Project Report on Intelligent Irrigation System (I2S) for Plant-Specific Hydration

SIES College of Arts, Science & Commerce
RISE WITH EDUCATION
NAAC REACCREDITED - 'A' GRADE
ISO 9001 : 2008

S.I.E.S College of Arts, Science and Commerce, Sion(W), Mumbai - 400 022.

CERTIFICATE

This is to certify that **Dhopawakar Abdul Rafae**, **Nadar Kibson**, and **Nair Harsh** Roll Nos **TCS2324011**, **TCS2324045**, and **TCS2324049** have successfully completed the project work entitled **Intelligent Irrigation System for Plant-Specific Hydration** as the partialfulfilment Bachelor of Science (Computer Science) during the academic year 2023 - 2024 complying with the requirements of University of Mumbai.

Project Guide

Dr. Manoj Singh

Examination Date:

Examiner's Sign and Date:

Head of the Department
Dr. Manoj Singh

College Seal
And Date

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PREFACE

Project I2S involves leveraging data on soil moisture levels, weather patterns, and plant-specific needs for plant irrigation. The system can precisely calibrate irrigation schedules and volumes on a per-plant basis.

We wrote this documentation to showcase and highlight details of our final year project "**Intelligent Irrigation System for Plant-Specific Hydration**".

The contents of this book on Intelligent Irrigation System offer precise plant-specific hydration, revolutionizing traditional methods for sustainable agriculture.

The IOT project has been described in detail including its components, working, algorithm, code and applications.

ACKNOWLEDGEMENT

We are very much grateful to **Dr. Manoj Singh,** Head of Department, for being resourceful, kind and helpful. Their positive attitude, unassailable optimism and unwavering faith in us assured that we came out of words whenever we encountered difficulties.

Finally, we would like to thank all our professors and friends, who directly or indirectly helped us complete this project.

Last but not the least we would like to thank our family without whose support, motivation and encouragement this would not have been possible.

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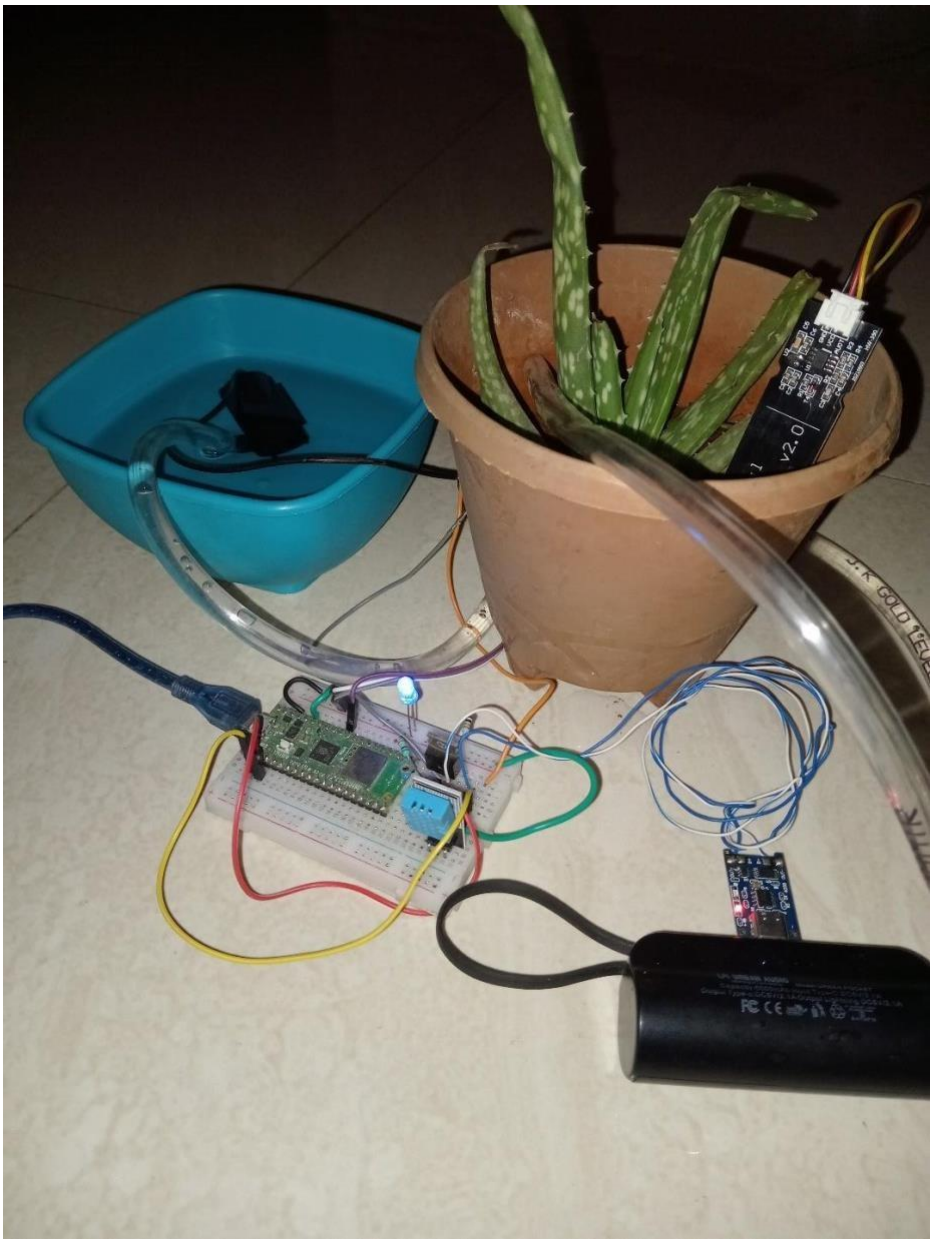
PROJECT OVERVIEW



Introduction:

Project I2S (Intelligent Irrigation System) represent a significant advancement in agricultural technology, offering precise control over water distribution tailored to the specific needs of different plant species. Traditional irrigation methods often involve manual or timer-based watering, which can result in inefficient water usage, over-watering, or under-watering, leading to reduced crop yields and water wastage.

The concept of an intelligent irrigation system involves integrating various technologies such as sensors, actuators, data processing algorithms, and communication systems to optimize water delivery based on factors like soil moisture levels, weather conditions, plant type, and growth stage. These systems utilize real-time data to make informed decisions about when and how much water to apply, resulting in more efficient water usage, improved crop health, and increased productivity.

Overall, intelligent irrigation systems hold great promise in revolutionizing agricultural practices by providing efficient, automated, and sustainable solutions for plant-specific hydration needs. As technology continues to advance, these systems are expected to become even more sophisticated, offering farmers greater control and efficiency in managing water resources and optimizing crop production.

Mission:

The mission of intelligent irrigation systems is to revolutionize agriculture by providing precise, efficient, and sustainable water management solutions tailored to the specific needs of different plant species. These systems aim to optimize crop production, conserve water resources, and promote environmental sustainability by leveraging advanced technologies such as sensors, data processing algorithms, and automation. Ultimately, the mission is to enhance food security, economic viability, and environmental stewardship in agriculture through innovative irrigation practices.

