SMART IRRIGATION SYSTEM USING MACHINE LEARNING AND IOT

Project submitted in partial fulfillment of the
Requirements for the Degree of

MASTER OF TECHNOLOGY

IN

ELECTRONICS AND COMMUNICATION ENGINEERING

By

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UNDER THE GUIDANCE OF
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DECLARATION

I hereby declare that the work reported in the M.Tech Dissertation Report entitled **“Smart Irrigation System using machine learning and IOT”** submitted at **Jaypee University of Information Technology, Waknaghat, India** is an authentic record of our work carried out under the supervision of **Dr Pardeep Garg.** I have not submitted this work elsewhere for any other degree or diploma.

Prashant Kumar
212053

This is to certify that the above statement made by the candidate is correct to the best of my knowledge.

Signature of Supervisor | Head of the Department
Dr. Pardeep Garg | **Dr. Rajiv Kumar**
Date:

ACKNOWLEDGEMENT

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ABSTRACT

A significant opportunity to put into action practical ideas that aimed is to improve village infrastructure so that it benefit our aim of intelligent water irrigation, that is demonstrated by the automation of agriculture by proper beginning of enlarge variety of technology skills improvement, like wise as the term of Internet of Things and cloud computing. The first study that we go through was provided by independent watering systems with a simple route based on the Internet of Things for remotely controlling water pumps and keep eyes on robotic systems. Technology advancements and improvement are utilized in this ongoing project. The sensors are connected to the network so that it can collect information and send it to the cloud. Thus as a result of the method's improved capacity to conjugate the real world with computer based structures, financial advantage will improve.

This provides a pair of suggestions and advice that would allow farmers to think the market price of a crop they think to grow on their farmland. A crop grower who wishes to cutout the profits of their workers must make a tough decision about the harvest's market worth. The recommendation system uses recurrent neural networks with long short-term memory cells to broadcast the crop's price. The programmed proved successful in accurately predicting crop prices during cutting of crops that surely will help crop grower to select the different crop to sow in need increase financial profit .

CHAPTER 1
INTRODUCTION

1.1 WHAT IS MODERN FARMING ?

Farming is one of the key economic and ecological sectors in the country. The worth and significance of farming increase along with the planet's population. Increasing agricultural output is the only way to attain a sustainable symmetry. Ecological factors including climate, soil, and water have a significant impact on the long-term production of a range of crops [1].

Farming is one of the primary sources of income for a sizeable section of overall population of India, and it is crucial for boosting food production. Utilizing cutting-edge technology like the IoT a new approach known as "smart farming" aims to increase productivity while keeping a sustainable level of growth for the agricultural sector. Utilize IoT, machine intelligence, and other cutting-edge technology to increase the inefficiencies of agricultural produce. This project's top priority is to build and design a system that can trace different crop that is produce and help during using the lowest amount of water that is requires.

Despite of containing 18 percent of total world population, India only possesses 4% freshwater, 80% of which is used for agriculture. On the other hand, due of decreased harvests brought on by dry weather patterns, several farmers are currently struggling to make ends meet. Urbanization of water management practices is required to overcome this problem.

Farmers must have easier access to agricultural information management, such as temperature, soil moisture, and humidity. Crop monitoring employing IoT and supervised learning algorithms can regulate the basic components of an irrigation system, such as motors and valves, to recognize when to select whether or not to irrigate crops.

Crop yield was a highly effective way to gauge whether or not agricultural was working. In order to categorize farming procedures, before and publish-sowing were usually the two basic categories employed. Crop selection according to soil type, nutrients in the soil evaluation, soil texture composition, and climate evaluation for the sowing time are all part of the from before-sowing procedure. It is integrated with the majority of agricultural operations practices throughout the publish-sowing stage, comprising weed control, strategic planning for irrigated and fertilizer use, insect control, tool use, and optimal harvesting.

Each step before and after planting has a remarkable impact on the growth of crops. If all steps are done as they are instructed to be done and are attentively came next, the production will be increased. This innovative technology, which heavily relies on accurate farming, enables the enhancement of the ideal agricultural system. In other nations where farming is completely mechanized and overseen by robots and the IoT, this strategy has proved effective.

Deep learning is a competence of AI that mimics the structure and operations of the brain of a person. Typically, this term refers to the neural network that forms the core of the deep learning architecture. Everybody is perplexed as to why agribusiness needs AI as it is completely dependent on knowledge transformation and labour by people. The primary justification is that diversity is essential to the health of the earth as a whole. Farming is the most important aspect in maintaining nature.

Agriculture products and waste are utilized to feed the world's living things. Life stock likewise suffers more mutations and difficulties in maintaining the environmental cycle's equilibrium, much as when farming's equilibrium evolves into something more intricate than humanity. Deep learning expands its functionality in the field of harvesting, whereby AI-assisted equipment was initially introduced and monitored through aerial vehicles that may use IoT. Crop harvesting was completed by combining IoT and machine learning techniques.

1.2 UNDERSTAND THE IOT CONCEPT IN SMART IRRIGATION.

Agriculture has come a long way considerably during the previous 50 years. As response to global warming and increasing populations, farming is changing towards agricultural precision, the Internet of Things (IoT), and the application of statistics to increase profitability. The IOT is well described as being development and widen the area of of digital functionality depending on internet to smart applications and common place devices that are not at level of as computers [4].

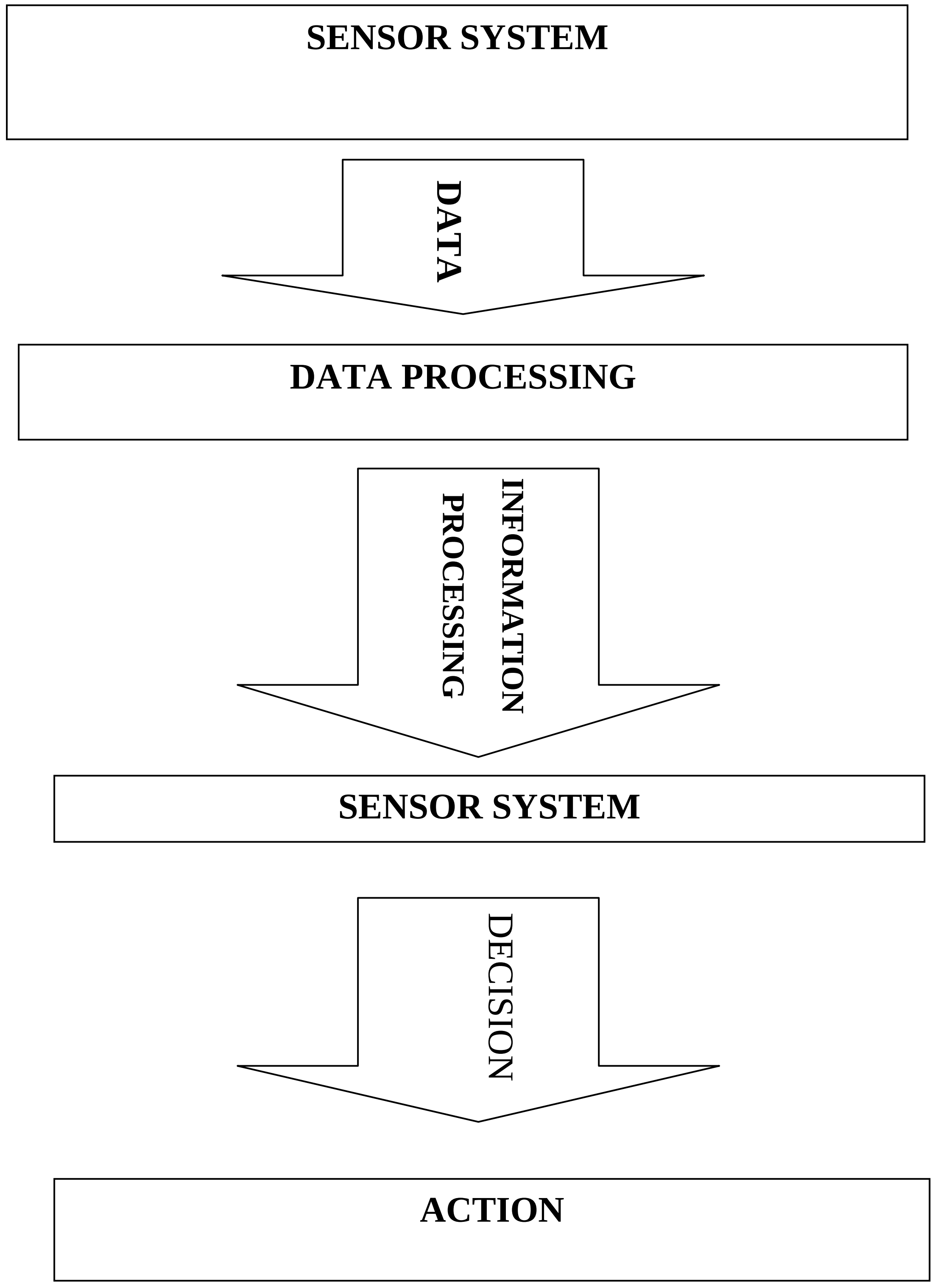


Fig 1.1 : The internet of things processing

The Internet of Things enables these small appliances to generate, toggle switch, and receive content with the bare minimum of human interaction. The IoT design created an elaborate procedure whereby the sensor gathers statistics, sends it to the administrator, and is later analyzed, checked out, and recorded on an accessible cloud platform. Figure 1.1 depicts the Internet of Things in operation.

In order to give permission for estimated and tracked data, the agricultural sector is incorporating IoT. Growers require watering because, particularly when it comes to precision, the production of crops can't be increased lacking it. Thus, farming requires carefully planned watering, it is challenging to maintain continually. Numerous professionals have recently been interested in intelligent irrigation, and utilizing a range of contemporary technologies is crucial to its success.

Intelligent watering uses a variety of technologies, including IoT, cloud computing, software, and hardware components, and algorithms for machine learning. Growers can obtain information on the moisture content of the soil, temperature, relative humidity, and other important ecological variables from detectors in the field of crops. Upon both the gathering of info and the drafting of an inference, practice is required. Cultivation is an essential component of a country's economic development. Agriculture-related problems have long hampered the growth of the nation. The only answer to this issue is innovative agriculture, which entails modernizing traditional agricultural procedures.

The idea aims to integrate IoT and contemporary technologies to create agricultural modern. Thanks to the Internet of Things (IoT), a different type of products for tracing and choosing the farming improvement in addition to automatically irrigation are accessible. The Internet of Things provides a variety of programmers, including the monitoring and choosing of crop expansion and computerized watering choice assistance. In order to stay notified and improve agricultural productivity, we proposed an IoT watering system [2].

Growers may use statistics to judge situations and gather information for advice on managing resources, output, and optimization. Figure 1.2 depicts the four-layered IoT configuration that is now most popular.

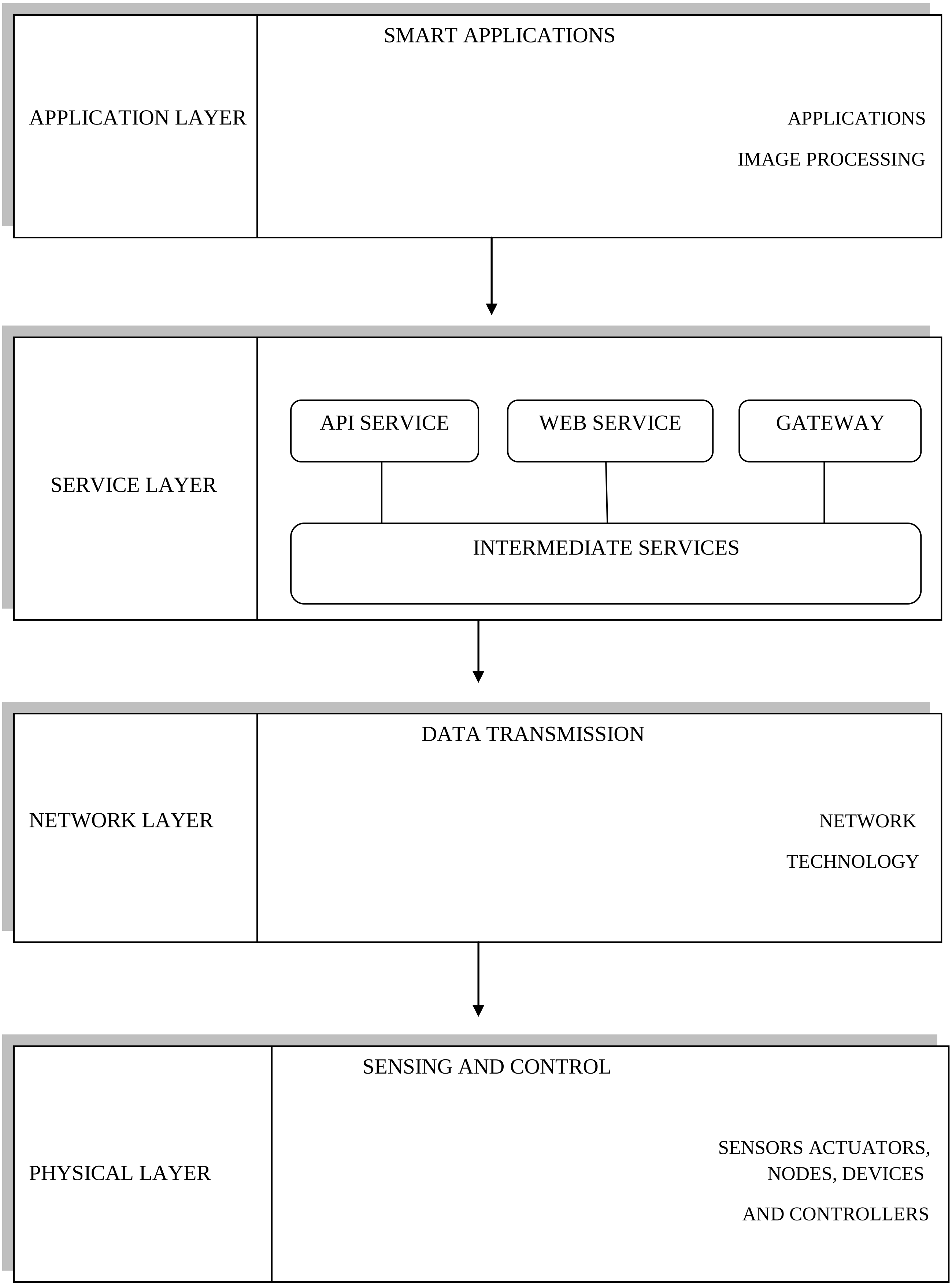


FIG 1.2 : IOT ARCHITECTURE

A recommendation system is a type of system that filters information that makes use of machine learning techniques to execute or foresee a desired product, price, or outcome according to the data that is accessible. Intelligent farming employs equipment and principles to control the seasonal and geographical changes related to all sectors of growing crops with the goal to increase profitability and safeguard the natural environment.

