Experiment No._08

Title: Mini Project

SOMAIYA
VIDYAVIHAR UNIVERSITY
K J Somaiya College of Engineering

Batch: B–1 **Roll No.: 16010422234** **Experiment No.: 08**

Aim: Mini Project

Resources needed: Internet and Component required for prototype development

Theory:

Nowadays, the Internet of Things (IoT) plays a vital role in industry, policy, and engineering circles. IoT systems are contained in a large number of networked products, systems, and sensors. The revolution of IoT creates new market opportunities and business models by considering the security, privacy, and technical interoperability aspects. IoT-enabled products like smart appliances, smart vending machines, smart lighting, and smart payments systems offer more security, privacy, and energy efficiency to the user. There are vast numbers of IoT applications including home automation, environment monitoring, healthcare applications, wearable devices which are available. Slowly, IoT is becoming part of our lives, and users are adapting and using IoT-enabled devices easily. IoT is more popular due to the enhancing features which give comfort to the users. The basic building blocks of IoT are hardware, software, and connectivity using the Internet. Nowadays, in keeping eyes on the future prospect of IoT, many companies take initiatives to come up with IoT solutions. The Internet of Things (IoT) applications span a wide range of domains including homes, cities, environment, energy systems, retail, logistics, industry, agriculture, and health.

Activity:

Select any one specific domain of IoT and develop the working prototype. Also write a short report including the following points.

• Abstract

• Introduction
• Methodology
• Result
• Conclusion
• References

Note: Share project demonstration video link in the document

Report of the Project

Abstract

This IoT-based Smart Irrigation System is designed to monitor soil moisture levels and automate the irrigation process using real-time data. The system utilizes an ESP32 microcontroller, a soil moisture sensor, a relay module, an LCD display, and a buzzer for alerts. It is integrated with ThingSpeak for cloud-based data monitoring. The objective is to help farmers and gardeners conserve water and improve crop health by triggering irrigation only when necessary.

Introduction

With the increasing demand for smart agriculture solutions, IoT plays a crucial role in enabling efficient and sustainable farming practices. The manual monitoring of soil and plants is labor-intensive and prone to inefficiencies. This project addresses this problem by automating the watering process based on real-time soil conditions. The Smart Irrigation System helps in reducing water wastage and provides an affordable solution for small and medium-scale farmers and urban gardeners.

Methodology

Hardware Components Used:

• ESP32 Wi-Fi-enabled microcontroller
• Soil moisture sensor

• 16x2 I2C LCD display

• Relay module (for controlling a water pump)

• Buzzer and LED for alerts

Working:

• The soil moisture sensor continuously monitors the moisture content of the soil.

• Data is read by the ESP32 and converted to a percentage value.

• If the moisture level drops below 30%, the relay activates the water pump, and the buzzer and LED are triggered to alert the user.

• The moisture data is sent to ThingSpeak every 15 seconds for remote monitoring.

• The LCD display provides real-time updates on the moisture level and pump status.

Results: (Program printout with output / Document printout as per the format)

