An Internship Report

On

AUTOMATIC PLANT IRRIGATION SYSTEM

Submitted in partial fulfilment of the requirements for the award of the degree of

BACHELOR OF TECHNOLOGY

In

COMPUTER SCIENCE AND ENGINEERING

By

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

VIGNAN'S NIRULA INSTITUTE OF TECHNOLOGY AND SCIENCE FOR WOMEN

PEDAPALAKALURU, GUNTUR-522005

(Approved by AICTE, NEW DELHI and Affiliated to JNTUK Kakinada.)

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VIGNAN'S NIRULA INSTITUE OF TECHNOLOGY AND SCIENCE FOR WOMEN

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

CERTIFICATE

This is to certify that the project entitled **"Automatic Plant Irrigation System"** is a bona fide work of **G. Tejaswi (22NN1A0515), G. Chaturya (22NN1A0519), G. Triveni (22NN1A0514), G. Charmila (22NN1A0522)** submitted to the faculty of Computer Science and Engineering, in the partial fulfilment of the requirements for the award of degree of **BACHELOR OF TECHNOLOGY** in **COMPUTER SCIENCE AND ENGINEERING** from **VIGNAN'S NIRULA INSTITUTE OF TECHNOLOGY AND SCIENCE FOR WOMEN, GUNTUR.**

Project Guide	Head of the Department
Dr. A. Naresh	Dr.V.Lakshman Narayana
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EXTERNAL EXAMINER
DECLARATION

We hereby declare that the work described in this project work, entitled "**Automatic Plant Irrigation System.**" which is submitted by us in partial fulfilment for the award of **Bachelor of Technology** in the **Department of Computer Science and Engineering** to the **Vignan's Nirula Institute of Technology and Science for women**, affiliated to Jawaharlal Nehru Technological University Kakinada, Andhra Pradesh, is the result of work done by us under the guidance of **Dr. A. Naresh**, Professor. The work is original and has not been submitted for any Degree/ Diploma of this or any other university.

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We express our heartfelt gratitude to our beloved principal **Dr. P. Radhika** for giving a chance to study in our esteemed institution and providing us all the required resources. We would like to thank **Dr. V Lakshman Narayana, Professor, Head of the Department of Computer science and Engineering**, for his extended and continuous support, valuable guidance and timely advices in the completion of this project thesis. We wish to express our profound sense of sincere gratitude to our Project Guide **Dr. A. Naresh, Professor, Department of Computer Science and Engineering**, without whose help, guidance and motivation this project thesis could not have been completed the project successfully. We also thank all the faculty of the Department of Computer Science and Engineering for their help and guidance of numerous occasions, which has given us the cogency to build-up adamant aspiration over the completion of our project thesis. Finally, we thank one and all who directly or indirectly helped us to complete our project thesis successfully.

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An Internship Report

On

DENSITYBASED TRAFFIC SIGNAL CONTROL SYSTEM

Submitted in partial fulfilment of the requirements for the award of the degree of

BACHELOR OF TECHNOLOGY

In

COMPUTER SCIENCE AND ENGINEERING

By

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AUTOMATIC PLANT IRRIGATION SYSTEM

TABLE OF CONTENTS

LIST OF FIGURES

ABSTRACT

The Automatic Plant Irrigation System project aims to enhance the efficiency of agricultural practices through automation. Traditional methods of irrigation often suffer from inefficiencies due to manual oversight and timing constraints. This project proposes a solution that leverages sensors, microcontrollers, and actuators to create an automated system capable of monitoring soil moisture levels and dispensing water accordingly. Key components include soil moisture sensors to measure the moisture content of the soil, a microcontroller (such as Arduino or Raspberry Pi) to process sensor data and make decisions based on predefined thresholds, and actuators (like water pumps or valves) to regulate water flow to plants. The system is designed to be adaptable, providing real-time feedback through sensors and adjusting irrigation schedules dynamically. By implementing this automated approach, the project aims to optimize water usage, reduce labor requirements, and improve crop yield by ensuring plants receive water precisely when needed, thus contributing to sustainable agricultural practices. Future enhancements may include integration with weather forecasting for more precise irrigation planning and scalability for larger agricultural settings. In agriculture, efficient water management is crucial for ensuring optimal crop growth and sustainability. Manual irrigation methods often lead to over- or under-watering, resulting in decreased crop yields and wastage of resources. To address these challenges, there is a growing interest in automated plant irrigation systems that can monitor soil conditions and adjust water supply accordingly. An embedded system is a computer system that is designed to Performa specific task or set of tasks. It is a combination of computer hardware and software that

is integrated into a larger system. Embedded systems are used in various applications such as home appliances, transportation, healthcare, business sector & offices, defense sector, aerospace, and agricultural sector. The three main components of an embedded system are hardware, software, and firmware. Hardware refers to the physical components of the system such as microprocessors or microcontrollers.

CHAPTER-1
INTRODUCTION

1.1 Introduction to Project

In agriculture, efficient water management is crucial for ensuring optimal crop growth and sustainability. Manual irrigation methods often lead to over- or under-watering, resulting in decreased crop yields and wastage of resources. To address these challenges, there is a growing interest in automated plant irrigation systems that can monitor soil conditions and adjust water supply accordingly. The Automatic Plant Irrigation System project proposes a technological solution to enhance irrigation practices by automating the process of watering plants based on real-time soil moisture data. By integrating sensors, microcontrollers, and actuators, this system aims to provide timely and precise irrigation to plants, thereby improving water efficiency and overall crop health. This project not only seeks to mitigate the labor-intensive nature of manual irrigation but also aims to optimize water usage by delivering water directly to plants when and where it is needed most. By leveraging advancements in sensor technology and automation, the system promises to contribute to sustainable agricultural practices by conserving water resources and enhancing crop productivity. In this introduction, we will explore the components and functionality of the Automatic Plant Irrigation System, its potential benefits for agriculture, and the technological framework that supports its operation. Additionally, we will discuss future prospects for expanding and refining this system to meet evolving agricultural needs and challenges.

Fig1.1 Automatic plant irrigation system

1.2 Introduction to Embedded System

An embedded system is a computer system that is designed to perform a specific task or set of tasks. It is a combination of computer hardware and software that is integrated into a larger system. Embedded systems are used in various applications such as home appliances, transportation, healthcare, business sector & offices, defense sector, aerospace, and agricultural sector. The three main components of an embedded system are hardware, software, and firmware. Hardware refers to the physical components of the system such as microprocessors or microcontrollers. Software refers to the programs that run on the hardware. Firmware is a type of software that is embedded in the hardware and is responsible for controlling the system. An Embedded system is a special- purpose system in which the computer is completely encapsulated.

Characteristics of Embedded System:

1. An embedded System is any computer system hidden inside a product other than a computer.
2. Throughput – Our system may need to handle a lot of data in short period of time.
3. Response – Our system may need to react to events quickly.
4. Test ability- Setting up equipment to test embedded software can be difficult.
5. .Debug ability- Without a screen or a keyboard, finding out what the software.
6. .Reliability – Embedded Systems must be able to handle any situation.
7. Memory Space - Memory is limited on Embedded Systems.
8. Power Consumption – Portable systems must run on battery power.

1.3. Introduction to IOT

INTERNET OF THINGS (IoT) is the networking of physical objects that contain electronics embedded within their architecture in order to communicate Interaction amongst each other or with respect to the external environment. In the upcoming years, IoT-based technology will offer advanced levels of services and practically away people lead their daily lives. Advancements in medicine, power, gene therapy agriculture, smart cities, and smart homes are just a very few of the categorical example where IoT is strongly established. IoT is network of interconnected computing devices which are embedded in everyday objects, enabling them to send and receive data. With more than 7 billion connected IOT devices today, experts are expecting this number to grow to 10 billion by 2020 and 22 billion by 2025. Oracle has a network of device partners.

Connectivity: Connectivity refers to establish a proper connection between all the things of IoT platform it maybe server or cloud. After connecting the IoT devices, it needs a high-speed messaging between the devices and cloud to enable reliable, secure and bi-directional communication.

Analyzing: After connecting all the relevant things, it comes to real-time analyzing the data collected and use them to build effective business intelligence. If we have a good insight into data gathered from all these things, then we call our system has a smart system.

Integrating: IOT integrating the various models to improve the user experience as well.

Artificial Intelligence: IOT makes things smart and enhances life through the use of data. For example, if we have a coffee machine whose beans have going to end, then the coffee machine it orders the coffee beans.

