# Smart System for Plants Using IOT & AI

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***Abstract*— As we know, Internet of Things (IOT) and the internet have completely taken over today's world. Only a selected few gadgets, such as PCs and smartphones, are internet-connected in the modern world. All humans utilize the internet to fulfil basic needs. The network of actual items is known as the Internet of Things (IOT). It simply refers to the act of keeping an eye on a machine or physical object. It can also refer to the interconnection of physical objects that have been embedded with electronics, sensors, software, and network connectivity to enable them to provide better value and services by exchanging data with their creators. This project is envisioned as an IOT-based plant monitoring system. We employed a variety of modules in this project, including IOT, temperature, moisture, and humidity sensors.**

***Keywords—IOT, Humidity, Moisture, Monitoring, Temperature etc.***

## I. INTRODUCTION

In order to preserve the ecological cycle and preserve the food chain's pyramid, plants are crucial. Every area of the human lifestyle has been altered and improved by the lightning speed development of technology, especially the agriculture sector. Many these days like to continue using the internet while engaging in daily tasks like cooking, watching television, etc. The Internet of Things (IOT) and artificial intelligence are the main game-changers in the agriculture industry, though there are hundreds of other helpful technologies as well.

People suffer from hunger in developing nations like Asia and south-east Asia due to a lack of food. However, solely a lack of food supplies caused the deaths of close to 10 million people. Farmers still favor traditionaltechnology over cutting-edge tools, which has resulted in a decrease in food production. Some people wanted to cultivate in their gardens to supply the needs for regular meals. The identified problem can be resolved with the aidof IOT and AI technology.

Setting up cross-device connectivity over the internet is the idea underlying IOT technology. It is a sizable network that links people and various connected objects in order to gather and share data. The sensors that are incorporated into connected devices are linked to IOT platforms, allowing access to the devices' data and application of various analytics to produce and show useful information from the data. An IOT-based solution for the plant monitoring system was suggested by the IOT and AI-based system.

Temperature, humidity, and light intensity are the variables employed in this study. Moreover, data kept on a cloud server can be accessed via a smartphone. IOT-based solutions to categorized plant illnesses and track current conditions like air quality, soil moisture, pH, and temperature. The AI model is used to categorize the shape, texture, and color aspects.

## II. PROBLEM FORMULATION

The majority of people rely on agriculture, which is the backbone of our nation. Water scarcity is the fundamental problem in agriculture. Water is squandered because the resources are not utilized effectively. The irrigation process can be mechanized to get around this. Water waste will be decreased because to the application of the Internet of Things in this area. Sensors are used to measure the temperature, humidity, and light, and based on the results, additional processing can be done. We suggest a system that will use various sensors to record all the information about the soil and temperature. Using network infrastructure, IOT enables remote sensing or control of items. As a result, accuracy, financial gains, and efficiency increase while human intervention decreases. We will discuss the fundamental ideas of IOT as well as its potential in the future in this system.

### OBJECTIVE

The following are this paper's primary objectives:

- Design and development of an IOT-based real-time plant monitoring system that uses machine learning to make predictions.
- IOT data is collected and stored on real-time cloud servers.
- Statistical parameters are used to track and assess how well the model is working in practice.

## III. LITERATURE SURVEY

In India, 35% of the land was effectively irrigated. And the monsoon provides water to about two thirds of the area. The use of irrigation increases agricultural output, decreases reliance on the monsoon, increases food security, and creates more employment opportunities in rural regions. Farmers are having issues with their irrigation system, namely how much water has to be supplied and when. Crop damage and water waste can occasionally result from overwatering. So, we must keep an approximate water level in the soil to prevent such harm.

***C. Verdouw et. al. 2019,*** In this study, plant roots are equipped with humidity, wetness, and temperature sensors. A gateway unit (ESP8266) manages sensor data and transmits it to an Android application. This application was created to estimate the values of temperature, humidity, and moisture sensors that were programmed into a microcontroller to regulate the amount of water.

