IOT BASED SMART IRRIGATION SYSTEM USING CISCO PACKET TRACER

Submitted in partial fulfillment of the requirements for the award of
Bachelor of Engineering degree in Computer Science and Engineering

By

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(DEEMED TO BE UNIVERSITY)
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APRIL - 2023

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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the Bonafede work of **Yaswanth Chowdary K (Reg. No - 39110543) and Vishal Varma K G S (Reg. No - 39110542)** who carried out the Project Phase-2 entitled **"IOT BASED SMART IRRIGATION SYSTEM USING CISCO PACKET TRACER"** under my supervision from December 2022 to April 2023.

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DECLARATION

I, **Vishal Varma K G S (Reg.No - 39110542),** hereby declare that the Project Phase-2 Report entitled "**IOT BASED SMART IRRIGATION SYSTEM USING CISCO PACKET TRACER"** done by me under the guidance of **Dr. Jeslin Shanthamalar J, M.E., Ph.D.** is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering degree in **Computer Science and Engineering**.

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ACKNOWLEDGEMENT

I am pleased to acknowledge my sincere thanks to the **Board of Management** of **SATHYABAMA** for their kind encouragement in doing this project and for completing it successfully. I am grateful to them.

I convey my thanks to **Dr. T. Sasikala M.E., Ph.D.**, **Dean**, School of Computing, **Dr.L.Lakshmanan, M.E., Ph.D.,** Head of the Department of Computer Science and Engineering for providing me necessary support and details at the right time during the progressive reviews.

I would like to express my sincere and deep sense of gratitude to my Project Guide **Dr.Jeslin Shanthamalar J, M.E., Ph.D.** for her valuable guidance, suggestions and constant encouragement that paved the way for the successful completion of my phase-2 project work.

I wish to express my thanks to all Teaching and Non-teaching staff members of the **Department of Computer Science and Engineering** who were helpful in many ways for the completion of the project.

ABSTRACT

Agriculture plays a vital role in developing countries. In India, most of the population depends on agricultural farming. Many issues hinder the development of agriculture in developing countries. Hence the project aims at making agriculture smart using automation and IoT technology. Nowadays water scarcity is a big concern for farming. This project helps farmers to irrigate the farmland in an efficient manner with an automated irrigation system based on soil humidity. Automation of farm activities can transform the agricultural domain from being manual and static to intelligent and dynamic leading to higher production with lesser human supervision. The main aim of the project is to create awareness among the farmers about new technologies. And adopt those technologies for the better yield of the crops.The Internet of things(IoT) technology has revolutionized in various industries and farming is no exception.IoT has immense potential to transform agriculture by enabling farmers to make more informed decisions, increase productivity, reduce costs, and improve the quality of their crops. In this project we are using Cisco packet tracer. Cisco packet tracer is a computer networksimulation tool that was commonly used by students, professionals to design, configure, and troubleshoot computer networks. It is not directly related to farming, but it could have some potential applications in this field.

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LIST OF ABBREVIATIONS

ABBREVIATION	EXPANSION
IOT	Internet Of Things
IC	Integrated Circuit
CISCO	Computer Information System Company
LAN	Local Area Network
I/O	Input/Output
MCU	Microcontroller Unit

CHAPTER 1

INTRODUCTION

Agriculture is the major source of income for the largest population in India and is a major contributor to the Indian economy. However, technological involvement and its usability have to be grown and cultivated for the agro sector in India. Although the Indian Government has also taken a few initiatives for providing online and mobile messaging services to farmers related to agricultural queries and agro vendor information to farmers. Based on the survey it is observed that agriculture contributes 27% to GDP, and Provides employment to 70% of the Indian population.

IoT is changing the agriculture domain and empowering farmers to fight the huge difficulties they face. Agriculture must overcome expanding water deficiencies, and restricted availability of lands while meeting the expanding consumption needs of the world population. New innovative IoT applications are addressing these issues and increasing the quality, quantity, sustainability, and cost-effectiveness of agricultural production.