Sensing: The sensor devices used in IOT technologies detect and measure any change in the environment and report on their status. IOT technology brings passive networks to active networks. Without sensors, there could not hold an effective or true IOT environment.

Active Engagement: IoT makes the connected technology, product, or services to active engagement between each other.

Endpoint Management: It is important to be the endpoint management of all the IoT system otherwise, it makes the complete failure of the system. For example, if a coffee machine itself orders the coffee beans when it goes toned but what happens when it orders the beans from a retailer and we are not present at home for a few days, it leads to the failure of the IoT system.

1.4. Need of IoT

The Internet of Things (IoT) stands as a transformative force, reshaping our interactions with the world and revolutionizing diverse aspects of our daily lives. At its core, IoT thrives on connectivity, fostering seamless communication between devices and promoting interoperability. Through automation, IoT enhances efficiency by enabling devices to operate autonomously based on predefined conditions or real-time data, reducing the need for constant human intervention. In the realm of smart cities, IoT contributes to urban development by introducing intelligent transportation systems, energy management, and sustainable practices, thereby enhancing overall quality of life. Health care benefits from IoT through wearables and remote monitoring tools, offering personalized insights and timely interventions. Industries leverage Industrial IoT (IoT) to optimize manufacturing processes, monitor equipment health, and implement predictive maintenance strategies, leading to increased productivity and cost savings. From smart homes with connected appliances to environmental monitoring and supply chain optimization, IoT's impact is far-reaching, creating a more connected, efficient.

CHAPTER-2

LITERATURE SURVEY

2.1 Introduction:

Efficient water management in agriculture is increasingly recognized as a critical factor in ensuring food security and sustainability, particularly in the face of climate change and water scarcity challenges. Traditional methods of irrigation often rely on manual intervention and predetermined schedules, which can lead to inefficient water usage and suboptimal crop yields. In response to these issues, automated plant irrigation systems have emerged as a promising solution to enhance irrigation efficiency and reduce resource wastage. A literature survey reveals significant advancements and insights into various aspects of automatic plant irrigation systems. Researchers have explored different sensor technologies for measuring soil moisture, such as capacitance, resistance, and time-domain reflectometry sensors, each offering unique advantages in accuracy and reliability. The integration of these sensors with microcontrollers, such as Arduino and Raspberry, enables real-time data processing and decision-making to adjust irrigation schedules based on plant water requirements.

2.2 Basic System with Timer:

This is the simplest form where irrigation is controlled based on a timer. Watering intervals are pre-set and do not adjust dynamically based on soil moisture levels. A basic timer system for automatic plant irrigation provides a straightforward yet effective solution to enhance plant care through automated watering. By integrating essential components and following systematic implementation steps, you can create a reliable system that contributes to healthier and thriving plants in your project. In conclusion, implementing a basic timer system for an automatic plant irrigation project offers a practical and effective solution to ensure plants receive water at regular intervals without manual intervention. This system leverages a microcontroller, relay module, and optionally sensors like water level or soil moisture sensors to automate the watering process. In essence, a basic timer system for automatic plant irrigation optimizes plant care by automating watering processes, thereby fostering healthier and more resilient vegetation while minimizing resource wastage. Its simplicity and effectiveness make it suitable for various applications, from small home gardens to larger agricultural projects, offering a sustainable solution for maintaining plant vitality.

2.3 Sensor – Activated System:

A literature review focusing on sensor-activated systems for automatic plant irrigation would cover research and practical applications related to sensor technologies, their integration into irrigation systems, control algorithms, and the impact on water management efficiency. The conclusion for a literature review on sensor- activated systems for automatic plant irrigation would summarize key findings and insights drawn from the reviewed literature. Sensor-activated systems represent a transformative approach to irrigation management, offering precise control and significant water savings. Continued research and development are essential to overcome existing challenges and unlock the full potential of sensor technology in agriculture.

2.4 Microcontroller-Based System (Arduino, Raspberry Pi):

Utilizes a microcontroller to process sensor data and control irrigation actuators (such as solenoid valves or water pumps). This system can be programmed to adjust watering schedules based on real-time sensor readings. Implementing a microcontroller-based system, such as Arduino or Raspberry Pi, for an automatic plant irrigation system introduces significant advantages in automation, customization, and efficiency. Microcontrollers are designed to operate efficiently, minimizing power consumption while maintaining continuous operation. This aspect is crucial for sustainable agriculture practices. In conclusion, microcontroller-based systems represent a robust solution for automatic plant irrigation, combining technological sophistication with practical usability. They empower growers with precise control over irrigation processes, promoting plant health, resource conservation, and operational efficiency in agricultural and horticultural applications. As advancements in microcontroller technology continue, these systems promise even greater capabilities in optimizing water management and enhancing agriculture. Small-scale home gardens to large agricultural setups. They support modular expansions and enhancements, accommodating future upgrades or additions of sensors and actuators as needed.

2.5 Solar-Powered System:

Implements solar panels to power the irrigation system, reducing dependency on grid electricity and making it suitable for remote or off-grid locations. Implementing a solarpowered system for an automatic plant irrigation project offers compelling advantages in sustainability, reliability, and cost-effectiveness. Solar- powered systems are suitable for remote locations where access to electricity may be limited. They provide autonomy and flexibility in irrigation management without dependency on infrastructure. Once installed, solar-powered systems have minimal operating costs since they rely on free solar energy. This reduces long-term expenses associated with traditional electricity-powered systems. Solar-powered system for automatic plant irrigation represents a sustainable and efficient solution for modern agriculture. It combines renewable energy technology with advanced irrigation techniques to enhance crop yields, conserve water resources, and mitigate environmental impact. As solar technology continues to evolve, these systems promise even greater efficiency and affordability, making them an ideal choice for growers seeking reliable and environmentally responsible irrigation solutions.

2.6 Hydroponic System:

Specifically designed for soil-less cultivation, these systems automate nutrient and water delivery to plants grown in nutrient-rich water solutions. In conclusion, implementing a hydroponic system for an automatic plant irrigation project offers numerous benefits, including efficient water usage, optimal nutrient delivery, and improved plant growth. This sustainable approach not only conserves water but also enhances crop yields while reducing maintenance efforts. By harnessing technology to automate irrigation based on plant needs, such systems ensure consistent and healthy plant development. Overall, integrating hydroponics into an automatic irrigation setup represents a forward-thinking solution for modern agriculture, promising both environmental and productivity advantages. The number of ways to implement an Automatic Plant Irrigation System can be conceptualized as the different combinations and configurations of these systems.

2.7 LITERATURE REVIEW:

A literature review for an automatic plant irrigation system project would typically cover research and studies related to various aspects of such systems, including sensor technology, control systems, water management, and plant physiology. Here's a structured outline to guide your review:

Basic System with Timer:

For a literature review focusing on a basic automatic plant irrigation system with a timer, you would explore foundational research and practical applications related to such systems. In conclusion, implementing a basic timer system for an automatic plant irrigation project offers a practical and effective solution to ensure plants receive water at regular intervals without manual intervention. This system leverages a microcontroller, relay module, and optionally sensors like water level or soil moisture sensors to automate the watering process. In essence, a basic timer system for automatic plant irrigation optimizes plant care by automating watering processes, thereby fostering healthier and more resilient vegetation while minimizing resource wastage. Its simplicity and effectiveness make it suitable for various applications, from small home gardens to larger agricultural projects, offering a sustainable solution for maintaining plant vitality.

Sensor – Activated System:

A literature review focusing on sensor-activated systems for automatic plant irrigation would cover research and practical applications related to sensor technologies, their integration into irrigation systems, control algorithms, and the impact on water management efficiency. The conclusion for a literature review on sensor- activated systems for automatic plant irrigation would summarize key findings and insights drawn from the reviewed literature. Sensor-activated systems represent a transformative approach to irrigation management, offering precise control and significant water savings. Continued research and development are essential to overcome existing challenges and unlock the full potential of sensor technology in agriculture. Implementing sensor-activated irrigation systems can contribute to sustainable agricultural practices, ensuring efficient resource use and environmental stewardship. Sensor-activated systems play a crucial role in modern agriculture by enabling precise and efficient irrigation management. Soil moisture sensors are widely used and have demonstrated effectiveness in optimizing water use and improving crop yield. Integration of weather and environmental sensors enhances irrigation scheduling by considering real-time weather condition.

