SEMINAR REPORT

ON

# HYDROPONICS BASED PRECISION FARMING WITH FEATURE OPTIMIZATION

SUBMITTED BY

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# CERTIFICATE

This is to certify that

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of B.E. (E&TC) have successfully completed the seminar titled '**Hydroponics Based Precision Farming with Feature Optimization**' during the academic year 2023-2024. This report is submitted as partial fulfillment of the requirement of degree in E&TC Engineering as prescribed by Savitribai Phule Pune University.

| | | |
|---|---|---|
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# ACKNOWLEDGEMENT

We would like to express our sincere appreciation to all the individuals who contributed to the success of our project "Hydroponics Based Precision Farming with Feature Optimization".

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- Janhavi Bhor
- Varad Chaskar
- Sahaj Chaudhari

# ABSTRACT

The world is changing rapidly, bringing both innovations and problems. As the population grows, land and water resources are shrinking. Conventional farming methods are becoming unsustainable due to climate change and harmful environment. Hydroponics offers an innovative solution that uses less space and water and produces more food with fewer chemicals than soil based farming. Furthermore, hydroponics can grow food in any location and season, providing fresh, local, and nutritious .vegetables to consumers. The proposed system aims to enhance the hydroponics concept by not only automates crucial aspects of hydroponic systems such as water and nutrient supply but also incorporates features like machine learning algorithms, IoT, cloud computing, M2M communication, and image analysis  and controlling environmental parameters in plant growth but also verifying whether the system functions as intended. The system is in product-ready form that may be used commercially or domestically.

# LIST OF FIGURES

# LIST OF TABLES

# TABLE OF CONTENTS

# 1. INTRODUCTION

Agriculture is vital for feeding the world's rising population and stands as a vital lifeline, ensuring sustenance for a fast-changing world. With ever-increasing demand for resources, food and the scarcity of arable land, there is a need to create sustainable and efficient agricultural practices. As the world is facing challenges such as climate change, population growth, and limited natural resources, there is a pressing need for innovative solutions that can maximize crop productivity while minimizing resource consumption. By creating a self-sustaining agriculture automation system we can increase a yield significantly compared to traditional agriculture methods, this project can help meet this demand and ensure a sustainable future for agriculture.

## 1.1 Objectives

1. To improve efficiency and productivity in farming and reduce labor costs. Using automation to achieve higher yields and profitability for farmers.

2. To reduce environmental impact and promote sustainable farming practices. Implementing and efficient resources management to minimize waste and conserve natural resources.

3. To increase food security and help address food supply issues in the world. Utilize self-sustaining agriculture technologies to improve crop yield and provide more food for a growing population.

4. To collect data from sensors and optimize system operations using machine learning algorithms, including humidity prediction and nutrient level.

## 1.2 Scopes

1. It encompasses comprehensive research and selection of suitable sensors, modules, and components.

2. It includes the design and development of circuitry, connections, and control mechanisms to integrate the sensors, actuators,microcontrollers, and communication modules effectively.

3. It also involves programming the microcontroller with machine learning algorithms to optimize system operations based on sensor data.

4. Extensive research will be conducted to gain insights into the effects of various parameters on plant growth, enabling further system optimization.

5. Develop a user-friendly website and mobile application that will serve as a centralized platform for remote control, monitoring, and alerts. This interface will enable farmers and agricultural practitioners to conveniently manage and monitor their hydroponic systems, ensuring real time data visualization and timely interventions when necessary.

## 1.3 Hydroponics NFT Automation

Nutrient Film Technique(NFT), is a popular hydroponic system that involves a continuous flow of a thin film of nutrient solution over the plant roots . This technique allows for efficient nutrient absorption and water conservation, leading to higher crop yields compared to traditional soil-based farming methods. By integrating sensors and control systems, farmers can remotely monitor and manage multiple NFT hydroponic systems simultaneously . Sensors placed in the nutrient solution tanks can measure parameters such as pH, EC, temperature, humidity, and water level . The collected data can be transmitted wirelessly to a central control system, allowing farmers to monitor the conditions of each system and make necessary adjustments as needed .

Automation in NFT hydroponics also enables precise control of nutrient solution flow rates and timing. By automating the nutrient film flow, farmers can ensure a continuous and uniform supply of nutrients to the plant roots, promoting efficient nutrient absorption and preventing nutrient imbalances. Furthermore, automation simplifies the management of multiple NFT hydroponic systems. With centralized control systems, farmers can monitor and control multiple systems simultaneously, reducing the need for manual intervention and saving time and effort.

## 1.4 Application of  Hydroponics NFT Automation

Automating a hydroponic system has wide-ranging applications in various sectors. Firstly, it improves the accuracy and reliability of parameter monitoring and control, minimizing the risk of human error and optimizing plant growth conditions. Secondly, it allows for more efficient resource utilization, such as water and nutrients, as automation systems can precisely deliver the required amounts to the plants. Lastly, automation enables farmers to remotely monitor and manage a NFT hydroponic system, providing flexibility and convenience in system management.

# 2. LITERATURE SURVEY

## 2.1 Literature Survey Of The Reference Papers

“Nutrient Film Technique (NFT) Hydroponic Monitoring System Based on Wireless Sensor Network,” by Helmy, Marsha Gresia Mahaidayu, Arif Nursyahid, Thomas Agung Setyawan, Abu Hasan (2017), there are issues related to urban development, such as the conversion of agricultural land to housing and industry, leading to a decrease in agricultural land in cities. As urban food needs are dependent on agricultural production, hydroponic cultivation has emerged as a popular technique. Hydroponics is a method of cultivation using nutrient solutions, with soil functions replaced by water, nutrition, and oxygen which are delivered directly to the plant. The Nutrient Film Technique (NFT) is one such hydroponic technique that uses nutrient solution drained on the root area, which crucially defines success in hydroponic cultivation.

“A Controlled Environment Agriculture with Hydroponics: Variants, Parameters, Methodologies and Challenges for Smart Farming,” Srivani P, Yamuna Devi C and Manjula S H (2019), the paper discusses the increasing issues of urbanization, food scarcity, insecurity, and unpredictable climate in agriculture. To fight these problems, Hydroponics, which is a soilless culture, is presented as an alternative to conventional farming. Hydroponics is a sustainable model for controlled environment and precision agriculture. It efficiently uses water and nutrients for optimal growth of plants and is expanding worldwide as a sustainable model. The technology has advanced to automate the agriculture system and efficiently utilize resources. Urban farming with Controlled environment methods can be adapted as it eliminates the use of pesticides and genetically modified organisms (GMO).

“Technological Influences on Monitoring and Automation of the Hydroponics System,” by Geetali Saha (2021), this paper undertakes a detailed examination of hydroponics. The paper presents an in-depth review of the key components that constitute an efficient hydroponic system: an extensive atmospheric database capturing detailed data on prevailing weather, a sensor database logging minute details, an integration unit that conducts decision making based on a blend of historical and current readings, automated control systems managing the flow of water and nutrients, data storage, an IoT interface, and remote access capabilities for seamless connectivity.
Moreover, potential challenges of system performance are unpredictable weather patterns, power failures, and abrupt system disturbances, proposing interfaces to counteract these issues. This study ultimately aims to propel further research and technological advancements in hydroponics, an essential solution for today's diminishing arable land resources and climate change effects on traditional farming methods.

## 2.2 Brief Findings From Research Literature

- New technologies are being researched and improvements are being done in areas like nutrients composition, supply, medium as well as effect of light, temperature, humidity and EC/TDS and pH conditions as these have shown to have a linear relation with plant growth.
- Although introduction of automation and AI in hydroponics has been stated for a long long time, most of it has been for simulated environments, either physical or virtual through matlab.
- Even model building of Ai research work exists; most of them are either for simulated environments, and built using data from real life, but their effectiveness in actual farming has not been shown.
- As most work in his domain has not utilized/shown research techniques that will turn this technology(introduction of ai and automation) into a feasible product , showing efficiency, and effectiveness which we intend to do rather than only focusing on plant growth.

## 2.3 Literature Survey Of Similar Products Available In The Market

### 2.3.1 Automation kit by Growtronix

The Hydroponic Automation Kit by Growtronix and the Hydroponic Starter Kit by General Hydroponics are two similar products available in the market. The Growtronix kit provides a complete hydroponic automation solution with features such as temperature and humidity sensors, water level sensors, and nutrient dosing systems. The General Hydroponics kit includes a water pump, air pump, and air stone, and is designed for use with a 5-gallon bucket.


**Fig: 2.3.1 Automation by Growtronix**
**Source: growtronix.com/cart/blog/how-growtronix-works-n5**

### 2.3.2 City Greens

City greens provide low cost hydroponic solutions for farmers who are on budget and would like to grow seasonal and local crops, but at the same time enjoy higher yields and improved profits as compared to what is possible in traditional farming. They are currently serving 18+states right now. They provide setup , support and automation to farming systems.

**Fig: 2.3.2 Product by City Greens**
**Source: https://www.citygreens.shop/Images/202211/1080x1080/Kits.webp**

## 2.4 Comparison With Various Technologies Available

Compared to traditional soil-based farming methods, hydroponic systems have several advantages such as higher crop yields and reduced water usage. Automation further enhances the efficiency and effectiveness of hydroponic farming. While several technologies are available for hydroponic automation, each has its own pros and cons. For instance, automated dosing systems provide precise nutrient delivery, but they can be expensive and require regular maintenance. On the other hand, simple systems with a timer and a water pump may be more affordable, but they lack the precision of automated dosing systems.

Also, there is no such system that operates the UV light, fan, air pump, and water pump all 4 at once. Furthermore, there is no such technology invented that verifies whether UV lights and pumps are working or not. Thus, these factors make the project unique.

