IIIT Sricty

ROBOTIC INTELLIGENCE PROJECT

Team : 1000 Sunny

Akansh Vaibhav - S20210010010
Pranav Gupta - S20210010179
Urjasvi Suthar - S20210010232
Sai Deepthi - S20210010166

INTRODUCTION

PROJECT TITLE : Solar Tracking Robot for Solar Panels To Maximize Energy Output

DOMAIN : CIVIL APPLICATIONS

1000 Sunny is a solution designed to **optimize solar panel performance** by dynamically **aligning with the sun's position** throughout the day. The Solar Tracking Robot employs a sophisticated tracking system that autonomously follows the sun's trajectory, ensuring that solar panels are always positioned at the optimal angle to harness the maximum sunlight. This innovative robot enhances energy efficiency by continuously adapting to the sun's movement, resulting in significantly increased power generation compared to fixed solar installations.

Key features include **LDR sensors**, **Linear Regression algorithms**, and a **robust mechanical design**, allowing the Solar Tracking Robot to navigate the solar array's surface seamlessly. This not only boosts energy yield but also prolongs the lifespan of solar panels by minimizing stress and wear caused by suboptimal angles.

With sustainability at the forefront of our mission, the Solar Tracking Robot represents a giant leap toward harnessing renewable energy more efficiently. Whether deployed in residential, commercial, or industrial settings, this automated solution promises to revolutionize solar energy systems, making them more productive, cost-effective, and environmentally friendly.

MOTIVATION

The motivation behind our Solar Tracking Robot project is rooted in the pressing need for sustainable and efficient energy solutions to address the ever-growing global demand for electricity. As we navigate the complexities of an energy-hungry world, it becomes imperative to harness renewable resources intelligently.

Traditional fixed solar installations are limited by their static orientation, often unable to fully capitalize on the sun's varying position in the sky. This inefficiency represents a missed opportunity to unlock the true potential of solar energy. The Solar Tracking Robot is conceived as a response to this limitation, driven by the motivation to revolutionize how we harness solar power.

By dynamically tracking the sun's movement throughout the day and relative positions over the year our Solar Tracking Robot aims to significantly enhance the energy output of solar panels. The Project aims to increase the net energy generated while also covering the cost of moving the solar panels.

In summary, our motivation for the Solar Tracking Robot project is rooted in environmental responsibility, a commitment to advancing technology, and the vision of a future where clean energy is not just an option but a global standard.

EXPECTED EFFICIENCY INCREASE

Static Solar Panel :

Energy Produced by Solar Panel in “Peak Condition” (per meter sq): **1kW**

Average Efficiency of the Solar Panel Throughout the Day: **20 - 40 %**

Energy Produced by Solar Day in One Day (per meter sq): **(1000 * 0.2) * 6 hours = 1200kWh**

Dynamic Solar Panel :

Peak Efficiency of the Solar Panel: **50 % More efficient than regular efficiency**

Energy Produced by Dynamic Solar Panel (per meter sq): **((1000 * 0.2)*1.5) * 6 hours = 1800kWh**

*

Energy Required to Move the Solar Panel: **6w * 24 hours = 144Wh**

Net Increase in Energy Produced : **(1800000 - 144) - 1600000 = 1,99,856 = 200kWH (roughly)**

RELATED WORK

DESIGN AND IMPLEMENTATION OF SOLAR TRACKING SYSTEM USING LDR SENSOR

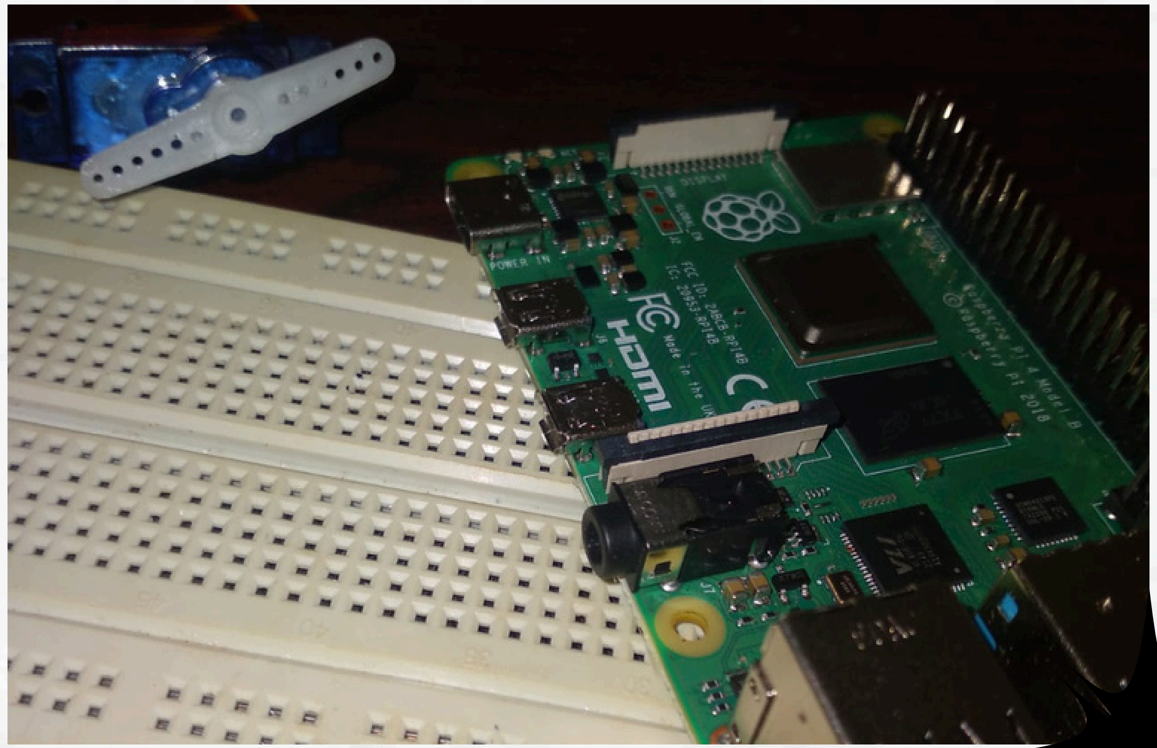
Int. J. Adv. Sci. Eng. Vol.6 No.3 1456-1461 (2020 1456 E-ISSN: 2349 5359; P-ISSN: 2454-9967 Sumathi et al., International Journal of Advanced Science and Engineering www.mahendrapublications.com. Design and Implementation of Solar Tracking System using LDR Sensor S.Sumathi*, G.Gayathri, A.Jancy Rani, S.Deepalakshmi, K.Karthikeyan Department of Electrical and Electronics Engineering, Mahendra Engineering College, Mallasamudram - 637 503, Namakkal District, Tamil Nadu, India

