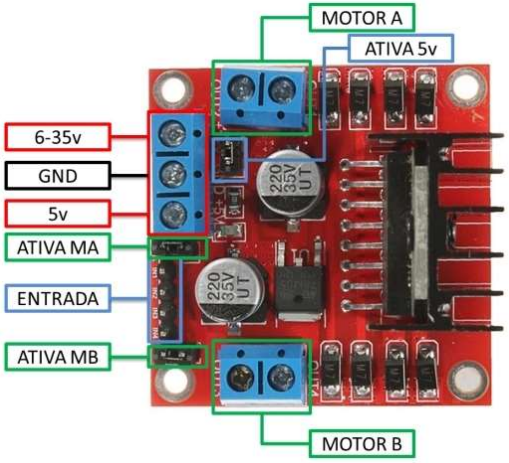
Arduino UNO



Antenna

Bluetooth Module

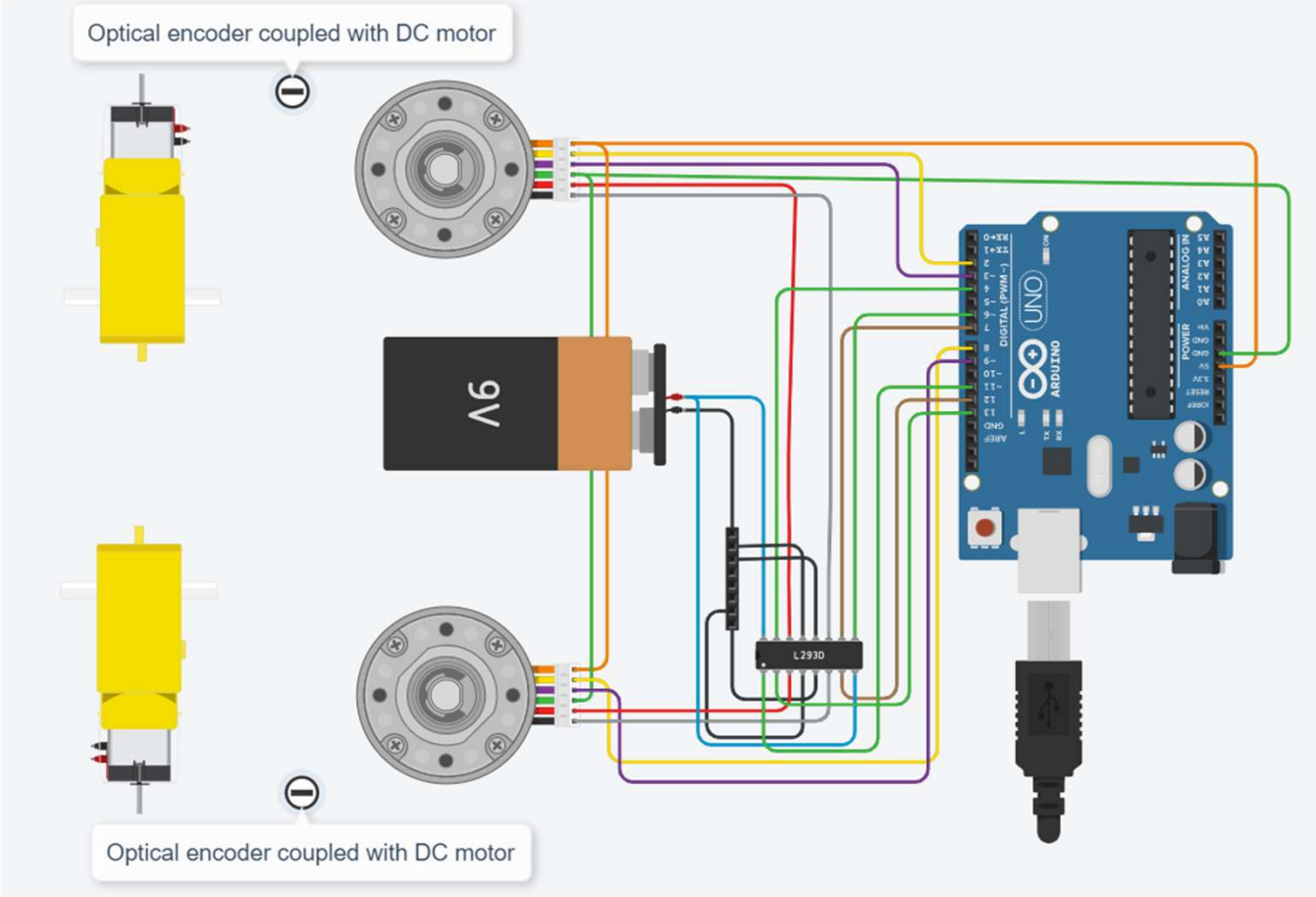
DC motor



Motor driver (L298N)