## 2.5 Market Survey  Based On Economy Literature

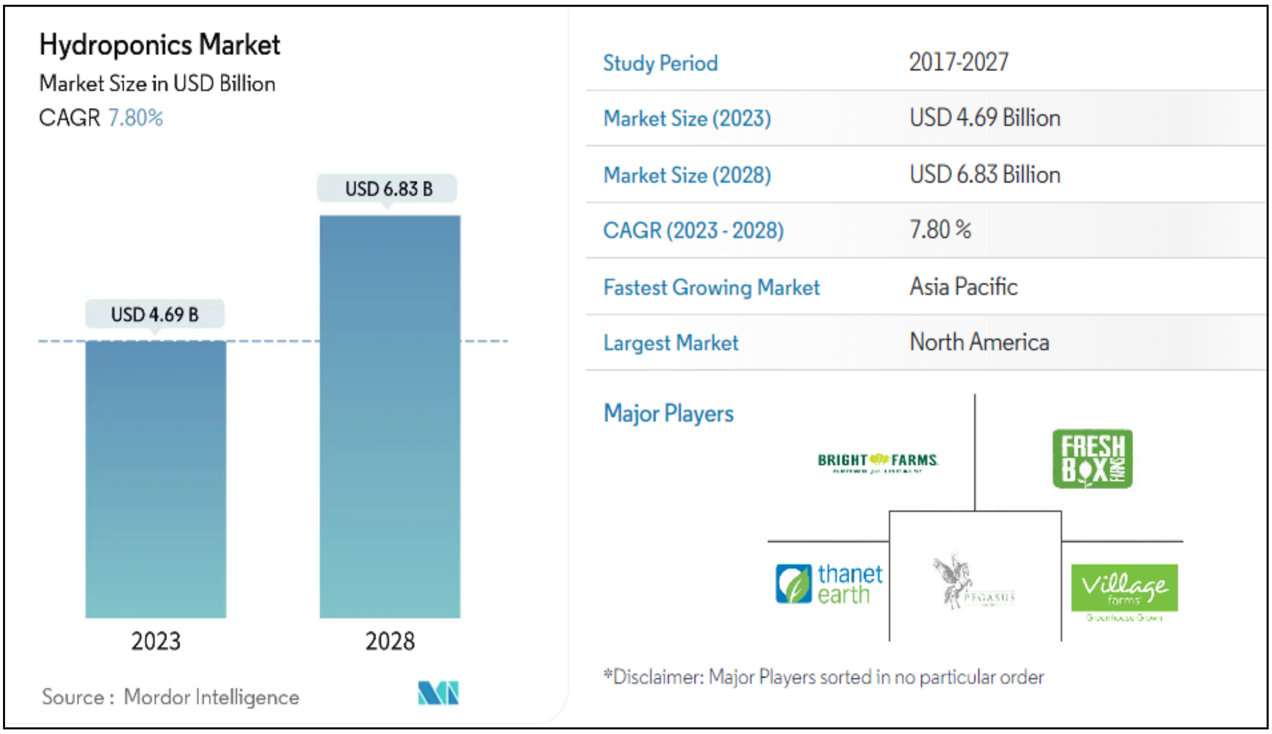



**Fig: 2.5 Hydroponics Market Size**
**Source: https://www.mordorintelligence.com/industry-reports/hydroponics-market**

- The Hydroponics Market size is expected to grow from USD 4.69 billion in 2023 to USD 6.83 billion by 2028, at a CAGR of 7.80% during the forecast period (2023-2028).North America Dominates the Market, while asia pacific is fastest growing in market [4].
- It  is set to grow rapidly on account of the surging implementation of this agricultural method in Australia, Japan, India, and China [5].
- The global market is highly fragmented with the presence of multiple companies. Most of them are focusing on R&D activities to come up with state-of-the-art techniques for surging sustainability and saving costs [6].
- March 2021: The state government of Ahmedabad announced its plan to accelerate hydroponic farming in cities to encourage households to grow vegetables in their homes. The agriculture department staff will provide hands-on training to residents with DIY videos.
- The key players operating in the hydroponics market are Argus Control Systems Ltd[7].. (Canada), Signify Holding B.V. (Netherlands), The Scotts Miracle-Gro Company (U.S.), Hydroponic Systems International (Spain), Hydrodynamics International Inc (U.S.), AmHydro (U.S.), Emerald Harvest (U.S.), Heliospectra AB (Sweden), Freight Farms, Inc. (U.S.), Logiqs BV (Netherlands), AirLogix (U.S.), and Nutriculture Grow Systems (U.K), among others.

# 3. SPECIFICATIONS

## 3.1 General specifications

● Temperature range: 0-50 degree Celsius

● Humidity range: 20% to 90%

● Accuracy: ±2°C and ±5%

● Bluetooth protocol: Bluetooth v2.0+ & EDR

● Frequency: 2.4GHz ISM band

● Core RAM size: 2K

## 3.2 External system specification

### 3.2.1 UV light

- Type: USB
- Adjustable intensity
- Adjustable color (red, blue, violet)
- Voltage consumption at Max. Brightness: 5V, DC
- Current consumption at Max. Brightness: 1.45A

### 3.2.2 Air pump

- Type: USB
- Voltage consumption: 5 – 5.1V, DC
- Current consumption: 0.15A

### 3.2.3 Fan

- Type: USB
- Voltage consumption at maximum speed: 5V, DC
- Current consumption at maximum speed: 0.91A

### 3.2.4 Water pump

- Voltage consumption: 5V
- Current consumption: 0.31A

Thus, the whole project runs on 5V DC USB power supply, and at Max. load, the current consumption is 3.03A.

### 3.3 Technical Specifications

- Microcontroller: ESP 01 (Espressif Systems)
  - ESP8266EX chip
  - 32-bit RISC CPU operating at 80 MHz
  - Integrated TCP/IP stack for internet communication
  - Integrated Wi-Fi (802.11b/g/n)
  - Frequency Bands: 2.4 GHz (Wi-Fi)

- Motor Driver: 2 x L293D Motor Driver IC
  - Capable of driving two DC motors or one stepper motor per L293D
  - 4.5V to 36V supply voltage range with bi-directional drive current up to 600mA.

- Temperature and Humidity Sensor: DHT11
  - Temperature measurement range: 0°C to 50°C
  - Humidity measurement range: 20% to 90%

- Camera: ESP32
  - FPC connector.
  - Support for OV2640 (sold with a board) or OV7670 cameras.
  - Image Format: JPEG( OV2640 support only ), BMP, grayscale.
  - LED flashlight.
  - Temperature Range: Operating: -20 ℃ ~ 85 ℃
  - Power Supply: 5V via pin header.
  - External Storage: micro SD card slot up to 4GB.

# 4. BLOCK DIAGRAM AND DESCRIPTION

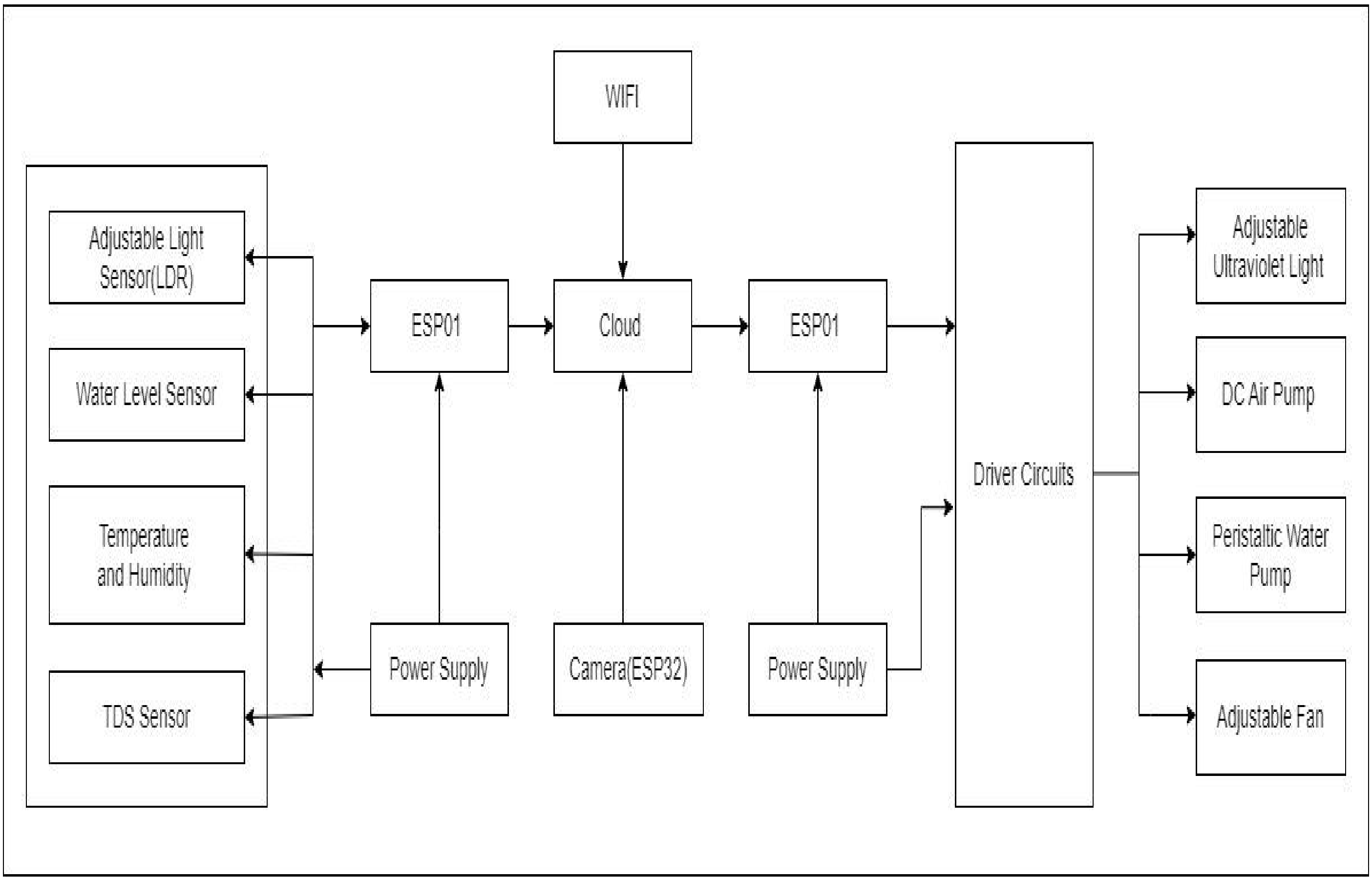



**Fig. 4.1: Block diagram of the system**

## 4.1 Description of the block diagram

### 4.1.1 The working of each block

**1. Sensors Block:**

- Water Level Sensor: Measures the water level in the hydroponic system to ensure it remains within the desired range and expected setup.
- Temperature Sensor: Monitors the temperature within the hydroponic environment for optimal plant growth. And measures the humidity levels to maintain an ideal atmosphere for plant growth.
- LDR (Light Dependent Resistor): Checks the light status to determine if additional artificial light is needed.