Microcontroller-Based System (Arduino, Raspberry Pi):

A literature review on microcontroller-based systems using platforms like Arduino and Raspberry Pi encompasses a broad range of applications across various fields. This aspect is crucial for sustainable agriculture practices. In conclusion, microcontrollerbased systems represent a robust solution for automatic plant irrigation, combining technological sophistication with practical usability.

Solar-Powered System:

A literature review on solar-powered systems covers a wide range of applications across various fields, from renewable energy generation to practical implementations in different sectors. Implementing a solar-powered system for an automatic plant irrigation project offers compelling advantages in sustainability, reliability, and cost-effectiveness. Solar-powered systems are suitable for remote locations where access to electricity may be limited. They provide autonomy and flexibility in irrigation management without dependency on infrastructure. Once installed, solar-powered systems have minimal operating costs since they rely on free solar energy. This reduces long-term expenses associated with traditional electricity-powered systems. Solar- powered system for automatic plant irrigation represents a sustainable and efficient solution for modern agriculture. It combines renewable energy technology with advanced irrigation techniques to enhance crop yields, conserve water resources, and mitigate environmental impact. As solar technology continues to evolve, these systems promise even greater efficiency and affordability, making them an ideal choice for growers seeking reliable and environmentally responsible irrigation solutions.

Hydroponic Systems:

A literature review on solar-powered systems for hydroponic systems explores the integration of renewable energy with soilless agriculture techniques, focusing on sustainability, energy efficiency, and practical applications. By harnessing technology to automate irrigation based on plant needs, such systems ensure consistent and healthy plant development. Overall, integrating hydroponics into an automatic irrigation setup represents a forward-thinking solution for modern agriculture, promising both environmental and productivity advantages. The number of ways to implement an Automatic Plant Irrigation System can be conceptualized as the different combinations and configurations of these systems and technologies. Depending on budget, environmental factors, crop type, and the desired level of automation, the system can be tailored to meet specific needs. Each approach offers its own advantages and challenges, contributing to the overall flexibility and adaptability of automated irrigation solutions in modern agriculture.

CHAPTER-3

DESIGNED SYSTEM

3.1Introduction

In contemporary agriculture, efficient water management is crucial for ensuring optimal crop growth and sustainability. Automatic plant irrigation systems offer a promising solution by leveraging technology to monitor soil moisture levels and deliver water precisely when and where plants need it most. This project aims to design and implement an automatic plant irrigation system using state-of-the-art technologies to enhance water use efficiency and promote sustainable farming practices. Efficient water management in agriculture is increasingly recognized as a critical factor in ensuring food security and sustainability, particularly in the face of climate change and water scarcity challenges. Traditional methods of irrigation often rely on manual intervention and predetermined schedules, which can lead to inefficient water usage and suboptimal crop yields. In response to these issues, automated plant irrigation systems have emerged as a promising solution to enhance irrigation efficiency and reduce resource wastage. A literature survey reveals significant advancements and insights into various aspects of automatic plant irrigation systems. Researchers have explored different sensor technologies for measuring soil moisture, such as capacitance, resistance, and time- domain reflectometry sensors, each offering unique advantages in accuracy and reliability. The integration of these sensors with microcontrollers, such as Arduino and Raspberry Pi, enables real-time data processing and decision-making to adjust irrigation schedules based on plant water requirements.

3.2 Objectives:

The main objectives of an Automatic Plant Irrigation System project are as follows:

1.Efficient Water Usage

- Ensure optimal water consumption by supplying water to plants only when needed, minimizing wastage.

2.Automation

- Automate the irrigation process to reduce manual intervention and labor requirements.

3.Improved Plant Health

- Provide consistent and timely watering, promoting healthier plant growth and reducing the risks of under- or over-watering.

4.Energy Efficiency

- Design a system that consumes minimal energy, often integrating solar panels or other renewable energy sources.

5.Adaptability

- Ensure the system is adaptable for different types of plants, soil conditions, and environmental factors.

6.Cost-Effectiveness

- Develop a system that is affordable to build and maintain, making it accessible for small-scale farmers and gardeners..

7.Ease of Use

- Provide a user-friendly interface for monitoring and controlling the system, such as through mobile apps or IoT integration.

8.Monitoring and Alerts

- Include sensors and real-time monitoring to detect soil moisture levels and provide alerts for system issues or unusual conditions.

3.3 Block Diagram:

Watering plants manually can be labor-intensive and often leads to under- or overwatering, which can harm plant growth. An automatic irrigation system solves these challenges by automatically supplying water based on the moisture level in the soil.

Fig1.2: Block Diagram on Automatic Plant Irrigation System

3.4Tools Required:

3.4.1 Hardware Components

3.4.1.1 Water Motor

3.4.1.2 Soil Moisture Sensor

3.4.1.3 LCD (Liquid Crystal Display)

3.4.1.4 Relays

- Power Supply
- Micro Controller or Development Board

3.4.2 Soft Ware Requirements

Arduino IDE

IDE2.Thingspeak

3.4.3. Techniques Used

Implementing an automatic plant irrigation system involves integrating various techniques and methodologies to ensure efficient water management and optimal plant health. Here are some key techniques commonly used in such projects: **Soil Moisture Sensing:**

Sensor-based Irrigation: Utilize soil moisture sensors to measure the moisture content in the soil. This data helps in determining when and how much to irrigate. Sensors can be placed at different depths to monitor moisture levels accurately.

Weather Monitoring and Forecasting:

Integration with Weather Data: Incorporate weather forecasting data (e.g., temperature, humidity, rainfall predictions) to adjust irrigation schedules accordingly. This helps in avoiding unnecessary watering during rainy periods or adjusting irrigation based on temperature changes.

Evapotranspiration (ET) Monitoring:

ET-based Irrigation: Calculate evapotranspiration rates to estimate the water loss from the soil and plants due to evaporation and transpiration. This data is used to schedule irrigation to replenish the lost water effectively**.**

Automation and Control Systems:

Microcontroller or IoT Integration: Use microcontrollers (e.g., Arduino, Raspberry Pi) or IoT platforms to automate irrigation processes based on sensor inputs. Control actuators like water pumps or valves to start and stop irrigation cycles as per preset conditions.

Flow Control and Pressure Regulation:

Optimized Water Flow: Employ flow control valves and pressure regulators to maintain consistent water delivery rates. This prevents over-irrigation or underirrigation by ensuring that water is distributed evenly across the irrigation system.

Mulching and Soil Management:

Mulch Application: Apply mulch around plants to reduce soil evaporation and maintain soil moisture levels. This complements irrigation efforts by conserving water and enhancing plant health.

Data Logging and Analysis:

Monitoring and Optimization: Log sensor data over time and analyze it to optimize irrigation schedules and improve water use efficiency.

Remote Monitoring and Control:

IoT Connectivity: Enable remote monitoring and control of the irrigation system using IoT technology. This allows users to monitor plant conditions and system status remotely, as well as adjust irrigation schedules based on real-time data.

Implementation Considerations

Scalability: Design the system to be scalable, allowing for easy expansion as the garden or farm grows.

Reliability: Ensure robustness in sensor readings, actuators control, and communication to avoid system failures.

User Interface: Develop a user-friendly interface for monitoring, configuring, and controls the irrigation system.

Maintenance: Plan for regular maintenance and calibration of sensors and actuators to ensure accurate operation over time.

3.5WORKING:

Working on a project for an automatic plant irrigation system involves several key steps and considerations. Here’s a structured approach to get you started:

Define Requirements and Objectives:

- **Identify Goals**: Determine the scope of your project—whether it’s for a small garden or a larger agricultural setting.
- **Specify Requirements**: List out what functionalities your system needs (e.g., soil moisture sensing, weather integration, automation capabilities).
- **Set Objectives**: Clearly define what outcomes you aim to achieve, such as water conservation, improved plant health, or ease of maintenance.

Design and Planning:

- **Sensor Placement**: Decide where and how many soil moisture sensors and other environmental sensors (e.g., temperature, humidity) you need and where they will be placed.
- **Irrigation Strategy**: Plan how the system will determine when and how much water to deliver to plants based on sensor data and other inputs (e.g., weather forecasts).
- **Power Supply**: Determine the power requirements and sources (e.g., battery, solar) for your system components.

Implementation:

- **Hardware Assembly**: Build the physical components of your system, including connecting sensors, actuators (e.g., water pump, valves), and microcontroller.
- **Software Development**: Write code to read sensor data, process it, and control actuators. Use appropriate programming tools and libraries (e.g., Arduino IDE, Python).