Considering the majority of recent agricultural advancements focused on food production, such as the ideal use of water, input optimization, and a variety of others, IOT offers major advantages. In today's agriculture, algorithms for recommending crops are used for transmitting crop proposals, resource requirements, and price broadcasting. In order to detect the characteristics of a farming area, preconfigured IoT sensors are utilized in this study. The data that was obtained is then gathered on an IoT cloud platform called Thing Speak.

Computerized watering is modified based on observed data and a strategy for optimization. An watering alarm and suggestion mechanism is implemented using neural networks and machine learning algorithms. Cost predictions are prepared for the plants that will be sown throughout crop harvesting periods to provide growers a general estimate of the earnings they could make. Internet of Things (IoT) smart farming options are a system designed to automate watering and track the agricultural field using sophisticated devices.

Growers may monitor the condition of their land from wherever they are and take action based on their observations and statistics. They can also decide between human and computerized methods for carrying out crucial activities using this information. For example, if the amount of soil moisture lowers, the grower may install detectors to activate watering. Intelligent agriculture is considerably more organized than traditional farming. Table 1.1 lists the popular sensors used in farming for internet of things applications.

Table 1.1 : Major sensors used in agriculture

SENSOR USED	DESCRIPTION
TEMPERATURE	It measures the temperature.
TURBIDITY	Measures the turbidity by calculating the dispersion of a light beam as a function of angle.
HUMIDITY	It measures and specifies the amount of wetness amount, in the environment
SOIL MOISTURE	It indicates the existence of volumetric water present in the soil.
WATER FLOW	Indicates the amount of water that flows through a pipe.
ORGANIC MATTER	Organic matter is the nutrients that are present in the soil. It includes Nitrogen, Phosphorus, Potassium, Sulphur, Calcium and others.
PRESSURE	Pressure imposed by the pipeline.

1.3 USE OF CLOUD COMPUTING IN AGRICULTURE BUSINESS

Only one decentralized business was created by combining networking, storage, and the "cloud computing" network based business. Watering is crucial in agricultural activity, particularly for precision since it is necessary for higher yields from agriculture. Thus, good watering is necessary for cultivation, even if it might be challenging to keep up at the right times. The appropriate intelligent programming must be used in smart farming to assist growers. Evidence from locations may be gathered via cloud computing. Computing through the cloud may also be applied to agriculture to provide a controlled atmosphere [6].

Using the application of cloud computing, it is theoretically feasible to create programs that creates a full environment, from sensors and validating equipment that gather soil data to digital images of agricultural areas. The knowledge is given greater value and assessment by keeping the geographic location for significant information gathering inspections. For example, detectors have the ability to record how much wetness they detect. Upcoming agricultural company growth will be greatly influenced by how quickly decentralized and online computing are adopted while keeping a close watch on farmer and agricultural needs.

Growers are very appreciative of a reactive system provided by cloud computing for complex agribusiness since it allows them to install resources on themselves, modify based on liabilities to the environment, and respond to alterations in that environment. This platform integrates scientific techniques including field analysis, smart phone computing, and satellite navigation with the power of many device types, including field sensors, cellular phones, and plant detectors.

Using the cloud platform of predicting analytic institutions, crop growers may obtain data relating to the forecasting of crop supply and cost in various types of market locations. Operations may be carried out in accordance with orders, thereby improving profitability. The data may be utilized to generate insights into factors affecting production, such as the climate and other characteristics [4].

1.4 PRECISION AGRICULTURE

Utilizing software applications and smart networks, automated agriculture increases food production's effectiveness and environmental sustainability while utilizing fewer assets and laborers. For precision farming to be effective, it is crucial to periodically measure, manage, and monitor for variations in crop yield over time. The opportunity for advanced farming to have positive effects on the economy, the environment, and society still exists largely because the space-time consistency of cultivation hasn't been fully recognized [9].

Using the use of images from satellites and aerial photographs, the first phase of the precision agriculture revolution is carried out. Crop health detection, variable rate fertilization, and climate prediction were other significant uses. The success of precision agriculture is astounding provided that use of aerial information almost became possible in the starting of the twenty first century. A second wave related to machine learning and AI's impact on agricultural productivity will result in substantially more accurate data, forecasts, and terrain mapping. The goal of accurate agriculture is to simplify the management of the following at the field level.:

- **Environmental Security:** attained through reduced environmental risks and trails in Farming
- **Crop Science:** through appropriate farming practices that satisfy the crop requirements (e.g., manure inputs);
- **Financial Aspects:** through additional productive practices (for given handling of fertilizer consumption and variety of sources of data).

Precision farming has been economically feasible for agriculture, generally dependent on the utilization of common principles at small area. In line with this, precision agricultural sector offers crop grower with a development of scientific skills to:

- Develop a clear record on their agricultural land;
- Advanced decision-making;
- Improved traceability
- Upgrade promotions of agrarian products
- Foster future contracts and proprietors relationship
- Increase the quality of the farm products.

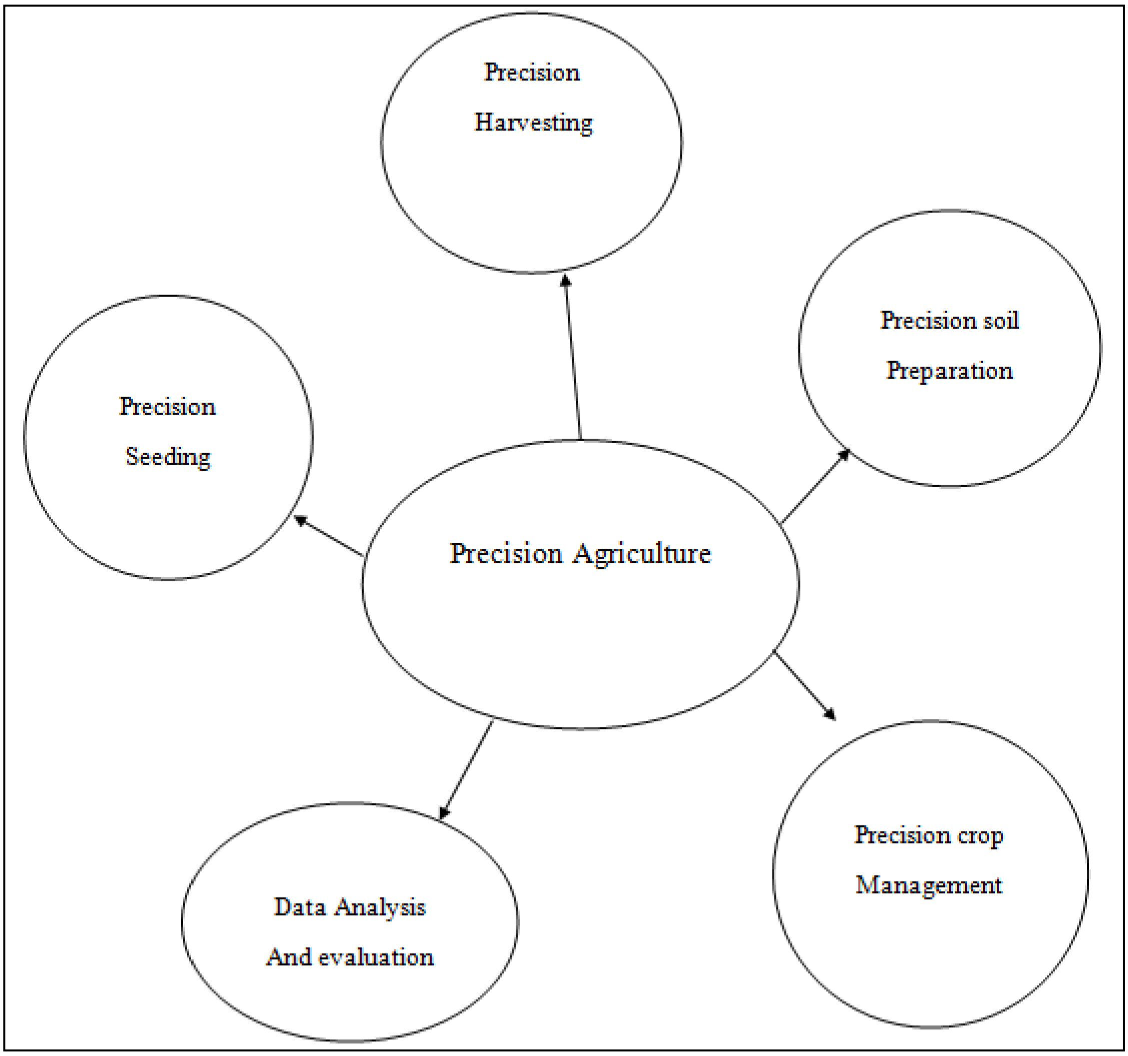


Fig 1.3 : Precision Agriculture

A time in the past, agricultural companies could be completely rely on accurate farming technology; there were several issues that needed to be resolved. This technique has an opportunity to significantly improve the farming environment. For example, the discipline of meteorology and satellite observations needs competent workers even if aircraft information is less expensive than actual sensors. Another significant issue is that farmers' capacity to gather this data without creating additional infrastructure. Figure 1.3 displays the range of uses for accurate farming.

CHAPTER 2

LITERATURE SURVEY

2.1 INTRODUCTION

The phrase "agricultural 4.0" refers to all types of farming, however this time there is a stronger emphasis on details along the whole food supply chain, beginning with the different soil types, weather, irrigation methods, water management, and plant recovery. To do this, we will need the many instruments offered by agriculture 4.0 or agribusiness of the future generation. The business environment has recently made investments in technological advances, concentrating primarily on low cost and significant quantities of valuable manufacturing measures with expertise and tolerance for enhancement gained through long time of revelation and knowledge storing that have paid by creating the Internet of things system centered around smart watering and reusing water that has maintained 5.5 billion m3 annually as well as a The World Wide Web of things system based on intelligent illumination

The Chinese government has been compelled by the aforementioned information to expand and establish technology to support water conservation irrigation (WSI) and moving through the upcoming of farming by developing solutions that use cloud computing, the Internet of Things (IoT), and SOA technological advances in order to tackle the issue of a scarce supply of a crucial component for the growth of agriculture, namely water [1].

2.2 USE OF MACHINE LEARNING AND IOT FOR SMART IRRIGATION TECHNIQUE.

From farmers who employ cutting-edge farming equipment to impoverished rural communities, Indian agriculture is unique. China's infrastructure has complete control over the world's agriculture industry. However, its technology and system for monitoring the environment are still in their formative years and are only somewhat intelligent. A number of issues that farmers encounter will be addressed by integrating contemporary technologies into farming. The loss of productivity is caused by the absence of crucial information [4].

Ref. No.	IEEE/Year	Description	Contribution	Key approaches
[6]	Youness Tace Et al. (2022)	Intelligent watering system based on IoT and machine learning	This study postulates a smart, flexible irrigation method that takes little energy and costs minimal money and can be used in a range of situations..	In a setting that encourages good plant growth for months, they used a set of sensors (soil humidity, temperature, and rain), from which they gathered information based on an acquired map using the Node RED stage and Mongo DB.
[1]	Anusha Kumar et al. (2017)	IOT Based Intelligent Irrigation Using Regression Algorithm	The suggested system uses the Internet of Things to automatically monitor and control the irrigation method in an effort to provide a sustainable solution (IoT)	Regression analysis is used in this study to predict how much water will be required for daily irrigation using data from various sensor devices.
[2]	D. Poornima et al. (2020)	Achievement of correctness soil and water conservation agriculture (PSWCA) through ML, cloud enabled IOT	In this study, an unique method to machine learning-based precision soil and water conservation agriculture (PSWCA) using cloud-enabled	A wireless sensor network, or WSN, that is made up of a different type of sensors including moisture, temperature, ultrasonic, light

		Integration and wireless sensor network	Internet of Things (IoT) integration and wireless sensor networks is presented.	recognition, soil nutrition, and others. These sensors are used to determine the ideal irrigation and fertilizer demands for the plants.
[3]	Bhanu K.N. et al. (2020)	Internet of Things based intelligent System for improved Irrigation in Agriculture	This study takes into account a few of these variables while analyzing data to propose ways for customers to use IoT to make better farming decisions.	The main factors that should be taken into account for better crop growth are soil types, soil moisture, essential minerals, temperature, light, and oxygen, among others. These data can now be detected by a variety of sensors and transmitted to the cloud.
[4]	Sachin kumar et. Al. (2017)	Accurate sugarcane caring using SVM classifier	In this study, a system model for managing sugarcane crops is proposed. The model's recommended parameters—temperature, humidity, and moisture—are actively monitored to ensure the crop grows healthily.	In this case, virus identification through images taken at periodic intervals is done utilizing KNN clustering and an SVM classifier.

[5]	S. Meivel et. Al. (2020)	Standard farming drone information analytics using KNN algorithm	Such a system does real-time data processing, creates correlations, produces insights from Standard Drone - Agricultural data (Drone Network), and makes those insights accessible to diverse applications.	This strategy improves each software's performance while optimizing the standard Drone - Farm data (Drone Network) investments through various application.
[7]	Yuya Suzuki et. Al. (2013)	An SVM Based watering handle expertise for Home Gardening	In this research, we recommend an farming cloud support system that is an automatic irrigation system based on SVM that continuously modifies the amount of water depending on sensor data.	This technology makes it possible for consumers to irrigate effectively even if they lack agricultural irrigation expertise.