**2. Controller Block:**

- ESP01 Microcontroller: It is a compact and cost-effective WiFi module based on the ESP8266 microcontroller, enabling wireless connectivity for IoT and embedded systems.

**3. IoT + Bluetooth Block:**

- IoT Protocols of Communication: Enables communication with external networks or devices, allowing remote monitoring and control.
- Bluetooth Connectivity: Allows for local control and monitoring via a mobile device or Bluetooth-enabled interface.

**4. Web/App Block:**

- Smartphone UI: Provides a user-friendly interface on a mobile app or web application for users to monitor and control the hydroponics system remotely.

**5. Actuator Block:**

- LED Light: Controls the artificial lighting system to supplement natural light as needed.
- Fan: Regulates ventilation and air circulation within the hydroponic environment.
- Air Pump: Manages aeration of the nutrient solution for plant roots.
- Water Pump: Controls the flow of nutrient-rich water to the plant roots.

**6. Camera Block:**

- ESP32 CAM: It is a compact, Wi-Fi and Bluetooth-enabled module with a built-in camera, suitable for various IoT and image capture applications

# 5. HARDWARE SYSTEM DESIGN

## 5.1 Schematic Circuit Diagram With 555 IC

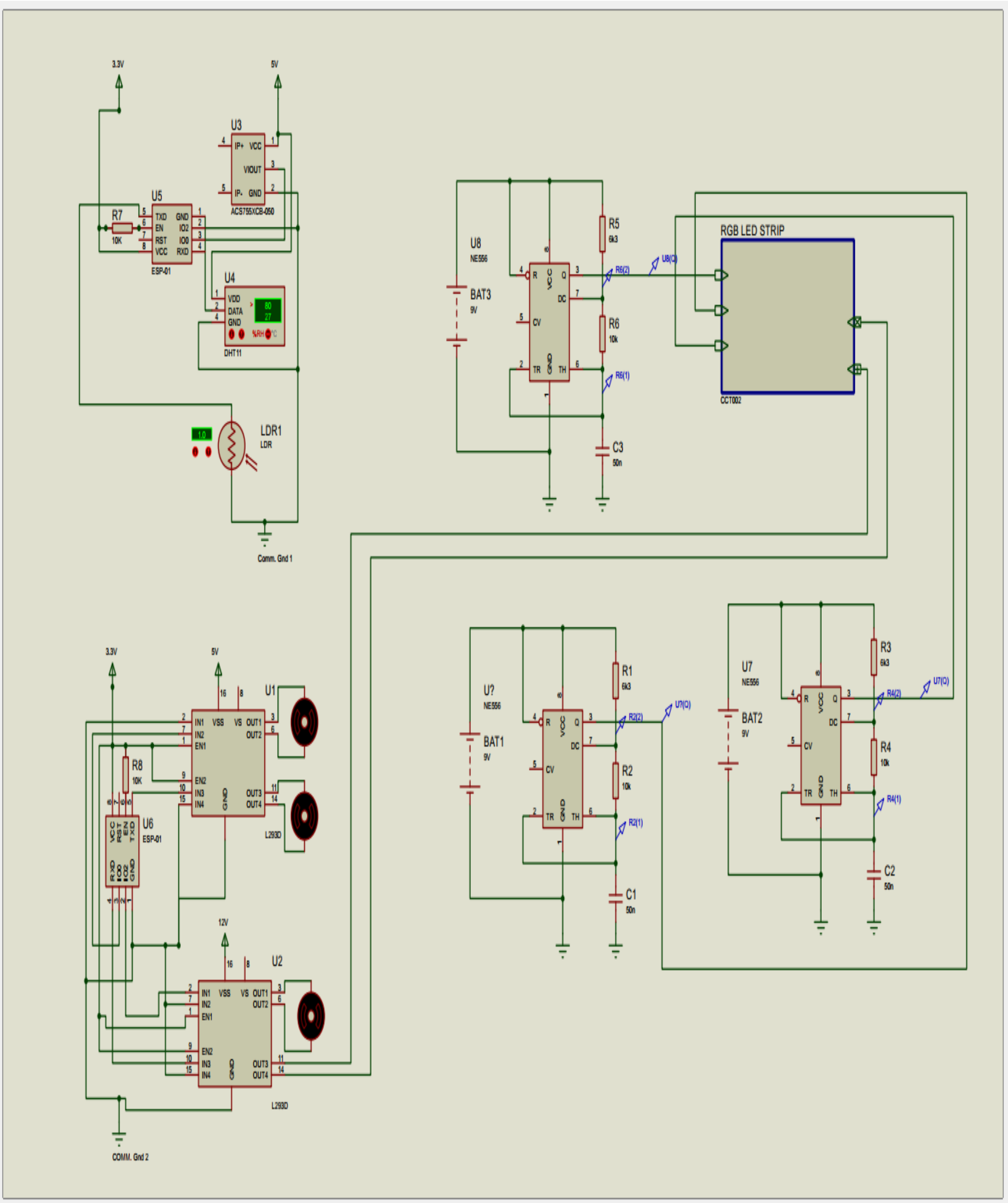



**Fig. 5.1: Schematic circuit diagram**

### 5.1.1 Specifications of components

| Sr. No. | Sensor/Actuator | Specification of Sensor / Actuators | Advantages | Limitations |
|---|---|---|---|---|
| 1. | Temperature and Humidity sensor ( DHT 11) | Operating Voltage: 3.5V to 5.5V<br>Operating current: 0.3mA<br>Temperature Range: 0°C to 50°C<br>Humidity Range: 20% to 90% | • low power consumption<br>• long-term stability | • limited accuracy<br>• limited measurement range. |
| 2. | LDR Sensor | Operating Voltage: 5V to 3.3V<br>Operating current: 5mA<br>Temperature Range: -25°C to +75°C | • Sensitivity is High<br>• Easy Installation<br>• Resistance ratio is high (light-dark) | • Highly inaccurate with high response time.<br>• Resistance varies continuously. |
| 3. | Water level Sensor | Operating Voltage: 3.3 V to 5V<br>Operating current: 4-20mA<br>Temperature Range: -10°C to 30°C<br>Humidity Range: 10% to 90% | • Fully Automated<br>• Energy Conservation.<br>• Compact Size. | • More Difficult Installation<br>• Resistance varies continuously. |
| 4. | L293D Motor Driver | Operating Voltage: 12V to 36V<br>Operating current: 600mA<br>Temperature Range: 0°C to 70°C | • Bi-directional Control<br>• Low Voltage Drop<br>• Overcurrent Protection. | •Not suitable for High Voltage & speed motors.<br>•Lacks Advanced Control Features. |
| 5. | ESP01 | Operating Voltage: 3.3V<br>Clock Speed: 80MHz<br>Operating current: 70mA to 100mA<br>Temperature Range: -20°C to 85°C | • Low Cost<br>• WiFi Connectivity<br>• Integration with microcontroller. | • Limited Flash and RAM<br>• External Antenna Required. |

**Table 5.2: Specifications of components**

## 5.2 Working Of Each Components

### 5.2.1 DHT11 Temperature and Humidity

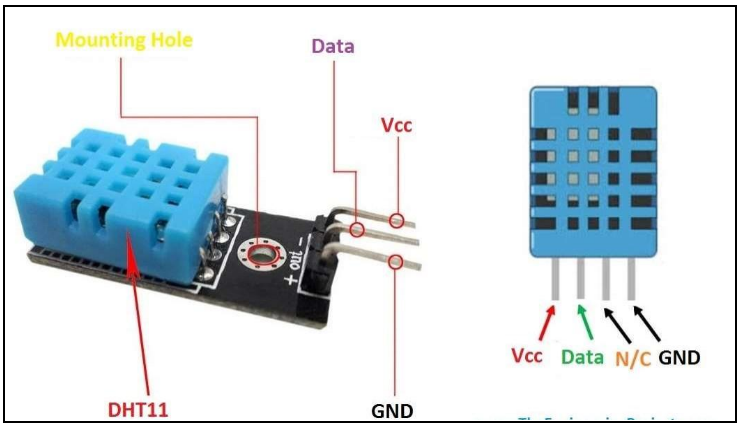



**Fig 5.2.1: DHT11 Temperature and Humidity**

- It uses a capacitive humidity sensor to measure humidity.
- And a thermistor to measure the surrounding air.
- It spits out a digital signal on the data pin (no analog input pins needed).

### 5.2.2 LDR Sensor


**Fig 5.2.2: LDR Sensor**

- LDR (Light Dependent Resistor) is a resistor whose resistance varies inversely with the amount of light falling on it
- It is also known as a photoresistor, photocell, photoconductive cell, etc. LDR are available in 5mm, 8mm, 12mm, and 25mm dimensions.
- The semiconductor material used for the photoresistors is cadmium sulfide, CdS.

### 5.2.3 Water Level Sensor

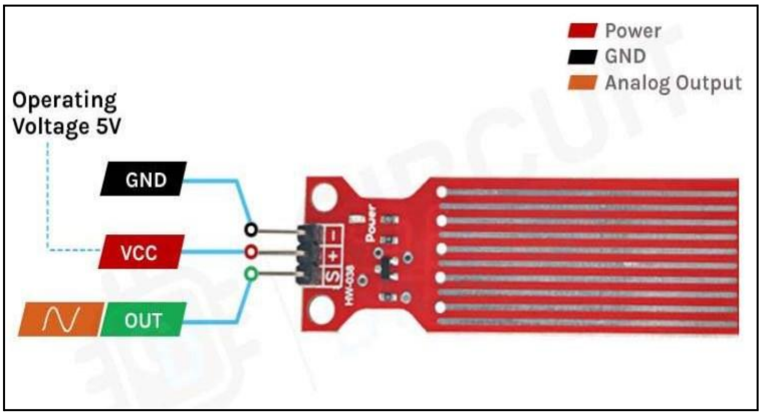



**Fig 5.2.3: Water level Sensor**

- The water level sensor is a device that measures the liquid level in a fixed container that is too high or too low.
- According to the method of measuring the liquid level, it can be divided into two types: contact type and non-contact types.
- Water level sensors are an important tool for water management and can help prevent flooding, monitor water usage and ensure that water systems are operating efficiently.