Construction and Circuit Diagram

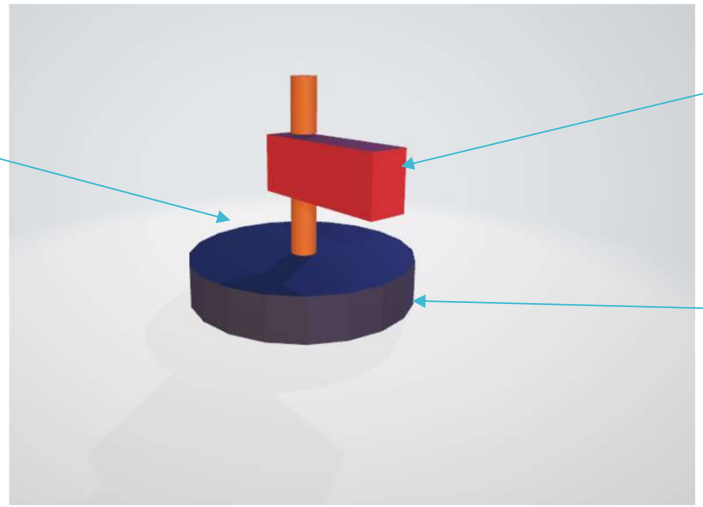
Fig B :circuit diagram

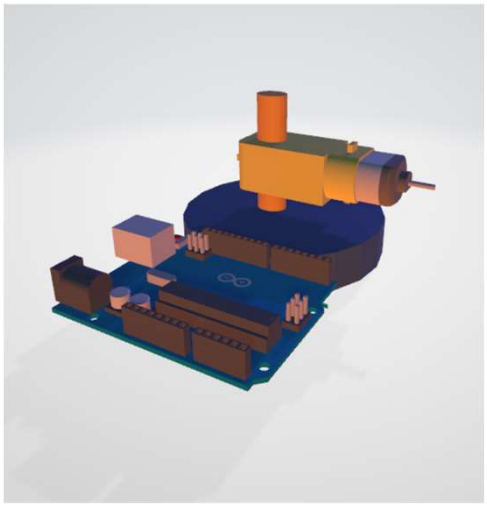


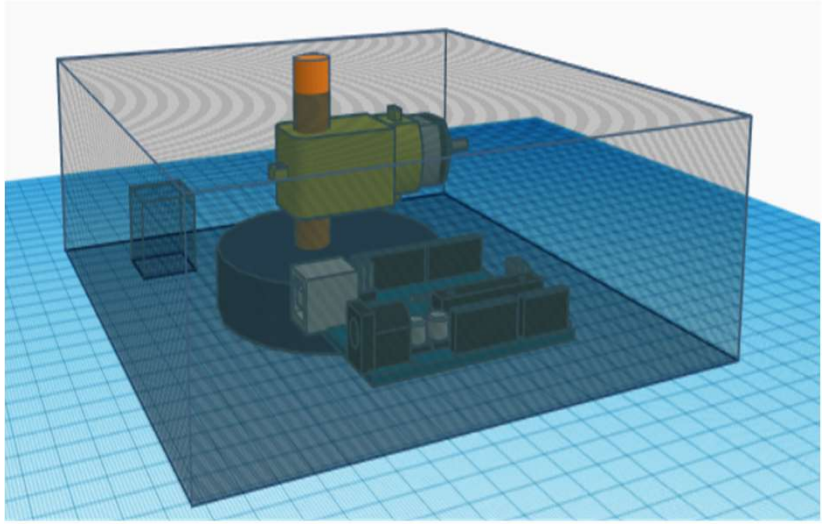
For viewing the circuit in tinker cad please click here