***M. A. Zamora-Izquierdo, et. al. 2019,*** A review article According to an IOT-based plant monitoring system[2], 35% of the land in India has reliable irrigation. Moreover, the monsoon provides water to around two thirds of the land. The use of irrigation increases agricultural output, decreases reliance on the monsoon, increases food security, and creates more employment opportunities in rural regions. Farmers are having issues with their irrigation system, namely how much water has to be supplied and when. Crop damage and water waste can occasionally result from overwatering. So, we must keep an approximate water level in the soil to prevent such harm.

***N. Ahmed, et. al. 2018,*** A review article Prototyping is the initial phase in creating an Internet of Things (IOT) product, according to Internet of Things and Node MCU[3]. User interface, hardware devices such as sensors, actuators, and CPUs, backend software, and connection make up an IOT prototype. Prototyping is done using an IOT microcontroller unit (MCU) or development board. Low-power CPUs used in IOT microcontroller units (MCUs) or development boards allow for numerous programming environments, the firmware-based collection of data from sensors, and the transmission of raw or processed data to a local or cloud-based server. NodeMCU is a firmware for the ESP8266 Wi-fi chip that is open source and based on the LUA programming language.

## IV. CONCEPT AND METHODOLOGY

### *A. Block Diagram*

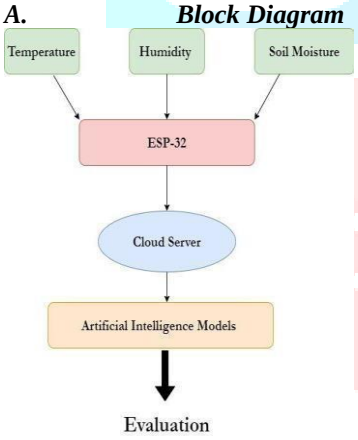



Fig.1. Block Diagram of system

### *B. Working of system*

A. **Sensors:** In this study, three environmental parameters, including ambient temperature, humidity, and soil moisture, are monitored using two different types of sensors. Following is a discussion of the sensors:

**a. DHT11:** The DHT11 is a sensor that measures both humidity and temperature. The sensor has a specialized negative temperature coefficient for sensing temperature. This sensor has been factory pre-calibrated and is prepared to connect to any processing device. It is sufficient to measure the humidity and temperature in the ranges of 0% to 500°C and 20% to 90%, respectively.

**b. Soil Moisture Sensor:** To gauge the amount of moisture in the soil, soil moisture is utilized. This sensor has two metallic pads that serve as both a variable resistor and a sensor probe. A portion of the water is carried by these two lengthy pads inside the soil. The amount of water affects the conductivity between the pads, the amount of resistance, and the voltage that leaves the sensor.

**c. Processing Unit**: Any type of IOT system's main component is the processing unit. It is used to gather data from the sensors, transform it into usable form, and then assist in transferring it to the cloud or other devices via Bluetooth or Wi-Fi. The primary processing component in this project is the ESP32, which aids in capturing sensor data before processing and sending it to ThingSpeak cloud.

**d. IOT Cloud Server**: An open source IOT platform called Server offers an API that allows users to send, save, and retrieve data via the protocol. The multi sensor data logging, supplying GPS co- ordinates, and social network of objects are the major servicesoffered by the server platform.

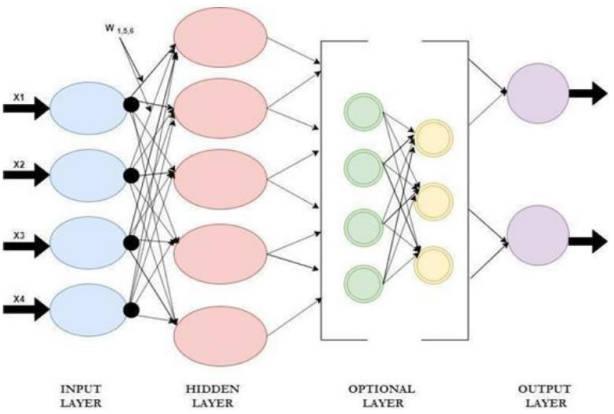
**e. Artificial Intelligence Models**: There are AI models used in this project.