Testing and Debugging:

a. Functional Testing: Test each component individually and then the system as a whole to ensure operate correctly.

b. Simulation and Validation: Use simulations or controlled experiments to validate the system's performance under different conditions (e.g., varying soil moisture levels). C. c. **c. debugging**: Address any issues or bugs encountered during testing and refine the System accordingly.

Continuous Improvement:

a. **Iterative Development**: Consider future enhancements or additional features (e.g., automated fertilization, more sensors) based on feedback and evolving needs.

b. **Community and Knowledge Sharing**: Share your project experience with others, contribute to forums or communities, and learn from similar projects to enhance your skills and knowledge.

ADVANTAGES:

1. Efficient Water Usage

- Delivers water precisely where and when it is needed, minimizing wastage.
- Prevents over-watering and under-watering, conserving water resources.

2. Time and Labor Saving

- Reduces the need for manual watering, saving time and effort.
- Especially beneficial for large-scale farms and busy gardeners.

3. Consistent Plant Growth

- Provides uniform and timely watering, ensuring healthier and more productive plants.
- Reduces plant stress caused by inconsistent watering.

4. Cost-Effective in the Long Term

- Lowers water bills and labor costs over time.
- Minimal supervision required after installation, reducing recurring expenses.

5. Energy Efficiency

- Can integrate solar panels or other renewable energy sources for eco-friendly operation.
- Consumes less power compared to traditional irrigation methods.

6. **Environmental Sustainability**
   - Helps in water conservation and reduces soil erosion caused by over-irrigation.
   - Promotes sustainable agricultural and gardening practices.
7. **Scalability and Flexibility**
   - Easily adaptable for various setups, from small home gardens to large agricultural fields.
   - Can be customized for different soil types, plant needs, and climatic conditions.

CHAPTER-4

HARDWARE IMPLEMENTATION

4.1 Node MCU ESP8266

4.1.1 Description

Node MCU ESP8266 Description Node MCU is an open-source firmware for which opensource prototyping board designs are available. The name “Node MCU” combines “node” and “MCU” (micro-controller unit). The term “Node MCU” strictly speaking refers to the firmware rather than the associated development kits. Both the firmware and prototyping board designs are open source. Node MCU ESP8266 and Node MCU ESP32 are becoming very popular and are almost used in more than 50% IoT based projects today.

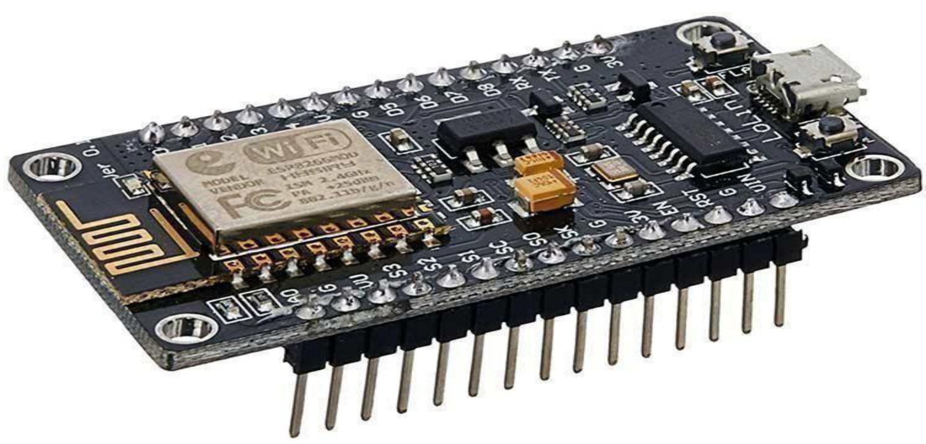

Fig 4.1: Node MCU

The firmware uses the Lua scripting language. The firmware is based on the Elua project and built on the Espresso Non-OS SDK for ESP8266. It uses many open-source projects, such as Lacson and SPIFFS. Due to resource constraints, users need to select the modules relevant for their project and build a firmware tailored to their needs. Support for the 32-bit ESP32 has also been implemented. The prototyping hardware typically used is a circuit board functioning as a dual in-line package (DIP) which integrates a USB controller with a smaller surface-mounted board containing the MCU and antenna. The choice of the DIP format allows for easy prototyping on breadboards. Integrates a USB controller with a smaller surf prototyping on breadboards. The design was initially was based on the ESP-12 module of the ESP8266, which is a WIFI SoC integrated with Aten silica Xtensa LX106 core, widely used in IoT applications.

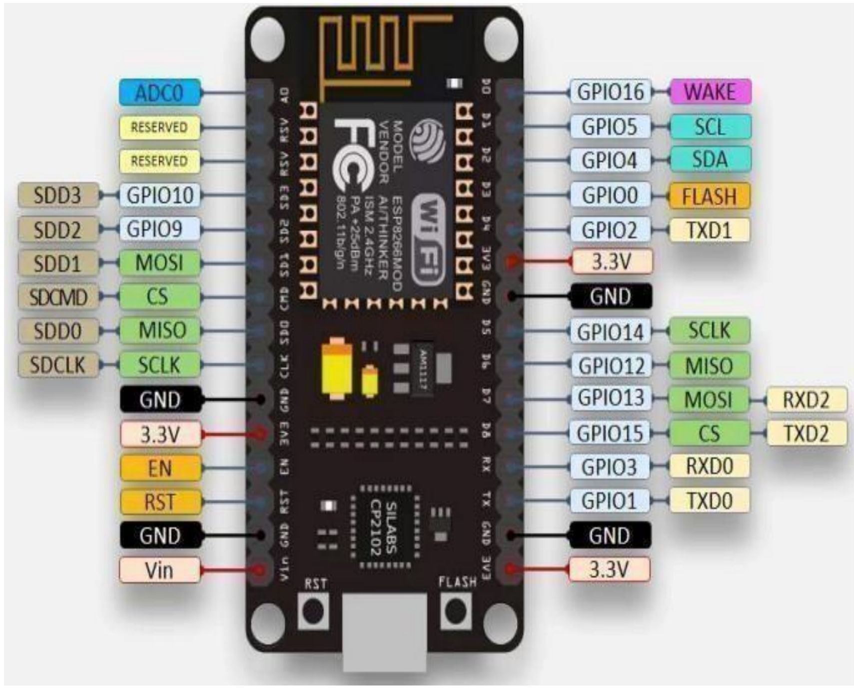

Fig 4.2: Pin Diagram of Node MCU

4.1.2 Node MCU ESP8266 Features: Microcontroller: Ten silica 32-bit RISC

CPU XtensaLX106Operating Voltage: 3.3V Input

Voltage: 7- 12V Digital I/O Pins (DIO): 16

Analog Input Pins (ADC):

1UARTs: 1

SPIs: 1

I2Cs: 1

Flash Memory: 4

MBSRAM: 64 KB

Clock Speed: 80 MHz

USB-TTL based on CP2102 is included onboard, Enabling Plug n Play Cantina Small

Sized module to fit smartly inside your IoT projects

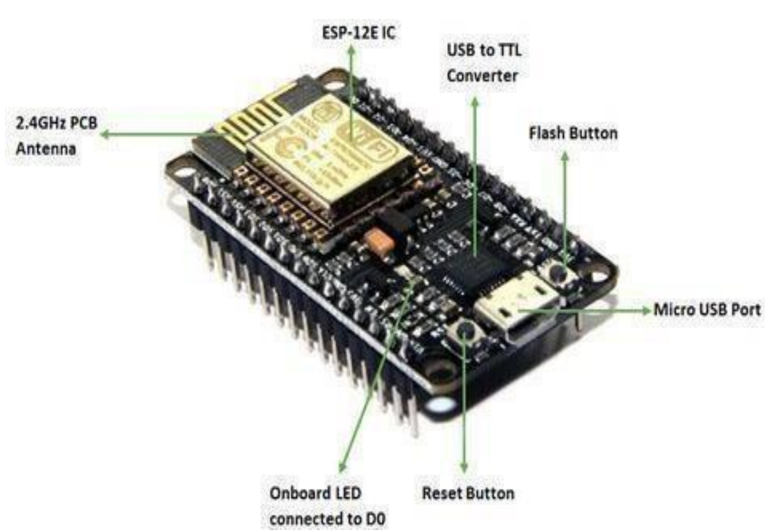

Fig 4.3: Layout of the Node MCU

4.1.3 Node MCU ESP8266 Pinout:

For practical purposes ESP8266 Node MCU V2 and V3 boards present identical pinouts.

While working on the Node MCU based projects we are interested in the following pins.

Power pins (3.3 V).