Vision:

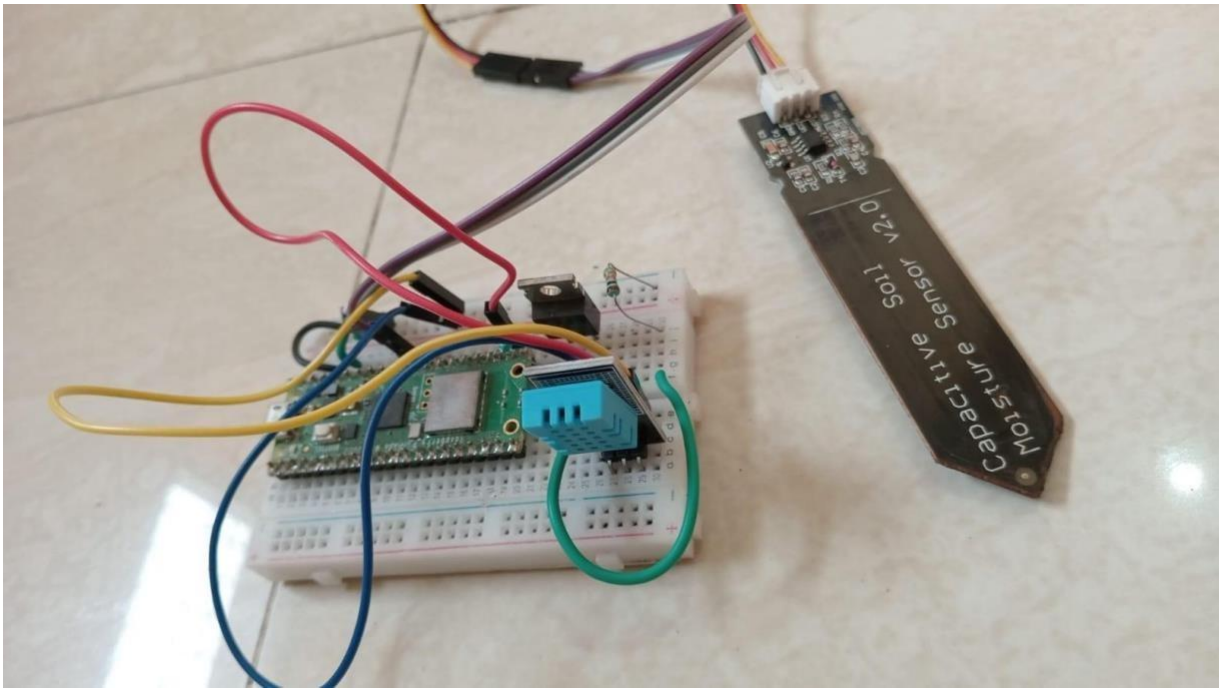
The vision of intelligent irrigation systems is to create a future where agriculture is sustainable, efficient, and resilient. These systems envision a world where water resources are managed intelligently, ensuring optimal hydration for every plant while minimizing waste. Through the integration of cutting-edge technology and data-driven decision-making, the vision is to empower farmers to achieve higher yields, better crop quality, and increased profitability. Ultimately, the vision is to foster a more resilient food system that can adapt to changing environmental conditions and contribute to global food security.

Components:

Hardware	Software
● Capacitive soil moisture sensor ● DHT11 Temperature/Humidity Sensor ● Mini Water Pump ● Power supply ● IRF530 MOSFET	● Micropython (for raspberry pi pico w) ● HTML CSS & JS (for dashboard) ● PHP (for database and server)

Component Description

Hardware



1. DHT11 Temperature/Humidity Sensor:

The DHT11 is a basic, low-cost digital temperature and humidity sensor. It provides humidity readings ranging from 20-90% with ±5% accuracy and temperature readings ranging from 0-50°C with ±2°C accuracy. It communicates with a microcontroller using a single-wire digital protocol. Commonly used in weather stations, home automation systems, and environmental monitoring applications.

2. Mini Water Pump:

A mini water pump is a small-scale pump designed for pumping liquids, typically water, in various applications. They come in various flow rates and power ratings suitable for different tasks such as water circulation in aquariums, hydroponic systems, or small-scale irrigation systems. They are often low voltage and can be powered by batteries or low-voltage power supplies.

3. Power Supply:

A power supply is an electrical device that converts electrical power from one form to another. In the context of this setup, it likely refers to a DC power supply providing the necessary voltage and current to operate the DHT11 sensor, mini water pump, and other components.

It's important to ensure the power supply provides stable and regulated voltage to prevent damage to sensitive components. Depending on the application, the power supply may need to be capable of delivering sufficient current to power all connected devices simultaneously.

4. IRF530 MOSFET:

The IRF530 is an N-channel power MOSFET (Metal-Oxide-Semiconductor Field-Effect Transistor). It is commonly used as a switch or amplifier in electronic circuits. MOSFETs like the IRF530 are capable of handling high currents and voltages, making them suitable for controlling devices like motors, pumps, or heaters. When used as a switch, the MOSFET can be turned on and off using a small voltage or current signal, allowing it to control larger loads with minimal power loss.

5. Capacitive Soil moisture sensor:

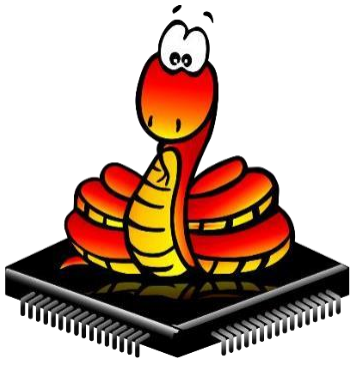
A capacitive soil moisture sensor measures soil moisture by detecting changes in capacitance between two conductive plates placed in the soil. It's accurate, affordable, and widely used in agriculture for irrigation management and research purposes.

Software

1. MicroPython :
   MicroPython is a version of the Python programming language tailored for microcontrollers like the Raspberry Pi Pico. It enables developers to write Python code to control hardware components and perform tasks in embedded systems.

2. HTML, CSS, and JavaScript (JS):
   - HTML (Hypertext Markup Language): It's the standard language for creating web pages and defines the structure and content of a webpage.
   - CSS (Cascading Style Sheets): Used for styling HTML documents, it defines the presentation, layout, and design of web pages.
   - JavaScript (JS): A programming language used to create interactive and dynamic elements on web pages. It adds behavior to web pages, enabling features like form validation, animations, and interactivity.

3. PHP:
   PHP is a server-side scripting language used for web development. It's embedded within HTML code and executed on the server, generating dynamic content before sending it to the client's web browser. PHP is often used for building dynamic websites, web applications, and server-side scripting tasks.



SYSTEM ANALYSIS AND DESIGN

PROJECT: Intelligent Irrigation System for Plant-Specific Hydration
GANTT CHART

TASK/PROCESS	PROCESS 1			PROCESS 2			PROCESS 3			PROCESS 4		
	DEC	DEC	DEC	JAN	JAN	JAN	FEB	FEB	FEB	FEB	MAR	MAR
Planning	15-21											
Analysis		22-31										
Design				01-15								
Development					15 JAN- 2 MAR							
Testing											03-10	
Deployment												10-12

EVENT TABLE:

Event Name	Description	Trigger Condition	Response Action
Moisture Level Low	Soil moisture level drops below threshold	Soil moisture sensor reading falls below set threshold	Initiate watering for affected plant(s)
Watering Schedule Triggered	Plant-specific watering schedule initiated	Scheduled watering time for a particular plant species	Activate irrigation system based on schedule
Plant Growth Stage Change	Change in plant growth stage detected	Plant growth monitoring system detects growth stage change	Adjust watering schedule according to new growth stage
Humidity Adjustment	Watering schedule adjustment due to humidity change	Humidity sensor detects significant humidity variation	Modify watering schedule based on humidity changes
Growth Stage Adjustment	Watering schedule adjustment due to plant growth stage	Growth monitoring system detects significant plant growth	Update watering schedule according to growth stage change
Remote Access Request	Remote access request received	User initiates a request for remote access to the system	Grant or deny remote access based on authentication
Watering System Activation	Irrigation system activation	System activates irrigation based on watering schedule	Confirm successful irrigation system activation

FACT FINDING

Effective fact-finding techniques are essential for gathering accurate and reliable information for the development of the Intelligent Irrigation System. Here are some techniques employed to ensure project's success:

1. **Plant-Specific Requirements**: Researching the specific hydration needs of different plant species is essential. Factors such as water uptake rates, root depths, and tolerance to drought or waterlogging vary significantly across plant types.

2. **Soil Analysis**: Conducting soil tests to assess its composition, moisture retention capacity, and drainage characteristics is crucial. This information helps determine how water moves through the soil and how it interacts with plant roots.

3. **Climate Data**: Gathering data on local weather patterns, including rainfall, temperature, humidity, and evapotranspiration rates, provides insights into environmental conditions that influence plant hydration requirements.