**Evaluation Parameters**: In this project, performance evaluation of the models is performed using statistical methods.

### *C. Artificial Intelligence Models*

Artificial Neural Network (ANN):-

Artificial Neural Network (ANN) is an AI research domain using machine learning. We started research towards ANN and presented a mathematical model of the establishment and refinement of neuronal activities in the brain. The diagram illustrated the learning procedure of the human brain with the use of reinforcement learning. The main purpose behind the research in the domain of ANN is to construct a machine learning-based system that can study and analyze the bioelectrical activities and biological model of the brain. ANN architecture for supervised learning is presented as follows (Figure 1). ANN architecture is categorized into four different layers: Input Layer, Hidden Layer, Optional Layer, and Output Layer. The input layer consists of input elements that represent the independent variables. In the hidden Layer, weighted connection is set up between the nodes in the adjacent layer and also works as a processing layer. Optional layers are the hidden processing layer used for extra processing if required. Output layer consists of more than one layer to represent or show the dependent layer. In the given architecture, every input element is associated with all other processing elements in the hidden layer and further connected repeatedly until it reaches the output layer.



### *D. a. Components Used*

- Arduino 328p Controller
- LCD display
- IOT module
- Relay Board
- Moisture sensor
- Temperature and Humidity sensor
- Adapter
- Other

### *b. Software tools*

- 1PROTEUS IDE
- HI-TECH compiler
- C- Language

## V. RESULTS & DISCUSSION

We can automate many different home appliances by establishing communication between them using the Internet of Things. Routine domestic duties can be automated to save time and to better organize a person's lifestyle. The goal of this project was to design a sensor-based circuit that makes use of the Internet of Things concept, monitors and analyses the data produced by the sensors, and alerts the user to changes in the conditions of the plant. This inexpensive plant monitoring device is mostly used for domestic use. Also, it is kind of an intriguing idea because the plant may request water and protection anytime it requires them.

Results from the experiment are discussed in this section. The built module to collect data from sensors, process it, and register every value at a server cloud is shown in Figure 4.

Fig. 2. Project Model

Fig.3. Project is in ON testing Condition


Fig. 4 Sensor Values shown on LCD display

Figure 4 shows the information entered into the server cloud. Three separate variables, including atmospheric temperature, humidity, and soil moisture, are used in this investigation. Figure 6 shows the deployed module in a real- time setting to gather data for additional analysis.
In Table 1. Values derived from sensors in tabular form

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| S.No | Temperature | Humidity | Moisture | Date |
|---|---|---|---|---|
| 1 | 31 | 34 | Dry | 2023-02-27 12:46:12 |
| 2 | 31 | 34 | Dry | 2023-02-27 12:45:23 |
| 3 | 31 | 34 | Dry | 2023-02-27 12:44:34 |
| 4 | 31 | 35 | Dry | 2023-02-27 12:43:45 |
| 5 | 30 | 35 | Dry | 2023-02-27 12:42:56 |
| 6 | 30 | 35 | Dry | 2023-02-27 12:42:07 |
| 7 | 30 | 34 | Dry | 2023-02-27 12:32:21 |
| 8 | 30 | 34 | Dry | 2023-02-27 12:31:32 |
| 9 | 30 | 35 | Dry | 2023-02-27 12:30:42 |
| 10 | 30 | 35 | Dry | 2023-02-27 12:29:53 |
| 11 | 29 | 37 | Dry | 2023-02-27 11:55:03 |
| 12 | 29 | 32 | Dry | 2023-02-23 12:53:57 |
| 13 | 35 | 85 | Dry | 2023-02-20 15:44:52 |
| 14 | 38 | 29 | Dry | 2023-02-20 15:44:24 |
| 15 | 38 | 35 | Dry | 2023-02-20 15:44:03 |
| 16 | 30 | 58 | Dry | 2023-02-20 15:43:18 |
| 17 | 29 | 35 | Wet | 2023-02-20 15:42:44 |
| 18 | 29 | 35 | Wet | 2023-02-20 15:42:23 |
| 19 | 32 | 85 | Dry | 2023-02-20 14:29:54 |
| 20 | 29 | 36 | Dry | 2023-02-20 14:29:23 |

Fig. 5. Collected Data at server cloud from different sensors.

Data is taken from the cloud of servers. putting pre- processing techniques to use to get rid of any useless or empty values. The dataset will be ready for dividing into train and test sets in the following step. The prepared dataset is subjected to two distinct modelling techniques, including ANN and SVM. The dataset, which is divided into an 80:20 train:test set ratio, is based on time series that include variables for air temperature, humidity, and soil moisture. The RMSE and MAE values for the ANN and SVM, respectively, are 27.2188 and 42.1498 and 31.9681 and
34.9675 correspondingly.