Table no 2.1: Literature survey

2.3 DISCUSSION OF LITERATURE SURVEY

[1] Smart Farming based on IOT Using Regression Algorithm. This study develops a sensor-based irrigation system for farm areas that is totally automated. The sensors for temperature measurement, soil moisture, and raindrop size have all been fitted. Various farming plant species are grown in various tubs, and the plants are irrigated using a drip irrigation system. There are sensor nodes in each of the tubs. Each sensor is built inside the Raspberry Pi, and it has software that enables it to control an electromagnetic valve that drives the motor and starts or ends the irrigation system. The microprocessor receives the sensor data, compares it to the threshold value, and decides whether or not to water the field based on its results. The microprocessor turns on the motor if the moisture values exceed the specified range. Periodically, data gathered by various sensors is updated in the cloud, where users can access it via a mobile app. The water table in the tank has been measured using sensors that detect rainfall. The user gets notified via the app to refill the tank if the water level falls below the predetermined level.

[2] Using ML, cloud computing IOT, and wireless sensor networks to implement accurate Soil and Water preservation farming.

In a fuzzy-based precision irrigation system was suggested. This device kept count of three variables: temperature, humidity, and moisture. To the microcontroller device, these parameters are sent. This device includes an inbuilt fuzzy algorithm that can be used to predict how the valve will operate. A machine learning and IoT-based precision irrigation system was suggested. The data from the weather forecast is also used in this study to effectively use available water resources and conserve water. Furthermore, sensors for wetness, temperature, and humidity are employed. The use of water was regulated in a closed-loop using this technology. A precise watering system was created using a Raspberry Pi. In this case, the sensor values are used to control the motor valve. Furthermore, a webcam is used to watch the plants' progress. Mobile phones can be used to constantly monitor plant growth due to cloud-based design. In order to streamline soil and water conservation, sensors for moisture, temperature, and humidity are monitored in this paper. The Thing Speak application also saves these values in the cloud. Every time dry conditions are detected, water conservation is automatically carried out. A mechanism for managing gardens was suggested.

In this study, smart phone applications are used to constantly monitor the garden's parameters. Using an ultrasonic sensor, the water level in the water tank is monitored. Node MCU is likewise utilized as a centre for automating the full process. This paper uses Firebase as its mobile platform. The use of wireless sensor systems based on IP for accurate soil and water conservation was presented. Protocol stacks are used in this paper. Additionally researched and modeled are the round-trip time and packet loss. Here, the radio duty cycle is also investigated.

[3] IoT-based Smart System for Improved Agriculture Irrigation

IoT refers to the network of connected electronic devices that send data to the cloud. IoT data is processed to carry out the required activities. Agriculture is the primary industry in developing nations like India. About 70% of Indians depend [directly or indirectly] on agriculture. The GDP [Gross Domestic Product] of the country is derived from 15–16% of farming. Numerous short-term variables, such as the weather, soil erosion from flooding, and repeatedly producing the same crop without using scientific farming methods, have an impact on agriculture. Using smart farming methods leads in less water waste, higher-quality crops, and less consumption of resources. This aids in achieving a high crop yield more rapidly than with previous farming techniques. Today's agriculture needs to take into account a number of factors, such as the type of crop that will grow best in the soil's current state, the type of irrigation required, the amount of fertilizer needed, etc. A novel system that uses factors like moisture, temperature, humidity, ground temperature, soil PH, etc. is the soil caring technology for farming. Microcontrollers and sensors work together to implement the Internet of Things (IoT) in farming, where sensors have the ability to gather a lot of field information. It can be only feasible to assess the compatibility and fertility of the soil by combining the

Information from a unique sensor. IoT contributes to a greater crop output, which increases productivity. Understanding the state of the soil in the field is essential for increasing productivity when evaluating the crop in an agricultural field. IoT makes it possible to monitor the field anytime necessary from any location. For monitoring soil conditions, factors including moisture, temperature, weather, and soil PH are taken into account. The user is sent details about the farm's condition via the Global System for Mobile [GSM] technology.

[4] Accurate sugarcane caring using SVM classifier.

At the moment, agriculture is mainly responsible for India's agricultural production. Farmers, those with farms of smaller size which survival depends on fresh farming, crop disease poses a serious case to proper crop growth and can have terrible effects. One of the latest disciplines in engineering, precision agriculture (PA), uses information technology image processing methods to improve the farming production procedure. Cost reduction for crop disease identification is one of PA's key benefits, and when these techniques are used, crop diseases may be quickly and precisely identified. It enables the prompt distribution of crucial knowledge for disease prevention and treatment, thereby improving crop output. In order to improve crop yield, precision agriculture seeks to precisely analyze variables including temperature, humidity, and soil conditions. One of India's most important crops, sugarcane accounts for 7% of the nation's overall agricultural production. A system for managing sugarcane agriculture has been created by the authors to detect crop infections and keep a close eye on the growing environment. The proposed system, which is based on a variety of sensor inputs and crop images, offers a number of actions that could be helpful in optimizing crop production. The sensor node gathers and transmits data on the soil, temperature, and water system quality in the agricultural field.

[5] Standard Farming Drone Information Analytics using KNN Algorithm.

Prior to using equipped Drone Agricultural Data (Drone Network) strategies as needed, standard Drone - Agricultural Data (Drone Network) obtain company assistance buildings, opportunities, network information analysis, generating value, comprehensive telephony competence, customer satisfaction, optimal control computer programming, get protocol standardize, data stability operation, and how to comprehend everything or how the pertinent insights can be obtained from the initial data. Correct judgment was necessary for a telecommunications administration business strategy to succeed. Telecommunications companies support the Standard Drone - Agricultural Data (Drone Network) analytics in resolving the key problems to support company development.

Enterprise Plan daily categorization and telecom confirmation, a system of this kind analyses data in real-time, creates correlations, produces insights from Standard Drone Agricultural data (Drone Network), and makes those insights available to diverse applications.

By using this strategy, the standard Drone Agricultural data (Drone Network) investments across diverse applications are maximized while also increasing the efficacy of each application. Processing and storing large amounts of information are no longer issues. The key issue right now is figuring out what has to be done during the typical Drone Agricultural data (Drone Network) analytics stage to provide a particular value. In order to fully satisfy customer expectations, Drone Farming data modify nodes dynamically. The fundamental drone-agricultural data (drone network) value may be dynamically changed and used to a variety of tasks. The finding of data that is sufficient, accurate, and substantial must be made possible by the traditional big data resources and innovations. To have good information-driven understanding, one needs spatial ability. For businesses that focus on interactions, this means having a thorough understanding of how the system works, knowing what information to draw from the system's hubs, and knowing how to link data from different places end to end to organize data sources in a more effective manner.

Recognizing company social backing networks, opportunities, scheme analysis of information, business esteem, wide telecom expert knowledge, client experience, best-practice coding, get convention the standard, carrying out of statistical stability strategies, as well as expertise of using typical big data strategies.

[6] Intelligent irrigation system based on IoT and ML.

The phrase "agricultural 4.0" refers to all farming practices, but this time there is a greater emphasis on factors that are crucial across the whole food supply chain, beginning with the different variety of soil, climate, watering methods, water management, and crop improvement system. For this, we will require a number of instruments from agriculture 4.0 or farming of the future. The latest investment in technological advancement by the industrial eco-system is famous due to its cost-effective and high output activities. The creation of an Internet of Things network based on intelligent watering and water recycling has saved 5.5 billion m3 of water annually and has a 44% reduction in the energy use of total water extraction. This knowledge and improvement has paid dividends. The Chinese government was compelled by this knowledge to build and invent tools to support WSI and advance crop production 4.0 by offering a solution based on the use of cloud computing, the Internet of Things, and SOA technology to address the issue of water scarcity, a problem that is crucial for agricultural output.

[7] An SVM Based Watering supervision System for Home Farming.

A variety of recommended methods for supporting agriculture. In the situation of data mining in farming, the groundnut disease interaction and predictions have been studied using the EM (Expectation- Maximization) method and Naive Bayes classifier. The infiltration technique has also been used to forecast when to irrigate fruit plants. However, this study has concentrated on how to examine the connection between environmental data and plant development. It thus has no interest in having useful applications. Beginners in home gardening may find it challenging to use this method since, based on the research findings; farmers cannot receive practical guidance from this study. For agricultural environmental control systems, a wireless sensor network greenhouse auto control system was created. Furthermore, a nice illustration of a realistic implementation for greenhouse farming may be seen in Fujitsu's Akisai: Greenhouse Horticulture SaaS. Customers may remotely monitor and manage greenhouse climate using a Smartphone or tablet with the cloud-based Akisai system. The regulation period or threshold must be manually set by users of a wireless sensor network or an Akisai-based greenhouse auto control system.

Therefore, knowledgeable farmers are necessary for the agriculture sustainability monitoring system. These efforts can benefit indoor gardening. Despite the fact that there are several solutions for assisting farmers, each one assumes that the users are knowledgeable about the industry. In this work, we implement a home gardening aid method that doesn't require any prior information of agriculture.

CHAPTER 3

3. 1 DATA COLLECTED

1. For the given below data set we applied machine learning algorithms

Table 3.1: Data of crops

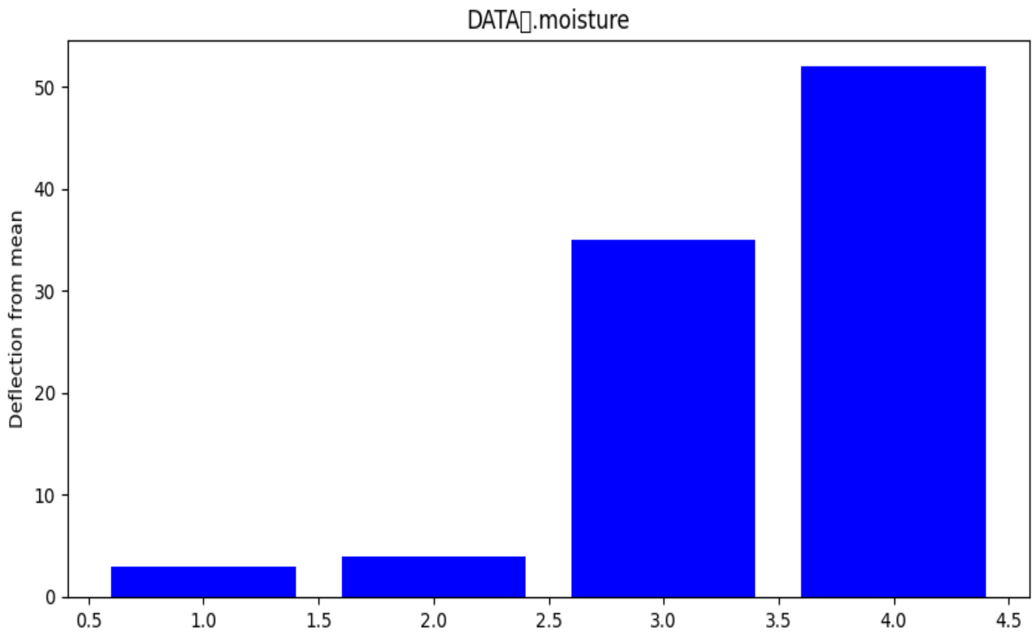
1	crop	moisture	temp	pump
2	cotton	638	16	1
3	cotton	522	18	1
4	cotton	741	22	1
5	cotton	798	32	1
6	cotton	690	28	1
7	cotton	558	23	1
8	cotton	578	12	1
9	cotton	673	35	1
10	cotton	642	45	1
11	cotton	723	11	1
12	cotton	671	23	1
13	cotton	758	34	1
14	cotton	507	45	1
15	cotton	586	33	1
16	cotton	703	45	1
17	cotton	716	25	1
18	cotton	724	11	1
19	cotton	828	41	1
20	cotton	633	23	1
21	cotton	783	18	1
22	cotton	635	36	1
23	cotton	525	33	1
24	cotton	636	24	1
25	cotton	813	15	1

Result obtained on basis of applied KNN algorithms

CODE 1

```
data=[638,522,741,798,690,558,578,673,642,723,641,768,507,586,703]
import  math

def euclideanDistance(instance1, instance2):
    distance = pow((float(instance1) - float(instance2)), 2)
    return math.sqrt(distance)

def getNeighbours(trainingSet,k):
    distance = []
    for x in range(1,len(trainingSet)):
        dist = euclideanDistance(k, trainingSet[x])
        distance.append((dist))
    distance.sort()
    return [distance[0],distance[1],distance[2],distance[3]]

a=getNeighbours(data,data[0])
print(a)

import matplotlib.pyplot as plt
import numpy as np
sr=[1,2,3,4]
values = a
fig = plt.figure(figsize=(10, 5))
plt.bar(sr, values, color='blue')
plt.ylabel("Deflection from mean")
plt.title("DATA\1.moisture")
plt.show()
```

GRAPH 1



RESULT

```
> predicted='dry', actual='dry'
> predicted='dry', actual='dry'
> predicted='dry', actual='dry'
> predicted='dry', actual='dry'
> predicted='dry', actual='dry'
> predicted='dry', actual='dry'
> predicted='dry', actual='wet'
> predicted='dry', actual='dry'
> predicted='dry', actual='dry'
> predicted='dry', actual='dry'
```

Accuracy of dry soil: 91.17 %

CHAPTER 4

USE OF IOT DEVICES TO AUTOMATE AND OPTIMISE IRRIGATION

4.1 INTRODUCTION

Water is a valuable but expensive resource in farming, and controlling it properly is getting more and harder. The purpose of this project is to develop a robotic irrigation system for agricultural that utilizes less water. It does this through using the Internet of Things, cloud computing, and tools for optimization. The information is handle in the cloud function that Thing Speak offers for record-keeping and management. The optimal watering rate is then decided using an optimization model. With a solenoid valve controlled by an ARM manager, this procedure is computerized. After two seconds, the sensor sends knowledge to the supervisor, and every 15 minutes, the governing body refreshes the information that is in the cloud [8].

Due to the fact that they are updated on the cloud, growers can contact the pertinent variables for an investigation. The findings from evaluating the recommended approach on a tiny farming site show a reduction in consumption of water and up gradation in access to data and visualization. The Internet of Things, cloud computing, and optimization were used in this inquiry to suggest a mechanized watering system that would reduce water consumption in agriculture. The automated watering system is made possible by the installation of inexpensive sensors that recognize critical parameters including pH, humidity, and temperature as well as and the surrounding environment.