Ground pins (GND).

Analog pins(A0).

Digital pins (D0 – D8, SD2, SD3, RX, and TX – GPIO XX)

Most ESP8266 Node MCU boards have one input voltage pin (Vin), three power pins (3.3v), four ground pins (GND), one analog pin (A0), and several digital pins (GPIO XX).

Pin Code Arduino alias

A0

D0 GPIO 16 16

D1 GPIO 5 5

D2 GPIO 4 4

D3 GPIO 0 0

D4 GPIO 2 2

D5 GPIO 14 14

D6 GPIO 12 12

4.2 Relay

Arely is an electrical switch that is operated by an electromagnet. It is used to control high voltage or high-current circuits using a low-voltage or low-current control signal. Here's a brief description and working principle of a relay:

4.2.1 Description

Electromagnetic Switch: A relay consists of an electromagnetic coil and a set of contacts (switches). These contacts can be either normally open (NO) or normally closed (NC)

Coil and Contacts: When a voltage is applied to the coil, it generates a magnetic field, which causes the contacts to move and make or break an electrical connection.

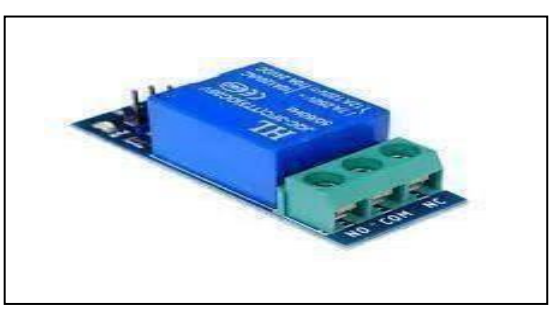

Fig4.4: Relay pin

Types of Relays: There are various types of relays, including electro mechanical relays, solid-state relays (SSRs), and reed relays, each with specific applications and characteristics.

4.2.2 Working Principle

Normally Closed (NC): In its resting state, the NC contacts are closed, allowing current to flow through the circuit. Normally Open (NO): In its resting state, the NO contacts are open, interrupting the current flow in the circuit. Energizing the Coil: When a lowvoltage control signal is applied to the relay coil, it creates magnetic field, which either attracts or repels the contacts depending on the relay type. Switching Operation: If it's an NC relay, applying the control signal opens the contacts, breaking the circuit. If it's an NO relay, applying the control signal closes the contacts, completing the circuit. Isolation and Protection: Relays provide electrical isolation between the control circuit and the high-voltage/high-current circuit, which helps protect sensitive control electronics.

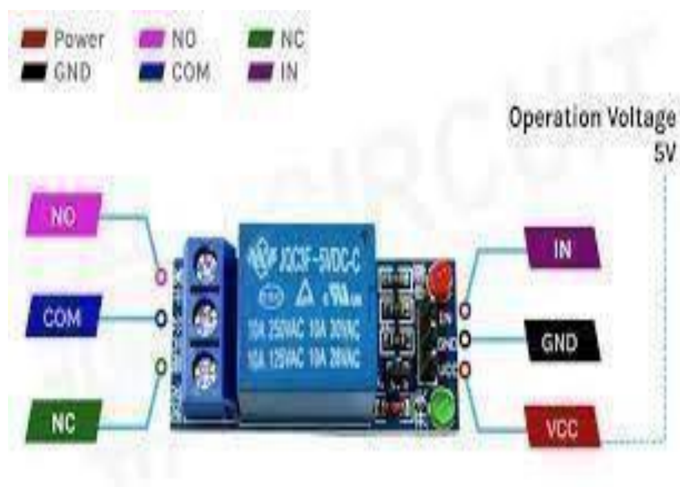

Fig4.5: Layout of Relay

4.2.3 Features

Voltage/Current Amplification: Relays allow small control signals, such as those from microcontrollers or sensors, to control larger loads like motors, heaters, or lights.

Electrical Isolation: They provide isolation between the control circuit and the load, enhancing safety and preventing interference.

Versatility: Relays are used in a wide range of applications, from home automation to industrial control systems.

Longevity: Electro mechanical relays can have a long operational life, making them suitable for many industrial applications.

Solid-State Relays (SSRs): These relays use semiconductor components (no moving parts) and are often used for high-speed switching, with the advantage of silent operation and faster response times.

4.3 Liquid Crystal Display

A liquid-crystal display (LCD) is a flat-panel display or other electronically modulated optical device that uses the light-modulating properties of liquid crystals combined with polarizers. Liquid crystals do not emit light directly but instead use a backlight or reflector to produce images in color or monochrome.

4.3.1 Description

A **liquid-crystal display** (**LCD**) is a flat-panel display or other electronically modulated optical device that uses the light-modulating properties of liquid crystals combined with polarizers. Liquid crystals do not emit light directly but instead use a backlight or reflector to produce images in color or monochrome. LCDs are available to display arbitrary images (as in a general-purpose computer display) or fixed images with low information content, which can be displayed or hidden: preset words, digits, and seven-segment displays (as in a digital clock) are all examples of devices with these displays. They use the same basic technology, except that arbitrary images are made from matrix of small pixels, while other displays have larger elements.

Liquid Crystal Display

LCDs are used in a wide range of applications, including LCD televisions, computer monitors, instrument panels, aircraft cockpit displays, and indoor and outdoor signage. Small LCD screens are common in LCD projectors and portable devices such as digital cameras, watches, calculators, and mobile telephones, including smartphones. LCD screens have replaced heavy, bulky and less energy-efficient cathode-ray tube (CRT) displays in nearly all applications.

Fig 4.5: LCD Display

e.g., the table frame for an airline flight schedule on an indoor sign. LCDs do not have this weakness, but are still susceptible to image persistence.

4.3.2 Working

An LCD panel is made of many layers. These consist of a polarizer, polarized glass, LCD fluid, conductive connections etc. Polarization is a process in which the vibration of light waves is restricted to a single plane, resulting in the formation of light waves known as polarized light. Since liquid crystals do not produce light of their own, they need an external light source to work. An LCD panel has sets of polarized glass consisting of liquid crystal materials in between them. When the external light passes through one of the polarized glasses and electric current is applied on the liquid crystal molecules, they align themselves in such a way that polarized light travels from the first layer to the second polarized glass, causing an image to appear on the screen.

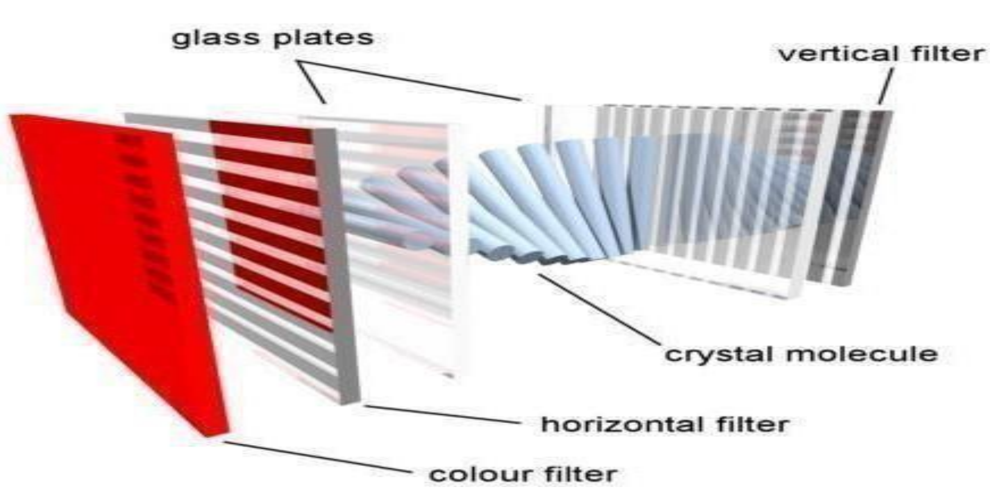

Fig4.6: LCD Layers

CHAPTER-5

SOFTWARE IMPLEMENTATION

5.1 Arduino IDE

5.1.1 Introduction to Arduino IDE

IDE stands for Integrated Development Environment - An official software introduced by Arduino.cc that is mainly used for writing, compiling and uploading the code in almost all Arduino modules/boards. Arduino IDE is open-source software and is easily available to download & install from Arduino Official Site. In this post, I'll take you through the brief Introduction of the Software, how you can install it, and make it ready for your required Arduino module. Let's dive in and get down to the nitty-gritty of this Software.