Agriculture is the backbone of the Indian Economy. In today's world, as we see rapid growth in the global population, agriculture becomes more important to meet the needs of the human race. However, agriculture requires irrigation and with every year we have more water consumption than rainfall, it becomes critical for growers to find ways to conserve water while still achieving the highest yield. But in the present era, the farmers have been using irrigation techniques through manual control in which they irrigate the land at regular intervals. It can also be used to modify the status of the device. The central processing unit will also include a communication device to receive data from the sensors and to be relayed to the user's device. This will be done using a higher communication device such as a Wi-Fi module.

1.1 HOME GATEWAY

An IoT gateway is a centralized hub that connects IoT devices and sensors to cloud based computing and data processing. Modern IoT gateways often allow bidirectional data flow between the cloud and IoT devices.15. This allows IoT sensor data to be uploaded for processing and commands to be sent from cloud-based applications to IoT devices. IOT gateways are also able to connect to one another to streamline and expand their functionality throughout a physical location and in use with a growing number of IoT devices and smart sensors. By installing universal IoT gateways early in your technology plan, you can add devices seamlessly while saving time and effort.

A true IoT gateway contains communication technologies connecting end-devices (sensors, actuators or more complex devices) and backend platforms (data, device and subscriber management) to the gateway. It has a computing platform allowing pre-installed or user-defined applications to manage data (for routing and computing at edge), devices, security, communication and other aspects of the gateway. As a centralized hub, an IOT gateway provides a single location where data is communicated to and from devices. This communication comes from other devices and users via the cloud. When you receive information or provide information to an IoT device—such as a change in protocol—you're communicating with these devices through IoT gateways via cloud-enabled software.

Many home gateways also have wireless connectivity, such as Wi-Fi, to allow devices to connect to the internet without a physical Ethernet cable. The configuration of a home gateway may be done through a web-based interface or a mobile app. This allows users to set up the security features and configure the wireless network.

Fig 1.1: Home Gateway

CISCO network simulation software–Packet Tracer which works on certain configurations such as security and routing purposes. Packet tracer helps in building network topologies, it simulates behavior of the network and simulates routers and switches using command line interface and it imitates modern computers. The below figures show the class address of IP, network and host identification. With the help of the home gateway we are going to connect other monitoring devices to the smartphone. Hence the smartphone is used to operate the other devices. In this way home gate is utilized to operate those devices with the help of smartphones.

1.2 Temperature Monitor

A temperature sensor is an electronic device that measures the temperature of its environment and converts the input data into electronic data to record, monitor, or signal temperature changes. Temperature is the most often-measured environmental quantity.

This might be expected since most physical, electronic, chemical, mechanical, and biological systems are affected by temperature. Certain chemical reactions, biological processes, and even electronic circuits perform best within limited temperature ranges. Temperature is one of the most measured variables and it is therefore not surprising that there are many ways of sensing it. Temperature sensing can be done either through direct contact with the heating source or remotely, without direct contact with the source using radiated energy instead.

IoT temperature monitoring solution allows the food industry to monitor the temperature of these chambers allowing them to ensure that the regulatory compliances are met. They can remotely monitor the temperature of the items and confirm the quality of their products. IOT Monitoring System (IMS) enables real-time temperature & humidity monitoring, location tracking, smart notification alert, and compliance reporting to ensure your products stay safe as they are being stored or transported.

How does a temperature monitor work?

Temperature sensors work by providing readings via electrical signals. Sensors are composed of two metals that generate an electrical voltage or resistance when a temperature change occurs by measuring the voltage across the diode terminals. When the voltage increases, the temperature also increases. Once the temperature sensor has obtained a reading, it is typically sent to a microprocessor or other processing unit which can display the temperature or take action based on the reading.