Regarding storing and surveillance purposes, records are kept in the Thing Speak cloud service. Then, with the goal to reduce water use, an optimization model was created with limitations that reflected the extra physical requirements.

4.2 IOT ENABLED SMART FARM

Since irrigation requires an enormous amount of water, it's crucial for handling it appropriately. Building a computerized watering technology that leverages the IoT, optimization methods, and cloud computing to reap down on the quantity of water that is required for cultivation is a key objective of this project [11].

This independent watering system uses affordable sensors to monitor factors including water content in the soil, the condition of the soil, and the outside temperature. Immediately after being captured, the data are transferred to a cloud platform where it may be obtained on desktops and mobile devices. Cellular networks, a standard form of mobile interaction, are used to transmit information captured in the field to the cloud. The microcontroller-restricted solenoid valve automating the optimization model used to determine the ideal watered rate. The above-mentioned outstanding variables are available in the cloud as a service to agronomists. Our findings demonstrate reduced water use and improved data accessibility and idea generation when employing the suggested strategy, as demonstrated by pilot scale characteristics.

4.2.1 Irrigation Systems and Smart Irrigation

Micro Irrigation - Micro irrigation, also known as low volume irrigation, trickle irrigation, or localized irrigation, is a slow water supply system where water is given as a tiny discharge to each plant or close to it through a piped network in a predefined pattern at low pressure [8].

Drip irrigation - The most popular irrigation method for intelligent irrigation systems is droplet irrigation, often known as drip irrigation. The roots of the plants receive water in the form of droplets. Water is delivered drop by drop, minimizing over watering and reducing runoff and evaporation [8].

Sprinkler irrigation - Sprinkler irrigation is used to mimic natural rainfall. High-pressure sprinklers are positioned above, and a pump distributes water to all the designated spots through the pipes. A system uses nozzles created expressly for this task to spray water across an agricultural field [8].

4.2.2 Smart sensors and components used

1. Node MCU – The open source Node MCU is built on the cheap System on a Chip known as the ESP8266. The CPU, RAM, networking (Wi-Fi), and even a stylish software package and SDK are all there in the ESP8266, which was created and developed by Espressif Systems. It becomes an astonishing choice for every type IoT projects as a output [13].

Though, the ESP8266 is exceptionally tough to touch and use it as a chip. You might connect wires with important analogue power to its pins in order to perform the basic functions, such as changing it switch on or transferring a stroke of the keyboard to the chip's computer. Furthermore, you must program it with minimal manual that the chip technology can think over it. At this level of conjunction, using the ESP8266 as an embedded management chip in commercial goods is not difficult. It is a significant burden for novices, burglars, or learners that want to test it out in their own private IoT projects.

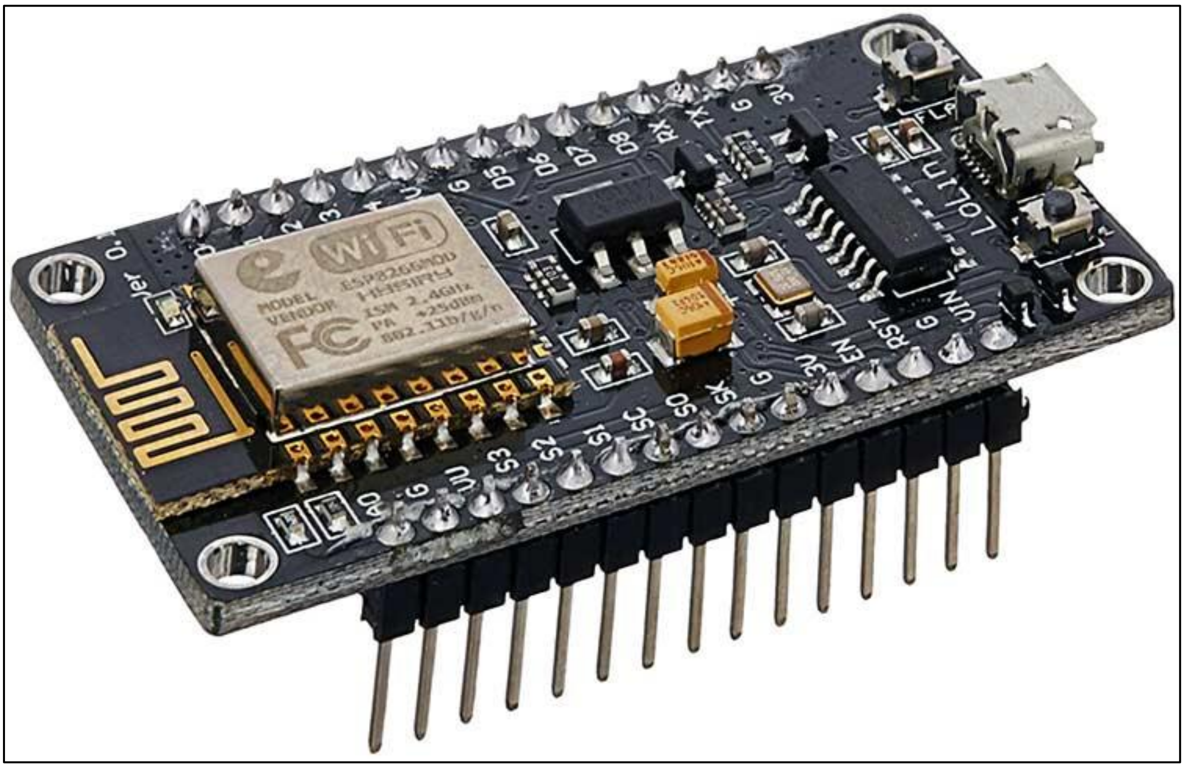


Fig. 4.1: Node MCU

2. Soil sensor - The soil wetness device is a kind of device generally used to find the hydrodynamic percentage of water in the soil. Gravimetric measuring of soil wetness must be extracted, dried, and sample weighted. These sensors approximate the volumetric water content indirectly by the use of other soil laws, such as the dielectric constant, electrical resistance, or alternatively, relationship to neutrons [13].

It is necessary to modify the relationship between the calculated property and soil moisture, and this relationship may change based on ecological factors like temperature, soil type, and electric conductivity. This sensor primarily employs capacitance to gauge the soil's dielectric permittivity, or water content. This sensor may be placed into the ground to activate it, and a proportion of the amount of liquid in the soil will be recorded. It is ideal for doing experiments in scientific classrooms covering a variety of subjects, including horticulture, biology, soil science, the farming industry, and the sciences of the environment.

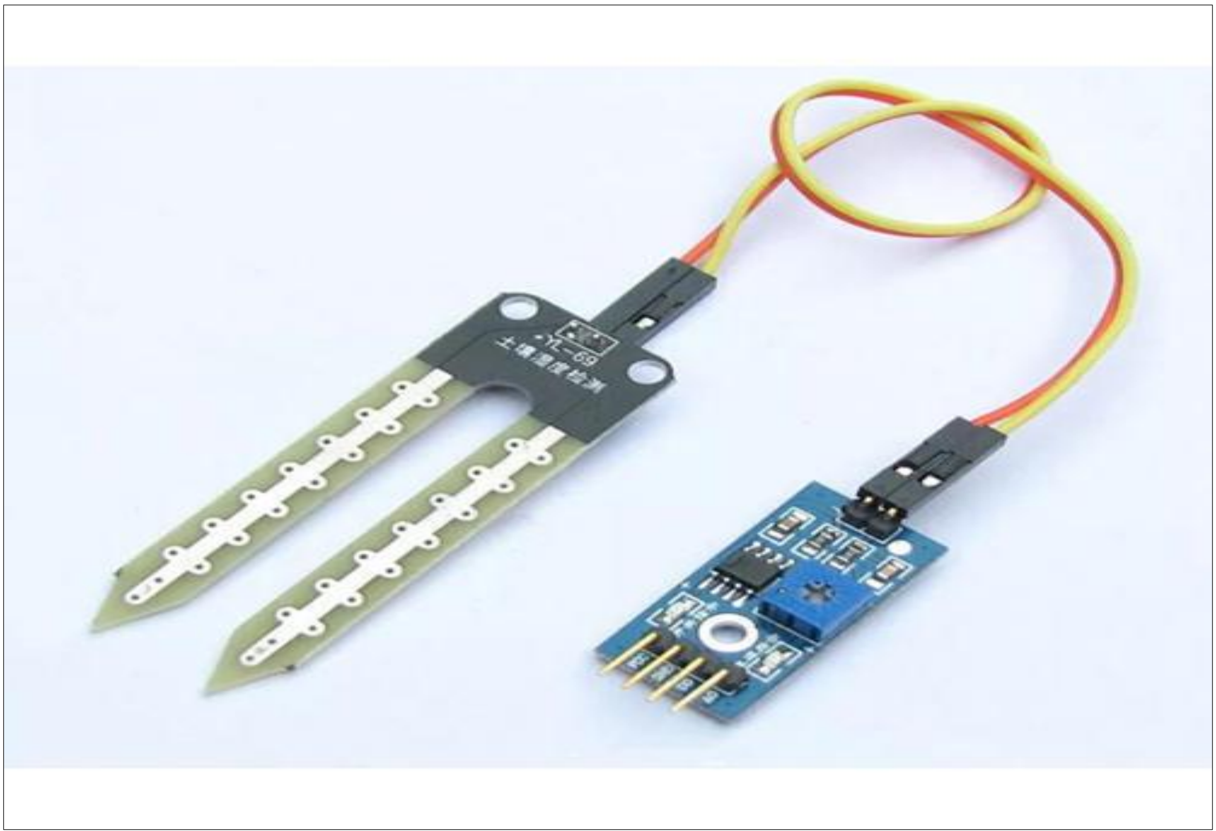


Fig. 4.2: Soil Moisture Sensor

3. DHT 11 - The DHT11 is a cheap digital device that calculates temperature and humidity. This sensor connect very smoothly with microcontroller, like as Raspberry Pi, Arduino, etc., to quickly keep eyes on humidity and temperature. DHT11 humidity and temperature sensor, it must be either a sensor or an holder to be present there. These sensor may be differentiated by the module from the pull-up resistor and a power-on LED. The DHT11 is a humidity sensor. To find the air surround us, this sensor or devices uses a thermistor and a capacitive humidity sensor.

The DHT11 is a cheap digital sensor that finds moisture and temperature. This device can smoothly joint with any kind of micro-controller, ex. Arduino, Raspberry Pi, etc., to quickly keep eyes on humidity and temperature. For the DHT11 humidity and temperature finder, there is either a sensor or a holder offered..

The operational temperature range for the DHT11 is zero to fifty degrees C, with a two degree correctness. Given sensor provides wetness vary from twenty to eighty percent with a 5 percent correctness. The information gathering speed of this device is one Hz. It provides one impression per second, in a many ways. The DHT11 is a tiny size device with a working voltage choice of three to five volts. The highest current that be calculated is 2.5mA.

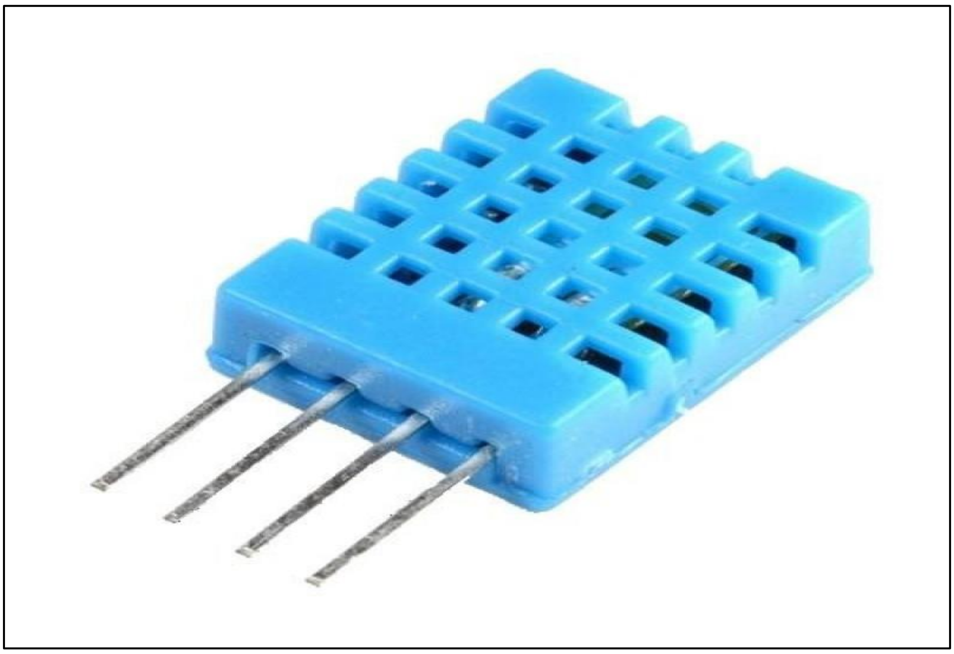


Fig. 4.3: DHT 11

4. Rain sensor - There are available cordless and established rain sensors for watering systems. Hygroscopic discs, which are used by the majority of these sensors, expand when it rains and shrink back down when it dries up. The pace of being exposed to air is then commonly regulated by modifying how much exposure to air entering the stack, which is followed by the hygroscopic disc stack pressing or releasing an electrical switch. However, other electrical type devices are also offered for sale that use dropping container or conductance type probes to estimate rainfall [11].

Both the Bluetooth-enabled and wired models of the irrigation management employ similar processes to temporarily suspend watering. In order to prevent any valves from releasing when rain is recognized, they are connected to the sensor contacts of the watering controllers or installed in series with the solenoid valve universal circuit. For instance, many watering rain sensors also have a frozen sensor to keep the system from operating in temperatures below freezing when watering systems are utilized in the winter.

A measuring pad with two nickel-coated metal series tracks is part of the rain detector module. This pad has two connector pins that are internally wired to the metal rails of the pad. The Measuring Pad and the rain sensor element are connected utilizing two jumper wires via these two header pins. In this case, one pin on the rain sensor module provides a +5v power supply, and the other pin is connected to a separate channel on the detector pad in order to get returning power.