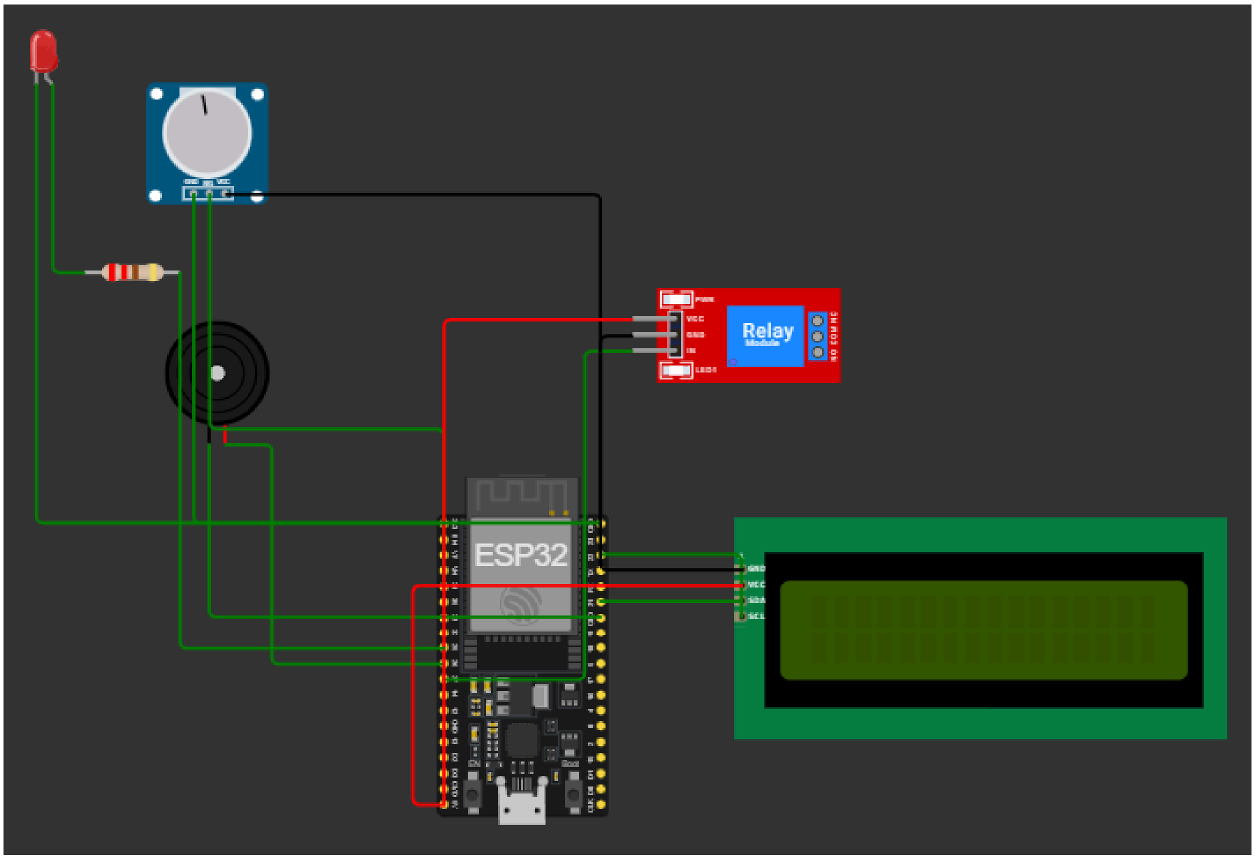
The prototype was successfully implemented and tested. It accurately measured soil moisture levels and activated the water pump when moisture fell below the threshold. Alerts were generated using the buzzer and LED, and real-time data was visible on the LCD screen. The integration with ThingSpeak allowed remote monitoring via the internet. The system operated reliably under test conditions and demonstrated the potential for practical use in small-scale irrigation setups.

```
#include <Wire.h>
#include <LiquidCrystal_I2C.h>
#include <WiFi.h>
#include <ThingSpeak.h>

#define SOIL_MOISTURE_PIN 34
#define RELAY_PIN 27
#define BUZZER_PIN 26
#define ALERT_LED 25

const char* ssid = "Wokwi-GUEST";
const char* password = "";

unsigned long channelID = 2888613;
```

```
const char* writeAPIKey = "3AQ2CV4IDCE44WDU";
const char* server = "api.thingspeak.com";

LiquidCrystal_I2C lcd(0x27, 16, 2);

WiFiClient client;

bool pumpState = false;

void setup() {
  pinMode(RELAY_PIN, OUTPUT);
  pinMode(BUZZER_PIN, OUTPUT);
  pinMode(ALERT_LED, OUTPUT);
  pinMode(SOIL_MOISTURE_PIN, INPUT);

  Wire.begin(21, 22);
  lcd.begin(16, 2);
  lcd.backlight();

  Serial.begin(115200);

  WiFi.begin(ssid, password);
  while (WiFi.status() != WL_CONNECTED) {
  delay(1000);
  Serial.println("Wifi not connected!");