### 5.2.4 L293D Motor Driver

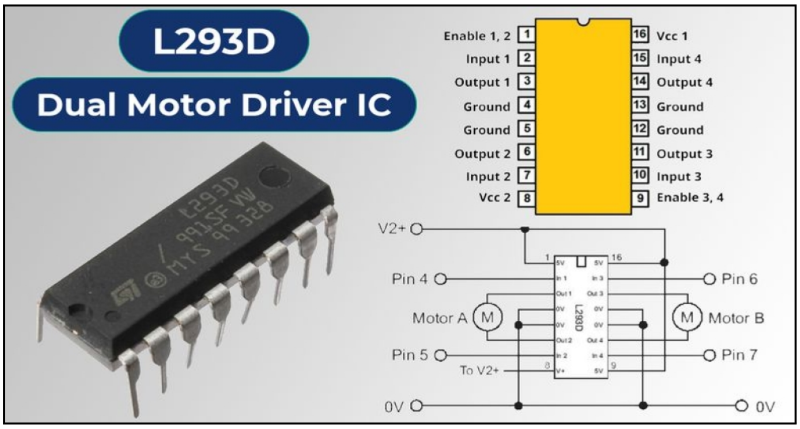



**Fig 5.2.4: L293D Motor Driver**

- L293D motor Driver IC is an integrated circuit that can drive two motors simultaneously and is usually used to control the motors in an autonomous system.
- The L293D is a 16-pin Integrated circuit, with eight pins, on each side, dedicated to the controlling of a motor. There are 2 input pins, 2 output pins and 1 enable pin for each motor.
- The L293D IC is designed to provide bidirectional drive currents of up to 600-mA at voltages from 4.5 V to 36 V.

### 5.2.5 ESP01 Module

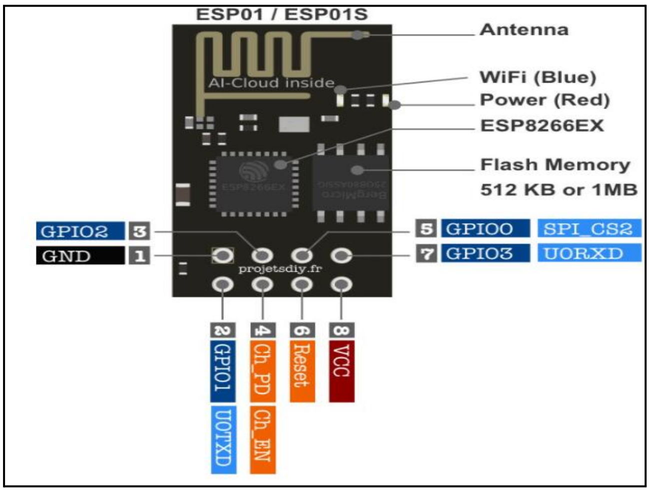



**Fig 5.2.5: ESP01 Module**

- The ESP-01 ESP8266 Serial WIFI Wireless Transceiver Module is a self-contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your WiFi network.
- The ESP-01 is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor with onboard 80 Mhz low power 32 bit processor.

### 5.2.6 ESP32 CAM

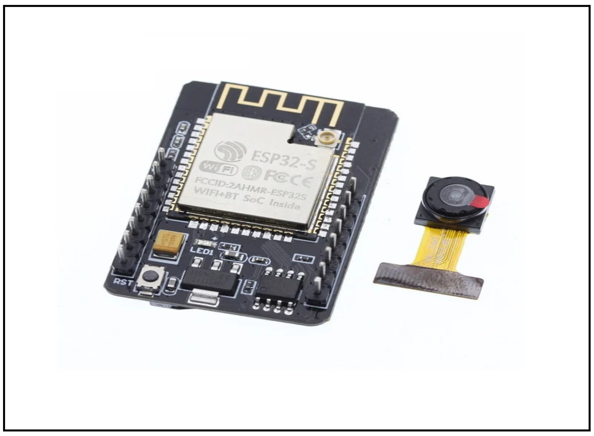


**Fig 5.2.5: ESP01 Module**

- The ESP32 CAM WiFi Module Bluetooth with OV2640 Camera Module 2MP For Face Recognization has a very competitive small-size camera module that can operate independently as a minimum system with a footprint of only 40 x 27 mm; a deep sleep current of up to 6mA and is widely used in various IoT applications.
- It is suitable for home smart devices, industrial wireless control, wireless monitoring, and other IoT applications.

## 5.3 Enclosure Design

### 5.3.1 Enclosure design of whole system

Material Used: Steel-Satin, Color Used: Metallic Brown

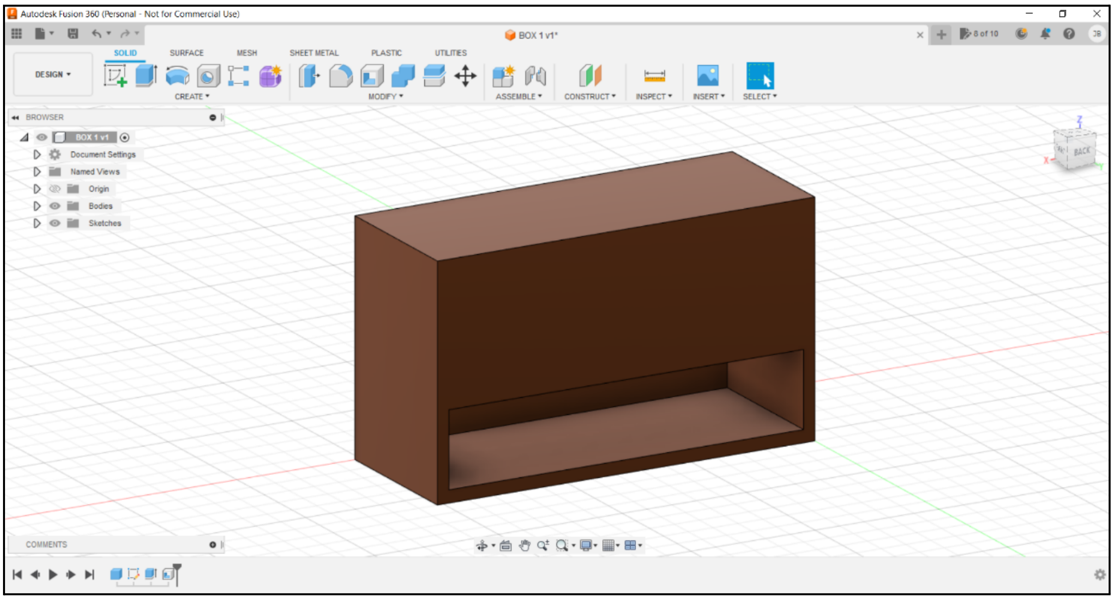



**Fig 5.3.1: Enclosure design of whole system on fusion 360**

### 5.3.2 Enclosure design for controller, design no. 1

Material Used: Steel-Satin, Color Used: Metallic Dark Grey

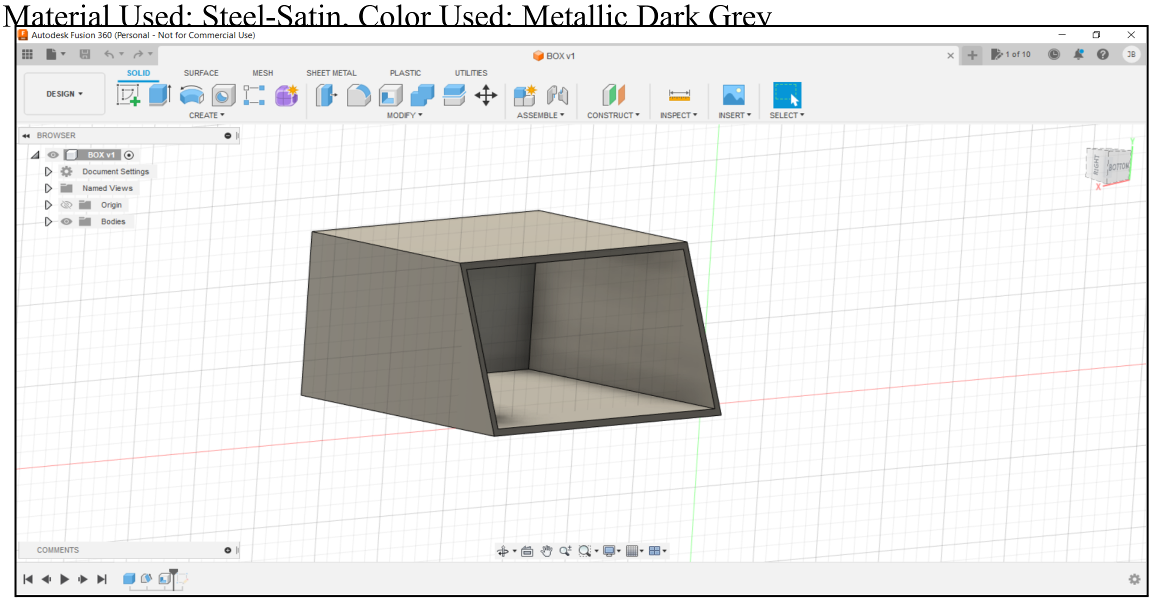
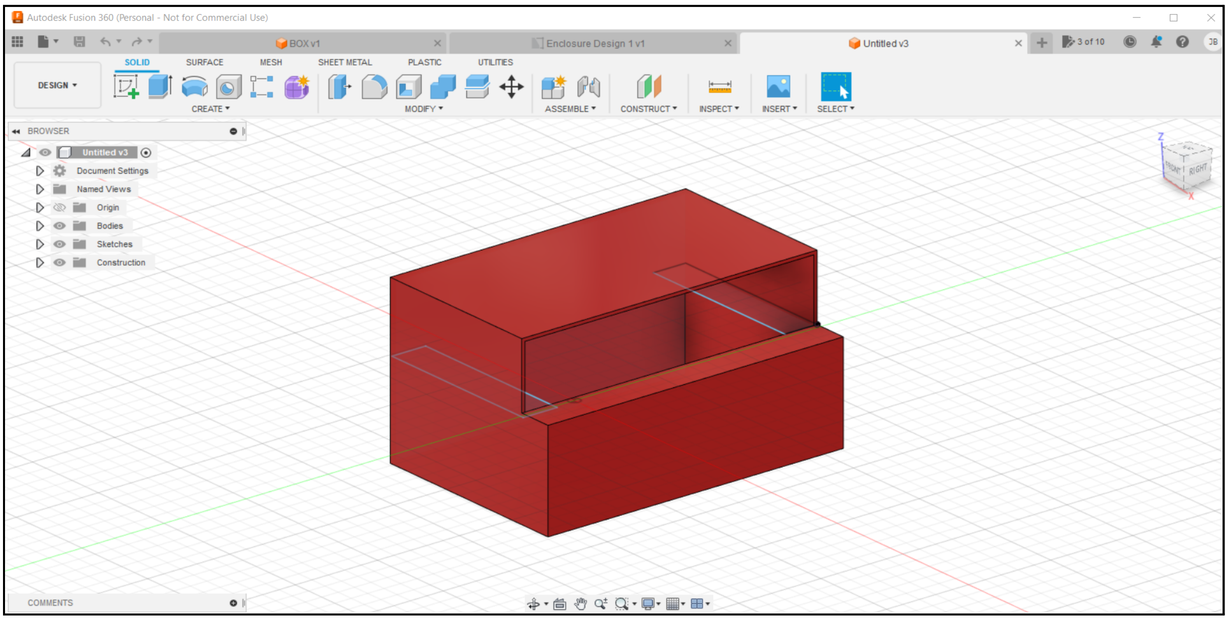