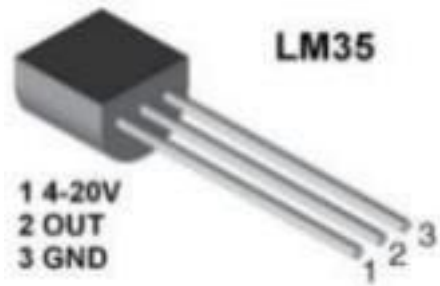


Fig 1.2: Temperature Sensor

The above temperature sensor has three terminals and requires a Maximum of 5.5 V supply. This type of sensor consists of a material that performs the operation according to temperature to vary the resistance. This change of resistance is sensed by the circuit, and it calculates the temperature. When the voltage increases then the temperature also rises. We can see this operation by using a diode.

Temperature sensors are directly connected to microprocessor input and are thus capable of direct and reliable communication with microprocessors. The sensor unit can communicate effectively with low-cost processors without the need for A/D converters. An example of a temperature sensor is **LM35**. The LM35 series are precision integrated circuit temperature sensors, whose output voltage is linearly proportional to the Celsius temperature. The LM35 operates at -55˚ to +120˚C. The basic centigrade temperature sensor (+2˚C to +150˚C) is shown in the figure below. The LM35 sensor outputs a voltage that is linearly proportional to the temperature beingmeasured. For every degree Celsius change in temperature, the output voltage of the sensor changes by 10 millivolts.

Therefore, if the temperature being measured is 25 degrees Celsius, the output voltage of the sensor will be 250 millivolts. The LM35 sensor is easy to use and does not require any calibration. It has a simple 3-pin design, with a power input pin, a ground pin, and an output pin. The output pin can be connected directly to an analog input of the microcontroller to read the temperature value.

Features of LM35 Temperature Sensor

- Calibrated directly in ˚ Celsius (Centigrade)Rated for full l

  −55˚ to +150˚C range Suitable for remote applications

- Low cost due to wafer-level trimmingOperates from 4 to 30

  volts

- Low self-heating,

- ±1/4˚C of typical nonlinearity

1.3 Humidity Monitor

Humidity monitoring is a crucial aspect of irrigation. Smart Monitoring of humidity levels can increase the chances of good produce and smart irrigation. Fig 5. Shows the Humidity monitoring system, which is one of the aspects of a smart irrigation system. In this system, a humidity sensor is used. Humidity sensors are used to sense the humidity in the environment. This sensor is registered to the home gateway. After the network configurations, the values of the humidity sensor can be viewed on the Tablet. Further, to make it more convenient, a humidifier is used. A humidifier is a device used for increasing the level of moisture in the environment. The users can set the conditions accordingly.
High humidity levels can lead to mold growth, respiratory problems, and damage to furniture and electronics, while low humidity can cause dry skin, respiratory issues, and damage to wood and other materials Humidity monitors are available in a variety of types, including digital and analog models, and can be used as standalone devices or integrated into other systems, such as smart thermostats for HVAC systems.

Another feature that some humidity monitors include is data logging. This feature allows you to record and store the humidity and temperature levels over a specified period. This can be useful for analyzing trends and patterns in your environment and making informed decisions based on the data collected.