  }
  Serial.println("Wifi connected!");
  Serial.println("Local IP: " + String(WiFi.localIP()));

  WiFi.mode(WIFI_STA);

  ThingSpeak.begin(client);
}

void loop() {
  int soilMoisture = analogRead(SOIL_MOISTURE_PIN);
  int moisturePercent = map(soilMoisture, 4095, 0, 0, 100);

  Serial.print("Soil Moisture: ");
  Serial.print(moisturePercent);
```

```
Serial.println("%");

lcd.setCursor(0, 0);
lcd.print("Moisture: ");
lcd.print(moisturePercent);
lcd.print("%    ");

if (moisturePercent < 30 && !pumpState) {
  digitalWrite(RELAY_PIN, HIGH);
  digitalWrite(ALERT_LED, HIGH);
  pumpState = true;

  tone(BUZZER_PIN, 1000);
  delay(200);
  noTone(BUZZER_PIN);

  lcd.setCursor(0, 1);
  lcd.print("PUMP: ON       ");
}
else if (moisturePercent >= 30 && pumpState) {
  digitalWrite(RELAY_PIN, LOW);
  digitalWrite(ALERT_LED, LOW);
  pumpState = false;

  lcd.setCursor(0, 1);
  lcd.print("PUMP: OFF      ");
}
else {
  lcd.setCursor(0, 1);
  lcd.print(pumpState ? "PUMP: ON       " : "PUMP: OFF      ");
}

ThingSpeak.setField(1, moisturePercent);
int responseCode = ThingSpeak.writeFields(channelID, writeAPIKey);

if (responseCode == 200) {
  Serial.println("Data sent to ThingSpeak successfully.");
} else {
  Serial.print("Error sending data. Response code: ");
  Serial.println(responseCode);
```

```
  }

  delay(15000);
}
```