**Fig 5.3.2: Enclosure design 1 for controller on fusion 360**

### 5.3.3 Enclosure design for controller, design no. 2




Material Used: Steel-Satin ,     Color Used: Metallic Red

**Fig 5.3.3: Enclosure design 1 for controller on fusion 360**

### 5.3.4 Enclosure design for NetPot

Material Used: Steel-Satin ,     Color Used: Metallic Black

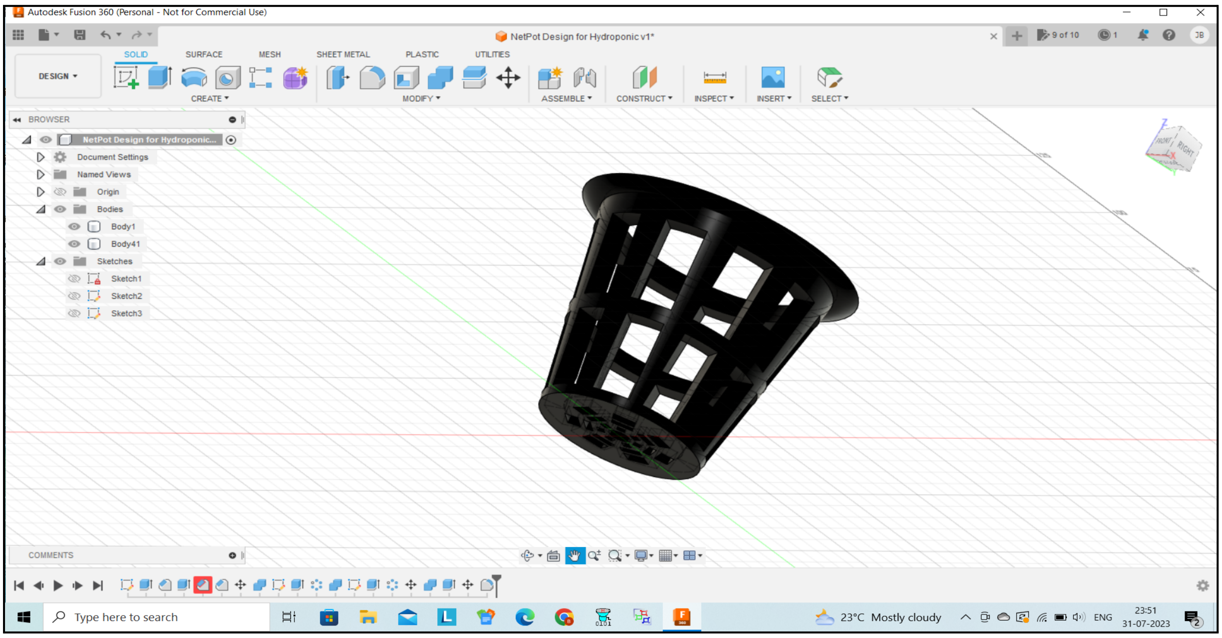



**Fig 5.3.4: Enclosure design for NetPot on fusion 360**

### 5.3.5 Enclosure design for NFT Channel

Material Used: Steel-Satin , Color Used: Metallic White

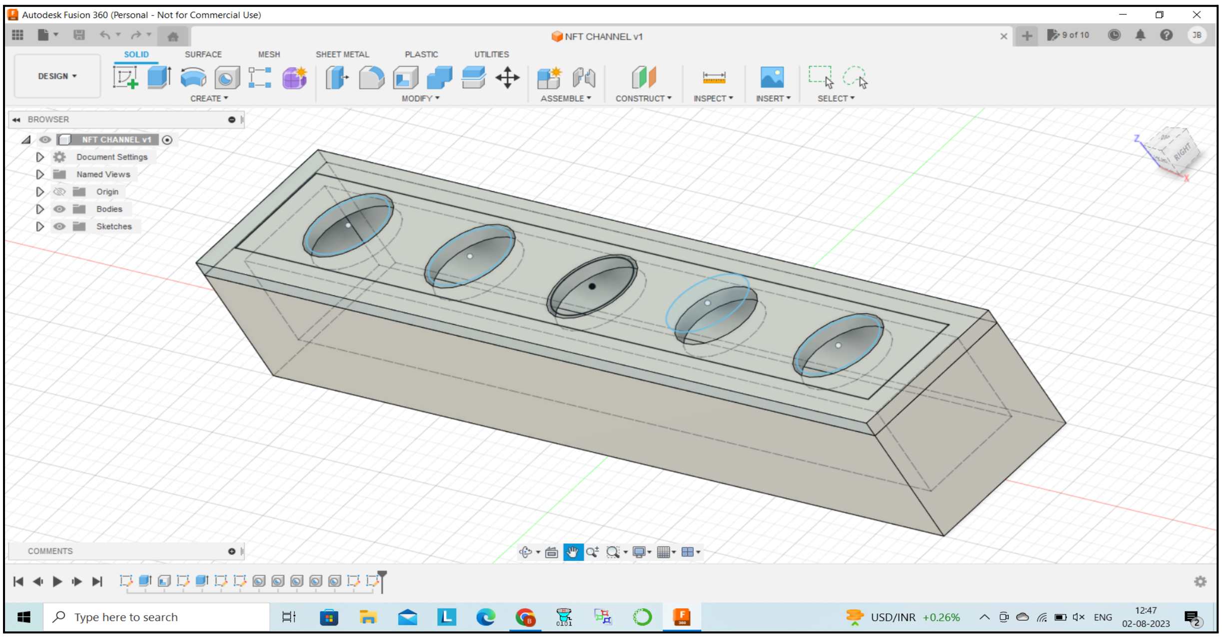



**Fig 5.3.5: Enclosure design for NFT Channel on fusion 360**

### 5.3.6 Sketch Constraint of Enclosure design of whole system

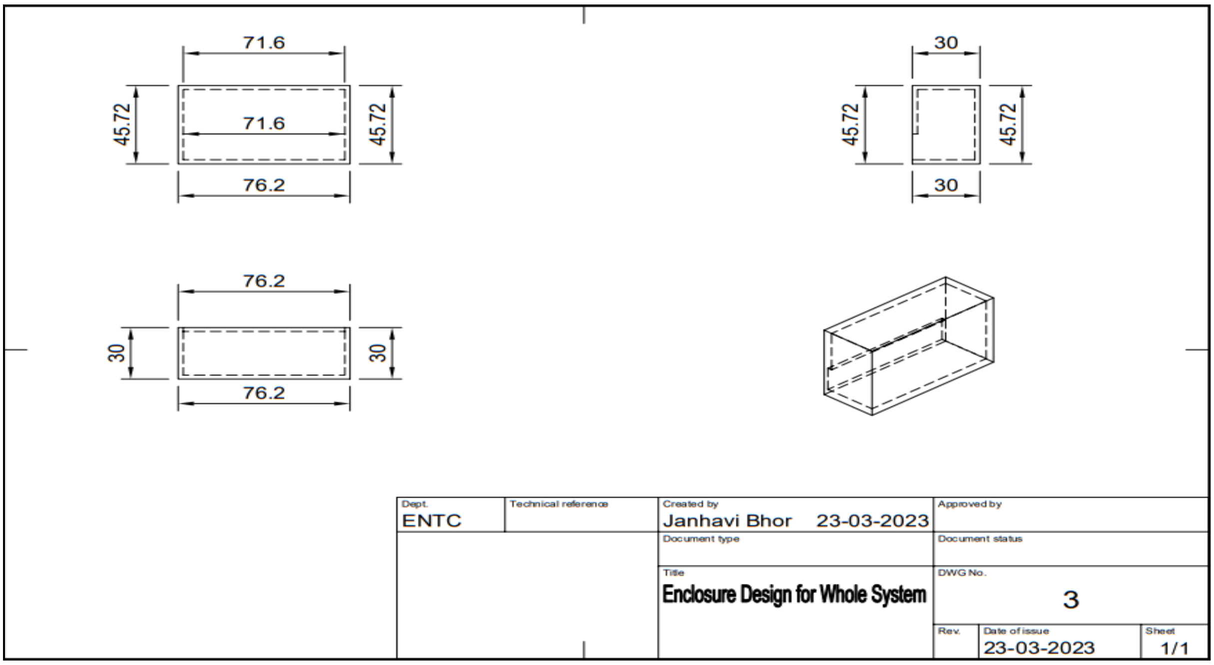



**Fig 5.3.6: Sketch Constraint of Enclosure design of whole system on fusion 360**

### 5.3.7 Sketch Constraint of Enclosure design for controller, design no. 1.

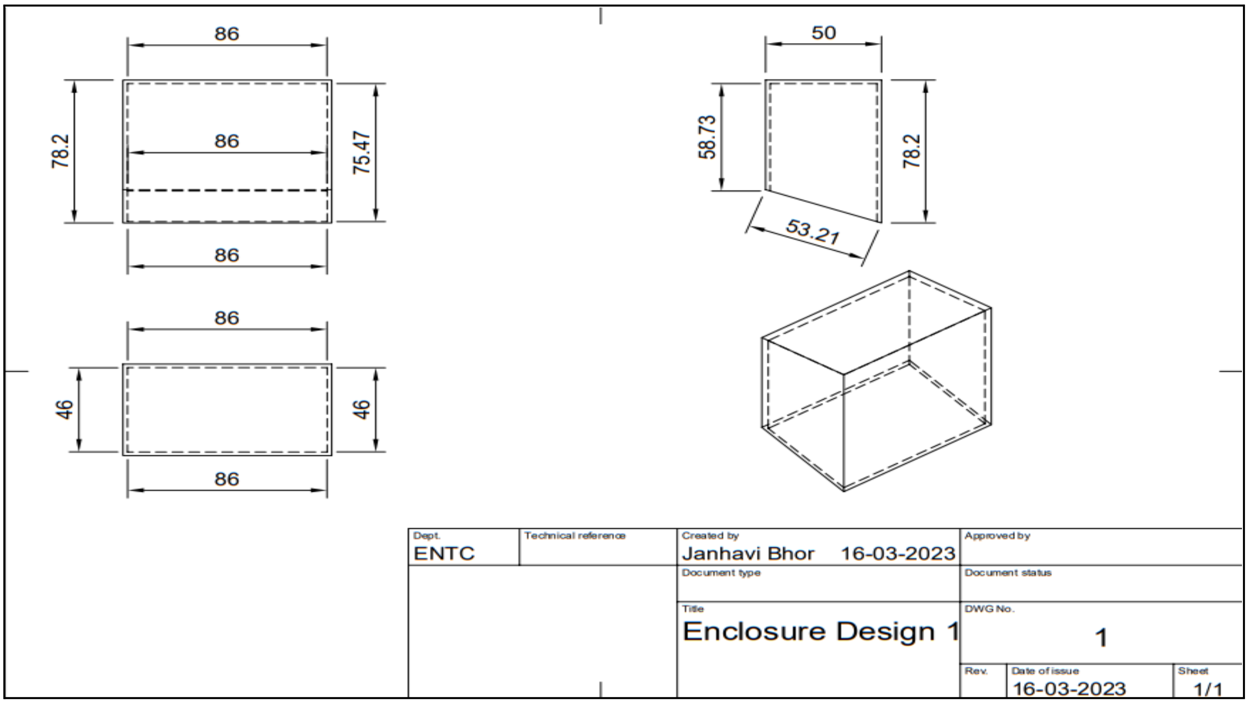



Fig 5.3.7: Sketch Constraint of Enclosure design 1 for controller on fusion 360

### 5.3.8 Sketch Constraint of Enclosure design for controller, design no. 2

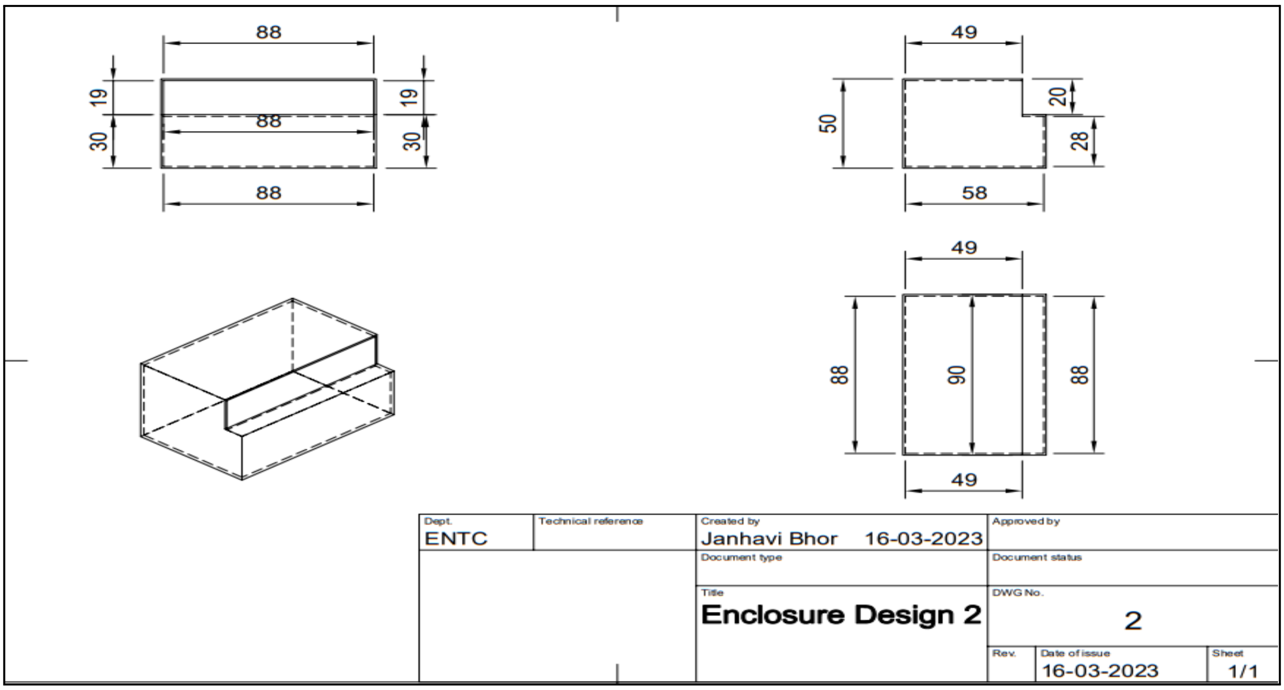



Fig 5.3.8: Sketch Constraint of Enclosure design 2 for controller on fusion 360

### 5.3.9 Sketch Constraint of Enclosure design of NetPot

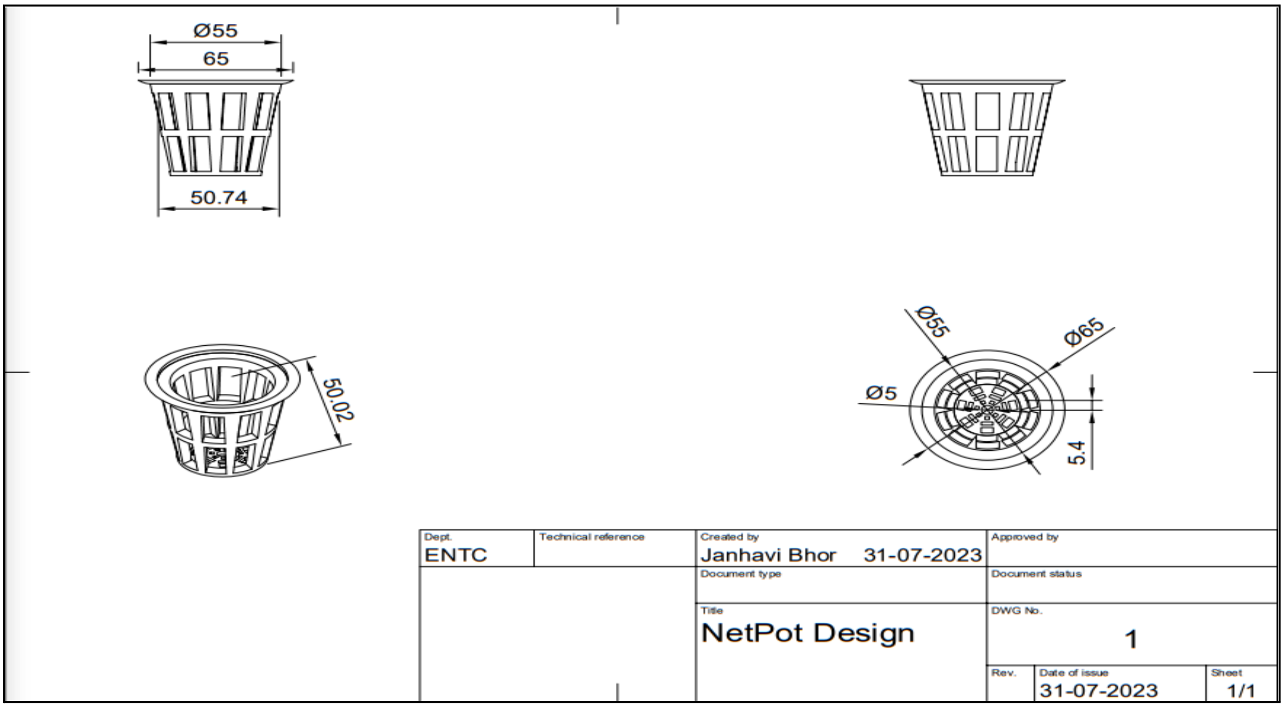



**Fig 5.3.9: Sketch Constraint of Enclosure design of NetPot on fusion 360**

### 5.3.10 Sketch Constraint of Enclosure design of NFT Channel

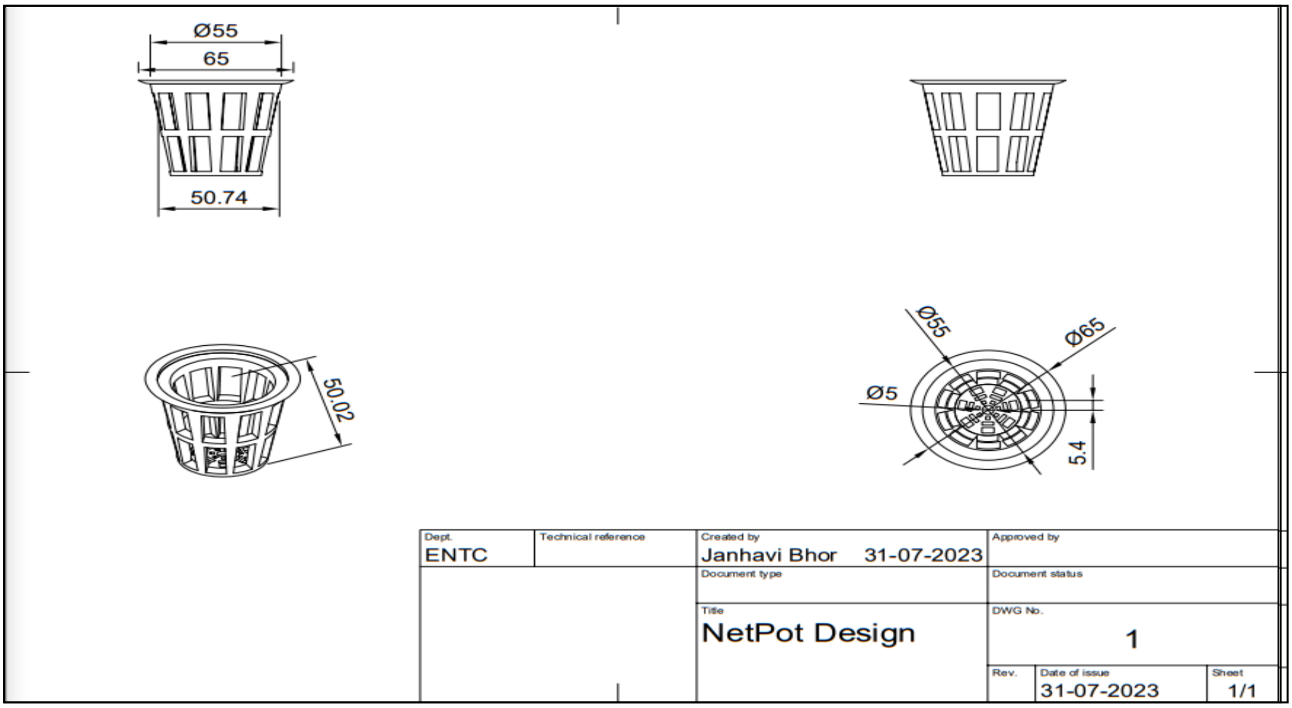