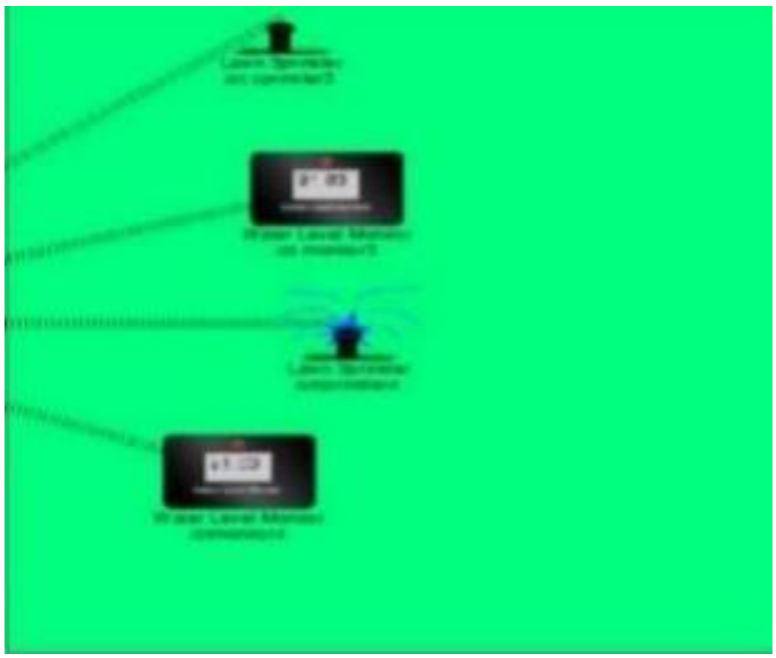


Fig 1.3: Automatic sprinkler and Humiditymonitoring system

Other Monitoring Devices The germination time of the seeds and plants may shorten due to frequent changes in the atmospheric pressure. This System has an Atmospheric Pressure level indicator for proper monitoring of atmospheric pressure levels and taking adequate measures that may help to increase the growth of plants and cause more massive and rapid root growth. Another aspect is the Humiture monitor, which helps in monitoring both temperatureand humidity levels. The temperature monitor senses the temperature levels in the atmosphere.

The main purpose of a humidity monitoring system is to measure the relative humidity of the air in a given space. This can be important in many applications, including HVAC systems, museums, data centers, and more. This allows for more efficient and effective management of building operations. This is also useful for identifying trends and making informed decisions about building operations.

1.4 WIND DETECTOR

The Wind detector detects wind in the environment. The carbon monoxide and carbon dioxide detect the carbon monoxide and carbon dioxide levels, respectively.A wind speed sensor is a physical device used to measure wind speed. The wind generated by the airflow drives the top three wind cups to rotate, and the central axis drives the internal sensing element to generate an output signal, which can be used to calculate the wind speed.

Wind speed sensor working principle

The wind generated by the airflow drives the top three wind cups to rotate, and the central axis drives the internal sensing element to generate an output signal, which can be used to calculate the wind speed.

ADVANTAGES

It provides specific measurements with minimal power consumption. This device calculates multiple parameters such as speed, velocity, pressure, and direction of the wind. Since it is a climate station instrument, it can detect, measure, and provide information concerning the wind. Wind turbines, which generate electricity from wind power, rely on accurate wind speed and direction measurements to optimize their performance.

Wind detectors are used in environmental monitoring to measure wind speed and direction, which can help identify areas where pollution is being carried by the wind. They are also useful in agriculture for implementing irrigation and planting strategies. This is very useful for the better yielding of the crops.

Fig 1.4: Other Monitoring Devices

1.5 SIREN The Smart Siren allows you to use voice prompts to support the normal siren functionality, which ensures customers don't need to remember patterns for different alarms. Voice prompts can also be used to accomplish important tasks such as notifications and confirmation of actions.

In Cisco Packet Tracer, a siren is a tTo add a siren to your Packet Tracer network, you can use the "Security" devices category and select the "Alarm Siren" device.

1.6 WATER SPRINKLER

An **Irrigation sprinkler** is a device used to irrigate agricultural crops, lawns, landscapes, golf courses, and other areas. They are also used for cooling and for the control of airborne dust. Sprinkler irrigation is a method of applying irrigation water that is like natural rainfall. Water is distributed through a system of pipes usually by pumping. It is then sprayed into the air through sprinklers so that it breaks up into small water drops which fall to the ground. The pump, valves, distribution pipes, and sprinklers are generally designed to apply water as uniformly as possible. Sprinklers that spray in a fixed pattern are generally called sprays or spray heads. Sprays are not usually designed to operate at pressures, due to misting problems that may develop.