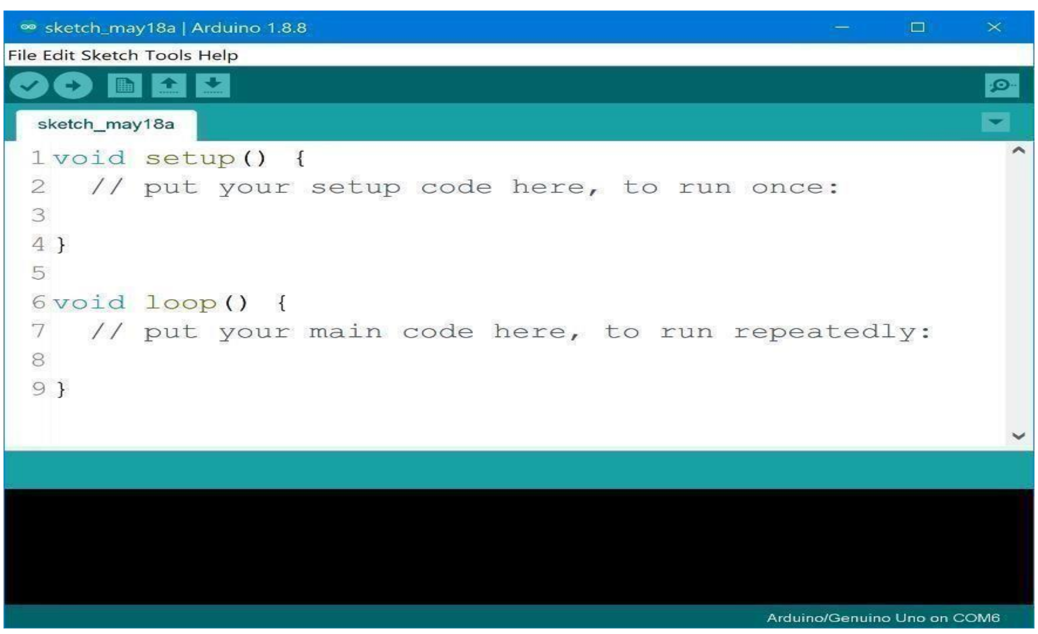

Fig 5.1: Arduino IDE Editor page

Arduino IDE is an open-source software, designed by Arduino.cc and mainly used for writing, compiling & uploading code to almost all Arduino Modules. This environment supports both C and++ languages.

5.1.2 How to Download Arduino IDE

You can download the Software from Arduino main website. As I said earlier, the software is available for common operating systems like Linux, Windows, and MAX, so make sure you are downloading the correct software version that is easily compatible with your operating system.8.1or Windows 10, as the app version is not compatible with Windows 7 or older version of this operating system. You can download the latest version of Arduino IDE for Windows (Non admi standalone version), by clicking below.

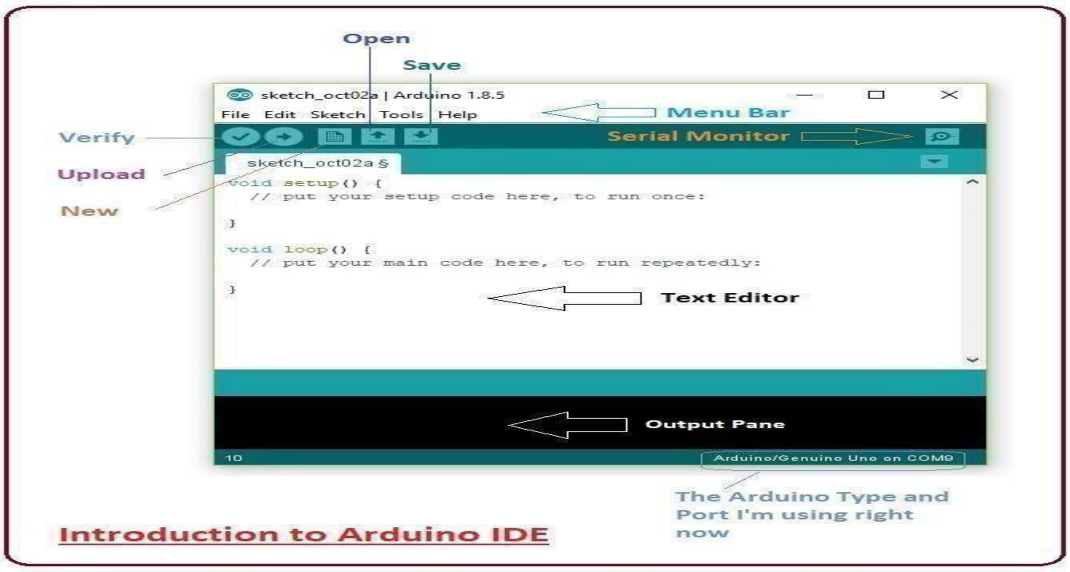

Fig5.2: Arduino IDE

The bar appearing on top is called Menu Bar that comes with five different options as File - You can open a new window for writing the code or open an existing one. The following table shows number of further subdivisions the file option is categorized.

File	
New	This is used to open new text editor window to write your code
Open	Used for opening the existing written code
Open Recent	The option reserved for opening recently closed program
Sketchbook	It stores the list of codes you have written for your project
Examples	Default examples already stored in the IDE software
Close	Used for closing the main screen window of recent tab. If two tabs are open, it will ask you again as you aim to close the second tab
Save	It is used for saving the recent program
Save as	It will allow you to save the recent program in your desired folder
Page setup	Page setup is used for modifying the page with portrait and landscape options. Some default page options are already given from which you can select the page you intend to work on
Print	It is used for printing purpose and will send the command to the printer
Preferences	It is page with number of preferences you aim to setup for your text editor page
Quit	It will quit the whole software all at once

Fig 5.3: File subdivision

As you go to the preference section and check the compilation section, the Output Pane will show the code compilation as you click the upload button.

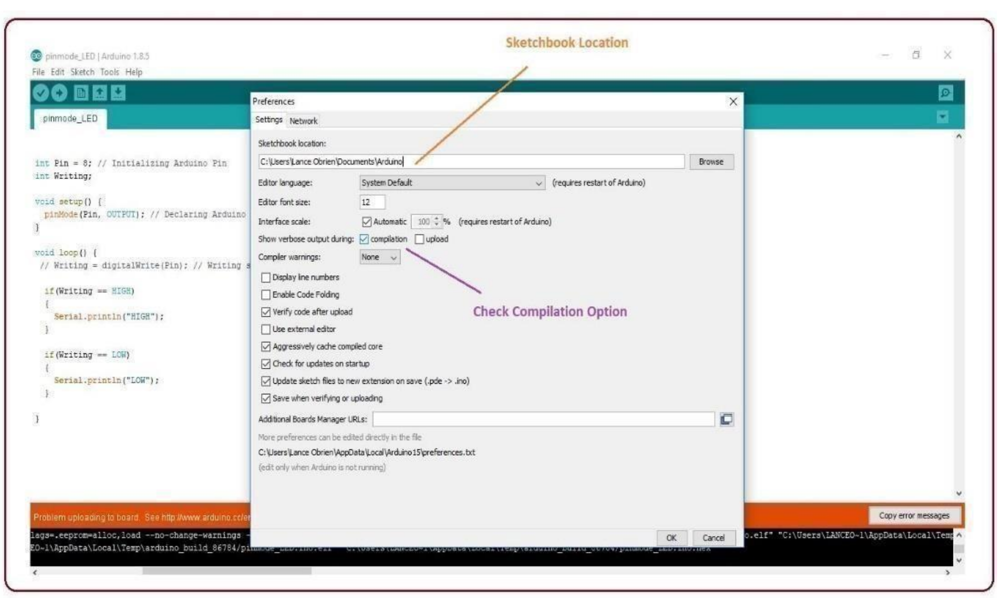

Fig 5.4: Selection of compilation

And at the end of the compilation, it will show you the hex file it has generated for sketch that will send to the Arduino Board for the specific task you aim to achieve.

- Tools - Mainly used for testing projects. The Programmer section in this panel is used forburning boot loader to the new microcontroller.
- Help - In case you are feeling Edit - Used for copying and pasting the code with further modification for font
- skeptical about software, complete help is available from getting started to troubleshooting.
- The Six Buttons appearing under the Menu tab are connected with the running program as follow
- The check mark appearing in the circular button is used to verify the code. Click this once you have written your code. The arrow key will upload and transfer the required code to the Arduino board.
- The dotted paper is used for creating a new file.
- The upward arrow is reserved for opening an existing Arduino project.
- The downward arrow is used to save the current running code.