4. **Water Availability**: Understanding the availability and quality of water sources is essential for sustainable irrigation practices. Fact-finding includes assessing water sources such as wells, rivers, or reservoirs, as well as considering water conservation measures.

5. **Existing Irrigation Practices**: Evaluating current irrigation methods used in the area helps identify inefficiencies and areas for improvement. This includes assessing the frequency, timing, and volume of irrigation, as well as the irrigation infrastructure in place.

6. **Technology Assessment**: Researching available technologies for intelligent irrigation systems, including sensors, actuators, controllers, and software platforms, is necessary to select the most suitable components for the specific needs and constraints of the project.

7. **Regulatory Considerations**: Fact-finding should also involve understanding relevant regulations, permits, and water rights that may impact the design and implementation of the intelligent irrigation system.

8. **Stakeholder Engagement**: Engaging with stakeholders such as farmers, agronomists, researchers, and policymakers helps gather valuable insights, perspectives, and support for the implementation of the intelligent irrigation system.

QUESTIONNAIRE:

To further understand customer preferences and expectations, we have designed a questionnaire that helps shape the development and improvement of the Intelligent Irrigation System:

1. **What types of plants do you cultivate on your farm?**
    - We cultivate a variety of crops including tomatoes, lettuce, cucumbers, and peppers.
2. **Can you describe the current irrigation methods used on your farm?**
    - We primarily use a traditional drip irrigation system with manual adjustments based on visual inspection.
3. **How do you determine when and how much to irrigate your crops?**
    - Currently, we rely on visual cues such as soil moisture levels and plant appearance, supplemented by experience.
4. **Have you encountered any challenges with your current irrigation practices? If so, please specify.**
    - Yes, we often struggle with overwatering certain crops while underwatering others. It's challenging to maintain optimal hydration for each plant species.
5. **Would you be interested in adopting an Intelligent Irrigation System for farm? Why or why not?**
    - Yes, we are interested because we believe it could help us optimize water usage, improve crop yields, and reduce manual labour.
6. **What specific features or capabilities would you prioritize in an Intelligent Irrigation System for your farm?**
    - We would prioritize accurate monitoring of soil moisture levels, real-time adjustments based on plant needs, and compatibility with our existing irrigation infrastructure.

SYSTEM IMPLEMENTATION

Algorithm:

The algorithm of the Intelligent Irrigation System executes in the following way:

User Interface

1. The user authenticates itself by logging in or signing up to the website.

2. When logging in, if the credentials (device ID and password) are correct then the user is directed to dashboard where they can monitor the system.

3. When signing up, the user registers the plant details (name, soil type, location, age) and is directed to dashboard on successful registration.

Device Startup

1. The device connects to the Wi-Fi and sends a request to the server for plant data registered by the user.

2. On successful retrieval of data the device executes the watering algorithm.

3. If the device is not registered by the user then it queries the server every 60 seconds to verify the registration and retrieve information.

Watering algorithm

1. The soil moisture sensor continuously monitors the moistures levels of the soil.

2. If the moisture levels fall below the plant's lower threshold then the water pump starts.

3. Once the soil moisture levels reach the higher threshold of the plant's water requirement the pump is turned off.

4. The tolerance for threshold is high during daytime (±10%) and low during the time meant for irrigation (±5%) – morning and evening.

Logging and Communication

The device logs data (moisture levels, temperature, humidity, rain chance) to the server every 60 seconds using HTTP protocol. The communication algorithm runs on a separate thread.

Code:

Device Code

main.py

```
# Project IIS (Intelligent Irrigation System)

"""
Software Architecture:
main.py - Main program
constants.py - Constants to be used by main program weather.py - For
accessing the weather API
"""

From machine import Pin, ADC, Timer import gc
import weather
import urequests
import time import
os
import network
import urequests
import json
from constants import PLANTS
import _thread
from dht import DHT11


# CONSTANTS
DRY = 30710
WET = 19641
RANGE = 11069

SOIL = ADC(Pin(26)) PUMP =
Pin(16, Pin.OUT)
TEMPERATURE_SENSOR = DHT11(Pin(17)) dht11 =
DHT11(Pin(17))
timer = Timer(-1)

DEV_ID = '12345678'
DEV_PASS = 'admin@123' FILE_NAME =
'data.json' JSON_PLANT_NAME =
'PLANT_NAME'
JSON_GROWTH_STAGE = 'GROWTH_STAGE'
JSON_DAYS_FOR_NEXT_STAGE = 'DAYS_FOR_NEXT_STAGE' JSON_TIME =
```