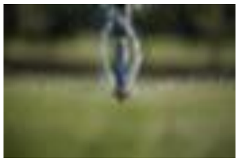
Higher pressure sprinklers that themselves move in a circle are driven by a ball drive, gear drive, or impact mechanism (impact sprinklers). These can be designed to rotate in a full or partial circle.

Rain guns are similar to impact sprinklers, except that they generally operate at very high pressures of 40 to 130 lf/in^2 (275 to 900 kPa) and flows of 50 to 1200 US gal/min (3 to 76 L/s), usually with nozzle diameters in the range of 0.5 to 1.9 inches (10 to 50 mm). The first use of sprinklers by farmers was some form of home and golf course type sprinklers. These ad hoc systems, while doing the job of the buried pipes and fixed sprinkler heads, interfered with cultivation and were expensive to maintain. To conserve water, it's important to use sprinklers that are designed to minimize water waste and to water plants during the early morning or late evening when evaporation rates are low. Regular maintenance is necessary to ensure the efficient operation of sprinklers. This includes cleaning the sprinkler heads, checking for leaks or clogs, and adjusting the water flow rate. The coverage area of a sprinkler depends on its design and water pressure.

Fig 1.5: Resident

- Underground Sprinkler
- End Gun style pivot applicator sprinkler
- Home lawn sprinklers vary widely in size, cost, and complexity. They include impact sprinklers, oscillating sprinklers, drip sprinklers, and underground sprinkler systems. Small sprinklers are available at home and garden stores or hardware stores for small costs. These are often attached to an outdoor water faucet and are placed only temporarily. Other systems may be professionally installed permanently in the ground and are attached permanently to a home's plumbing system. An ingenious domestic sprinkler made by Nomad called a 'set-and-forget tractor sprinkler' was used in Australia in the 1950s. Water pressure ensured that the sprinkler slowly moved across the lawn.[1]
- Sprinklers can be simulated in Cisco Packet Tracer by using the IoT (Internet of Things) devices available in the software.
- Test the Smart Sprinkler device by sending commands to it from a computer connected to the network. You can use the Command Line Interface (CLI) or a graphical user interface (GUI) to send commands to the device and see its response.

- Underground sprinklers function through means of basic electronic and hydraulic technology. This valve and all the sprinklers that will be activated by this valve are known as a zone. Upon activation, the solenoid, which sits on top of the valve is magnetized lifting a small stainless-steel plunger in its center. By doing this, the activated (or raised) plunger allows air to escape from the top of a rubber diaphragm located in the center of the valve.
- Water that has been charged and waiting on the bottom of this same diaphragm now has a higher pressure and lifts the diaphragm. This pressurized water is then allowed to escape downstream of the valve through a series of pipes, usually made of PVC. Atthe end of these pipes flush to ground level (typically) are pre-measured and spaced out sprinklers. These sprinklers can be fixed spray heads that have a set pattern and generally spray between 1.5–2m (7–15 ft.), full rotating sprinklers that can spray a broken stream of water from 6–12m (20–40 ft.), or small drip emitters that release a slow, steady drip of water on more delicate plants such as flowers and shrubs. Agricultural Science Sprinklers can help create a realistic simulation of a fire in a network environment, which can help network administrators prepare for and respond to potential disasters. Using sprinklers in Cisco Packet Tracer is a cost-effective way to test and refine network fire safety protocols before investing in physical hardware.



- In the 1950s a firm based in Portland, Oregon Stout-Wyss Irrigation System, developed the rolling pipe type irrigation system for farms that has become the most popular type for farmers irrigating large fields. With this system large wheels attachedto the large pipes with sprinkler heads move slowly across the field. Most irrigation sprinklers are used as part of a sprinkler system, consisting ofvarious plumbing parts, pump units,[4] ~~p~~iping and control equipment. Outdoor sprinkler systems are sometimes used as a deterrent against homeless people.