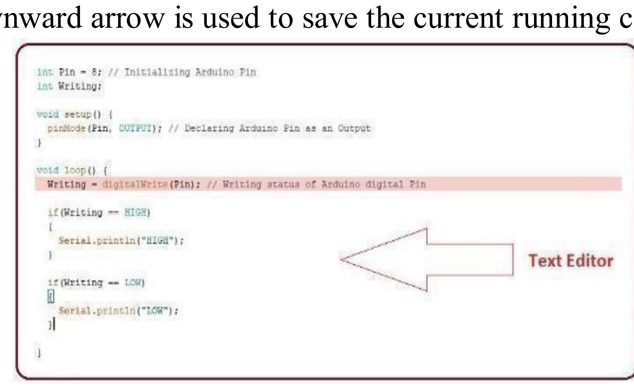

Fig 5.6: Text editor

5.1.3 Libraries

- Libraries are very useful for adding extra functionality into the Arduino Module.
- There is a list of libraries you can check by clicking the Sketch button in the menu bar and going to Include Library.
- As you click the Include Library and Add the respective library it will be on the top of the sketch with a #include sign. Suppose, I Include the Liquid Crystal library, it will appear on the text editor as #include <Liquid Crystal. h>. However, you can also download them from external sources.

5.1.4 Making Pins Input or Output.

The digital Read and digital Write commands are used for addressing and making the Arduino pins as an input and output respectively. These commands are text sensitive i.e., you need to write them down the exact way they are given like digital Write starting with small "d" and write with capital "W". Writing it down with Digital Write or digital Write won't be calling or addressing any function.

5.1.5 How to Select the Board

- In order to upload the sketch, you need to select the relevant board you are using and the ports for that operating system.

- As you click the Tools on the menu, it will open like the figure below:

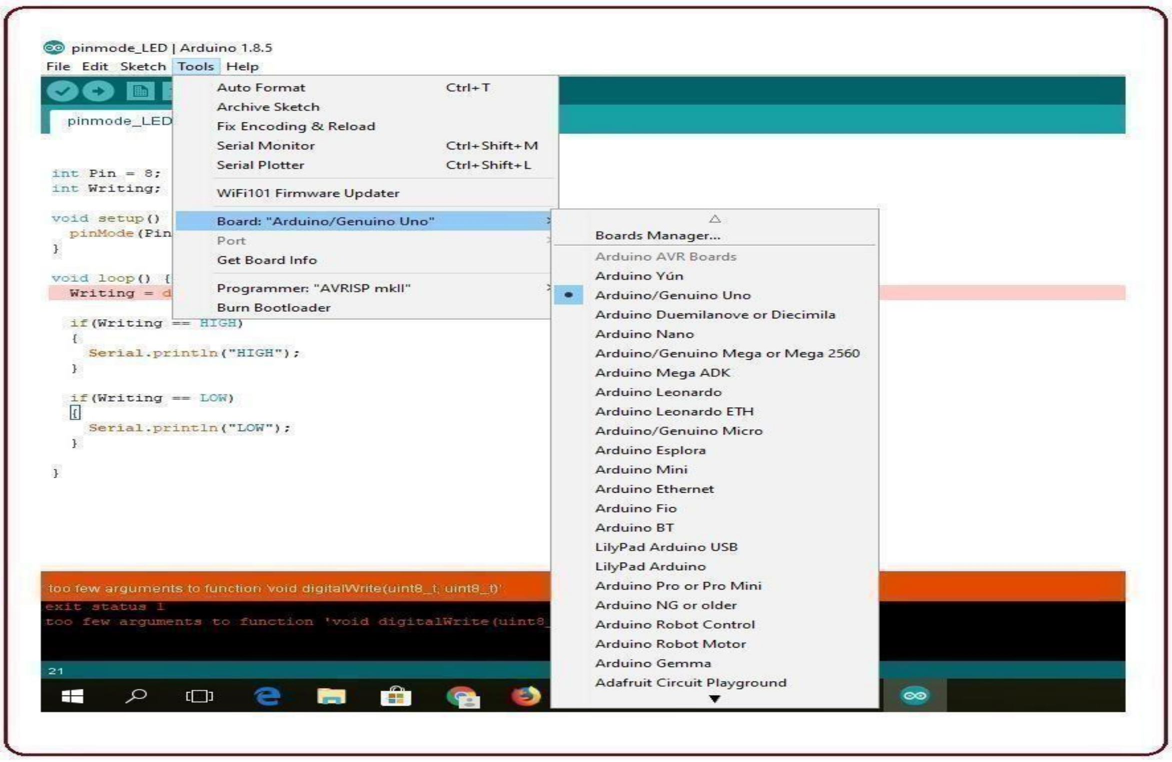

Fig 5.7: Selection of board manager

- Just go to the "Board" section and select the board you aim to work on. Similarly, COM1, COM2, COM4, COM5, COM7 or higher are reserved for the serial and USB board. You can look for thelusu serial device in the port section of the Windows Device Manager.
- The following figure shows the COM4 that I have used for my project, indicating the Arduino Uno with the COM4 port at the right bottom corner of the screen.
- Note: The port selection criteria mentioned above are dedicated to Windows operating system only, you can check this Guide if you are using MAC or Linux.

5.1.6 Uploading

After writing your code, click on the upload button which is above the window and the code will be directly uploaded into the Node MCU with a cable wire connector.

CHAPTER-6
RESULT

The **Automatic Plant Irrigation System using IoT** project demonstrated several significant results and benefits:

1. **Optimized Water Usage**: The automated system effectively monitored soil moisture levels and adjusted irrigation schedules, leading to more efficient water use. This reduced water waste and ensured that plants received adequate hydration based on real-time soil conditions.
2. **Increased Crop Yield**: By providing precise watering, the system contributed to healthier plant growth and improved crop yields. The reduced manual intervention allowed for consistent care, leading to better overall plant health.
3. **Reduced Labor Requirements**: Automation minimized the need for manual irrigation, saving time and labor. This allowed farmers and gardeners to focus on other important tasks while the system handled the irrigation process.

4. **Real-Time Monitoring and Control**: Integration with Thing Speak enabled realtime monitoring of soil moisture levels and water usage. The graphical representation of data provided valuable insights into irrigation efficiency and system performance.
5. **Adaptability and Scalability**: The system's design allowed for easy adaptation to different types of plants and soil conditions. Future enhancements could include integration with weather forecasting tools to further refine irrigation scheduling and scalability for larger agricultural operations.
6. **Educational Value**: The project provided hands-on experience with IoT components, including ESP8266 microcontrollers, soil moisture sensors, and actuators. It also offered practical insights into the development and deployment of IoT-based solutions.

Fig5.8: Result Image

Optimized Water Usage: Automatic systems use sensors to detect soil moisture levels and only irrigate when necessary. This prevents over-watering, which is a common issue in manual irrigation methods.

Precise Water Delivery: Systems can deliver water directly to the root zone of plants, minimizing evaporation losses and ensuring efficient water use.

Consistent Moisture Levels: Maintaining optimal soil moisture levels promotes.

CHAPTER-7
CONCLUSION

The implementation of an automatic plant irrigation system provides an efficient, costeffective, and reliable solution for modern agricultural and gardening practices. By integrating sensors, microcontrollers, and actuators, the system ensures that plants receive adequate water based on real- time soil moisture and environmental conditions. This reduces water wastage, promotes healthy plant growth, and minimizes manual labor. The system delivers precise amounts of water only when needed, conserving resources and reducing utility costs. Automation eliminates the need for manual watering, saving significant time for users. Such systems can be scaled to suit small gardens, urban landscaping, or large-scale agricultural fields. Reduced water consumption contributes to sustainable practices and less strain on local water supplies. Overall, the automatic plant irrigation system represents a smart, sustainable approach to addressing challenges in agriculture and horticulture, fostering innovation while meeting the growing demand for food security and environmental conservation. The automatic plant irrigation system ensures efficient watering by using sensors to monitor soil moisture and deliver water as needed. This reduces water wastage, saves time, and promotes healthy plant growth. It is a cost-effective, scalable solution suitable for both small gardens and large agricultural fields, contributing to sustainable water management and environmental conservation. The automatic plant irrigation system simplifies and optimizes the watering process by using sensors to monitor soil moisture and automate water delivery. It reduces water waste, lowers manual labor, and ensures plants receive adequate hydration for healthy growth. The automatic plant irrigation system ensures efficient watering by using sensors to monitor soil moisture and deliver water as needed. This reduces water wastage, saves time, and promotes healthy plant growth. It is a cost-effective, scalable solution suitable for both small gardens and large agricultural fields, contributing to sustainable water management and environmental conservation.