K J Somaiya College of Engineering

This image shows a schematic of an IoT-based project using an ESP32. Here's a list of the components used and their brief descriptions:

ESP32 Microcontroller:

A versatile microcontroller that provides both Wi-Fi and Bluetooth capabilities. It is used as the main controller to handle inputs, outputs, and communication in the project.

Potentiometer (with Knob):

A variable resistor used to adjust electrical resistance, providing an input control for the system. In this schematic, it's likely used to control a parameter such as light or motor speed.

Relay Module:

A module that acts as an electronic switch. It is used to control high-power devices (such as a motor or a light) through low-power signals from the ESP32. The relay can turn devices on or off depending on the circuit's logic.

Buzzer:

A sound-producing component, often used for signaling or alerting. In this schematic, it may sound an alarm or provide feedback when certain conditions are met (e.g., low values detected by the potentiometer or sensor).

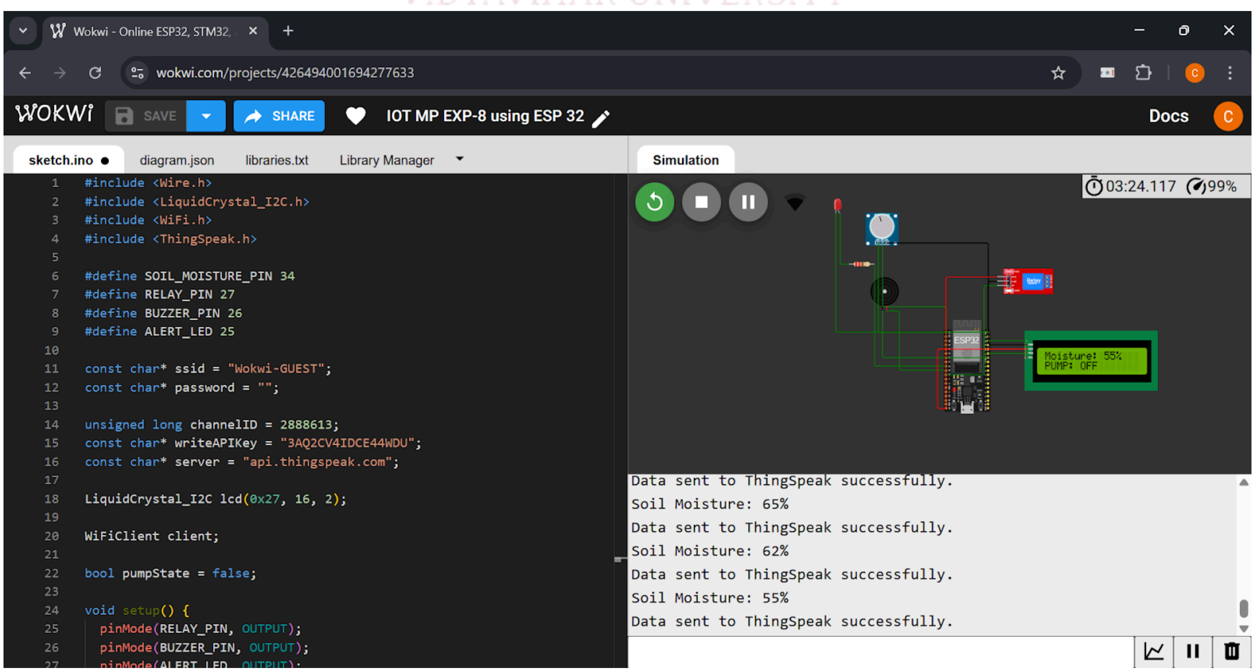
LED (Light Emitting Diode):

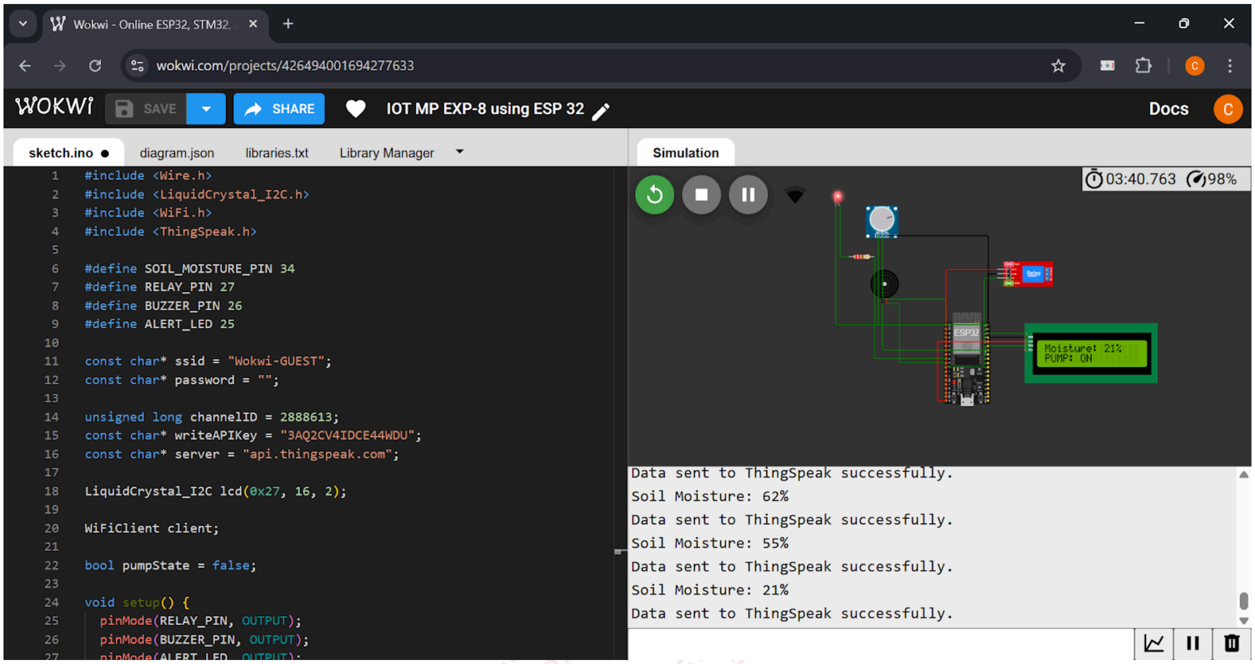
A small, low-power light used to indicate status or provide visual feedback. In this setup, it might be used to show whether the system is in a certain state or to alert the user about a condition.