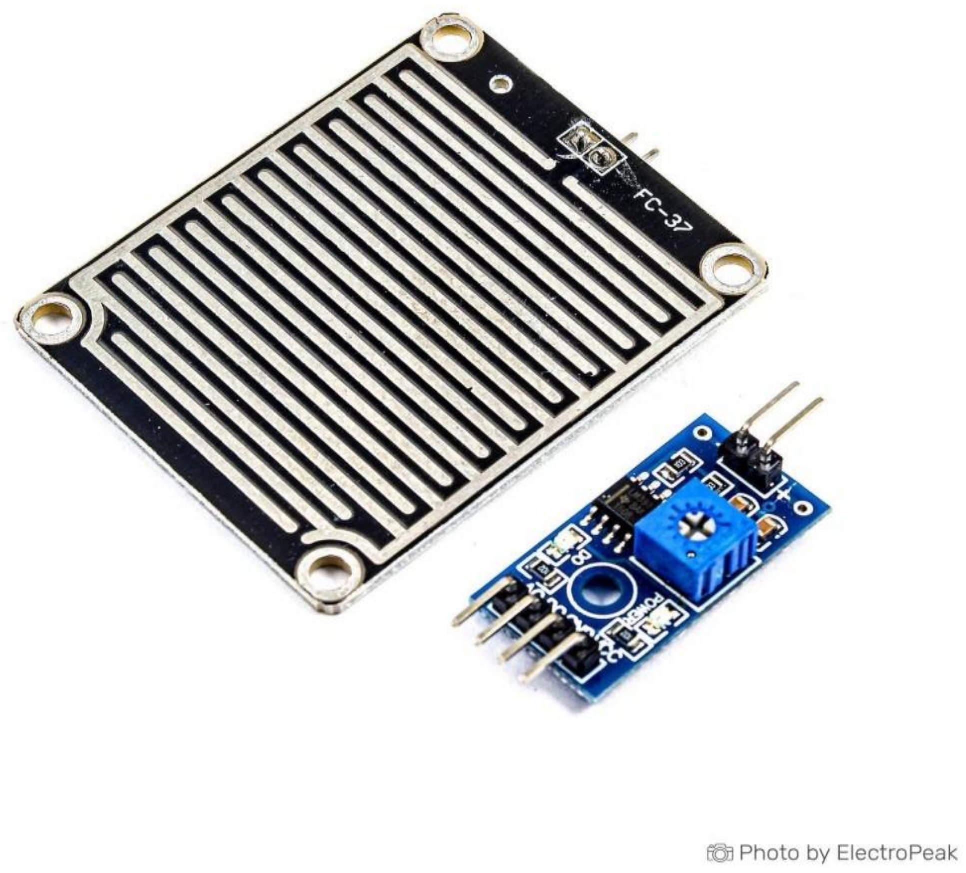
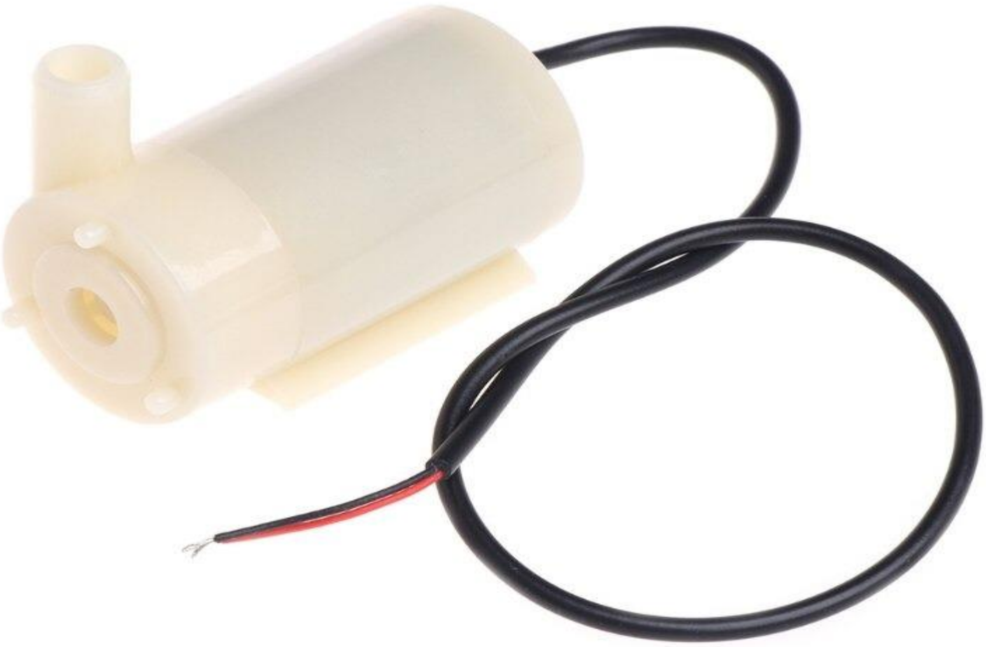


Fig .4.4: Rain sensor

5. Submersible motor - The power source for these small, lightweight submersible pump motor ranges from 2.5 to 6V. It uses just 220 mA of electricity and has a maximum flow rate of 120 liters per hour. All that is required is to connect a tube pipe to the motor output, submerge it, and then power it. Never allow the motor to submerge underwater. The dry run may damage the motor and generate noise as a result of heating. Drainage, sewage pumping, general industrial pumping, slurry pumping, and pond filtration are all common uses for single stage pumps. There are many

different applications for submersible pumps [11].



.

Fig. 4.5: Submersible motor

6. Relay module - A power relay component is an electronic switch that can handle on an electromagnet. The electromagnet is switched on by a divide small power signal that is sent by a microcontroller. Once it started, the electromagnet stated to either open or close an electrical circuit [11].

A changeable iron armature, a wire coil wound over a flexible iron hub or solenoid, a changeable iron yoke, and one or more sets of connections are the components of a simple relay. The movable armature is fixed to the yoke and jointed to either single or several sets of the effecting contacts. The armature, which is kept anchored by a spring whenever the relay stops working, left with a gap on the magnetic circuit. When device is in orientation, one of the 2 pairs of connections is off while the other set is on.

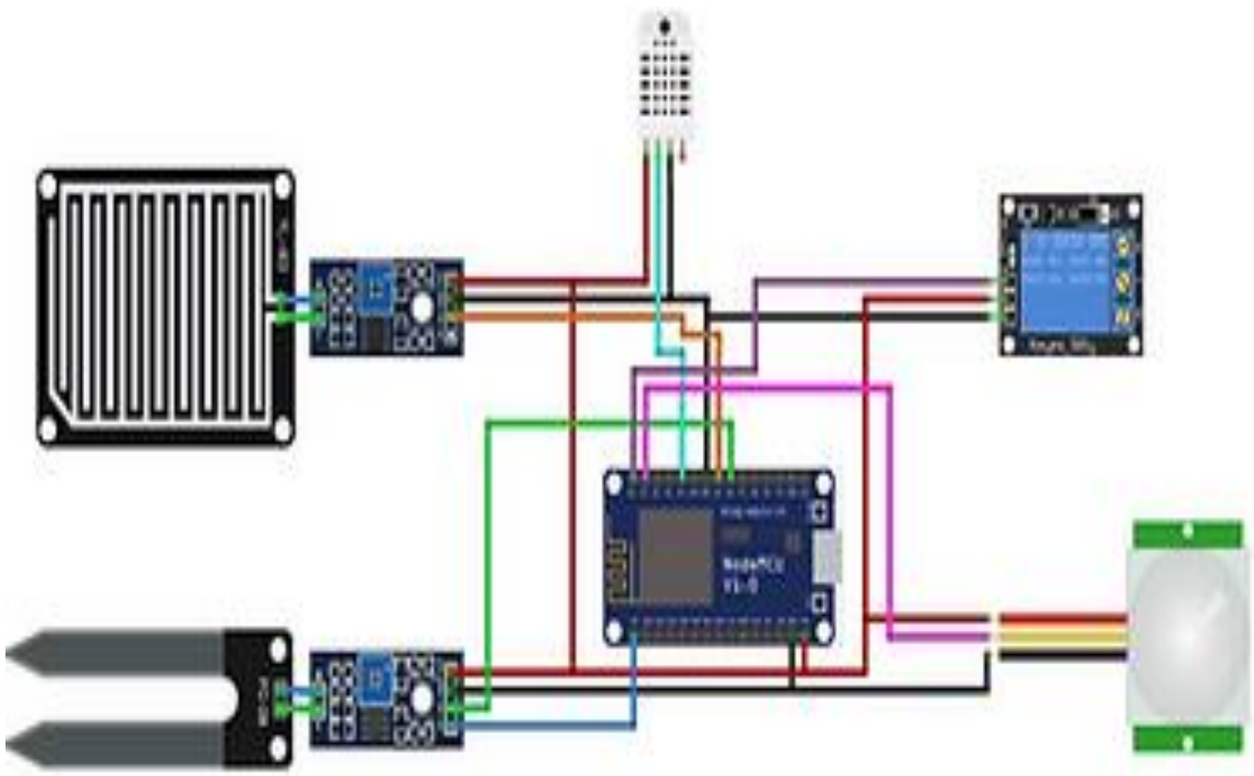
When electrical current passes through a coil, a magnetic field is produced, activating the structure known as the armature. This movement of the changeable contacts creates or destroys a relationship with the fixed contact. The sealed pairs of connections released and destroy their connection when the relay ceases to operate, and the relationship is severed if the contact surfaces were open. The coil's current is cut off, forcing the armature to return to its relaxed condition. While in rare circumstances earth may also be utilized, springs are usually required to make this force accessible. Power relays' best feature is that it is designed to operate swiftly.

The industry leader in powerful relay circuit design and manufacturing for power distribution in large current situations is GEP Power Products.

Fig.4.6: Relay module

CHAPTER 5

5.1 WORKING MODEL OF SMART IRRIGATION



5.2 WORKING PRINCIPLE OF SMART IRRIGATION

Prior to beginning, it's important to keep in mind that various crops require varying amounts of water in the soil, temperature, and humidity. As a result, that we are employing a crop in this article that requires soil that is around 50 and 55 percent moist. Therefore, when the soil loses more than 50% of its water, thus a motor pump will automatically switch on to sprinkle water. When the soil moisture level hits 55%, the pump will continue to shower water until it is shut off. At specific times, sensor information will be sent to the Thing Speak Server, enabling worldwide monitoring [14].