Fig 1.6: Water Sprinkler

- This sprinkler system was programmed to drench unsuspecting sleepers at random times during the night. Local businessmen soon copied this system to drive homeless people away from public sidewalks adjacent to their businesses. WithCisco Packet Tracer, network administrators can easily adjust the parameters of the sprinklers, such as water pressure and spray pattern, to test different scenarios. Using sprinklers in Cisco Packet Tracer can help students and network administrators learn about fire safety protocols, network design, and disaster recovery planning.

CHAPTER 2

LITERATURE SURVEY

Title 1: IoT-Based Smart Plant Irrigation System with Enhanced learning Author: Kemal Cagri Serdaroglu, Cem Onel, Sebnem Bayadere

In this study, we propose a smart plant irrigation IoT system that autonomously adapts itself to a defined irrigation habit. Automated plant irrigation systems generally make decisions based on static models derived from the plant's characteristics. In contrast, in our proposed solution, irrigation decisions are dynamically adjusted based on the changing environmental conditions.The learning mechanism of the model reveals the mathematical connections of the environmental variables used in the determination of the irrigation habit andprogressively enhances its learning procedure as the irrigation data accumulates in the model. We evaluated the success of our irrigation model with four different supervised machine learning algorithms and adapted the Gradient Boosting Regression Trees (GBRT) method in our IoT solution.

We established a test bed for the sensor edge, mobile client, and the decision service on the cloud to analyze the overall system performance. The early results from our prototype system that is tested with two indoor plants; namely Sardinia and Peace-lily are very encouraging. The results reveal that the proposed system can learn the irrigation habits of different plants successfully. The system uses sensors to measure environmental parameters such as soil moisture, temperature, and humidity. The data collected by the sensors is sent to amicrocontroller, which processes the data and determines whether irrigation is needed. The microcontroller also communicates with a server that collects and analyzes the data, providing insights to improve the irrigation system's performance. The system is designed to be energy-efficient and scalable, making it suitable for use in large agricultural fields as well as home gardens.

Title 2: Mobile Integrated Smart Irrigation Management and Monitoring System Using IoT

Author: Vaishali S, Suraj S, Vignesh G, Divya S,Udayakumar S Agriculture has been the most important practice from the very beginning of human civilization. Traditional methods that are used for irrigation, such as overhead sprinklers and flood type, are not that much efficient. About 85% of the total available water resources across the world are solely used for irrigation purposes. In upcoming years this demand is likely to increase because of the increasing population. To meet this demand, we must adopt new techniques which will conserve the need for water for the irrigation process. In the automation system, water availability to crops is monitored through sensors, and as per need, watering is done through controlled irrigation. The almost infinite capabilities of storage and processing, the rapid elasticity makes cloud computing an attractive solution to the large amount of data generated. The idea is to focus on parameters such as temperature and soil moisture. This is a Mobile Integrated and smart irrigation system using IOT based on anapplication-controlled monitoring system.

The central control unit processes the data and makes decisions about when and how much to water the crops based on the current weather conditions and the moisture level of the soil. The system can also be controlled remotely using a mobile app or web interface, allowing farmers to adjust settings and monitor the system from anywhere. Overall, the Mobile Integrated Smart Irrigation Management and Monitoring System Using IoT is a powerful tool for modern agriculture, providing farmers with greater control over their irrigation systems and helping to reduce water waste while increasing crop yields. This system can also be controlled remotely using a mobile app or web interface, allowing farmers to adjust settings and monitor the system from anywhere. This system can also reduce the need for manual labor and eliminate guesswork in irrigation management.