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mart Greenhouses.
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recision Farming.
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ata Analytics.

## VIII. CONCLUSION

A system to track temperature, humidity, and soil moisture level was developed, and this project offers a chance to examine the current systems, their benefits and shortcomings. One of the activities that uses the most water is agriculture. The suggested system can be used to automate irrigation by turning the motor on or off based on the health of the plants, or sensor values. Which is one of the farming operations that uses the least amount of time and prevents soil from being over or under irrigated, preventing crop damage. Via an android app, the farm owner may keep an eye on the procedure online. Notwithstanding this project's limitations, it can be said that automation and the Internet of Things can significantly advance farming.

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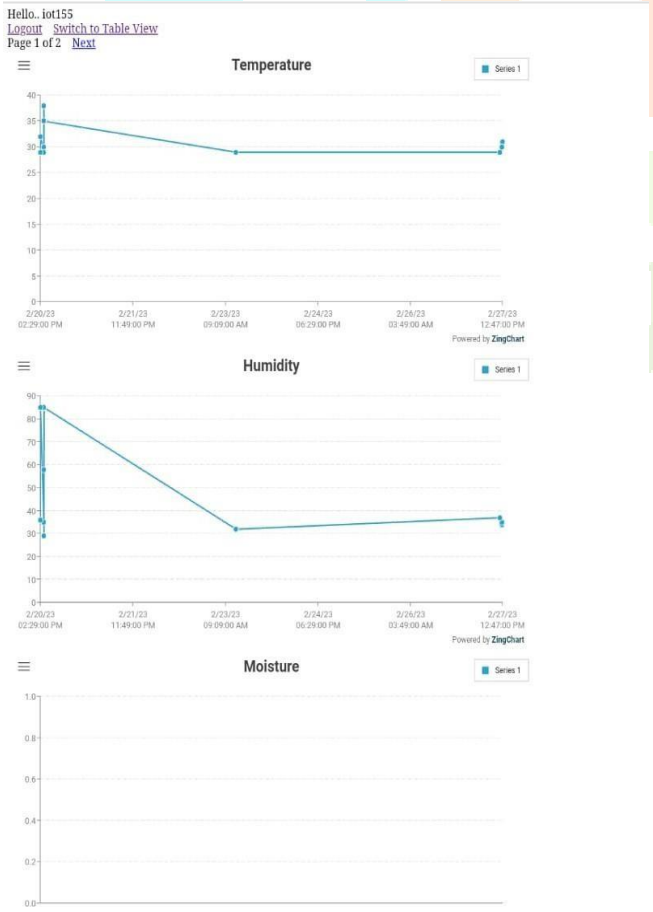


Fig.6. Collected Data at server cloud from different sensors.

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A system to track temperature, humidity, and soil moisture levels was developed, and this project offers a chance to examine the current systems, their benefits and shortcomings. One of the activities that use the most water is agriculture. One of the most time-efficient farming chores, irrigation can be automated by using the proposed system to switch depending on the health of the plants, or sensor values. This helps to avoid crop damage by preventing overwatering or underwatering of the soil. Via Front End Structure, the farm owner can keep an eye on the procedure online. By doing this task, it will be possible to save water and motor power for later use by reducing their waste. By this experiment, it can be inferred that the usage of IOT and automation may significantly advance farming.

## VI. ADVANTAGES

- The system is inexpensive in terms of hardware components and power consumption.
- The system helps in saving of water and electricity. It can be applied in large agricultural areas.
- The system helps the labor problem when there are no workers to work with and eliminate manpower.
- The system can be switched to manual mode if required.
- It is convenient to all climatic conditions and all sorts of irrigation.
- Monitoring the levels of water source from remote places.

## VII. APPLICATIONS

Irrigation can be completed on farms, orchards, farms etc. It is effective for a variety of crops. This application is useful for monitoring the patient. Software applications developed for this system can be used for domestic tasks such as tank storage. The system is operated automatically and manually

- IOT Irrigation Control.
- Soil Nutrient Analysis.

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