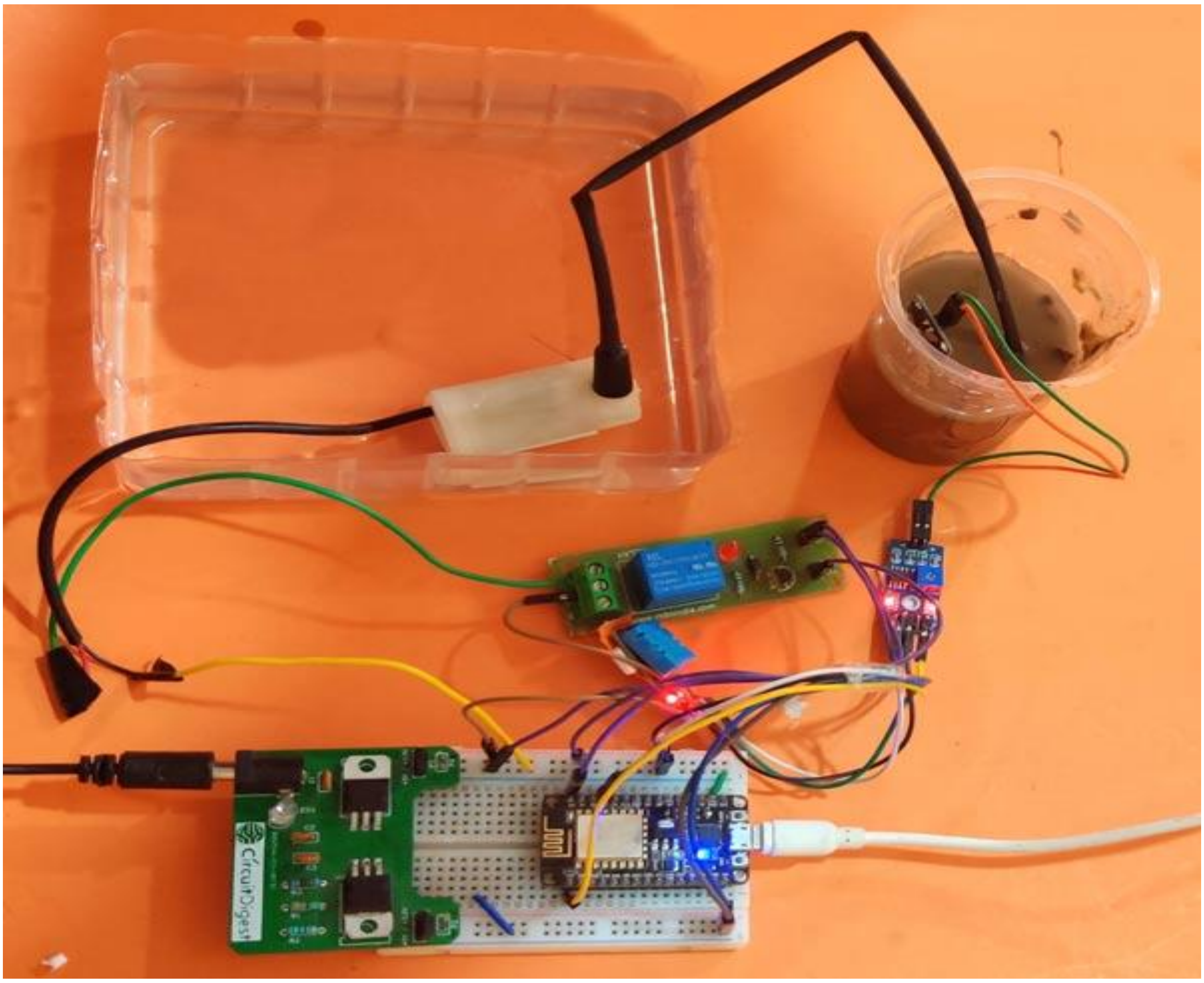


FIG.5.1: Working model

5.3 Programming ESP8266 Node MCU for Automatic Irrigation System

The DHT11 sensor source is the sole outside library used for programming the ESP8266 Node MCU module. The wetness sensor's analogue signal may be accessed using the ESP8266 Node MCU's analogue pin A0. Due to the Node MCU's GPIO being unable to create a voltage at the output higher than 3.3V, we often employ a relay module to supply electricity to the 5V motor pump. The DHT11 and moisture detectors are further powered by an external 5V power supply.

```
#define BLYNK_TEMPLATE_ID "TMPLnEkmnERJ"
#define BLYNK_TEMPLATE_NAME "smart farm"
#include <ESP8266WiFi.h>         // For Wi-Fi connectivity
#include <BlynkSimpleEsp8266.h> // For Blynk app
#include <DHT.h>                // For DHT11 sensor
#define rainSensorPin D1        // Rain sensor pin
#define soilSensorPin A0         // Soil moisture sensor pin
#define pirSensorPin D4          // PIR motion sensor pin
```

```
#define relayPin D2                  // Relay control pin
#define buzzerPin D5                 // Buzzer pin
 {
   // Read sensor data
   float temperature = dht.readTemperature();
   float humidity = dht.readHumidity();
   int soilMoisture = analogRead(soilSensorPin);
   int rainValue = digitalRead(rainSensorPin);
   int pirValue = digitalRead(pirSensorPin);

   // Print sensor data to serial monitor
   Serial.print("Temperature: ");
   Serial.print(temperature);
   Serial.print("°C, Humidity: ");
   Serial.print(humidity);
   Serial.print("%, Soil Moisture: ");
   Serial.print(soilMoisture);
   Serial.print(", Rain: ");
   Serial.println(rainValue);


   // Convert sensor data to strings for Blynk app
   String tempStr = String(temperature);
   String humStr = String(humidity);
   String soilStr = String(soilMoisture);
   String rainStr = String(rainValue);

   // Send sensor data to Blynk app
   Blynk.virtualWrite(V6, tempStr); // Display temperature on virtual pin
 V0
   Blynk.virtualWrite(V7, humStr);  // Display humidity on virtual pin V1
   Blynk.virtualWrite(V8, soilStr); // Display soil moisture on virtual
 pin V2
   Blynk.virtualWrite(V9, rainStr); // Display rain sensor value on
```

```
#define ledPin D6                  // LED pin
#define DHTPIN D3                  // DHT11 sensor pin
#define DHTTYPE DHT11
DHT dht(DHTPIN, DHTTYPE);
char auth[] = "Jcg-_1T4kpCmJR6GBmi-BLN5e4g8q8KA"; // Blynk
authentication token
char ssid[] = "Pk";          // Wi-Fi SSID
char pass[] = "12345678";     // Wi-Fi password

void setup() {
  // Initialize serial communication
  Serial.begin(9600);
  // Connect to Wi-Fi
  WiFi.begin(ssid, pass);
  while (WiFi.status() != WL_CONNECTED) {
    delay(1000);
    Serial.println("Connecting to Wi-Fi...");
  }
  Serial.println("Connected to Wi-Fi!");
  // Initialize Blynk app
  Blynk.begin(auth, ssid, pass);
  // Set pin modes
  pinMode(rainSensorPin, INPUT);
  pinMode(soilSensorPin, INPUT);
  pinMode(pirSensorPin, INPUT);
  pinMode(relayPin, OUTPUT);
  pinMode(buzzerPin, OUTPUT);
  pinMode(ledPin, OUTPUT);
  // Start DHT11 sensor
  dht.begin();
}
void loop() {



 virtual pin V3
   // Turn on pump if soil is too dry and it's not raining
   if (soilMoisture > 600 && rainValue == HIGH) {
     digitalWrite(relayPin, HIGH);
     Serial.println("Pump On");
  }
   else {
     digitalWrite(relayPin, LOW);
 }

   // Turn on buzzer and LED light if motion is detected
   If (pirValue == HIGH) {
      digitalWrite(buzzerPin, HIGH);
      digitalWrite(ledPin, HIGH);
      delay(1000); // Buzzer and LED on for 1 second
      digitalWrite(buzzerPin, LOW);
      digitalWrite(ledPin, LOW);
   }
 }
```

5.4 How Intelligent watering system work ?

A robotic watering system allows land owners and managers to fix a proper time gap that robotically switch on and off grass irrigation system. Whenever environment took over the task of washing the grass, these systems feature switches that can stop the sprinklers from operating, but these switches must be handled manually. In contrast, intelligent watering Intelligent watering benefits from the capacity to monitor either the regional climate or the real quantity of ground moisture. Due to the reason, smart irrigation system adjust the watering need whenever it is required automatically with full efficiency [16].

In so many of incident, smart watering technology can be fitted on currently working irrigation systems that surely will lower the consumption of water by 20 to 40 percent. Although costly, these systems can return the investment needed in during installment in a few short years by reducing monthly water bills. Smart watering technology can be installed on current underground watering systems by changing out the current water handler form a smart one handler. In few incident, add on a weather or wetness based device can be installed with current controllers and systems, thus lower the investment of buying a fresh regulator.

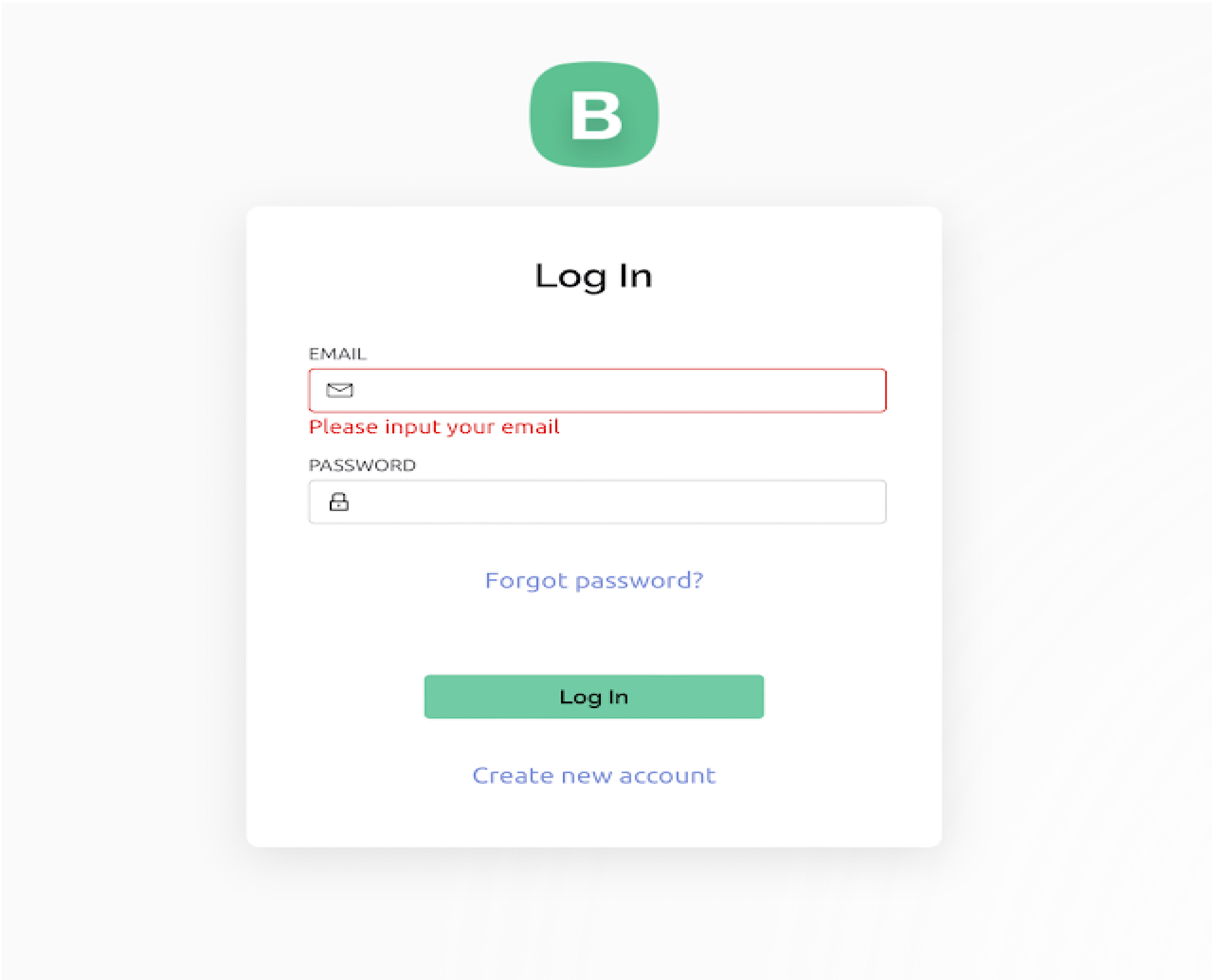
Previously buying this equipment, landlords and property controller are made to train to do their underground work to make sure intelligent controllers and sensors are properly matched to the current watering systems as well as smart appliances. In addition, they will need to decide linking environment based device or moisture based ones. Evapotranspiration controllers generally work on local different environmental data to control irrigation running timing. Those all types of sensors which can access in generally public available local weather data via Wi-Fi or can handle on site weather measurement. Temperature, wind, solar radiation, and humidity all these values are then considered to compute irrigation needs.

Soil wetness device uses probes or sensors which are fitted into the farmland to calculate real soil wetness levels. Depending upon the different type of sensor fitted, these systems can either postponed the upcoming watering cycle when the value point out good level soil moisture or can be installed on the basis of command system. The next type of sensor take both higher and lower moisture thresholds and the regulator will automatically switch on the sprinklers to preserve water levels between the two readings

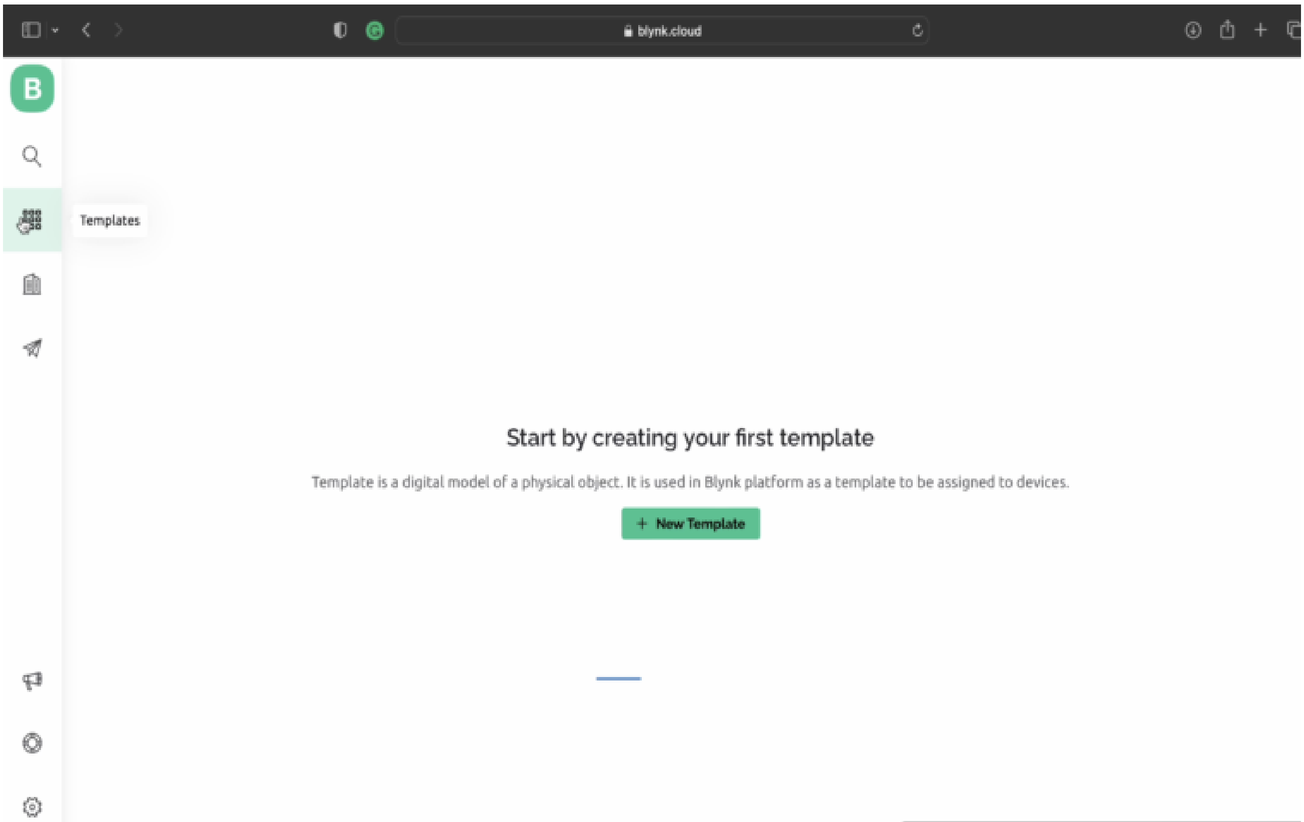
5.5 Blynk App Setup

Now, we created the New Blynk Application

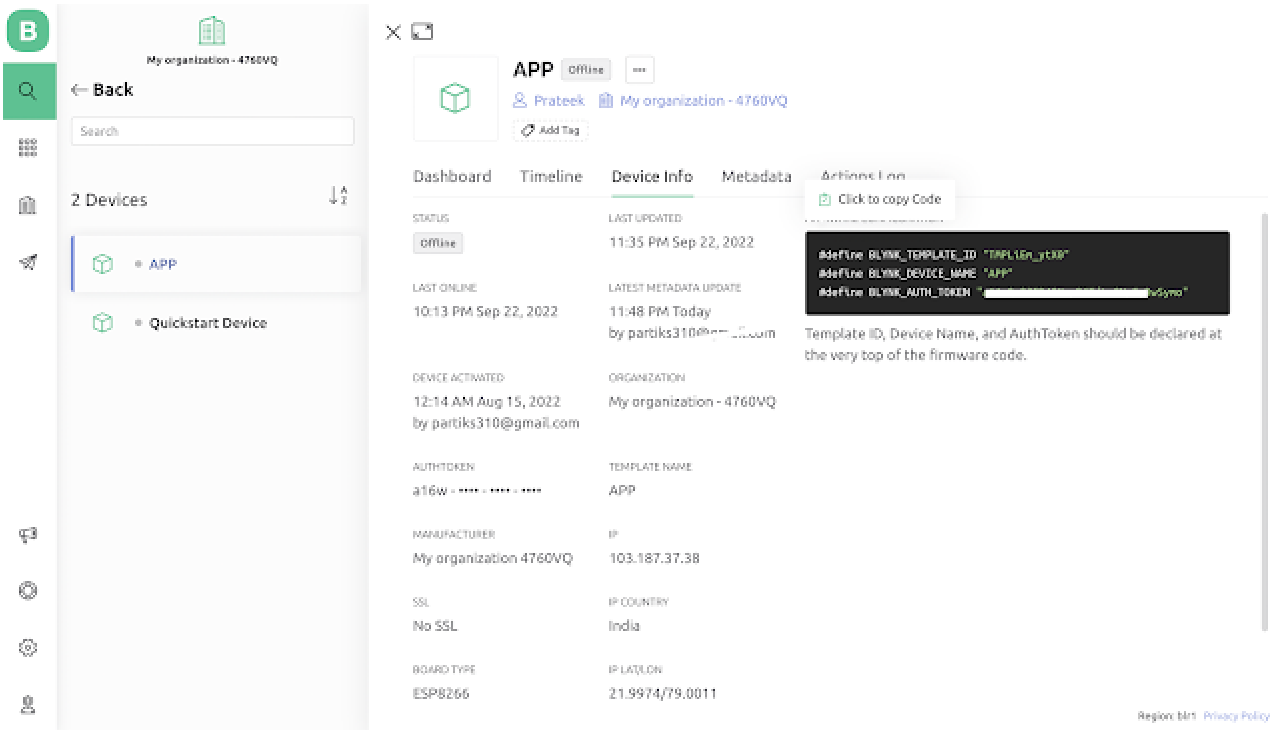
STEP 1.