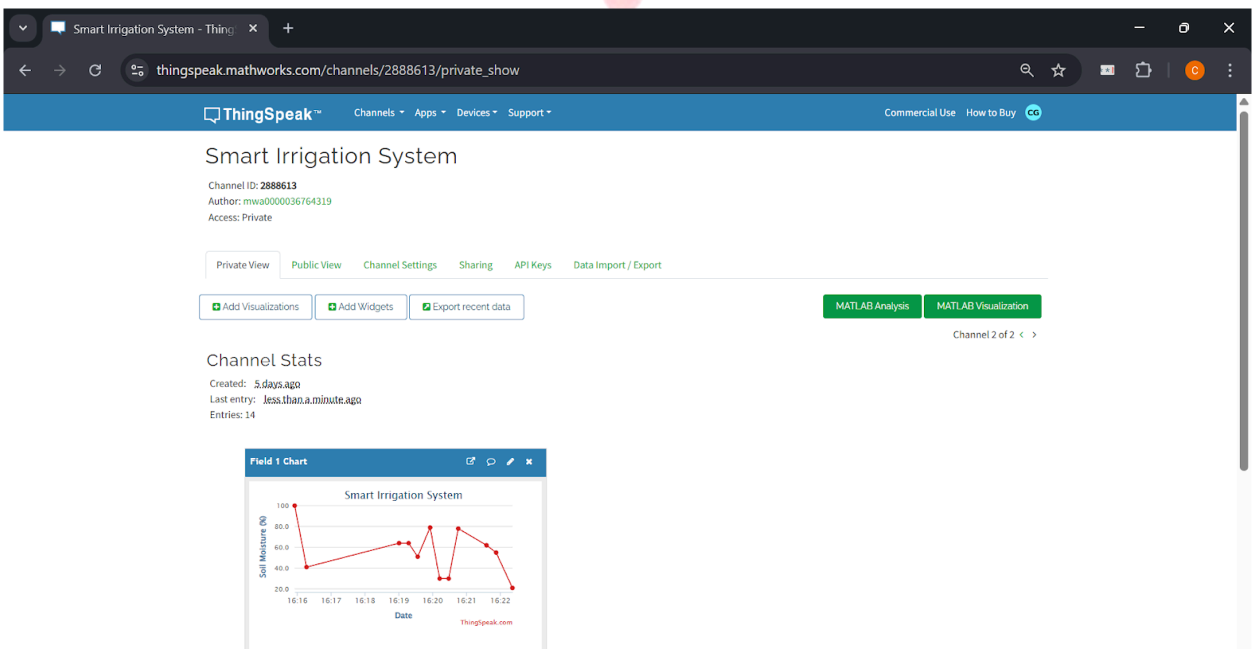
LCD Display (16x2 I2C):

A 16x2 LCD display that uses I2C communication to show text output, like system status, sensor data, or other information. It provides a user-friendly way to monitor and control the system.

This schematic represents a project where the ESP32 reads inputs (like the potentiometer) and controls outputs (such as the relay, buzzer, and LED), with data displayed on an LCD screen. It could be part of a system like home automation or an IoT-based control system.