'TIME'

```
#SERVER_BASE_URL    =    "http://irrigation.great-site.net/update_data"
SERVER_BASE_URL = "http://192.168.18.108/irrigation/update_data"
STAGES = {0: 'Germination', 1: 'Vegetative', 2: 'Reproductive', 3: 'Grain-
filling', 4: 'Maturation'}
FINAL_GROWTH_STAGE = 4

IRRIGATING = False
TIMESTAMP = 0
WAIT_TIME = 60 * 10  #  10  minutes

#  For  Recovery
if FILE_NAME in os.listdir(): file =
      open(FILE_NAME, 'r+') data =
      json.load(file)
      PLANT_NAME = data[JSON_PLANT_NAME]
      GROWTH_STAGE = data[JSON_GROWTH_STAGE]
      DAYS_FOR_NEXT_STAGE = data[JSON_DAYS_FOR_NEXT_STAGE] TIME
      = data[JSON_TIME]
      file.close()

      time_diff_days = (time.time() - TIME) / (60 * 60 * 24)

      if (time_diff_days >= 1): DAYS_FOR_NEXT_STAGE -=
            time_diff_days if (DAYS_FOR_NEXT_STAGE <= 0):
                  while DAYS_FOR_NEXT_STAGE <= 0:
                        if GROWTH_STAGE != FINAL_GROWTH_STAGE:
                              GROWTH_STAGE += 1
                              if PLANTS[PLANT_NAME][GROWTH_STAGE] == None:
                                    #  harvest
                                    pass
                              else:
                                    PLANT_UPPER, PLANT_LOWER, NEXT_STAGE = PLANTS[PLANT_NAME][GROWTH_STAGE]
                                    DAYS_FOR_NEXT_STAGE += NEXT_STAGE
                        else:
                              #  harvest
                              pass
      else:
            Timer(-1).init(mode=Timer.ONE_SHOT, period=(time.time()-TIME)*1000, callback=update_values)

else:
      PLANT_NAME = 'sugarcane'
      GROWTH_STAGE = 0
      PLANT_LOWER, PLANT_UPPER, DAYS_FOR_NEXT_STAGE =
PLANTS[PLANT_NAME][GROWTH_STAGE]#(60,    80)
      PLANT_AGE = 2
```

```
TOLERANCE = 5
BIASED_UPPER = PLANT_UPPER + TOLERANCE
BIASED_LOWER  = PLANT_LOWER - TOLERANCE
TEMP_LOWER, TEMP_UPPER = PLANTS[PLANT_NAME]['temp']

#  FUNCTIONS
def connect_to_wifi(): SSID =
        'ssid'
        PASS = 'password'
        sta_if = network.WLAN(network.STA_IF) if not
        sta_if.isconnected():
                print('connecting to network...')
                sta_if.active(True) sta_if.connect(SSID, PASS)
                while not sta_if.isconnected(): pass

        print('network config:', sta_if.ifconfig())

def calculate_moisture(n): total =
        0
        for i in range(0, n):
                total += SOIL.read_u16()
                time.sleep(0.01) return
        total / n

def get_moisture_percentage(moisture): inv_percent =
        (moisture - WET) / RANGE * 100 return (100 - inv_percent)

def irrigate():
        """To water plants by starting the pump""" global
        IRRIGATING, TIMESTAMP
        PUMP.value(1) IRRIGATING =
        True

        moisture = calculate_moisture(10)
        percentage = get_moisture_percentage(moisture) print("pump
        on")
        while not percentage > BIASED_UPPER: moisture =
                calculate_moisture(10)
                percentage = get_moisture_percentage(moisture)
                print(percentage)

        PUMP.value(0)
        print("pump off")
```

```
    TIMESTAMP = time.time()

def update_values(t):
    global DAYS_FOR_NEXT_STAGE, PLANT_LOWER, PLANT_UPPER, BIASED_UPPER, BIASED_LOWER,
GROWTH_STAGE

    DAYS_FOR_NEXT_STAGE -= 1
    if (DAYS_FOR_NEXT_STAGE == 0):
        if (GROWTH_STAGE == FINAL_GROWTH_STAGE or
PLANTS[PLANT_NAME][GROWTH_STAGE+1] == None):
            # Time to harvest
            pass
        else:
            # Next growth stage of plant
            GROWTH_STAGE += 1
            PLANT_LOWER, PLANT_UPPER, DAYS_FOR_NEXT_STAGE =
PLANTS[PLANT_NAME][GROWTH_STAGE]
            BIASED_LOWER, BIASED_UPPER = [PLANT_LOWER-TOLERANCE,
PLANT_UPPER+TOLERANCE]

    log_data()

def log_data():
    """Log important data for system recovery incase of power failure""" file =
    open(FILE_NAME, 'w')
    data = {
        JSON_PLANT_NAME: PLANT_NAME,
        JSON_GROWTH_STAGE: GROWTH_STAGE,
        JSON_DAYS_FOR_NEXT_STAGE: DAYS_FOR_NEXT_STAGE,
        JSON_TIME: time.time()
    }
    json.dump(data, file) file.close()

thread_lock = _thread.allocate_lock()

def send_data():
    thread_lock.acquire()
    print('sending data')
    dht11.measure()
    temp = dht11.temperature() humidity
    = dht11.humidity()

    moisture = calculate_moisture(10)
    percentage=get_moisture_percentage(moisture)

    rain_chance = 0#get_rain_data()
```

```
print(rain_chance)
```

```
        post_data = f'device-
id={DEV_ID}&password={DEV_PASS}&temperature={temp}&humidity={humidity}&soil_mo
isture={percentage}&growth_stage={STAGES[GROWTH_STAGE]}&rain_chance={rain_chan ce}'
        response = urequests.post(SERVER_BASE_URL, headers = {'content-type': 'application/x-
www-form-urlencoded'}, data = post_data)
        response.close() gc.collect()
        print(response.text)

        post_data = json.dumps({'device-id':DEV_ID, 'password':DEV_PASS, 'temperature':temp,
'humidity':humidity, 'soil_moisture':percentage, 'growth_stage':STAGES[GROWTH_STAGE],
'rain_chance':rain_chance}, separators=(', ', ':'))

        res = urequests.post(SERVER_BASE_URL, headers = {'content-type': 'application/x-
www-form-urlencoded'}, data = post_data)
        print(res.text)

        thread_lock.release()

def start_thread(t):
        _thread.start_new_thread(send_data, ())

connect_to_wifi()
timer.init(period=5*1000, callback=start_thread)

# MAIN LOOP
while True:
        moisture = calculate_moisture(10)
        percentage = get_moisture_percentage(moisture)

        hour_of_day = time.localtime()[3]

        if (percentage < PLANT_LOWER and 18 < hour_of_day < 10) or (percentage < BIASED_LOWER) :
                print('irrigating') irrigate()

        elif IRRIGATING and time.time() - TIMESTAMP > WAIT_TIME: if percentage
                < PLANT_UPPER:
                        print('reirrigating') irrigate()
                else:
                        IRRIGATING = False
        print(percentage)
        time.sleep(0.5)
```

weather.py

```
import urequests

def fetch_weather_data(api_key, city_name):
    base_url = "http://api.openweathermap.org/data/2.5/weather?" complete_url =
f"{base_url}q={city_name}&appid={api_key}&units=metric" response =
    urequests.get(complete_url)
    data = response.json() return data

def extract_rain_data(weather_data): print(weather_data)
    if 'rain' in weather_data: rain_info =
        weather_data['rain'] return rain_info
    else:
        return None

def get_rain_data():
    api_key = "482f5bea526cb4ff80e0ada18e2252de"
    city_name ="Mumbai, India" # Replace with your desired city and country
    weather_data = fetch_weather_data(api_key, city_name) if
    weather_data['cod'] == 200:
        rain_info = extract_rain_data(weather_data)
        print(rain_info)
        if rain_info:
            print("Rain information:")
            print(rain_info) return
            rain_info
        else:
            print("No rain information available.") return 0
    else:
        print("Error fetching weather data.")
```