A NEW DESIGN OF DUAL-AXIS SOLAR TRACKING SYSTEM WITH LDR SENSORS BY USING THE WHEATSTONE BRIDGE CIRCUIT

M. Saeedi and R. Effatnejad, "A New Design of Dual-Axis Solar Tracking System With LDR Sensors by Using the Wheatstone Bridge Circuit," in IEEE Sensors Journal, vol. 21, no. 13, pp. 14915-14922, 1 July 1, 2021, doi: 10.1109/JSEN.2021.3072876.
keywords: {Sensors;Bridge circuits;Resistance;Sun;Shafts;Sensor systems;Electrical resistance measurement;Wheatstone bridge;LDR sensors;DAST system;PV panel;closed-loop system},

AUTOMATED DUAL AXIS SUN TRACKING SOLAR PANELS BASED ON LDR AND RTC SENSOR

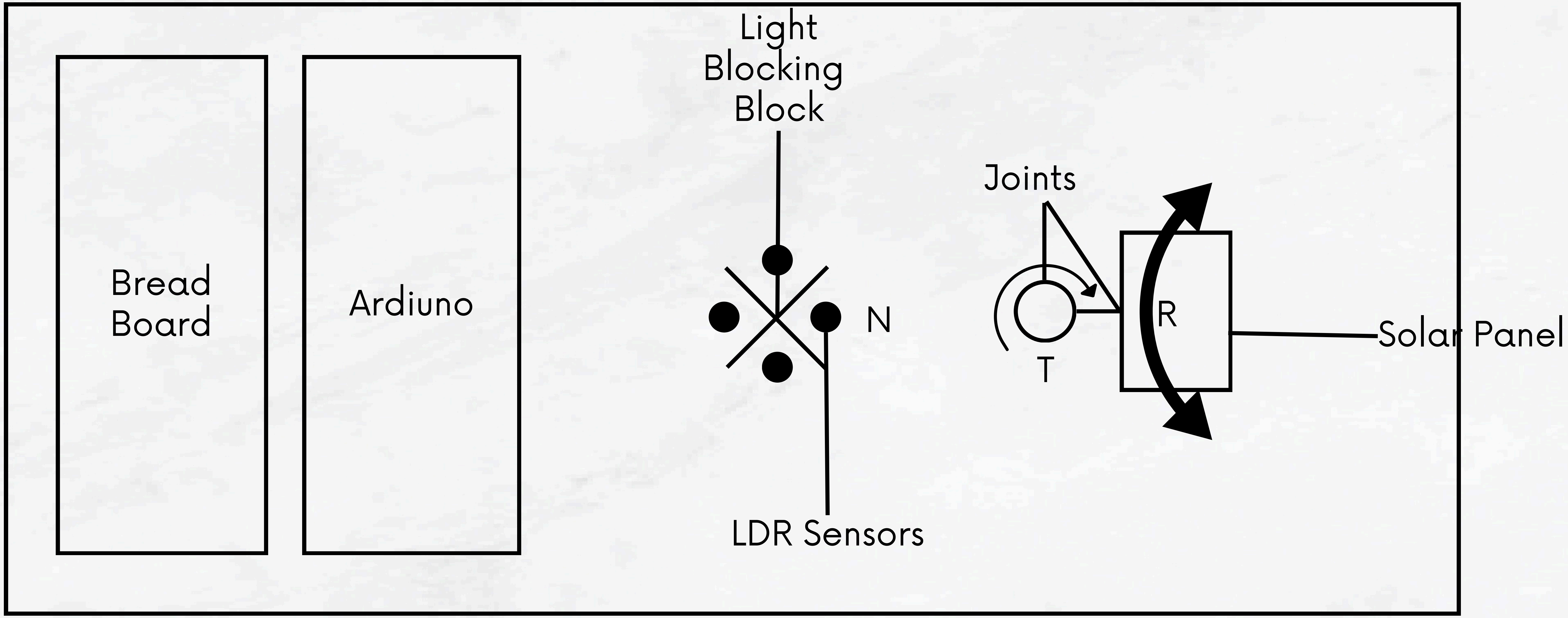
International Journal of Engineering Research & Technology (IJERT) Published by : http://www.ijert.org ISSN: 2278-0181 Vol. 10 Issue 04, April-2021 Automated Dual Axis Sun Tracking Solar Panels based on LDR and RTC Sensor Abhijeet Deshmukh, Prashant Devmane, Rajas Ambekar, Pawar Piyush, Prof. Maheshwari N Patil JSPM Rajarshi Shahu College of Engineering Tathawade.