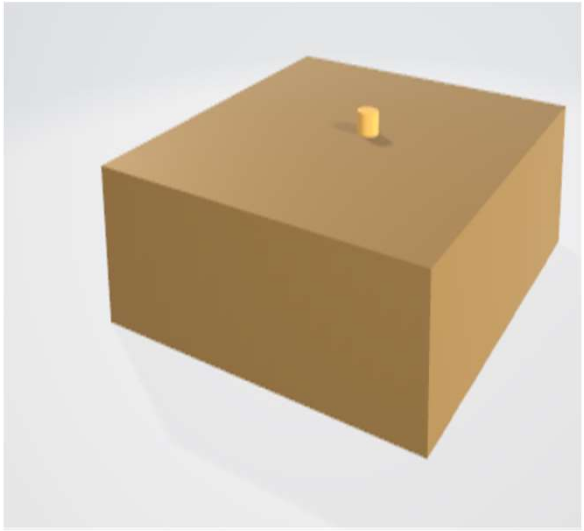
- Figure B shows the schematics of the circuit with proper connections
- Optical encoder mechanically coupled with dc motor with a coupler .
- Some thin rods can be used to to attach dc motor and encoder in order to ensure stability for DC motor(it is observed if we don't use these rods the system will be unstable i.e dc motor collapsed onto ground)
- The configuration roughly looks as follows

We can provide mechanical stability by just attaching rods so that the motor remains still







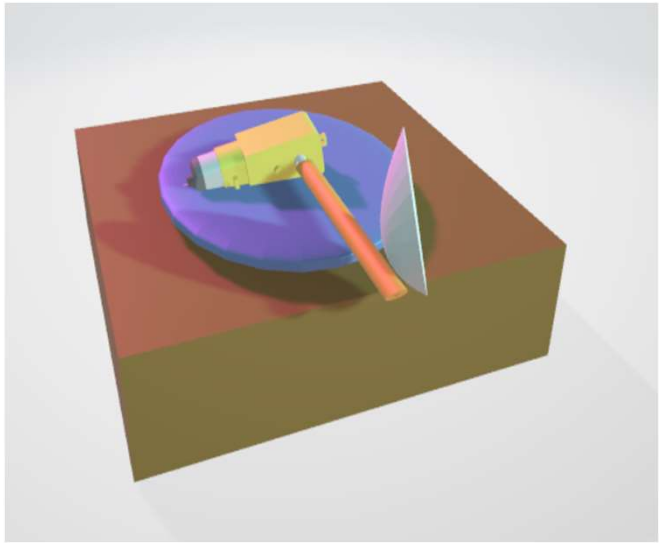


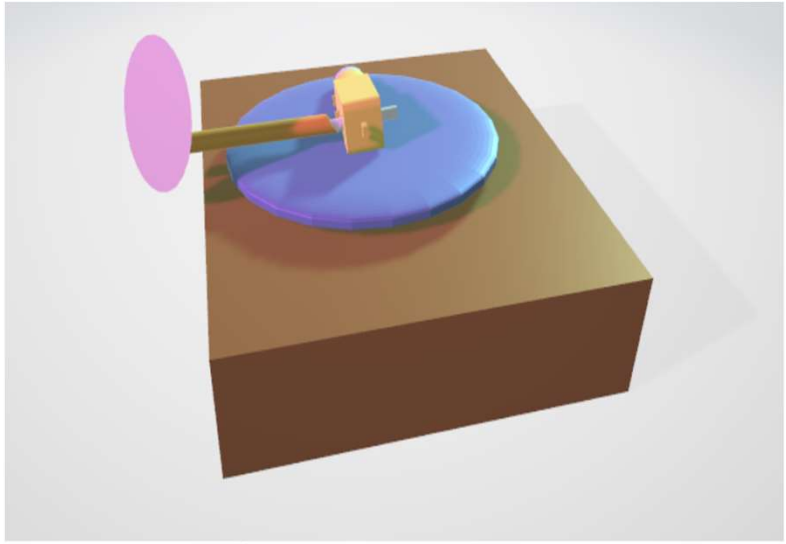
The above pictures shows the design with modelled parts after initial phase of design is completed we enclose the whole system in a box ,leaving space for motor shaft and few wires to pass through the hole .