constant.py

```
"""
 Growth Stages
0  - Germination
1  - Vegetative
2  - Flowering/Reproductive
3  - Grain-filling
4  - Maturation """

PLANTS = {
                        'sugarcane': {0: (50, 70, 15), 1: (70, 80, 280), 2: (70, 80, 140),
              3: (70, 80, 75), 4: (60, 70, 325), 'temp': (20, 35)},
                         'rice':{0: (100, 100, 7), 1: (50, 100, 120), 2: (50, 100, 140), 3:
             (50, 100, 30), 4: (20, 35, 150), 'temp': (20, 35)},
                     'watermelon':{0: (70, 80, 10), 1: (80, 90, 30), 2: (80, 90,
       45),3:None, 4:None, 'temp': (20, 30)},
                         'silk cotton':{0: (70, 80, 14), 1: (80, 90, 300), 2: (80, 90, 400),
     3:None,4:None,'temp': (20, 30)},
                         'lettuce':{0: (70, 80, 14), 1: ( 80,90,50), 2: (0, 0, 90), 3: None,
     4: None, 'temp': (10, 20)},
                         'chilli':{0: ( 50, 70, 14), 1: ( 70,80,50), 2: (70, 80, 90), 3:
      None, 4: None, 'temp': (21, 32)},
                        'rubber':{0: ( 70, 80, 14), 1: ( 80,90,120), 2: (80, 90, 240), 3:
      None, 4: None, 'temp': (20, 30)},
                         'carrot':{0: ( 50, 70, 14), 1: ( 70,80,90), 2: (70, 80, 150), 3:
        (60,70,90), 4: None, 'temp': (15, 21)},
                       'mango':{0: ( 70, 80, 14), 1: ( 80,90,240), 2: (80, 90, 240), 3:
      None, 4: None, 'temp': (24, 30)},
                       'pumpkin':{0: ( 70, 80, 10), 1: ( 80,90,60), 2: (80, 90, 120), 3:
      None, 4: None, 'temp': (18, 24)},
                       'spinach':{0: ( 50, 70, 14), 1: ( 0,0,60), 2: (70, 80, 150), 3:
      None, 4: None, 'temp': (10, 24)},
                       'sorghum ':{0: ( 50, 70, 7), 1: ( 70,80,70), 2: (70, 80, 120), 3:
      None, 4: None, 'temp': (20, 30)},
                       'banana':{0: ( 70, 80, 14), 1: ( 80,90,270), 2: (80, 90, 240), 3:
      None, 4: None, 'temp': (25, 3)},
                       'kiwi':{0: ( 70, 80, 28), 1: ( 80,90,180), 2: (80, 90, 300), 3:
      None, 4: None, 'temp': (10, 30)},
                       'grapes':{0: ( 70, 80, 14), 1: ( 80,90,150), 2: (80, 90, 120), 3:
      None, 4: None, 'temp': (15, 30)},
                     'potato':{0: ( 70, 80, 14), 1: ( 80,90,90), 2: None, 3: None, 4:
```

```
None, 'temp': (15, 20)},
                    'tomato':{0: ( 70, 80, 10), 1: ( 80,90,60), 2: (80, 90, 90), 3:
  None, 4: None, 'temp': (15, 30)},
```

```
                    'bell pepper ':{0: ( 70, 80, 14), 1: ( 80,90,60), 2: (80, 90, 90),
 3: None, 4: None, 'temp': (18, 27)},
                    'eggplant':{0: ( 70, 80, 14), 1: ( 80,90,60), 2: (80, 90, 90), 3:
 None, 4: None, 'temp': (21, 30)},
                    'pineapple':{0: ( 70, 80, 30), 1: ( 80,90,240), 2: (80, 90, 240),
 3: None, 4: None, 'temp': (21, 32)},
                    'raspberry':{0: ( 70, 80, 14), 1: ( 80,90,40), 2: (80, 90, 90), 3:
 None, 4: None, 'temp': (15, 24)},
                  'sweet potato':{0: ( 70, 80, 14), 1: ( 80,90,90), 2: None, 3: None,
 4: None, 'temp': (21, 29)},
                  'black pepper':{0: ( 70, 80, 21), 1: ( 80,90,240), 2: (80, 90,
    300), 3: None, 4: None, 'temp': (20, 30)},
                    'cinamon':{0: ( 70, 80, 45), 1: ( 80,90,360), 2: (80, 90,300), 3:
 None, 4: None, 'temp': (20, 30)},
                    'turmeric':{0: ( 70, 80, 14), 1: ( 80,90,300), 2: (80, 90, 300), 3:
 None, 4: None, 'temp': (20, 30)},
                 'mushroom':{0: ( 90, 100, 14), 1: ( 90,100,21), 2: None, 3: None,
 4: None, 'temp': (20, 30)},
                    'avacado':{0: ( 70, 80, 30), 1: ( 80,90,240), 2: (80, 90, 240), 3:
 None, 4: None, 'temp': (18, 25)},
                  'pomegranate':{0: ( 70, 80, 21), 1: ( 80,90,240), 2: (80, 90, 240),
  3: None, 4: None, 'temp': (25, 35)},
                    'lemon':{0: ( 70, 80, 21), 1: ( 80,90,360), 2: (80, 90, 240), 3:
 None, 4: None, 'temp': (10, 30)},
                    'dal':{0: ( 50, 70, 7), 1: ( 70,80,90), 2: (70, 80, 120), 3: None,
 4: None, 'temp': (18, 24)},
                    'chickpea':{0: ( 50, 70, 7), 1: ( 70,80,90), 2: (70, 80, 120), 3:
 None, 4: None, 'temp': (18, 25)},
                    'sunflower':{0: ( 70, 80, 10), 1: ( 80,90,90), 2: (80, 90, 90), 3:
 None, 4: None, 'temp': (12, 18)},
                    'peanut':{0: ( 50, 70, 7), 1: ( 70,80,120), 2: (70, 80, 150), 3:
 None, 4: None, 'temp': (25, 30)},
                    'indian gooseberry':{0: ( 70, 80, 45), 1: ( 80,90,180), 2: (80, 90,
    240), 3: None, 4: None, 'temp': (25, 30)},
                    'fig':{0: ( 70, 80, 45), 1: ( 80,90,180), 2: (80, 90, 240), 3:
 None, 4: None, 'temp': (15, 30)},
                    'jackfruit':{0: ( 70, 80, 21), 1: ( 80,90,240), 2: (80, 90, 240),
  3: None, 4: None, 'temp': (25, 35)},
                    'broccoli':{0: ( 70, 80, 7), 1: ( 80,90,90), 2: (80, 90, 120), 3:
 None, 4: None, 'temp': (18, 23)},
                    'cloves':{0: ( 70, 80, 21), 1: ( 80,90,360), 2: (80, 90, 300), 3:
 None, 4: None, 'temp': (20, 30)},
                    'mustard':{0: ( 70, 80, 7), 1: ( 80,90,60), 2: (80, 90, 90), 3:
```

```
None, 4: None, 'temp': (10, 25)},
                    'pistachio':{0: ( 70, 80, 21), 1: ( 80,90,360), 2: (80, 90, 300),
 3: None, 4: None, 'temp': (25, 35)},
```

```
        'apple':{0: ( 50, 70, 45), 1: ( 80,90, 360), 2: (80, 90, 300), 3:
None, 4: None, 'temp': (7, 24)},
        'rose':{0: ( 50, 70, 45), 1: ( 70,80,150), 2: (70, 80, 120), 3:
None, 4: None, 'temp': (15, 24)},
        'tulsi':{0: ( 50, 70, 14), 1: ( 70,80,50), 2: (70, 80, 90), 3:
None, 4: None, 'temp': (20, 30)},
        'orchids':{0: ( 70, 80, 60), 1: ( 80,90,180), 2: (80, 90, 180), 3:
None, 4: None, 'temp': (18, 30)},
        'garlic':{0: ( 70, 80, 14), 1: ( 80,90,120), 2: None, 3: None, 4:
None, 'temp': (12, 24)},
        'saffron':{0: ( 70, 80, 21), 1: ( 80,90,240), 2: (80, 90, 240), 3:
None, 4: None, 'temp': (15, 240)},
        'radish':{0: ( 50, 70, 5), 1: ( 70,80,40), 2: (70, 80, 40), 3:
(60,70,30), 4: None, 'temp': (15, 25)},
        'coconut':{0: ( 70, 80, 90), 1: ( 80,90,240), 2: (80, 90, 360), 3:
None, 4: None, 'temp': (27, 32)},
        'olive':{0: ( 50, 70, 60), 1: ( 70,80,240), 2: (70, 80, 360), 3:
None, 4: None, 'temp': (15, 30)},
        'cactus':{0: (70, 80, 14), 1: ( 50,60,60), 2: (30, 40, 120), 3:
None, 4: None, 'temp': (18, 27)},
```