LIST OF HARDWARES

- **Ardiuno x 1**
  Open-source hardware and software platform for DIY electronics projects and prototyping.
- **Bread Board x 2**
  Prototype circuits easily with a reusable breadboard for electronics projects
- **Servo Motor x 2**
  Precision motion control; electric motors for accurate and responsive applications.
- **Jumper Wires**
  Flexible connectors for electronic components, enabling seamless circuit connections.
- **Solar Cell**
  Efficient solar panels, inverters, batteries to track sun and generate energy
- **LDR x 4**
  LDR Sensors to collect Light Intensity values of Light Sources.

ROBOT MODEL

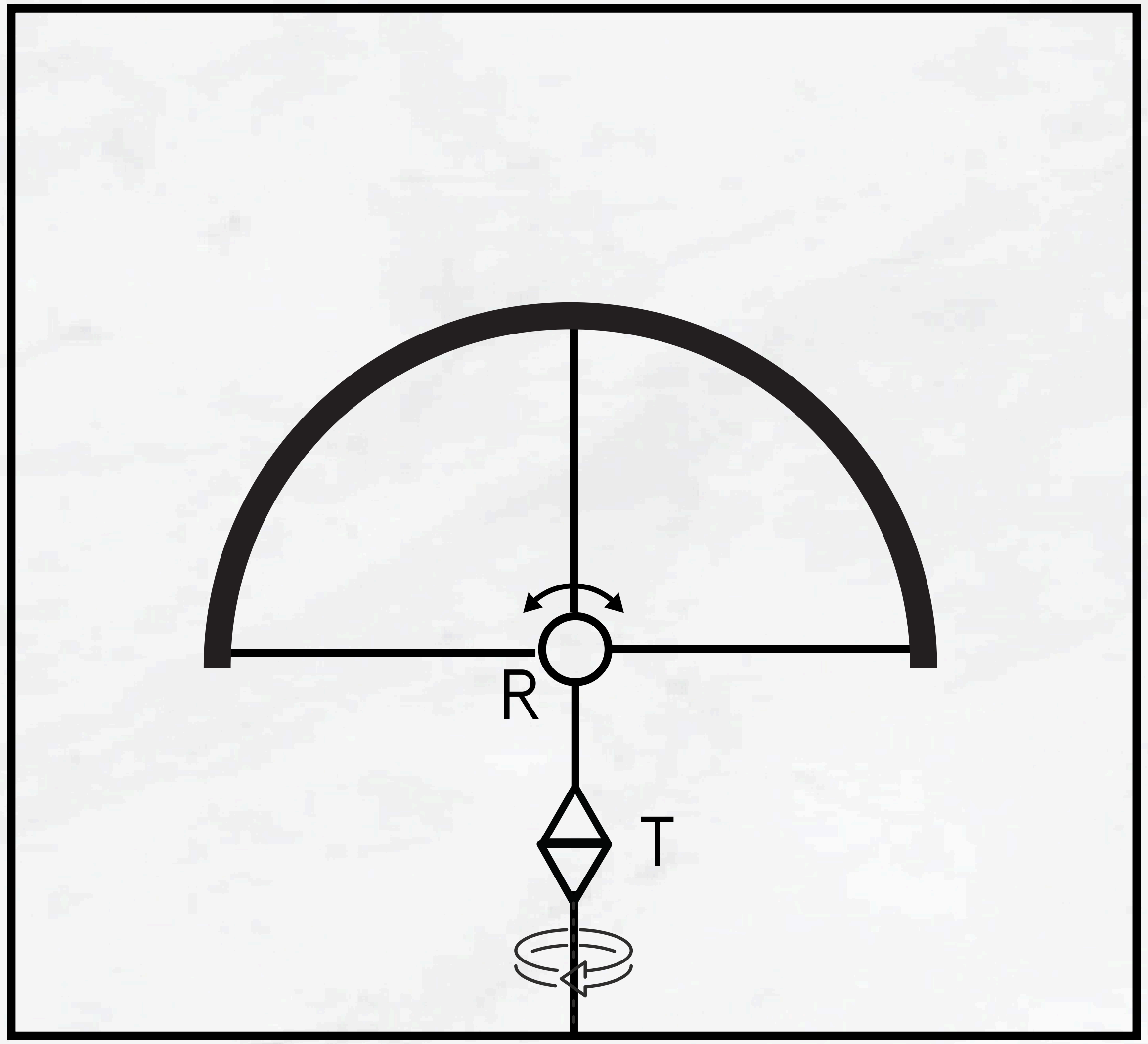


ROBOT DIAGRAM

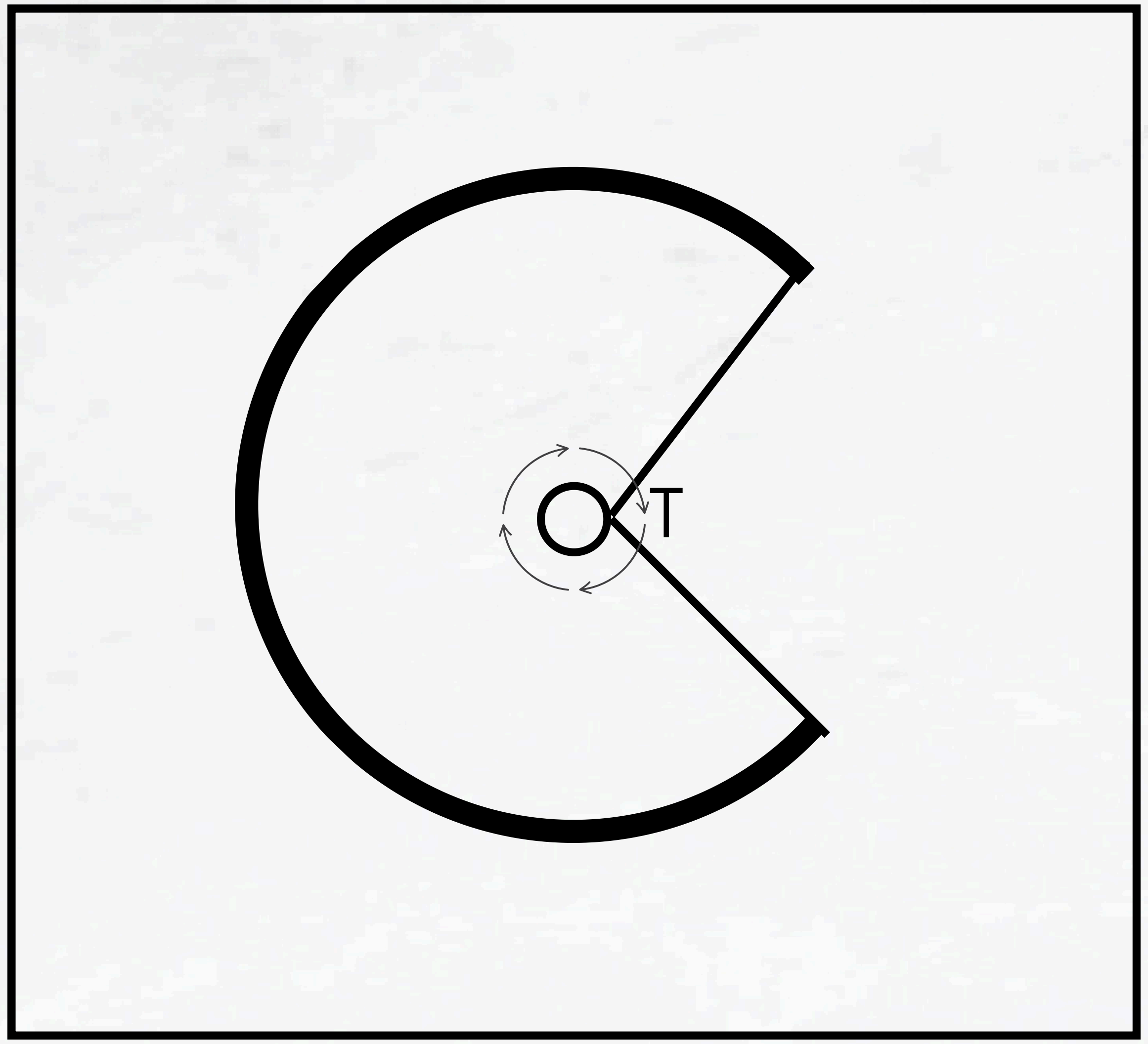
The Solar Panel Manipulator consists of two Servo Motors, one of which acts as a Twisting joint at the base and the other acts as a Revolute Joint at the Other Joint.

Thus, The Manipulator acts as Spherical pr Revolute manipulator without the third Manipulator