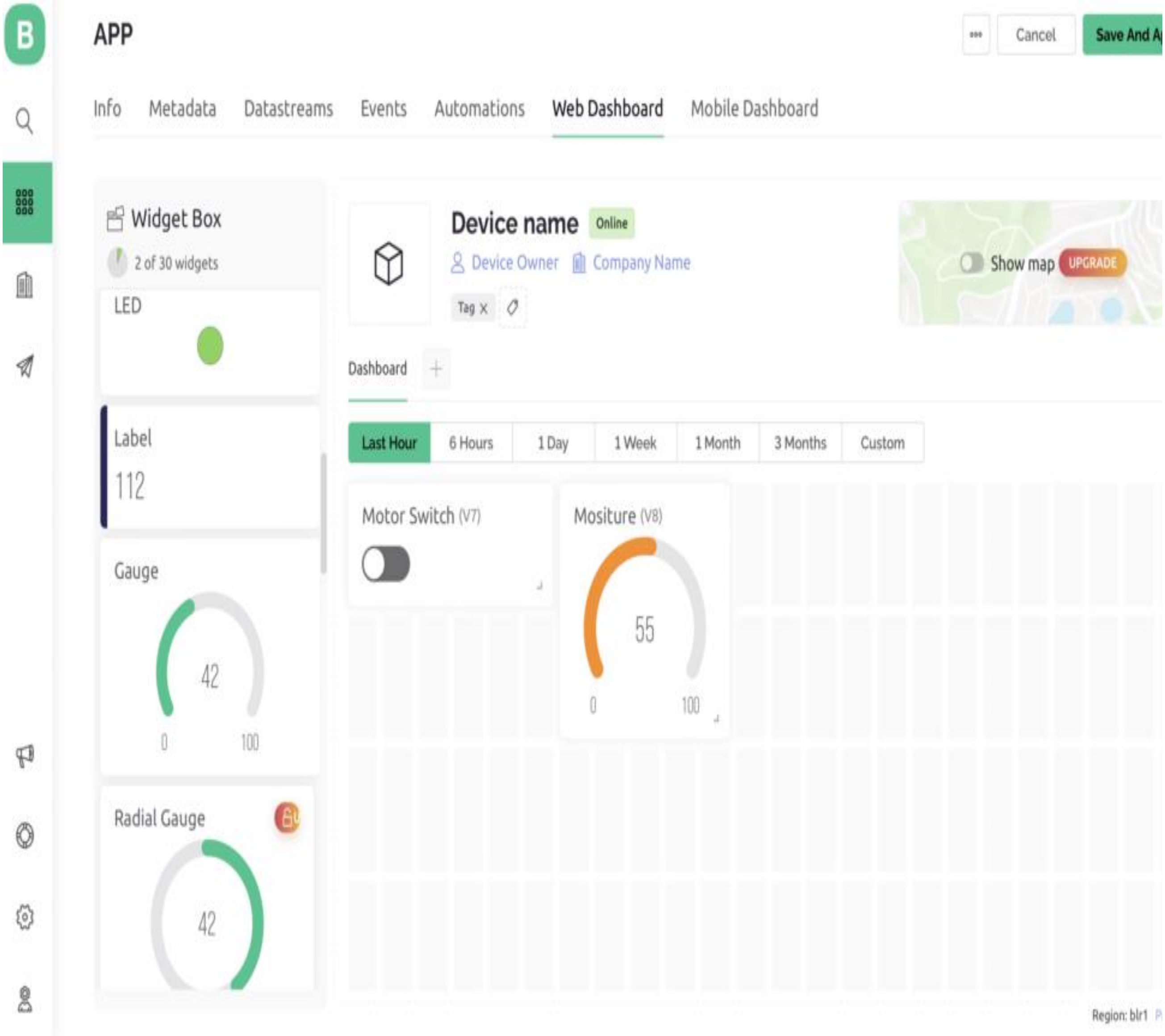
STEP 2


blynk.cloud
Templates
Start by creating your first template
Template is a digital model of a physical object. It is used in Blynk platform as a template to be assigned to devices.
+ New Template

STEP 3

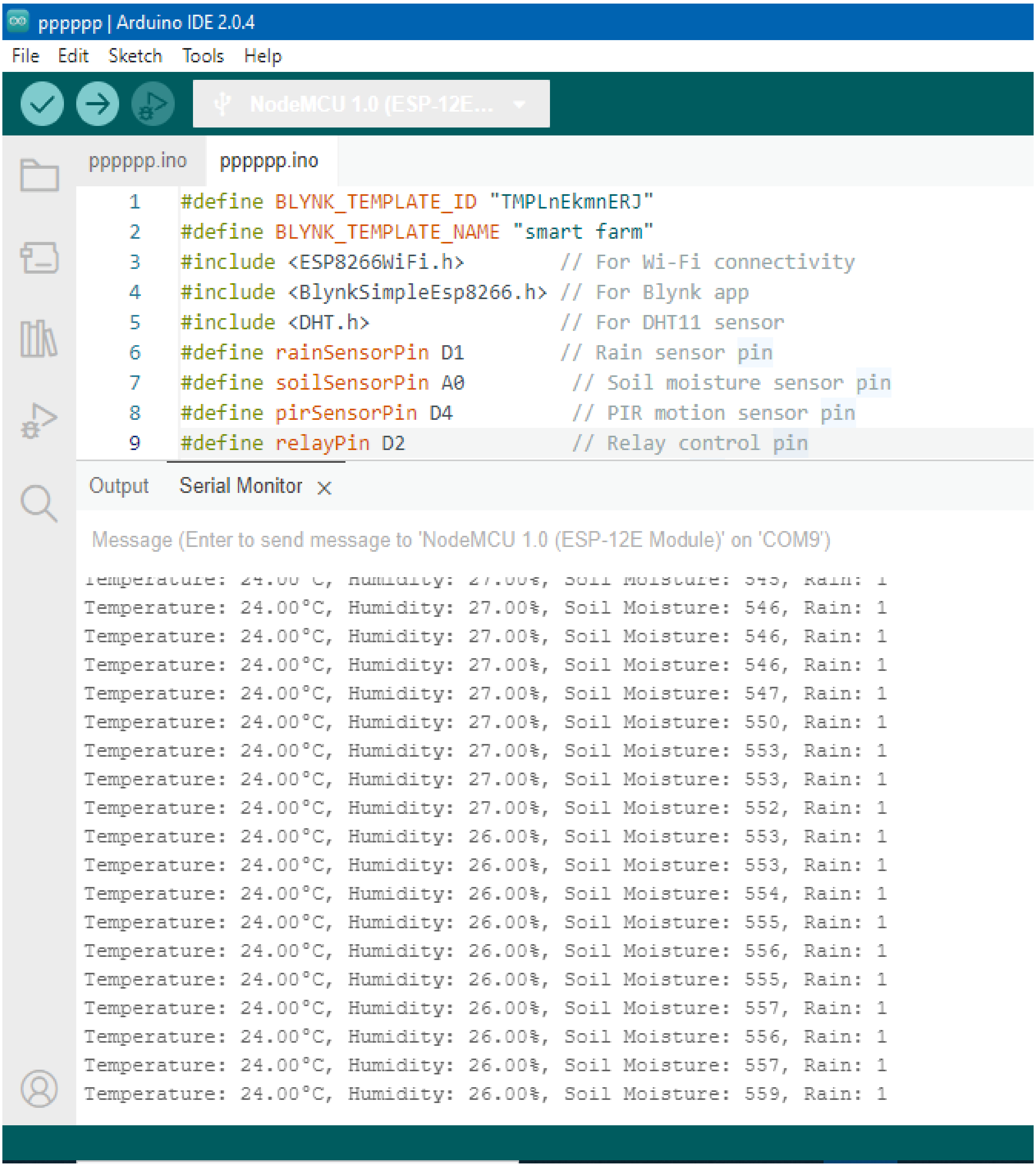

My organization - 4760VQ
Back
Search
2 Devices
APP
Quickstart Device
APP
Offline
Prateek
My organization - 4760VQ
Add Tag
Dashboard
Timeline
Device Info
Metadata
Click to copy Code
#define BLYNK_DEVICE_NAME "APP"
#define BLYNK_AUTH_TOKEN "[redacted]"
Template ID, Device Name, and AuthToken should be declared at the very top of the firmware code.
STATUS
Offline
LAST UPDATED
11:35 PM Sep 22, 2022
LAST ONLINE
10:13 PM Sep 22, 2022
LATEST METADATA UPDATE
11:48 PM Today
DEVICE ACTIVATED
12:14 AM Aug 15, 2022
by partiks310@gmail.com
ORGANIZATION
My organization - 4760VQ
AUTHTOKEN
TEMPLATE NAME
APP
MANUFACTURER
My organization 4760VQ
IP
103.187.37.38
SSL
No SSL
IP COUNTRY
India
BOARD TYPE
ESP8266
IP LAT/LON
21.9974/79.0011

STEP 4

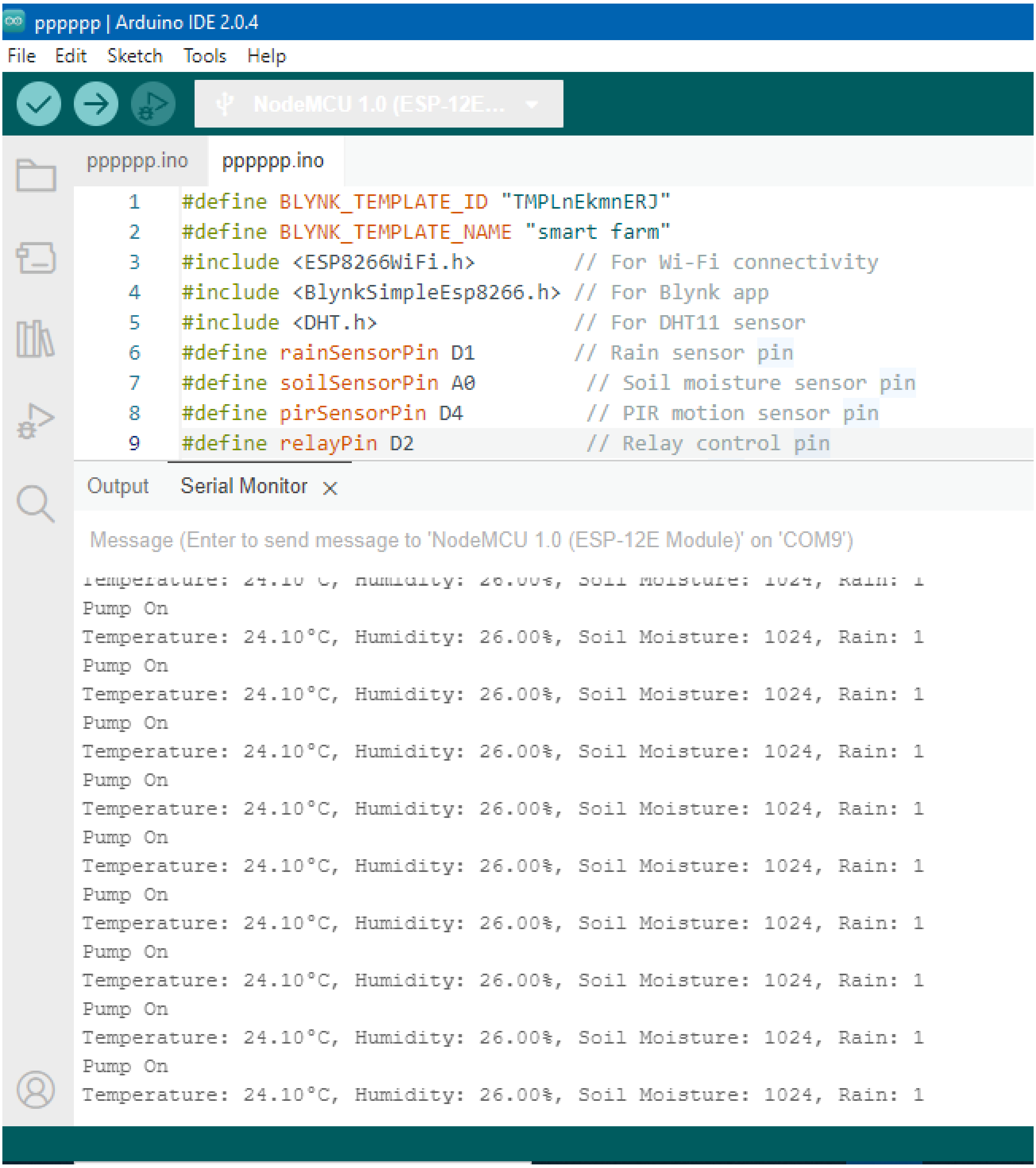


APP
Cancel
Save And A
Info
Metadata
Datastreams
Events
Automations
Web Dashboard
Mobile Dashboard
Widget Box
2 of 30 widgets
LED
Label
112
Gauge
42
0
100
Radial Gauge
42
Device name
Online
Device Owner
Company Name
Tag
Show map
UPGRADE
Dashboard
Last Hour
6 Hours
1 Day
1 Week
1 Month
3 Months
Custom
Motor Switch (V7)
Mositure (V8)
55
0
100
Region: blr1