Dashboard Code

./index.php (User Interface)

```
<?php
    require 'assets/includes/constants.php';
    session_start();

    if (!isset($_SESSION['device'])) {
        echo "<script>alert('Login')</script>";
        header("Location: auth"); exit();
    } else {
        $con = new mysqli($HOSTNAME, $DB_USERNAME, $DB_PASSWORD, $DB_NAME); if
        ($con->connect_error) exit(0);

                $getQuery = "SELECT * FROM active_devices WHERE device_id = '" .
    $_SESSION['device'] . "';";
            $res = $con->query($getQuery);

        if ($res->num_rows == 1) {
            $data =$res->fetch_assoc();
            $plant_name = $data['plant_name'];
            $location = $data['location'];
            $growth_stage = $data['growth_stage'];
            $num_days = $data['num_days'];
            $soil_moisture = $data['soil_moisture'];
            $temperature = $data['temperature'];
            $humidity = $data['humidity'];
            $rain_chance = $data['rain_chance'];
            // $con->close();
        } else {
            echo "<script>alert('Register your device.')</script>";
            header('Location: register'); exit();
        }
    }
?>

<!DOCTYPE html>
<html lang="en">

<head>
    <meta charset="UTF-8">
    <meta http-equiv="X-UA-Compatible" content="IE=edge">
    <meta name="viewport" content="width=device-width, initial-
            scale=1.0">
```

```
    <link href="https://unpkg.com/tailwindcss@^1.0/dist/tailwind.min.css" rel="stylesheet">
    <link rel="icon" href="./assets/images/Logo.png">
    <title>I2S - where tech meets farms</title>
    <link rel="stylesheet" href="./assets/css/dashboard_style.css">
    <link rel="stylesheet" href="./assets/css/Response.css">
</head>

<body>
    <!DOCTYPE html>
    <html lang="en">

    <!--  <head>
        <meta charset="UTF-8">
        <meta http-equiv="X-UA-Compatible" content="IE=edge">
        <meta name="viewport" content="width=device-width,
                initial-scale=1.0">
        <title>I2S Solutions</title>
        <link rel="stylesheet" href="./CSS Files/dashboard_style.css">
        <link rel="stylesheet" href="./CSS Files/Response.css">

    </head> -->


        <!-- for header part -->
        <header>

            <div class="logosec">
                <div class="logo">I2S</div>
                <img src="./assets/images/Dash.png" class="icn menuicn"
id="menuicn" alt="menu-icon">
            </div>
            </div>

            <div class="message">
                <div class="circle"></div>
                <img src="./assets/images/notification.png" class="icn"
alt="">
                <div class="dp">
                    <img src="./assets/images/sugarcane2.png" class="dpicn"
alt="dp">
                </div>
            </div>

        </header>

        <div class="main-container">
            <div class="navcontainer">
```

```
<nav class="nav">
```

```
                        <div class="nav-upper-options">
                            <div class="nav-option option1">
                                <img src="./assets/images/dashboard.png"
class="nav-img"  alt="dashboard">
                                <h3> Dashboard</h3>
                            </div>

                            <div class="nav-option logout"
 onclick="confirmLogout">
                                <img src="./assets/images/logout.png" class="nav-
img" alt="logout">
                                <h3>Logout</h3>
                            </div>

                        </div>
                    </nav>
                </div>
                <div class="main">

                    <div class="searchbar2">

                    </div>

                    <div class="box-container">

                        <div class="box box1">
                            <div class="text">
                            <?php echo "<h2 class='topic-
heading'>$rain_chance%</h2>"; ?>
                                <h2 class="topic">Chances of Rain</h2>
                            </div>

                            <img src="./assets/images/rain.png" alt="Views">
                        </div>

                        <div class="box box2">
                            <div class="text">
                            <?php echo "<h2 class='topic- heading'>$humidity%</h2>"; ?>
                            <h2 class="topic">Humidity Level</h2>
                            </div>

                            <img src="./assets/images/Warn.png" alt="likes">
                        </div>

                        <div class="box box3">
                            <div class="text">
```

```
                        <?php echo "<h2 class='topic- heading'>$soil_moisture%</h2>"; ?>
                            <h2 class="topic">Moisture Level</h2>
                        </div>

                        <img src="./assets/images/Moisture.webp"
alt="comments">
                    </div>

                    <div class="box box4">
                        <div class="text">
                        <?php echo "<h2 class='topic-heading'>$temperature
deg</h2>"; ?>
                            <h2 class="topic">Temperature</h2>
                        </div>
                        <img src="./assets/images/temperature.png"
alt="comments">

                    </div>
                </div>

                <div class="report-container">
                    <!--
                    <div class="report-header">
                        <h1 class="recent-Articles">Plant Details</h1>
                        <button class="view">View info</button>
                    </div>
                    -->
                    <div class="plant-info">
                        <!-- Add this inside the .plant-info container -->
                        <div class="plant-image-container">
                            <img src="./assets/images/sugarcane2.png" alt="Plant image"
class="plant-image">
                            <?php echo "<h3>$plant_name</h3>"; ?>
                        </div>
                        <div class="plant-grid">
                            <div class="grid-item">
                                <h3 class="grid-title">Normal</h3>
                                <p class="grid-subtitle">Plant Condition</p>
                            </div>
                            <div class="grid-item">
                                <?php echo "<h3 class='grid-
title'>$growth_stage</h3>"; ?>
                                <p class="grid-subtitle">Growth Stage</p>
                                        title'>$location</h3>"; ?>
```

```
</div>
<div  class="grid-item">
<?php echo  "<h3 class='grid-
```

```
                                    <p class="grid-subtitle">Location</p>
                                </div>
                                <div class="grid-item">
                                <?php echo "<h3 class='grid-title'>$num_days
Days</h3>"; ?>
                                    <p class="grid-subtitle">Age</p>
                                </div>
                            </div>
                        </div>
                    </div>
                </div>
            </div>
            <footer class="text-gray-600 body-font">
                <div class="container px-5 py-8 mx-auto flex items-center sm:flex- row flex-col">
                    <!------->
                    <a class="flex title-font font-medium items-center md:justify- start justify-center
text-gray-900">
                        <svg xmlns="./assets/images/Logo.png" fill="none"
stroke="currentColor" stroke-linecap="round"
                            stroke-linejoin="round" stroke-width="2"
                            class="w-15 h-15 text-white p-2 bg-green-500 rounded- full"
viewBox="00 00 24 24 ">
                            <path d="M12 2L2 7l10 5 10-5-10-5zM2 17l10 5 10-5M2
12l10 5 10-5"></path>
                        </svg>
                        <span class="ml-3 text-xl">Tetra Tribe Ltd</span>
                    </a>

                    <p class="text-sm text-gray-500 sm:ml-4 sm:pl-4 sm:border-l-2 sm:border-gray-
200 sm:py-2 sm:mt-0 mt-4">©
                        2024 Team Tetra Tribe
                        <!--<a href="images/twitter.png" class="text-gray-600 ml-
1" rel="noopener noreferrer" target="_blank">@TT</a>-->
                    </p>
                    <span class="inline-flex sm:ml-auto sm:mt-0 mt-4 justify- center sm:justify-
start">
                        <a class="text-gray-500">
                            <svg fill="currentColor" stroke-linecap="round"
stroke-linejoin="round" stroke-width="2"
                                class="w-5 h-5" viewBox="0 0 24 24">
                                <path d="M18 2h-3a5 5 0 00-5 5v3H7v4h3v8h4v-8h3l1-
    4h-4V7a1 1 0 011-1h3z"></path>
                            </svg>
                        </a>
                        <a class="ml-3 text-gray-500">
```

```
                                <svg fill="currentColor" stroke-linecap="round"
stroke-linejoin="round" stroke-width="2"
                                    class="w-5 h-5" viewBox="0 0 24 24">
                                    <path
                                        d="M23 3a10.9 10.9 0 01-3.14 1.53 4.48 4.48 0
00-7.86 3v1A10.66 10.66 0 013 4s-4 9 5 13a11.64 11.64 0 01-7 2c9 5 20 0 20-
11.5a4.5 4.5 0 00-.08-.83A7.72 7.72 0 0023 3z">
                                    </path>
                                </svg>
                            </a>
                            <a class="ml-3 text-gray-500">
                                <svg fill="none" stroke="currentColor" stroke-
linecap="round" stroke-linejoin="round"
                                    stroke-width="2" class="w-5 h-5" viewBox="0 0 24
24">
                                    <rect width="20" height="20" x="2" y="2" rx="5"
ry="5"></rect>
                                    <path d="M16 11.37A4 4 0 1112.63 8 4 4 0 0116
11.37zm1.5-4.87h.01"></path>
                                </svg>
                            </a>
                            <a class="ml-3 text-gray-500">
                                <svg fill="currentColor" stroke="currentColor" stroke-  linecap="round"
stroke-linejoin="round"
                                    stroke-width="0" class="w-5 h-5" viewBox="0 0 24
 24">
                                      <path stroke="none"
                                          d="M16 8a6 6 0 016 6v7h-4v-7a2 2 0 00-2-2 2 2
0 00-2 2v7h-4v-7a6 6 0 016-6zM2 9h4v12H2z">
                                    </path>
                                    <circle cx="4" cy="4" r="2"
   stroke="none"></circle>
                                </svg>
                            </a>
                        </span>
                    </div>
                </footer>

<script src="./assets/js/iot.js"></script>
<script>
    function confirmLogout() {
        if (confirm('Are you sure to logout?')) {
            alert('logged out')
        }
    }
</script>
```

```
</body>
</html>
```