Conclusion

The IoT-based Smart Irrigation System presents a practical solution to conserve water and promote efficient farming. It automates the irrigation process using real-time soil data, reducing manual intervention and minimizing water usage. The prototype proves the feasibility of integrating low-cost hardware with cloud-based services to build scalable and impactful IoT applications. With further development, this system can be adapted for larger-scale farms or integrated with AI for predictive analytics and smarter irrigation schedules.

References

1. Dash, S. and Prusty, D., 2021. Domain-specific IoT applications. Internet of Things: Enabling Technologies, Security and Social Implications, pp.27-36.

2. Holler, J., Tsiatsis, V., Mulligan, C., Avesand, S., Karnouskos, S., Boyle, D. From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence, Academic Press, 2014.

3. Madisetti, V. and Bahga, A. Internet of Things (A Hands-on-Approach), VPT, 2014.

4. Vermesan, O. and Friess, P. Internet of Things - From Research and Innovation to Market Deployment, River Publisher, 2014.

Questions:

1. Discuss challenges and future scope of IoT technologies.

Challenges:

1. Security and Privacy: IoT devices often store and transmit sensitive data, making them prime targets for cyber-attacks. Ensuring robust encryption, secure communication, and data privacy becomes a significant challenge as the number of connected devices grows.

2. Interoperability: With many manufacturers building IoT products, ensuring that devices from different vendors can work together seamlessly is a challenge. Different communication protocols and standards (e.g., Zigbee, Bluetooth, Wi-Fi) further complicate this issue.

3. Scalability: As IoT systems expand, ensuring that the infrastructure can scale to accommodate more devices without compromising performance or reliability is crucial. Managing thousands or even millions of devices in real-time is a challenge for both network and system resources.

4. Data Management: IoT systems generate massive amounts of data that must be stored, processed, and analyzed. Efficient handling of big data, real-time data processing, and data analytics can be overwhelming for conventional data management systems.

SOMAIYA VIDYAVIHAR UNIVERSITY K J Somaiya College of Engineering

5. Power Consumption: Many IoT devices, especially in remote locations, rely on batteries. Power consumption optimization is crucial for devices like sensors and wearables, where frequent charging or battery replacement is not practical.

6. Regulations: The IoT industry faces the challenge of evolving regulations, especially concerning data protection, privacy laws, and device certifications, which vary by region.

Future Scope:

1. Smart Cities: IoT can revolutionize urban living through smart infrastructure, improving transportation, waste management, and energy consumption. The future scope involves integrating IoT in urban planning to make cities more sustainable, efficient, and livable.

2. Healthcare: IoT's role in healthcare, through wearable devices, remote monitoring, and telemedicine, will continue to expand. Real-time monitoring of patients' health conditions can lead to proactive care and reduced hospital visits.

3. Industrial IoT (IIoT): IoT applications in manufacturing, including predictive maintenance, automated production lines, and supply chain optimization, are poised for rapid growth. IIoT will continue transforming industries into smarter, more efficient enterprises.

4. 5G and IoT Integration: The rollout of 5G technology will improve IoT capabilities by providing higher data transfer speeds, lower latency, and better network reliability, enabling IoT devices to communicate more effectively.

5. AI and IoT Integration: IoT devices will increasingly rely on artificial intelligence for real-time decision-making. Machine learning algorithms can help IoT systems predict future events, optimize operations, and improve efficiency.

6. Energy Management: With increasing concerns about energy consumption, IoT will play a key role in monitoring and optimizing energy usage in homes, buildings, and factories, reducing costs and environmental impact.

2. Write strategic notes on required budget, marketing and sell tactics for developed products (under IoT mini project).

Budget:

1. Development Costs:

• **Hardware:** Our mini project involves several components such as a soil moisture sensor, ESP32 (Wi-Fi module), relay, buzzer, and LCD display. We have to budget for the cost of these components, especially as we scale the prototype for possible future use.

    • **Example:** Soil Moisture Sensor, ESP32, Relay Module, LCD Display, etc.

• **Tools and Equipment:** We used Arduino IDE for programming, and ThingSpeak for cloud storage. While the software itself is free, depending on the usage, we may need to consider costs for more advanced features of cloud platforms if we decide to scale up.