CHAPTER-8

FUTURE SCOPE

The Automatic Plant Irrigation System using IoT has several exciting possibilities for future development and enhancement. Here are some ideas for expanding the project:

Future Scope

1. Integration with Weather Forecasting:

Enhanced Irrigation Scheduling: Incorporate weather forecasts to adjust irrigation schedules based on anticipated rainfall or temperature changes. This helps in optimizing water usage and preventing overwatering. **2. Data Analytics and Machine Learning**:

Predictive Analytics: Use machine learning algorithms to analyze historical data and predict future irrigation needs based on trends, weather patterns, and plant growth stages.

Anomaly Detection: Implement machine learning models to detect anomalies or malfunctions intha system, such as leaks or sensor failures.

3. Mobile and Web Applications:

User Interface: Develop mobile or web applications to allow users to monitor and control the irrigation system remotely. Users could receive notifications, adjust settings, and view real-time data. **4. Scalability and Modular Design**:

Expand to Larger Systems: Design the system to be modular, allowing it to scale up for use in larger agricultural settings, such as farms or greenhouses.

Multiple Zones: Implement the ability to manage multiple irrigation zones independently, catering to different types of plants with varying water requirements. **5. Integration with Smart Home Systems**:

Home Automation: Integrate with smart home platforms like Google Home or Amazon Alexa to provide voice control and automation features. **6. Soil Health Monitoring**:

Additional Sensors: Incorporate sensors to monitor soil pH, temperature, and nutrient levels, providing a more comprehensive view of soil health and allowing for more precise irrigation and fertilization.

7. **Energy Efficiency**:

Solar Power: Explore the use of solar panels to power the irrigation system, making it more sustainable and reducing reliance on conventional power sources.

8. **Water Quality Monitoring**:

Contamination Detection: Add sensors to detect water quality issues such as contamination or nutrient imbalances, ensuring the water being used is suitable for plant

CHAPTER-9
SOURCE CODE

```
/*
WriteMultipleFields
Description: Writes values to fields 1,2,3,4 and status in a single ThingSpeak update every
20 seconds.Hardware: ESP8266 based boards
!!! IMPORTANT - Modify the secrets.h file for this project with your network connection
and ThingSpeakchannel details. !!!
Note:
- Requires ESP8266WiFi library and ESP8622 board add-on. See
https://github.com/esp8266/Arduino for details.
- Select the target hardware from the Tools->Board menu
-This example is written for a network using WPA encryption. For WEP or WPA, change
the WiFi. begin()
Call accordingly.
ThingSpeak ( https://www.thingspeak.com ) is an analytic IoT platform service that allows
you to aggregate, visualize, and analyze live data streams in the cloud. Visit
https://www.thingspeak.com to sign up for a free account and create a channel.
Documentation for the ThingSpeak Communication Library for Arduino is in the
README.md folder where the library was installed.
See https://www.mathworks.com/help/thingspeak/index.html for the full
ThingSpeak documentation. For licensing information, see the accompanying license
Copyright 2020, The MathWorks, Inc.
*/ #include
<ESP8266WiFi.h>
#include "secrets.h"
#include"ThingSpeak.h"
#include <LiquidCrystal_I2C.h>
LiquidCrystal_I2C lcd(0x27,16,2); // always include thingspeak header file after other
header files and custom across
char ssid[] = "Narzo 50 pro"; // your network SSID (name)char pass[] = "ammu@1234";
// your network password
int keyIndex = 0; // your network key Index number
(needed only for WEP)WiFiClient client; unsigned long myChannelNumber =
2599962; const char * myWriteAPIKey = "LGOEJOPV6Q7R1GZB";
// Initialize our values int
number1 = 0; int number2 =
random(0,100);
```

```
int number3 = random(0,100); i
nt number4 = random(0,100);
String myStatus = "";
const int led=D5;
const int ldr=A0; int
a; void setup()
{
pinMode(led, OUTPUT);
pinMode(ldr, INPUT);
lcd.begin();
lcd.backlight();
 Serial.begin(115200);
// Initialize serialwhile (!Serial)
{
// wait for serial port to connect. Needed for Leonardo native USB port only }
WiFi.mode(WIFI_STA);
ThingSpeak.begin(client);
// Initialize ThingSpeak
}    void
loop()
{
// Connect or reconnect to WiFi if(WiFi.status() != WL_CONNECTED)
WiFi.begin(ssid, pass); // Connect to WPA/WPA2 network. Change this line if using open
or WEP network Serial.print("."); delay(5000);
}
Serial.println("\nConnected.");
}

// set the fields with the values ThingSpeak.setField(1, a); ThingSpeak.setField(2,
number2);    ThingSpeak.setField(3,    number3);    ThingSpeak.setField(4,
 number4); a=analogRead(ldr);
Serial.println(a);
delay(500);
if(a<500) {
lcd.setCursor(20);
lcd.print(" Low level ");
digitalWrite(led, HIGH);
}  else  if(a>500  &&
a<700)
{     lcd.setCursor(2,0);
lcd.print("Medium level");
digitalWrite(led, HIGH);
```

```
}

else if(a>500 && a<700)
{        lcd.setCursor(2,0);
lcd.print("Medium
level");   digitalWrite(led,
HIGH);
}    else    if(a>700    &&
a<1000)
{     lcd.setCursor(2,0);
lcd.print("High level ");
digitalWrite(led, LOW);
}

// figure out the status messageif(number1 >number2)
{  myStatus  =  String("field1  is  greater  than
field2");
} else if(number1 < number2){ myStatus =
String("field1 is less than field2");
} else{ myStatus = String("field1 equals
field2");
}
// set the status ThingSpeak.setStatus(myStatus);

// write to the ThingSpeak channel
Int      x       =       ThingSpeak.writeFields(myChannelNumber,    myWriteAPIKey);
if(x == 200)
{
Serial.println("Channel update successful.");
} else{
Serial.println("Problem updating channel. HTTP error code " + String(x));
}
// change the values
number1++;
if(number1 > 99)
{ number1 = 0; } number2
=             random(0,100);
number3 = random(0,100);
number4 = random(0,100);
delay(20000); // Wait 20 seconds to update the channel again
}
```

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CERTIFICATES

INTERNSHIP COMPLETION CERTIFICATE

PROUDLY PRESENTED TO:

Gavara Tejaswi

Student of Vignan's Nirula Institute of Technology and Science for Women, Reg No: 22NN1A0515 has successfully completed an Internship on IOT Internship (13-05-2024 to 06-07-2024) program at Vijayawada. During her internship program with us, She was found punctual, hardworking and inquisitive.

This certificate was awarded by:

Md. Mobina

MOBINA MD

Managing Director

PURPLE TECHNOLOGIES

PTS

06-07-2024

Issue Date

INTERNSHIP COMPLETION CERTIFICATE

PROUDLY PRESENTED TO:

Gudipudi Chaturya

Student of Vignan's Nirula Institute of Technology and Science for Women, Reg No: 22NN1A0519 has successfully completed an Internship on IOT Internship (13-05-2024 to 06-07-2024) program at Vijayawada. During her internship program with us, She was found punctual, hardworking and inquisitive.

This certificate was awarded by:

Md. Mobina

MOBINA MD

Managing Director

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INTERNSHIP COMPLETION CERTIFICATE

PROUDLY PRESENTED TO:

Gajula Triveni

Student of Vignan's Nirula Institute of Technology and Science for Women, Reg No: 22NN1A0514 has successfully completed an Internship on IOT Internship (13-05-2024 to 06-07-2024) program at Vijayawada. During her internship program with us, She was found punctual, hardworking and inquisitive.

This certificate was awarded by:

Md. Mobina

MOBINA MD

Managing Director

06-07-2024

Issue Date

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INTERNSHIP COMPLETION CERTIFICATE

PROUDLY PRESENTED TO:

Gunji Charmila

Student of Vignan's Nirula Institute of Technology and Science for Women, Reg No: 22NN1A0522 has successfully completed an Internship on IOT Internship (13-05-2024 to 06-07-2024) program at Vijayawada. During her internship program with us, She was found punctual, hardworking and inquisitive.

This certificate was awarded by:

Md. Mobina

MOBINA MD

Managing Director

06-07-2024

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