For models please click here

Now , for completing second stage of design we attach disc firmly pivoted to the shaft of the initial closed system which rotates along with the first dc motor, on this disc we attach our new dc motor and battery to run it will be provided by motor driver .

(The outer Layer is for demonstration purpose, actually we should use a motor with optical encoder embedded in itself in it and wiring to Arduino is given through hole)





Concepts Involved and Arduino Programming.

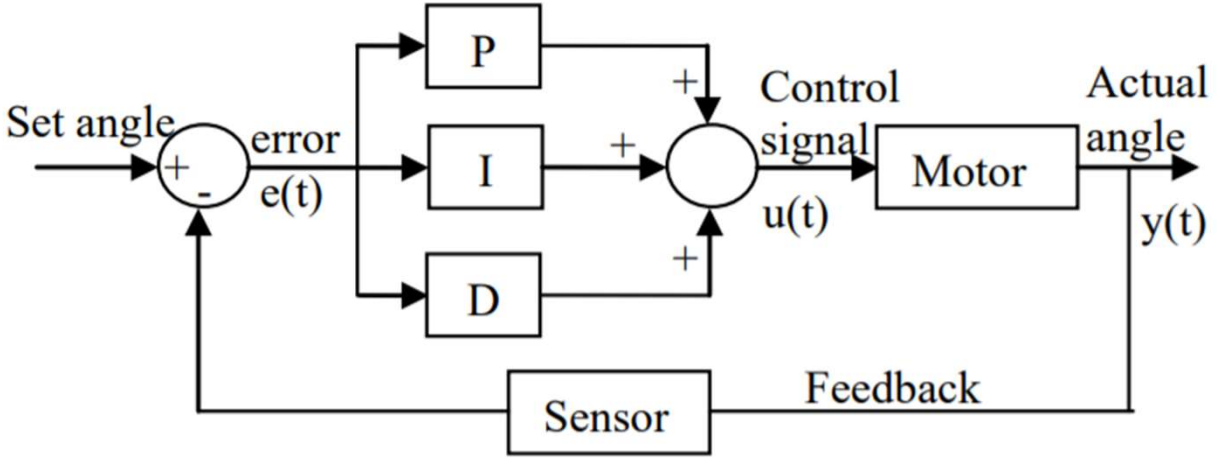
Main Concept involved in this design is PID

the optical encoder we used have precision of 2400 units per rotation

Inorder to tackle with this highly sensitive system, we should use good PID controller which has capacity to nullify all the vibrations it causes .

The smoothness of transition of antenna from one position to another mainly depends on PID.

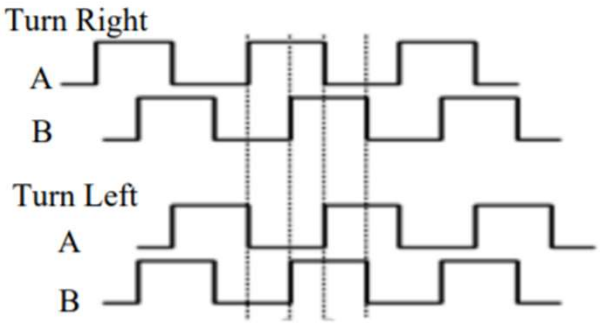
PID Controller



The closed loop position control of DC motor is shown in the figure. Here we use PID control to get the output smoothly and precisely We assume the values of kp, ki, kd and we have to find the values of it by hit and trial method from various observations.

Arduino Coding

- PWM signal is important concept in driving the motor through motor driver IC
- Amplitude of PWM signal decides the speed of DC motor.
- When motor rotates two series of pulses are generated by the optical encoder from Channel A and Channel B
- These pulses are given as input to Arduino and these determine the position of the DC motor
- Arduino code can be found here



1. First. we should know the gear torque ratio of given DC Motor (will be mentioned in the handout of DC motor)

2. As we are designing PID with suitable Kp , Ki , Kd. we assume them initially to be a certain initial values and then reassign them by observing output .