2. Software and Tools:

• The project was developed using Arduino IDE, which is free, but we might need to consider additional tools or cloud services as we expand or improve the system.

3. Maintenance and Infrastructure:

• **Cloud Service:** ThingSpeak is used to visualize the data. Although it's free for small-scale projects, we'll need to keep in mind that larger-scale deployment might require paid plans for enhanced features and better data handling.

• **Wi-Fi Costs:** Since we're using ESP32, it relies on a stable Wi-Fi connection. The cost here might not be significant for a prototype, but if we were to scale, ensuring robust network infrastructure would be crucial.

SOMAIYA
VIDYAVIHAR UNIVERSITY
K J Somaiya College of Engineering

Marketing Tactics:

1. Target Audience:

• Our system is geared toward agriculture, particularly for farmers, home gardeners, or hobbyists who want to automate irrigation and monitor soil conditions without being overly technical. We can market it as a smart irrigation solution that reduces water wastage and helps maintain optimal plant health.

2. Product Differentiation:

• The key differentiator is the real-time data monitoring through ThingSpeak, which allows users to track their soil's moisture levels remotely. The system can automatically turn on a water pump based on moisture levels, which makes it a highly useful tool for home and commercial gardening.

3. Digital Presence:

• We can create a website and social media presence to raise awareness about our project. Sharing educational content on IoT applications in agriculture, along with the benefits of smart irrigation systems, can draw attention to our product.

• Additionally, we could showcase our project through YouTube or Instagram with a demonstration video (as per the project requirements) to attract potential users.

4. Collaborations:

• Collaborating with agricultural businesses, gardening stores, or IoT product resellers could be a good strategy. Offering a demo of the working prototype and its benefits could help build trust and encourage adoption.

Sales Tactics:

1. Freemium or Subscription Model:

• We could offer a basic version of the system with essential features for a low price and then charge for additional services, such as advanced analytics on soil moisture trends or cloud storage for longer data retention.

2. Educational Offerings:

• Including a guide on how to set up and use the system can be a key selling point. Providing easy-to-follow instructions and video tutorials could make it easier for users to adopt the technology without feeling overwhelmed.

3. Partnerships with Gardening Platforms:

• We could work with gardening apps or websites to bundle our system as part of their offering, creating an incentive for their existing customers to try our smart irrigation solution.

4. Referral and Loyalty Programs:

• After successfully selling the first batch of units, we could implement a referral program, where users get discounts or free accessories for bringing in new customers.

By using these budget, marketing, and sales strategies, our group project can be effectively scaled and marketed for real-world use in home automation and agricultural fields.

Outcomes: CO3 -– Realize design process of IoT applications and IoT challenges

---

Conclusion:

The Internet of Things (IoT) holds significant promise for enhancing various sectors, from home automation to healthcare. However, it also presents challenges, especially around security, interoperability, and scalability. The development of IoT products requires careful budgeting, strategic marketing, and effective sales tactics. By focusing on differentiation, audience targeting, and fostering strong customer relationships, IoT companies can thrive in a competitive landscape. With continued advancements in technology, the future of IoT is bright, offering innovative solutions to everyday challenges and creating new business opportunities.

Grade: AA / AB / BB / BC / CC / CD / DD

Signature of faculty in-charge with date

References:

1. Dash, S. and Prusty, D., 2021. Domain-specific IoT applications. Internet of Things: Enabling Technologies, Security and Social Implications, pp.27-36.

Books:

1. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1st Edition, Academic Press, 2014.

2. Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)", 1stEdition, VPT, 2014.

3. Dr. Ovidiu Vermesan, Dr. Peter Friess, "Internet of Things - From Research and Innovation to Market Deployment", River Publisher, 2014

Knowledge Alone Liberates
Somaiya Vidyavihar
SOMAIYA
VIDYAVIHAR UNIVERSITY
K J Somaiya College of Engineering