Title 3: Automated Irrigation System-IoT Based Approach Author: Dweepayan Mishra, Arzeena Khan2 Rajeev Tiwari3, Shuchi Upadhay4

Agriculture is a major source of earnings for Indians, and agriculture has made a big impact on India's economy. The development of crops for a better yield and quality delivery is exceptionally required. So suitable conditions and suitable moisture in the beds of crops can play a major role in production. Most irrigation is done by traditional methods of stream flows from one end to another. Such supply may leave varied moisture levels in the field. The administration of the water system can be enhanced by utilizing a programmed watering framework This paper proposes a programmed water system with the framework for the terrains which will reduce manual labor and optimize water usage increasing the productivity of crops. For formulating the setup, an Arduino kit is used with a moisture sensor with a Wi-Fi module. The basic components of an automated irrigation system include soil moisture sensors, weather sensors, controllers, valves, and communication devices. Soil moisture sensorsare used to measure the moisture content of the soil, while weather sensors provide information about temperature, humidity, and rainfall. Controllers use this information to determine when and how much water to apply to the crops.

Title 4: Smart Irrigation System Using Machine Learning and IoT Author: Revanth Kondaveti, Akash Reddy, Supreet Palabtla

In urban areas, such as developed cities, the citizens have all the basic amenities like electricity supply with a minimal power cut, Food supply, comparatively proper roads and infrastructure of buildings, etc. But the same is not the case with rural areas, where the majority of villages suffer electricity shortages, agricultural issues, improper supply and distribution of water for various purposes, etc. Hence through our project Now, there are numerous factors that can influence the formation of a smart village. This mainfocus is on the Automatic Irrigation System. Smart Irrigation System using Machine Learning and IoT is a system that utilizes modern technologies to optimize water usage in agriculture.

CHAPTER 3

HARDWARE REQUIREMENTS

3.1 IOT (Internet Of Things)

The Future Internet goal is to provide an infrastructure to have immediate access to information about the physical world and its objects. Physical objects can be applicable to different application domains, such as e-health, warehouse management, etc. Each application domain may have different types of physical devices. Each physical device can have its own specifications, which are required to interact with it. To achieve the future Internet goal, a layered vision is required that can facilitate data access. Internet of Things (IoT) is a vision that aims to integrate the virtual world of information to the real world of devices through a layered architecture.

The term „Internet of Things" consists of two words, namely Internet and Things. Internet refers to the global network infrastructure with scalable, configurablecapabilities based on interoperable and standard communication protocols. Things are physical objects or devices, or virtual objects, devices or information, which have identities, physical attributes and virtual personalities, and use intelligent interfaces [1]. For instance, a virtual object can represent an abstract unit of sensor nodes that contains metadata to identify and discover its corresponding sensor nodes. Therefore, IoT refers to the things that can provide information from the physical environment through the Internet. Middleware is an interface between the hardware layer and the application layer, which is responsible for interacting with devices and information management [2]. The role of middleware is to present a unified programming model to interact with devices. Middleware overseas masks the heterogeneity and distribution problems that we face when interacting with devices [3]. In Cisco Packet Tracer, you can also use the built-in IoT simulation mode to create and test IoT applications. This mode allows you to simulate the behavior of IoT devices and monitor their interactions with other devices and applications.

3.2 Motivation

IoT-based systems oversee providing knowledge from an environment to a non-expert user. IoT-based systems can be used in different environments, so it needs to be able to address many heterogeneous devices. Thus, a major concern within developing an IoT based system is how to handle the interaction with the heterogeneous devices for non expert users. This concern can be addressed by a middleware layer between devices and non-expert users. This layer is responsible for hiding the diversity of devices from the user perspective and provides access transparency to the devices for the end users.The idea of creating abstractions of devices has been addressed in the literature. The middleware we found in the literature can provide satisfaction by facilitating the interaction with devices, but they do not support low-level device configuration [4].

3.3. IOT definition

In this section, we explain some of the IoT definitions. Also, we explain the layered architecture for IOT. The Internet of Things (IOT) has increasingly gained attention in industry to interact with different types of devices. IoT can have influence on industry and society by integrating physical devices into information networks [8]. IoT impacts can be from different perspectives, namely for private and business users. From the perspective of a private user, IoT influences both working and personal fields, such as smart homes and offices,e-health and assisted living. From the aspect of a business user the impacts would be infields such as automation and industrial manufacturing, logistics, business process management, intelligent transportation of people and goods [9]. IOT integrates physical things into information networks. IoT covers the overall infrastructure, including software, hardware and services, which is used to support these information networks.