It is a TR type Manipulator

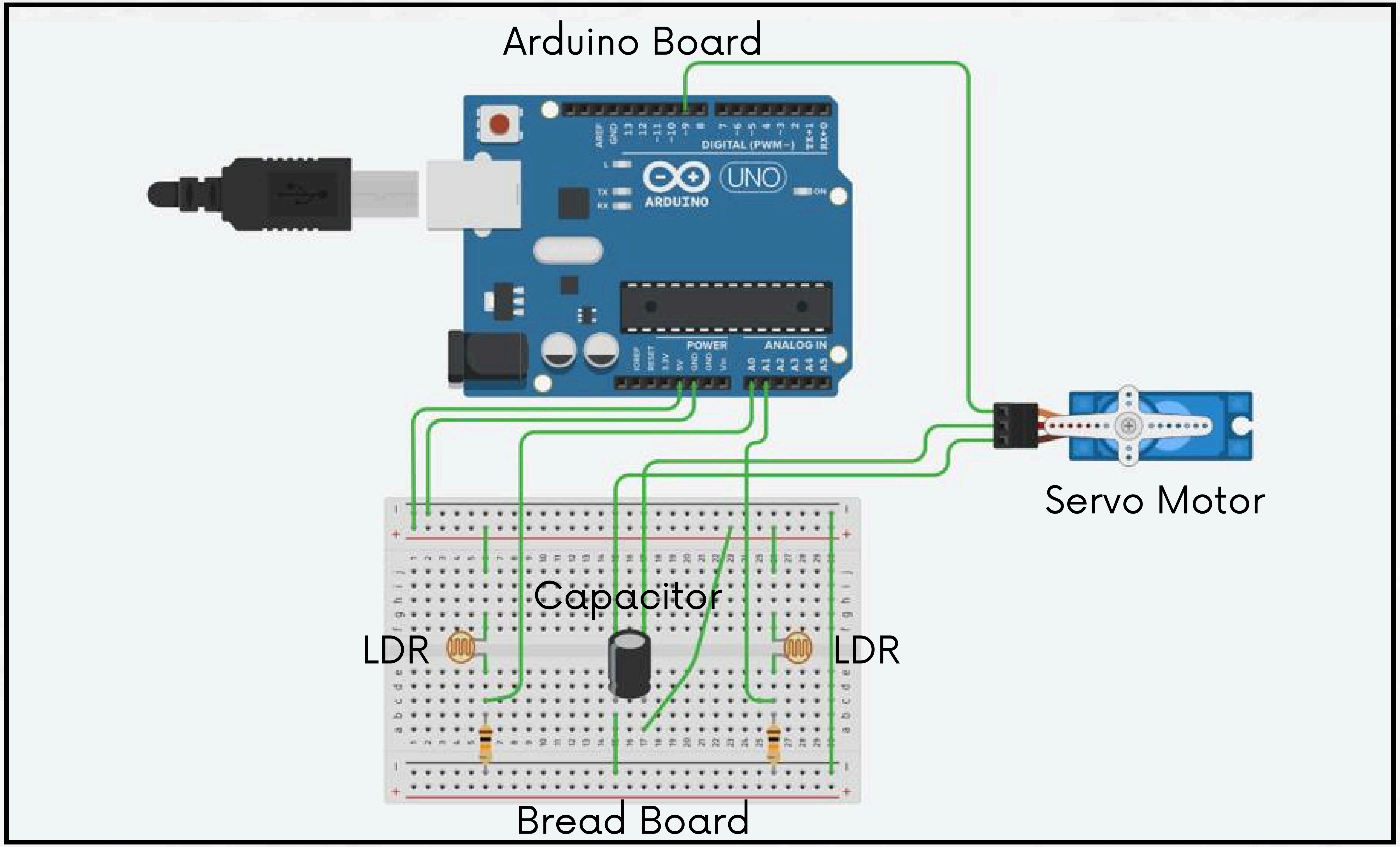


Elevation View



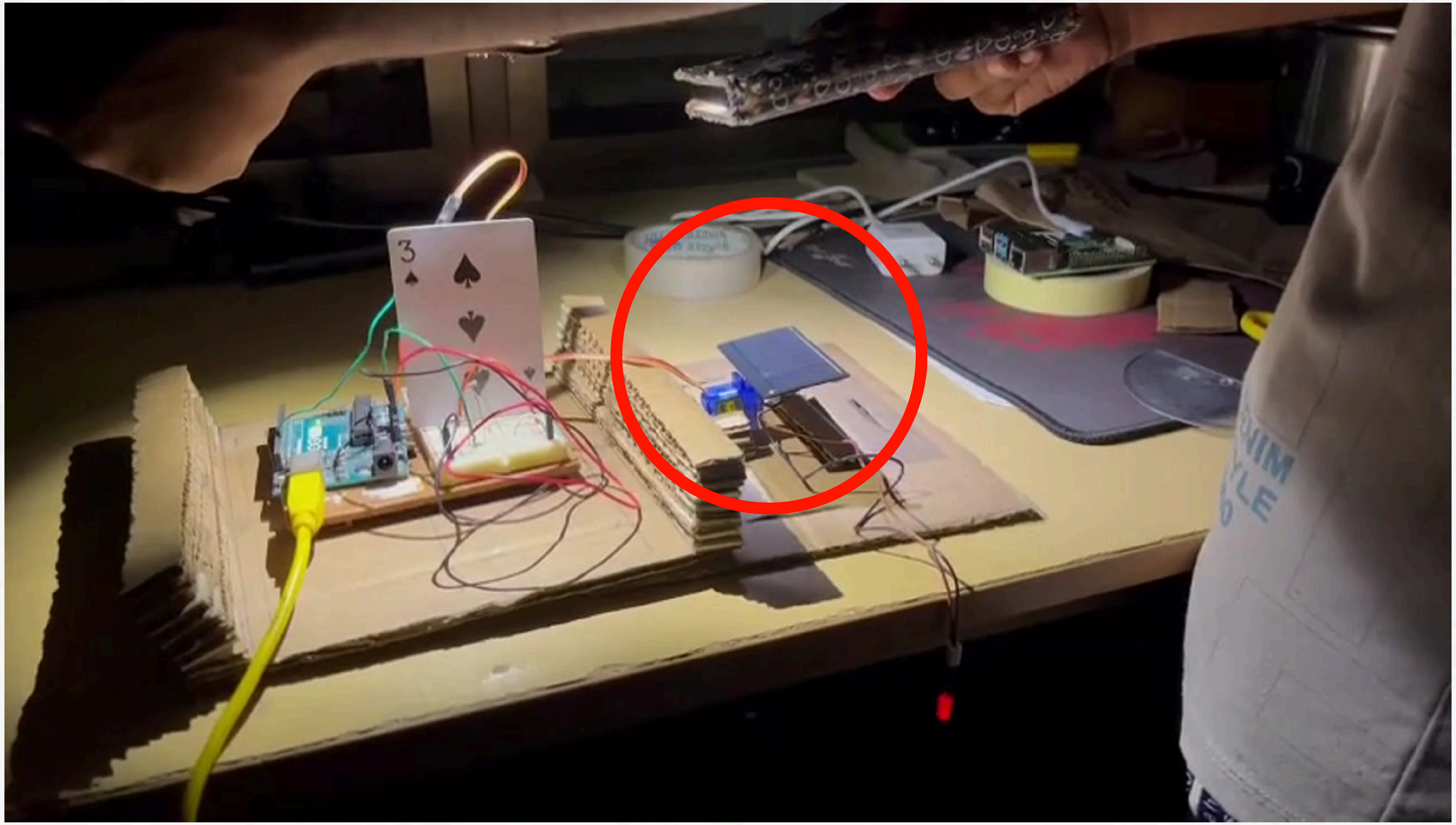
Plan View

MANIPULATOR DIAGRAM



CIRCUIT DIAGRAM

RUNNING VIDEO



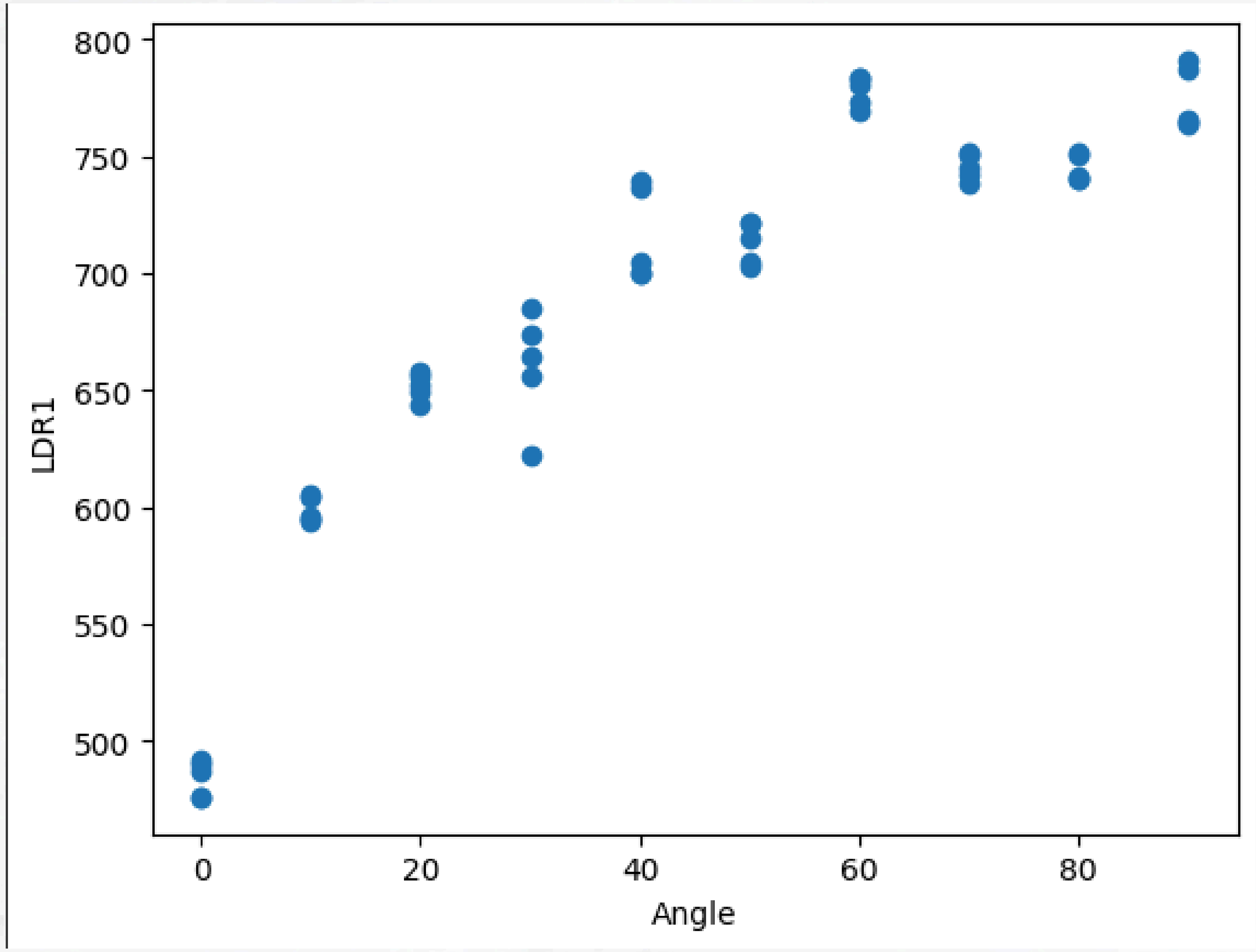
LINEAR REGRESSION

- Linear regression is a statistical method used for modelling the relationship between a dependent variable and one or more independent variables.

- Dependent Variable: Angle
- Independent Variable: LDR Values

- Linear Regression aims to find the best-fitting line (or hyperplane in higher dimensions) that minimizes the difference between the actual observed values and the values predicted by the model. This line is characterized by parameters: the slope and the intercept.

Trend Between LDR Value and Angle :



LINEAR REGRESSION

Code :

Model:

```
def get_predictions(model, X):
    (n, p) = X.shape
    q = p + 1

    new_X = np.ones(shape=(n, q))
    new_X[:, 1:] = X

    print(new_X)

    return np.dot(new_X, model)
```

```
def get_best_model(X, Y):
    (n, p) = X.shape
    q = p + 1

    new_X = np.ones(shape=(n, q))
    new_X[:, 1:] = X

    return np.dot(np.dot(inv(np.dot(new_X.T, new_X)), new_X.T), Y)
```

Results :

Output of the Best Model of Linear Regression

- Bias: -144.944038
- Weight1: 0.26921189
- Weight2: 0.0346417354

Loss in the Best Model:

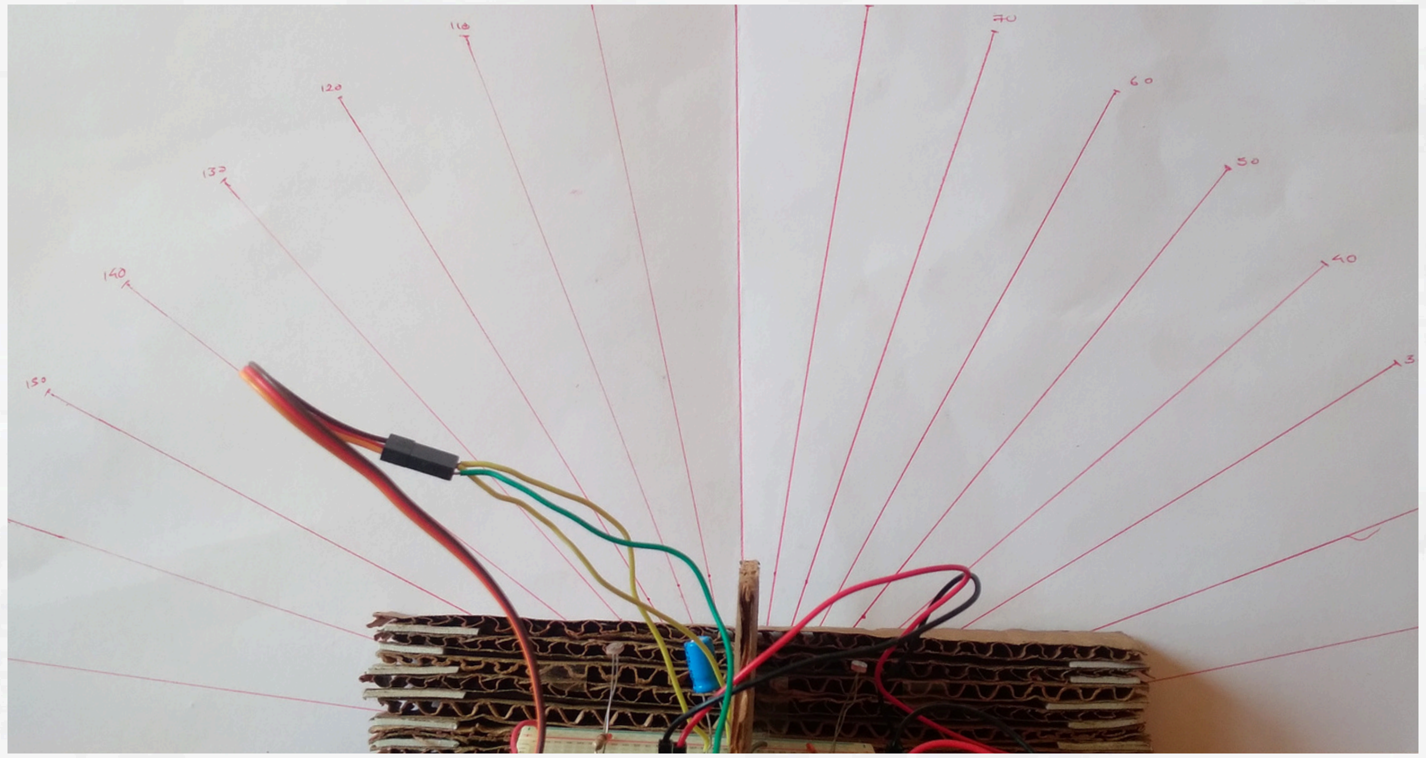
- Absolute Mean Average Loss: 9.2
- Mean Square Error: 124.0