auth/index.php (Login and Signup)

```
<?php
   require      '../assets/includes/constants.php';      require
   '../assets/includes/functions.php'; session_start();
?>

<!DOCTYPE html>
<html>
<head>
   <title>Login/Signup</title>
   <meta charset="UTF-8">
   <meta name="viewport" content="width=device-width, initial-scale=1">
   <link rel="icon" href="./assets/images/Logo.png">
   <link rel="stylesheet" type="text/css" href="../assets/css/style.css">
   <link href="https://fonts.googleapis.com/css?family=Nunito:400,600,700,800&display=s wap"
rel="stylesheet">
</head>
<body>

   <?php
      if ($_SERVER["REQUEST_METHOD"] == "POST") {
         // Securing against Header Injection
         foreach($_POST as $key => $value){
            $_POST[$key] = _cleaninjections(trim($value));
         }

         $con = new mysqli($HOSTNAME, $DB_USERNAME, $DB_PASSWORD, $DB_NAME); if
         ($con->connect_error) exit(0);

         $devId = mysqli_real_escape_string(
            $con, clean_input($_POST['device-id'])
         );
         $password = mysqli_real_escape_string(
            $con, trim($_POST['password'])
         );

         if (isset($_POST['login-btn'])) {
            $q1 = "SELECT device_id FROM devices WHERE device_id = '$devId'";
            $res = $con->query($q1);

            if ($res->num_rows == 1) {
               $q2 = "SELECT * FROM users WHERE device_id = '$devId'";
               $res2 = $con->query($q2);

               if ($res2->num_rows == 1) {
                  $corr_pass = $res2->fetch_assoc()['password'];
```

```
                    if ($password === $corr_pass) {
                        $_SESSION['device'] = $devId;
                header("Location: ../index.php"); // Verify this statement
                } else {
                    echo "<script>alert('Incorrect password!')</script>";
                }
            } else {
                echo "<script>alert('Device not registered. Go to signup tab to register.')</script>";
            }
        } else {
            echo "<script>alert('Incorrect Device ID!')</script>";
        }
    }

        else if (isset($_POST['signup-btn'])) {
        $email = mysqli_real_escape_string(
        $con, filter_var(
                clean_input($_POST['email']), FILTER_SANITIZE_EMAIL
        )
    );

    $q1 = "SELECT device_id FROM devices WHERE device_id = '$devId'";
    $res = $con->query($q1);

    if ($res->num_rows == 1) {
        $q2 = "SELECT device_id FROM users WHERE device_id = '$devId'";
        $res2 = $con->query($q2);

        if ($res2->num_rows == 0) {
            $insQuery = "INSERT INTO users VALUES ('$devId', '$email', '$password')";

            if ($con->query($insQuery) === TRUE) {
                $_SESSION['device'] = $devId;
                header("Location: ../register"); // Verify this statement
            } else {
                echo "<script>alert('Signup failed.')</script>";
            }
        } else {
            echo "Device already registered. Proceed to login.";
        }
    } else {
        echo "<script>alert('Device with entered ID does not exist!')</script>";
    }

}
```

```
    }
  ?>
  <div class="cont">
    <div class="form  sign-in">
      <h2>Log In</h2>
      <form method="post" name="login-form" action="index.php">
        <label>
          <span>Device ID</span>
          <input type="text" name="device-id" required>
        </label>
        <label>
          <span>Password</span>
          <input type="password" name="password" required>
        </label>
        <button class="submit" id="login-btn" type="submit" name="login- btn">Log
In</button>
      </form>
      <p class="forgot-pass">Forgot Password ?</p>

      <div class="social-media">
        <ul>
          <a href="https://www.facebook.com/siescsdept/"><li><img src="../images/facebook.png"></li></a>
          <a href="https://twitter.com/siesonsfest?lang=en"><li><img src="../images/twitter.png"></li></a>
          <a href="https://in.linkedin.com/school/sies-college-of-arts- science-&-commerce-sion-
w-/"><li><img src="../images/linkedin.png"></li></a>
          <a href="https://www.instagram.com/sies_centre_for_excellence/?hl=en"><li><img
src="../images/instagram.png"></li></a>
        </ul>
      </div>
    </div>

    <div class="sub-cont">
      <div class="img">
            <div class="img-text m-up">
              <h2>New to our Site?</h2>
        <p>Welcome, be part of our mission to connect farmers and technology!</p>
      </div>
      <div class="img-text m-in">
        <h2>One of us?</h2>
        <p>Already has an account? Welcome Back!. We missed you!</p>
      </div>
      <div class="img-btn">
        <span class="m-up">Sign  Up</span>
        <span class="m-in">Log  In</span>
```

```
            </div>
        </div>
        <div class="form sign-up">
            <h2>Sign Up</h2>
            <form method="post" name="signup-form" action="index.php">
                <label>
                    <span>Device ID</span>
                    <input type="text" required name="device-id">
                </label>
                <label>
                    <span>Email</span>
                    <input type="email" required name="email">
                </label>
                <label>
                    <span>Password</span>
                    <input type="password" required name="password">
                </label>
                <label>
                    <span>Confirm Password</span>
                    <input type="password" required>
                </label>
                <button type="submit" id="signup-btn" class="submit" name="signup- btn">Sign Up
Now</button>
            </form>
        </div>
    </div>
  </div>
<script type="text/javascript" src="../assets/js/script.js"></script>
```

register/index.php (Plant details)

```
<?php
    require '../assets/includes/functions.php'; require
    '../assets/includes/constants.php'; session_start();

    if (!isset($_SESSION['device'])) {
        echo "<script>alert('Login')</script>";
        header("Location: ../auth"); exit();
    }

    if ($_SERVER['REQUEST_METHOD'] == 'POST') {
        // Securing against Header Injection
        foreach($_POST as $key => $value){
            $_POST[$key] = _cleaninjections(trim($value));
        }

        $con = new mysqli($HOSTNAME, $DB_USERNAME, $DB_PASSWORD, $DB_NAME); if
        ($con->connect_error) exit(0);

        if (isset($_POST['register'])) {
            $plant_name=mysqli_real_escape_string(
                $con, clean_input($_POST['plant-name'])
            );

            $insQuery = "INSERT INTO active_devices VALUES ('" .
$_SESSION['device'] .
            "', '$plant_name','" . $_POST['location'] . "', '," .
$_POST['num-days'] . ", 0, 0, 0, 0);";

            if ($con->query($insQuery) === TRUE) {
                echo "<script>alert('Registration successful')</script>";
                header("Location: ../index.php"); exit();
            } else {
                echo "<script>alert('Registration failed')</script>";
            }
        }
    }
?>

<!DOCTYPE html>
<html lang="en">
<head>
    <meta charset="UTF-8">
    <meta http-equiv="X-UA-Compatible" content="IE=edge">
    <meta name="viewport" content="width=device-width, initial-scale=1.0">
```

```
    <link rel="icon" href="./assets/images/Logo.png">
    <title>I2S</title>
    <link type="text/css" rel="stylesheet" href="../assets/css/style1.css">
</head>
<body>
    <!---------------------------------------------------Main Body----------------------------------------------------->
    <div class="container">
                <form action="index.php" method="post" name="registration-form">
            <!----------------------Registration---------------------->
            <h2>Plant Registration page</h2>
            <!-------------Content--------------->
            <div class="grid-container">
                <div class="pname">
                    <label for="pname">Plant Name </label>
                    <select id="pname" name="plant-name" required>
                        <option hidden selected>- select an option -</option>
                        <option value="sugarcane">Sugarcane</option>
                        <option value="rice">Rice</option>
                        <option value="wheat">Wheat</option>
                        <option value="bajra">Bajra</option>
                    </select>
                </div>

                <div class="sname">
                    <!-- <div class="sname">
                        <label for="sname">Soil Type</label>
                        <select id="sname" name="soil-type" required>
                            <option hidden selected>- select an option -
</option>
                            <option value="sname1">Sandy soil</option>
                            <option value="sname2">Slit soil</option>
                            <option value="sname3">Clay soil</option>
                            <option value="sname3">Loamy soil</option>
                        </select>
                    </div>                                          -->
                    <div class="Location">
                        <label for="Location">Location</label>
                        <select id="Location" name="location" required>
                            <option hidden selected>- select a Location -
</option>
                            <option value="Vidharba">Vidharba</option>
                            <option value="Konkan">Konkan</option>
                            <option value="Western Maharashtra">Western
Maharashtra</option>

Maharashtra</option>
```

```
<option value="Northern
Maharashtra">Northern

<option
value="Marathwaada">Marath
waada</option>
```

```
                        </select>
                    </div>


                        <div class="input-box">
                            <div class="fname">
                        <label for="num-days">No. of days past sowing:
</label>
                        <input type="number" name="num-days" required>
                        </div>
                    </div>
                </div>
                <div class="alert">
                    <input type="checkbox" name="agreement" required> I agree
                    with the <a href="Terms and
Conditions.txt">Terms</a>, <a href="privacy Policy.txt"> Privacy Policy</a> and <a href="cookies
policy.txt">Cookies Policy</a> .
                    <br> You may receive SMS notifications from us and can opt out at any
time.</p>
                </div>
                <div class="register">
                    <button type="submit" class="submit" name="register">Register</button>
                </div>
            </div>
        </form>
    </div>
</body>
```