**Fig 5.3.10: Sketch Constraint of Enclosure design of NFT Channel on fusion 360**

## 5.4. Matlab Simulink Emulation

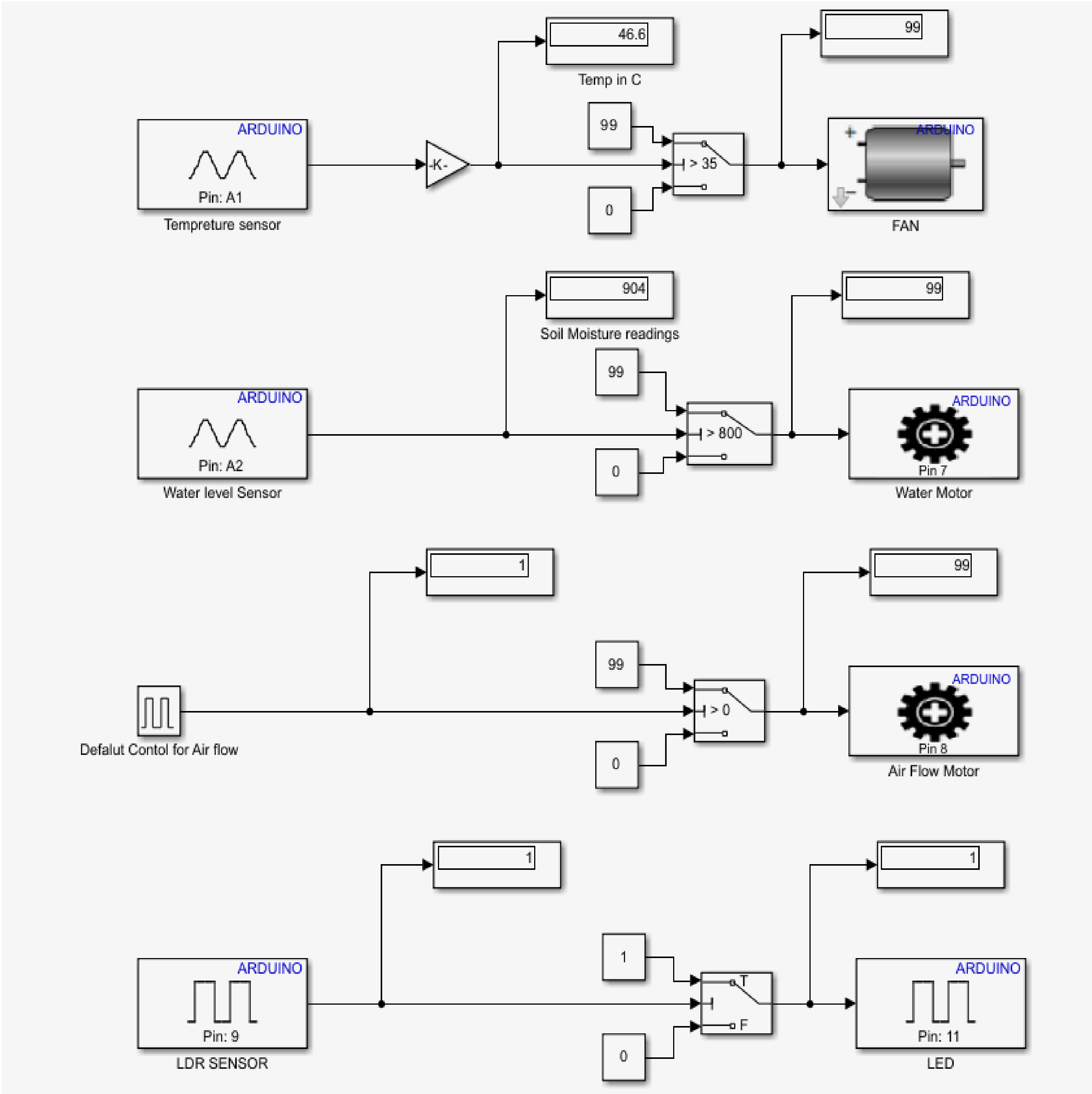



**Fig 5.4.1: Emulation conducted on matlab Simulink**

# 6. SOFTWARE SYSTEM DESIGN

## 6.1 Flow Chart for Sensors

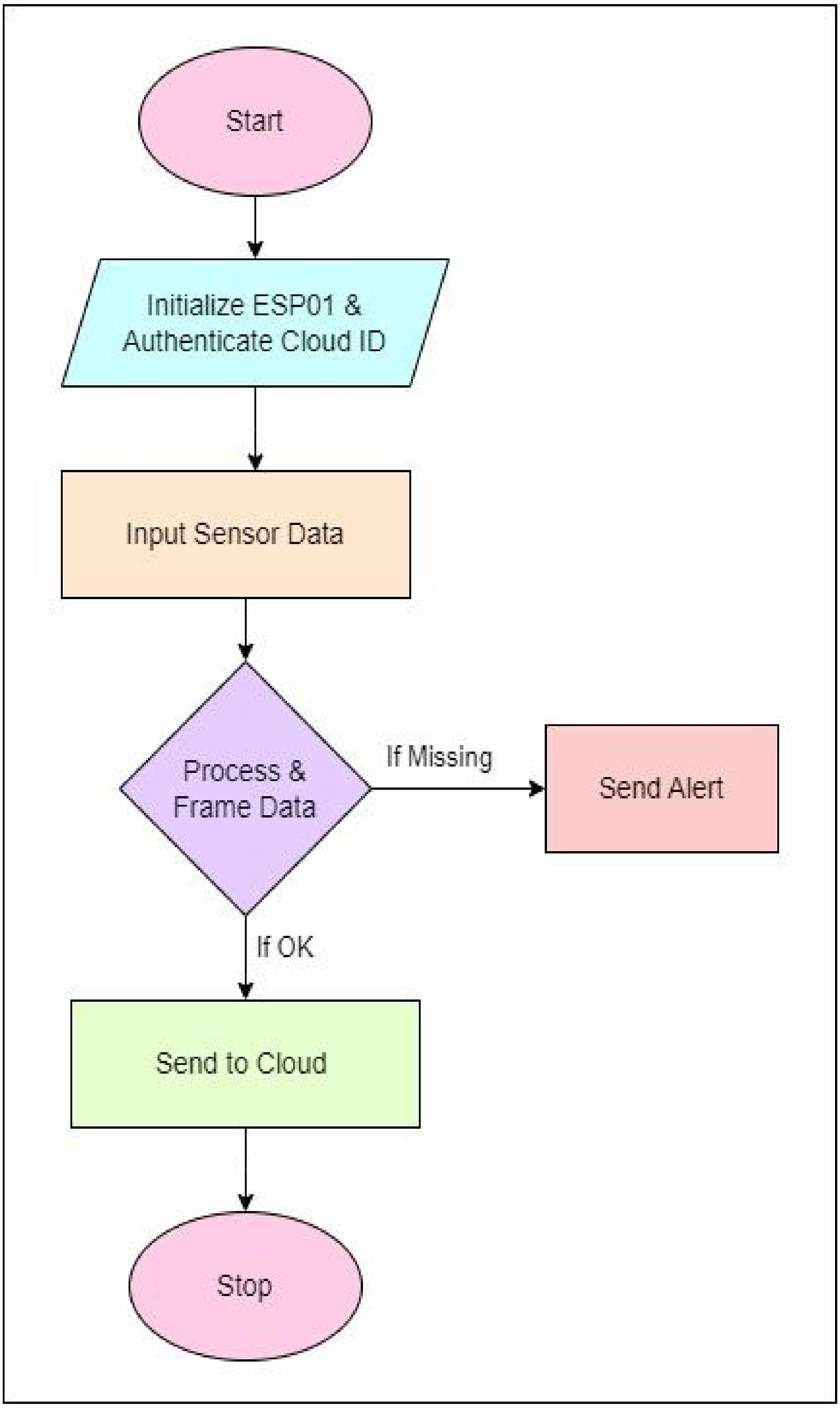



**Fig. 6.1: Flowchart for Sensors**

## 6.2 Flow Chart for Actuators

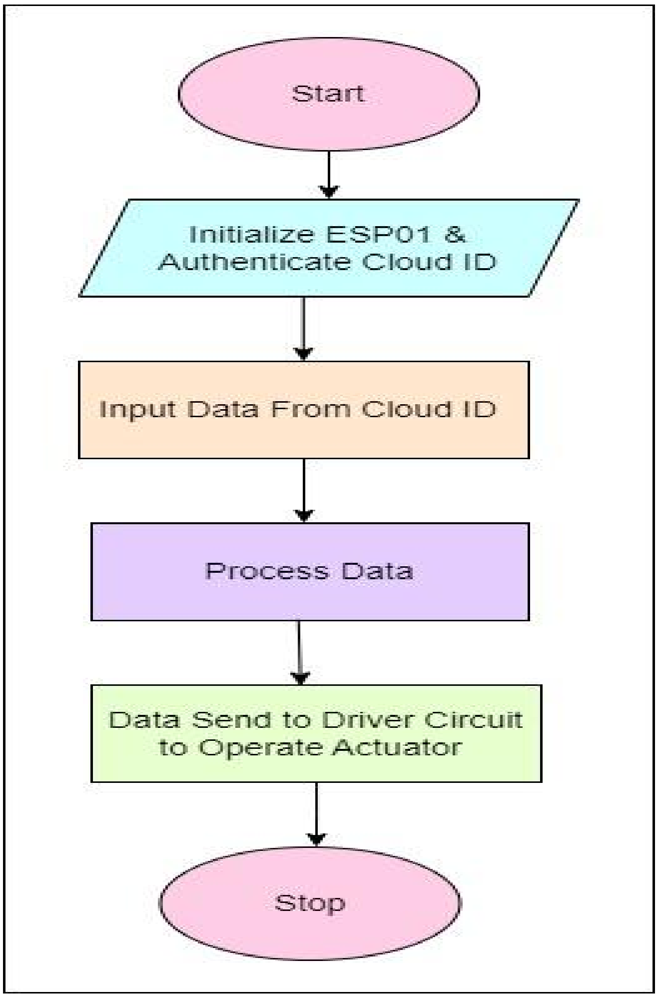



**Fig. 6.2: Flowchart for Actuators**

## 6.3 Flow Chart for Driver Circuit

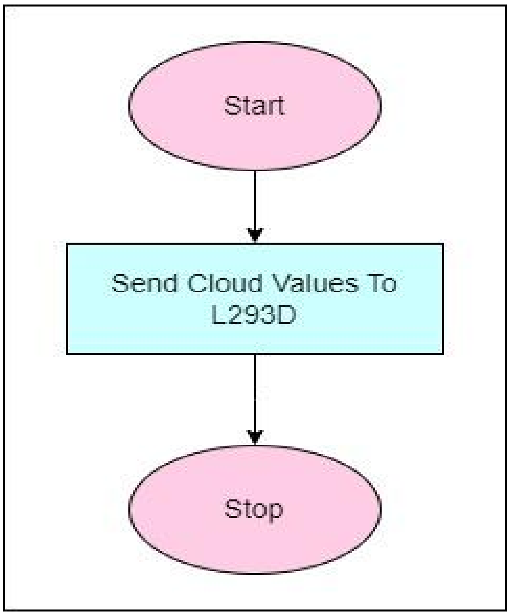



**Fig. 6.3: Flowchart fpr Driver Circuit**

## 6.4 Flow Chart of Whole System

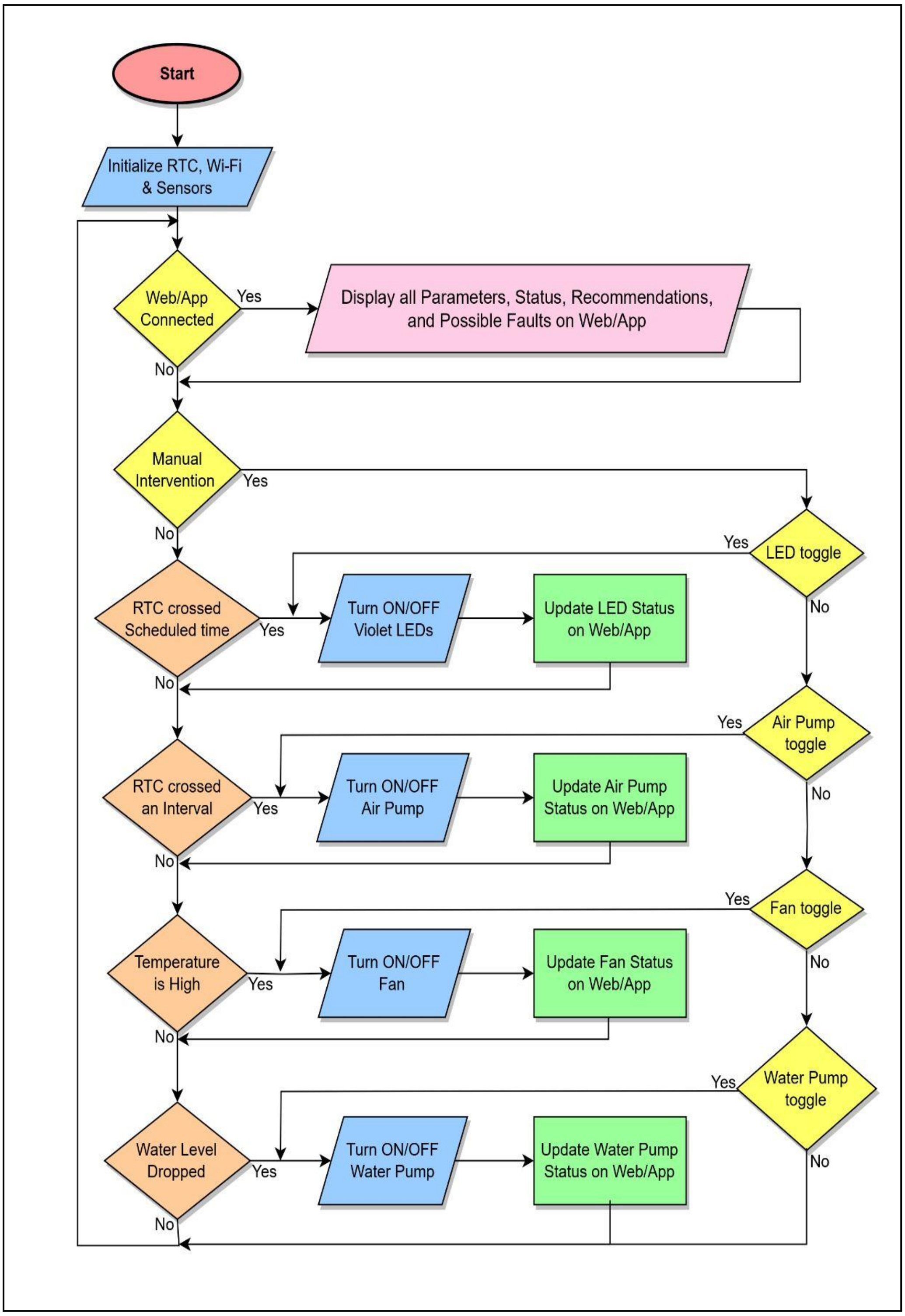



**Fig. 6.4: Flowchart of the system**

# 7. EXPECTED RESULTS

1. The Hydroponics Based Precision Farming With Feature Optimization effectively monitors and controls environmental factors, leading to **improved plant growth, health, and yield.**

2. The **system operates reliably and accurately, ensuring minimal manual intervention** and reduced human effort.

3. The user interface, including the website and mobile application, enables **easy and intuitive remote control, monitoring, and alerts.**

4. The machine learning algorithms **optimize system operations based on collected data,** improving resource management and productivity.

5. The research findings provide **insights into the effects of TDS on plant growth, air pump duration, UV light duration, and water tank refill time prediction, contributing to knowledge in the field.**

6. The project is completed within the defined **timeline and budget.**