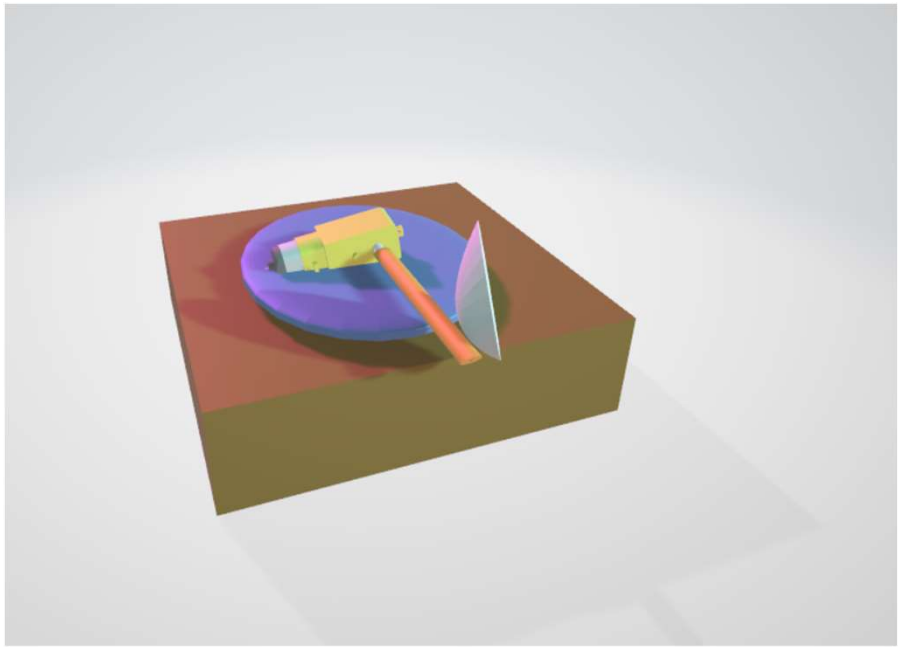
3. Once the results are satisfactory, we lock the values and freeze the code.

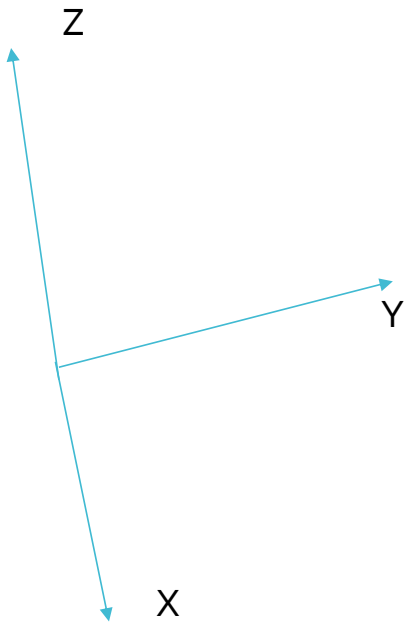
Working and Conclusion.

- Idea to operate this Antenna is by giving two angular co-ordinates through smartphone which defines the position of motor which is inside the box and the other which holds onto the Antenna respectively.

- Arduino is coded such that first disc starts rotating and when it reaches its position, antenna starts rotating .

- Once its stops, Again it starts repositioning once an input is given to serial monitor.





- The disc has access to rotate in XY –Plane and the DC motor attached to rotates in plane perpendicular to XY –Plane which is also perpendicular to the direction of shaft of DC motor

- If we Imagine a tip to antenna , we can deduce that the locus of tip forms a cylinder. And also there exist atleast a configuration (values of Input to Arduino) for every direction possible in space.

Applications and Links

Applications

The concepts of DC motor position control are used in various real-life applications such as

- Antenna positioning system
- Design of smart switches
- Used in printers and scanners

Links

- Design of the circuit in Tinker Cad can be found here
- Design and prototype of the mechanical model made in tinker cad can be found here
- Arduino code can be found here
- PID library used in Arduino code can be found here

Status of Completion

Completed

- Complete Mechanical design of entire project
- 1 dimensional approach to the concept.
- Prototypes are made in Tinker Cad

Incomplete

- Code for 2 motors running simultaneously
- Credibility of code made up to here(as we do not have components with us)
- Bluetooth transmission of input.

THANK YOU

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