Server Code

update_data/index.php (For logging sensor values)

```
<?php
	require '../assets/includes/functions.php'; require
	'../assets/includes/constants.php';

	if ($_SERVER['REQUEST_METHOD'] == 'POST') {
		// Securing against Header Injection
		foreach($_POST as $key => $value){
			$_POST[$key] = _cleaninjections(trim($value));
		}

		$devId = $_POST['device-id'];
		$password = $_POST['password'];

		if (empty($devId) || empty($password)) exit();

		$con = new mysqli($HOSTNAME, $DB_USERNAME, $DB_PASSWORD, $DB_NAME);

		$searchQuery = "SELECT * FROM devices WHERE device_id = '$devId' AND password =
'$password'";
		$res = $con->query($searchQuery);

		if ($res->num_rows != 1) exit();

		$growth_stage = $_POST['growth_stage'];
		$soil_moisture = $_POST['soil_moisture'];
		$temperature = $_POST['temperature'];
		$humidity = $_POST['humidity'];
		$rain_chance = $_POST['rain_chance'];

		if (empty($growth_stage) || empty($soil_moisture) ||
empty($temperature) || empty($humidity) || empty($rain_chance)) exit();

		$updateQuery = "UPDATE active_devices SET growth_stage='$growth_stage' AND
soil_moisture=$soil_moisture AND temperature=$temperature AND humidity=$humidity AND
rain_chance=$rain_chance WHERE device_id = '$devId'";
		$con->query($updateQuery);
	}

	else if ($_SERVER['REQUEST_METHOD'] == 'GET') {
	echo 'get<br/>';
		// Securing against Header Injection
```

```
foreach($_GET as $key => $value){
        $_GET[$key] = _cleaninjections(trim($value));
```

```
            }

            $devId = $_GET['device-id'];
            $password = $_GET['password'];
        echo  $devId . '<br/>';
            if (empty($devId) || empty($password)) exit();

            $con = new mysqli($HOSTNAME, $DB_USERNAME, $DB_PASSWORD, $DB_NAME);

            $searchQuery = "SELECT * FROM devices WHERE device_id = '$devId' AND password =
'$password'";
            $res = $con->query($searchQuery);

            if ($res->num_rows != 1) exit();

            $growth_stage = $_GET['growth_stage'];
            $soil_moisture = intval($_GET['soil_moisture']);
            $temperature = intval($_GET['temperature']);
            $humidity = intval($_GET['humidity']);
            $rain_chance = floatval($_GET['rain_chance']); echo
        $rain_chance . '<br/>';
            if (empty($growth_stage) || empty($soil_moisture) ||
empty($temperature) || empty($humidity) || empty($rain_chance)) exit();

            $updateQuery = "UPDATE active_devices SET growth_stage='$growth_stage',
soil_moisture=$soil_moisture, temperature=$temperature, humidity=$humidity,
rain_chance=$rain_chance WHERE device_id = '$devId'";
            $con->query($updateQuery);
return 'done';
        }
```

TESTING

Test Case:

Test Case ID	Description	Input	Expected Output	Actual Output	Pass/Fail
TC001	Detect Plant Species	Tomato plant	System recognizes tomato plant	System recognized tomato plant	Pass
TC002	Measure Soil Moisture	Soil moisture sensor reading	Moisture level displayed	Moisture level displayed	Pass
TC003	Calculate Water Requirements	Plant species, soil moisture level	Water required displayed	Water required displayed	Pass
TC004	Control Water Flow	Water flow control command	Water dispensed to plant	Water dispensed to plant	Pass
TC005	Handle Sensor Failures	Soil moisture sensor malfunction	Error message displayed	Error message displayed	Pass
TC006	Adjust Watering Schedule	Plant species, current weather conditions	Updated watering schedule	Updated watering schedule	Pass

SCOPE

Applications:

1. **Agriculture and Farming**: Large-scale farms can use intelligent irrigation systems to tailor watering schedules and amounts to different crops' specific needs. This can lead to more efficient water usage, increased crop yields, and reduced water wastage.
2. **Greenhouses and Nurseries**: Greenhouse operators and nursery owners can utilize plant-specific hydration systems to maintain optimal growing conditions for different types of plants. This ensures that each plant receives the right amount of water, contributing to healthier growth and better-quality produce.
3. **Urban Gardening and Landscaping**: In urban environments, where space is limited, intelligent irrigation systems can be used in community gardens, rooftop gardens, and landscaping projects. By customizing watering schedules based on plant species, these systems can help maintain green spaces efficiently.
4. **Research and Experimentation**: Botanical gardens, research institutions, and academic institutions can utilize plant-specific hydration systems to conduct experiments and studies on plant growth and water requirements. This can lead to valuable insights into plant biology and irrigation techniques.
5. **Environmental Conservation**: By optimizing water usage and reducing water wastage, intelligent irrigation systems contribute to environmental conservation efforts. This is particularly important in regions facing water scarcity or drought conditions, where efficient irrigation practices are crucial for sustainable agriculture and ecosystem health.

Future Improvements:

1. **Advanced Sensor Technology**: Integration of more advanced sensors, such as multispectral imaging or hyperspectral sensors, to provide detailed information about plant health and soil conditions. This would enable more precise adjustments to watering schedules based on real-time data.
2. **Machine Learning and AI Algorithms**: Utilization of machine learning algorithms to analyze historical data, weather patterns, and plant responses to optimize watering schedules dynamically. AI-powered systems can continuously learn and adapt to changing environmental conditions and plant requirements.
3. **Predictive Analytics**: Implementation of predictive analytics models to forecast future water requirements based on factors such as weather forecasts, plant growth stages, and historical data. This proactive approach can help prevent overwatering or underwatering and minimize water waste.
4. **Energy-Efficient Solutions**: Development of energy-efficient irrigation technologies, such as solar-powered pumps and controllers, to reduce reliance on grid electricity and minimize environmental impact.
5. **Water Recycling and Rainwater Harvesting**: Incorporation of water recycling systems and rainwater harvesting techniques to supplement irrigation water sources and reduce dependence on freshwater supplies.
6. **Advanced User Interfaces**: Design advanced user interfaces for irrigation system control panels and mobile applications, making it easier for users to manage watering schedules, view analytics, and receive alerts or notifications.

Conclusion:

The Intelligent Irrigation System for Plant-Specific Hydration represents a significant advancement in agricultural and horticultural practices, offering tailored solutions for optimizing water usage and promoting healthy plant growth. Through the integration of advanced sensor technology, AI algorithms, and IoT connectivity, these systems enable precise monitoring and control of watering schedules based on individual plant species' needs and environmental conditions.

The application of Intelligent Irrigation Systems extends beyond traditional farming to include urban gardening, landscaping, research, and environmental conservation efforts. By leveraging predictive analytics, variable rate irrigation, and energy-efficient solutions, these systems contribute to water conservation, improved crop yields, and sustainable water management practices.

Future enhancements such as advanced sensor technology, machine learning algorithms, and integration with weather stations and drones promise to further enhance the efficiency and effectiveness of Intelligent Irrigation Systems. These developments will enable proactive irrigation management, precise water application, and remote monitoring capabilities, leading to optimized resource utilization and environmental stewardship.

Overall, Intelligent Irrigation Systems (Project I2S) for Plant-Specific Hydration offer a promising solution to the challenges of water scarcity, climate variability, and food security, empowering growers, gardeners, and land managers to cultivate healthier plants while minimizing water waste and environmental impact. As technology continues to evolve, these systems will play a crucial role in shaping the future of agriculture and sustainable food production.