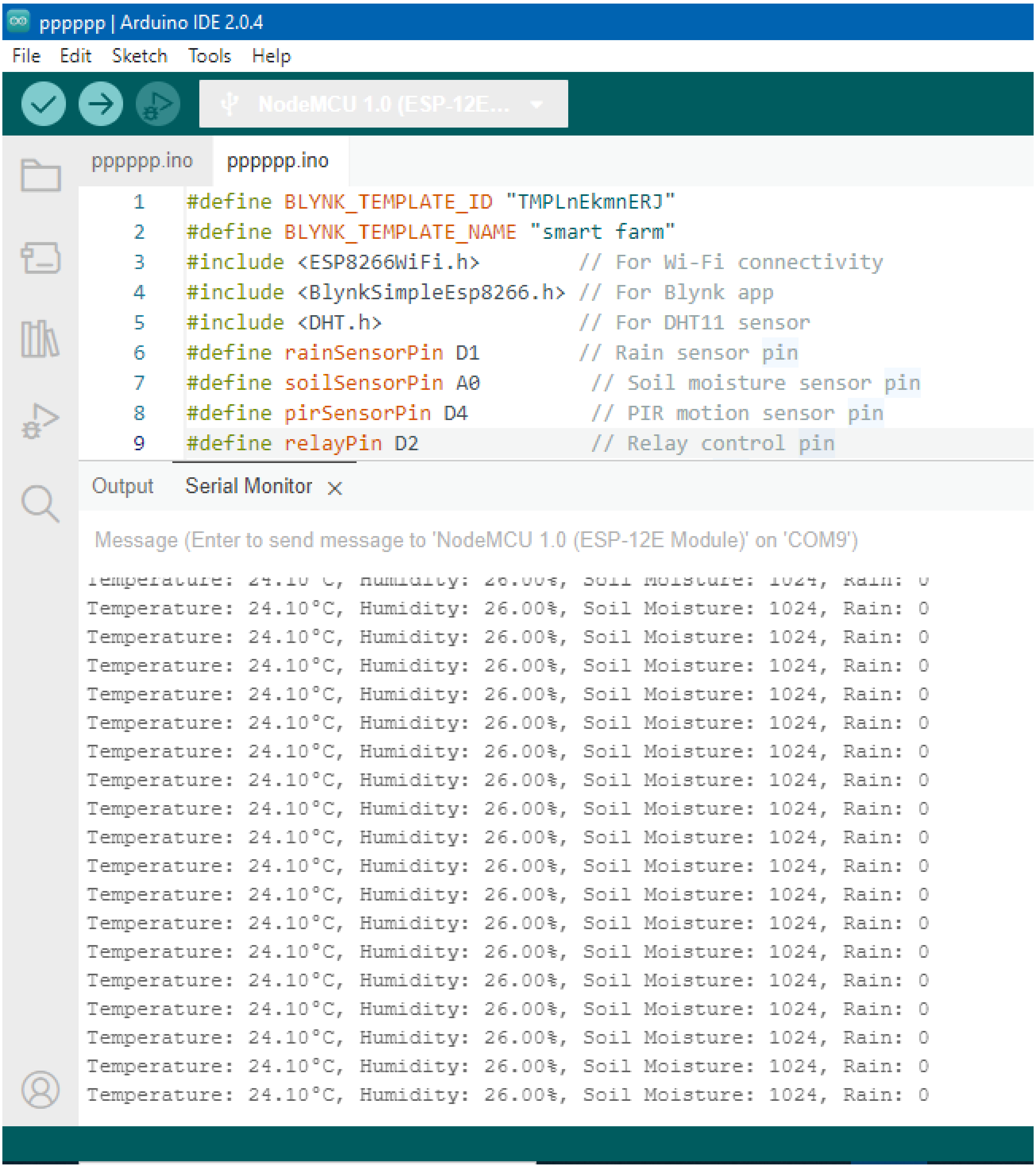
RESULTS



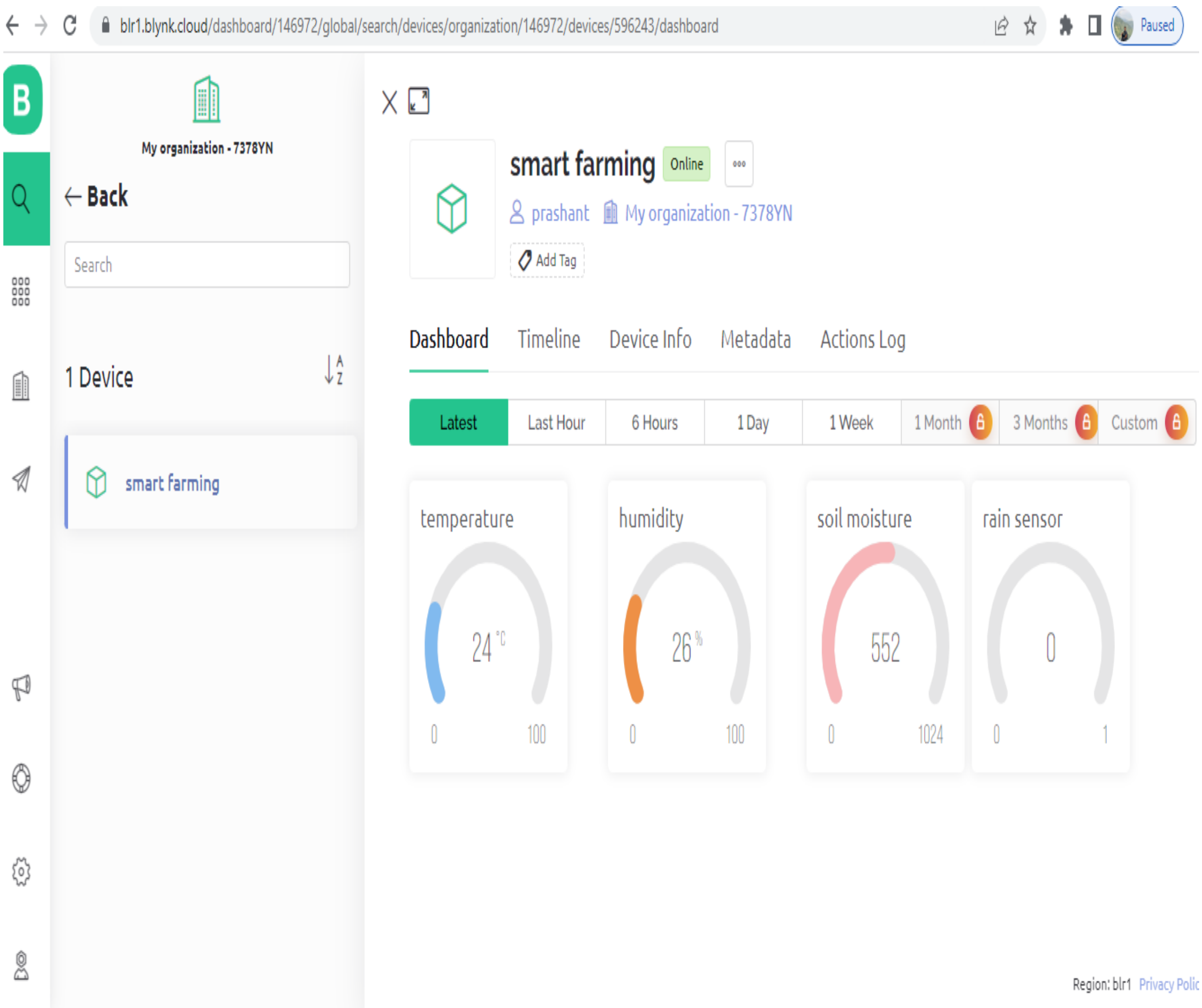
In this figure we can see the current sensor readings where it is showing temperature , humidity, Soil moisture and rain condition.



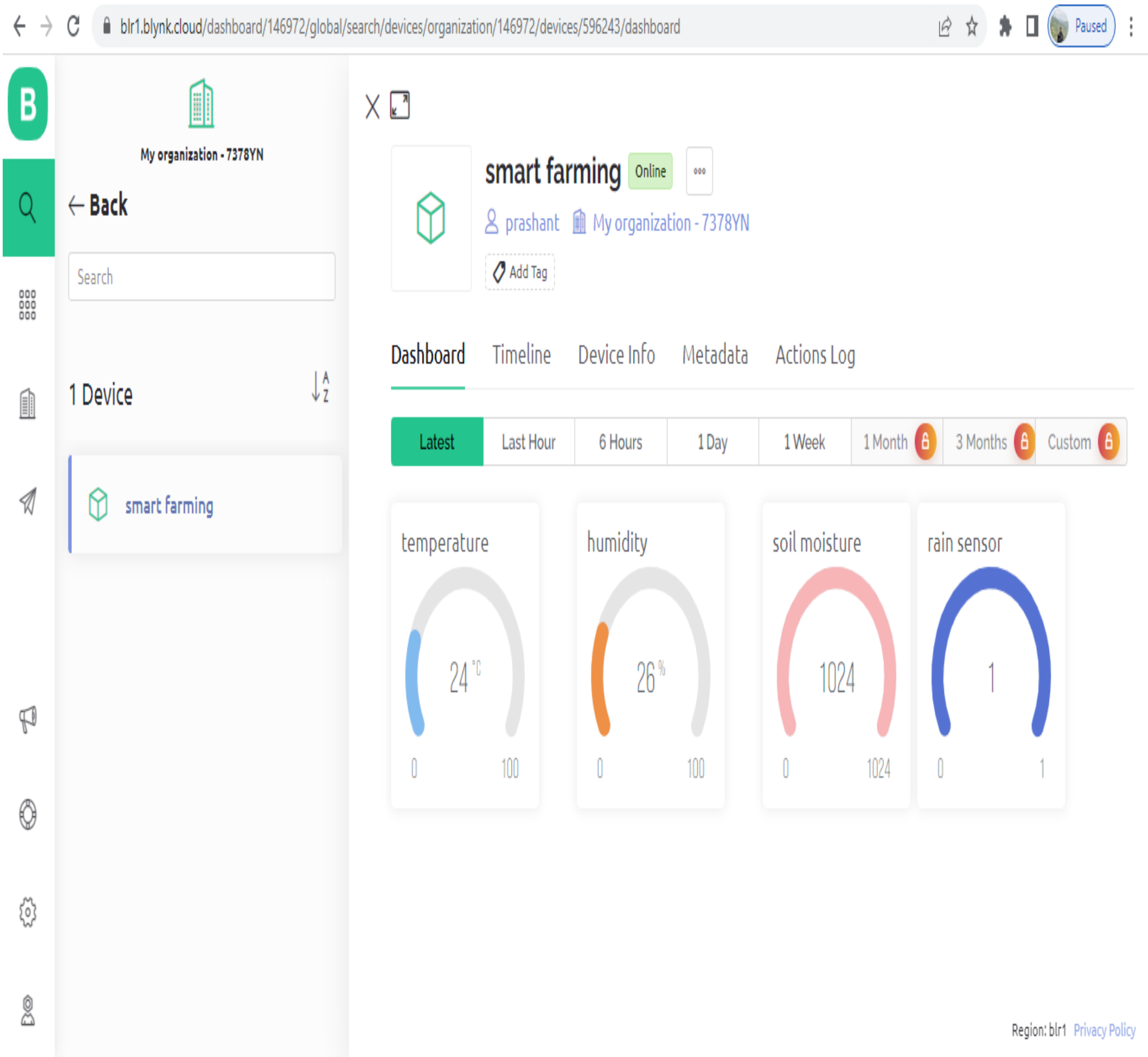
Here in this as soil moisture goes above 600 level the water pump start automatically given that rain is not happening.



Here we can see rain start happening the water pump automatically switch off .



This is the digital value of all the sensors working that is shown in blynk app.



This is the digital value of all the sensors working that is shown in blynk app.

Conclusion

In this project a smart irrigation system is implemented. It uses sensors, microcontrollers, and wireless communication technology to optimize water usage in agriculture. The system can monitor soil moisture, temperature, and humidity levels in real-time and adjust the irrigation schedule accordingly. The system also has the capability to provide remote access to the data and control functions through blink app.

The results of experiments demonstrate that the smart irrigation system can significantly reduce water consumption while maintaining crop health and yield. The system can provide precise and timely irrigation that is tailored to the specific needs of the crop and the environment. This can lead to substantial cost savings and environmental benefits, such as reduced water waste and improved water resource management.

Future scope

The smart irrigation system presented in this project has several potential avenues for further research and development. Some of the future scope includes:

Integration with advanced sensing technologies: The system can be integrated with advanced sensors, such as thermal cameras, drones, or satellite imagery, to enhance the precision and accuracy of the irrigation management. These sensors can provide additional information about crop health, growth, and stress that can inform irrigation decisions.

Machine learning algorithms: The system can be enhanced with machine learning algorithms that can learn from historical data and optimize the irrigation schedule based on weather patterns, crop growth stages, and other variables. This can lead to even more efficient and effective irrigation management.

Energy efficiency: The system can be further optimized for energy efficiency by incorporating renewable energy sources, such as solar panels or wind turbines, to power the sensors and microcontrollers. This can reduce the system's carbon footprint and operational costs.

Integration with other smart farming technologies: The smart irrigation system can be integrated with other smart farming technologies, such as precision farming, automated harvesting, or livestock monitoring, to create a comprehensive smart farming ecosystem. This can lead to greater efficiency, productivity, and sustainability in agriculture.

Overall, the smart irrigation system presented in this project has the potential to revolutionize irrigation management in agriculture. With further research and development, it can contribute to a more sustainable and efficient agricultural sector that can meet the growing demands of food production while conserving natural resources

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