7. Documentation and **user instructions** provide comprehensive guidance for system operation, maintenance, and data optimization.

# 8. APPLICATIONS

- **Home gardening**: NFT hydroponics is an ideal method for home gardening, as it allows for year-round cultivation of fresh herbs, vegetables, and fruits. The system can be set up in a small space and can be easily maintained, making it a convenient and cost-effective option for home gardeners.

- **Commercial agriculture**: NFT hydroponics is also used in commercial agriculture for growing crops such as lettuce, herbs, and strawberries. The system is highly efficient, as it requires less water and space compared to traditional farming methods, leading to higher yields and reduced costs.

- **Urban farming**: NFT hydroponics is becoming increasingly popular in urban farming, as it allows for the cultivation of fresh produce in urban areas with limited space. The system can be set up in rooftops, balconies, or indoor spaces, providing a sustainable and efficient method for urban farming.

- **Research and education**: NFT hydroponics is used in research and education to study plant growth and development in a controlled environment. The system allows researchers and students to manipulate the nutrient composition and environmental factors to study the effects on plant growth and development.

Overall, the NFT hydroponics system has a wide range of applications in home gardening, commercial agriculture, urban farming, research and education, and medical cannabis cultivation, making it a versatile and efficient method for indoor plant growth.

# 9. CONCLUSION

The Hydroponics Based Precision Farming With Feature Optimization, based on indoor farming with temperature, UV light, water level, and air pump control, has several benefits in addition to faster growth and reduced water consumption. Firstly, the system eliminates the need for large land areas, making it ideal for urban and suburban regions where space is limited. By precisely controlling temperature, light, and water levels, plants receive optimal growing conditions, leading to higher yields and healthier crops. Furthermore, automation reduces the risk of human error, ensuring consistent production to the highest standards.

The Hydroponics Based Precision Farming With Feature Optimization project is a highly effective and efficient system for growing plants. The system can lead to 30 to 50% faster growth than soil based farming while reducing water consumption by 70-85%. With the entire system operating on its own, there is no need for human intervention, making it an ideal solution for individuals or businesses seeking to maximize crop yields while minimizing labor and resource costs. Moreover it has been designed for Scaling by utilizing M2M and cloud. Overall, the Hydroponics Based Precision Farming With Feature Optimization project represents a significant advancement in sustainable farming practices, and its potential to revolutionize the agriculture industry cannot be overstated.

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