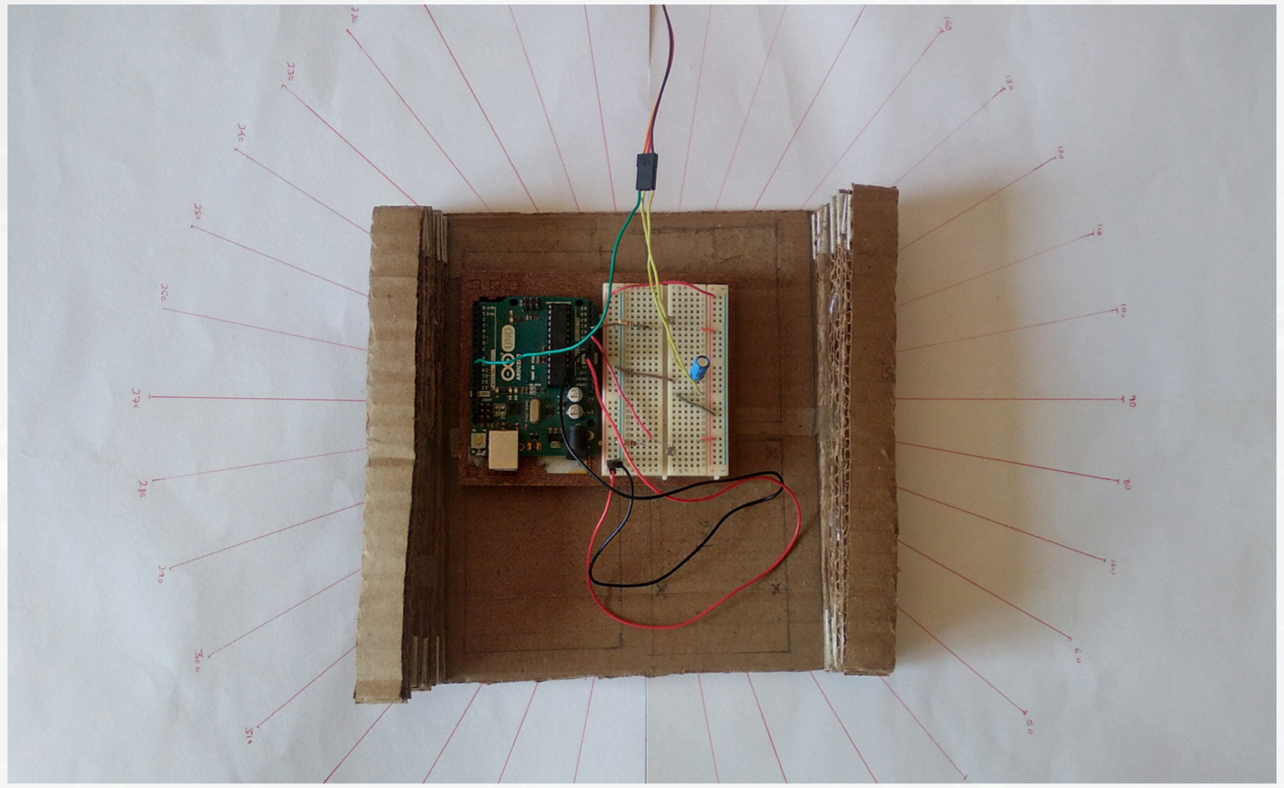
CODE

```
#include <Servo.h>

const int photo_res1 = A0;
const int photo_res2 = A1;

const float Bias = -144.944038;
const float Weight1 = 0.26921189;
const float Weight2 = 0.0346417354;

const int Normal = 70;

Servo my_servo;
int deg;

void setup() {

  Serial.begin(9600);
  my_servo.attach(9);
  //pinMode(photo_res, INPUT);
  // put your setup code here, to run once:

}

void loop() {
  int p_value1 = analogRead(photo_res1);
  int p_value2 = analogRead(photo_res2);
  Serial.println("Light 1 val: ");
  Serial.println(p_value1);
  Serial.println("Light 2 val: ");
  Serial.println(p_value2);
  int rotation = 0;
```

```
  if(abs(p_value1 - p_value2) > 100){

    if(p_value1 > p_value2){
      Serial.println("p1 greater");
      int Angle = Bias + (p_value1*Weight1) + (p_value2*Weight2);
      Serial.println(Normal + Angle);
      my_servo.write(Normal + Angle);

    }

    if (p_value1 < p_value2){
      Serial.println("p2 greater");
      int Angle = Bias + (p_value2*Weight1) + (p_value1*Weight2);
      Serial.println(Normal - Angle);
      my_servo.write(Normal - Angle);
    }

  }

  else{
    my_servo.write(Normal);
    Serial.println("no change");
  }
  //my_servo.write(120);
  deg += 1;
  delay(500);
  // put your main code here, to run repeatedly:
}
```

DATA COLLECTION METHOD





- We are collecting our data from the robot created.
- The data is in the Format :
  LDR1 Value; LDR2 Value; Position of Light Source;
  LDR1 Value; LDR2 Valure; LDR3 Value; LDR4 Value; Position of Light Source;
- Using this data we implemented a Linear Regression Model that takes real-time input from LDR and returns the correct angle of the Solar Panel so that it maximizes the energy output.

CONCLUSION

- Collected all the necessary parts required for the robot
- Prepared Models for the Robot and Manipulator.
- Prepared a Circuit Diagram for the Robot
- Assembled the prototype based on the proposed Model
- Collected Data for Light Source Position vs LDR Readings
- Applied Linear Regression Model Based on Data Collection method to predict accurate angle in real-time
- Added 4 LDR System to counter 360 degree movement of Light Source.
- Created a Final Working Prototype Prepared

TIMELINE

STAGE 1

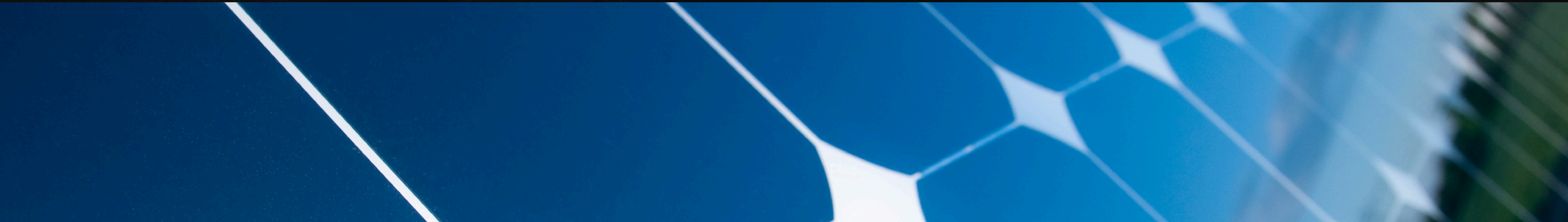
- Getting all the parts
- Preparing a model of Manipulator
- Assembling the Robot

STAGE 2

- Collecting/Creating a dataset of LDR Readings vs Sun Position in the sky
- Finding best Machine Learning Approach for the given dataset

STAGE 3

- Applying ML Approaches
- Applying 360 Degree Movement



WORK DISTRIBUTION

Akansh Vaibhav

- Creation of Dataset of LDR vs Light Source Position
- Making Base of Model
- Making Linear Regression Model for Two-Way Movement

Pranav Gupta

- Creation of Dataset of LDR vs Light Source Position
- Making Base of Model
- Making Linear Regression Model for Two-Way Movement

Urjasvi Suthar

- Assembled The Circuit
- Written code for the Solar Tracking Manipulator
- Setting Up 4 LDR Setup
- Training Model and making code for 360 manipulator movement

Sai Deepthi

- Assembled The Circuit
- Written code for the Solar Tracking Manipulator
- Training Model and making code for 360 manipulator Movement

THANK YOU !