The integrated physical things can exchange data about the physical properties and information that they sense in their environment. To identify devices, we can use identification technologies like for example RFID, which allow each device to be uniquely identified [10]. International Telecommunication Union (ITU)[1] defines IoT as “A global infrastructure for the Information Society, enabling advanced services by interconnecting (physical and virtual) things based on, existing and evolving, interoperable information and communication technologies” .

3.4 Challenges

IoT-based systems can be used for different purposes and areas, so we have to face different challenges. In this section, we explain some of the challenges that need to be considered in research activities [10]:

Edge technology

At the hardware level, more research efforts are required to develop the technology of embedded devices, sensors, actuators and (passive and active) identification, since an IoT-based system must be able to gather sufficient information about the real world by employing a large variety of devices and environments. Thus, more work is still required to connect heterogeneous devices and deploy them in IoT applications, and to provide support for new devices.

Networking technologies

In IoT, things are connected through different kinds of networks, i.e., mobile, wired and wireless networks. These networks support bi-directional communication at different levels among the real-world objects, applications and services that are employed by the IoT applications. This highly distributed structure should provide interconnection with low energy consumption, while distributed data can cause privacy issues.

Middleware system

In IoT, we have heterogeneous devices and networks. Their heterogeneity can potentially increase with new technologies. To facilitate the use of these devices by IoT applications, we should shield their heterogeneity. Therefore, we need to develop a secure, scalable and semantically enriched service-oriented middleware to cope with the heterogeneity of devices.

Platform services

They support superior management of all involved devices in an integrated way, ensuring scalability, high availability, and the safe and secure execution of the requested functionality from devices. In continuation, we focus on the middleware challenges, because we are looking for the functionalities that a middleware can provide for the application layer in the IoT-based systems Internet of Things-Architecture [2](IoT-A) defines it as “The idea of a globally interconnected continuum of devices, objects and things in general emerged with the RFID technology, and this concept has considerably been extended to the current vision that envisages a plethora of heterogeneous objects interacting with the physical environment.” [12]. IOT has a layered architecture designed to answer the demands of various industries, enterprises and society. Fig. 2.1 shows a generic layered architecture for IoT that consist of five layers, which are discussed, in the following:[13]

Edge Technology layer

This is a hardware layer that consists of embedded systems, RFID tags, sensor networks and all the other sensors in different forms. This hardware layer can perform several functions, such as collecting information from a system or an environment, processing information and supporting communication.

Access Gateway layer

This layer is concerned with data handling and is responsible for publishing and subscribing the services that are provided by the Things, message routing, and hovelling the communication between platforms.

Middleware layer

This layer has some critical functionalities, such as aggregating and filtering the received data from the hardware devices, performing information discovery and providing access control to the devices for applications.

Application layer

This layer is responsible for delivering various application services. These services are provided through the middleware layer to different applications and users in IoT-based systems.

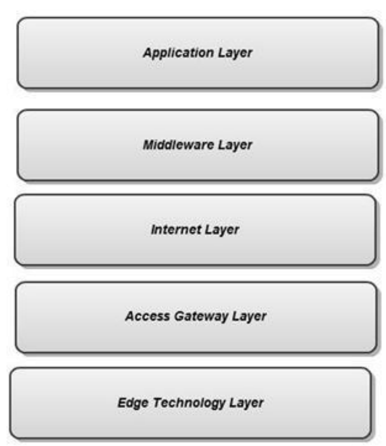


Figure:2.1 Layered architecture of the Internet of Things (IoT)

3.4. IOT based Middleware

Bandyopadhyay, S. et. al. has studied the middleware systems that have been applied in IoT-based systems [1]. They classify the required functionality of middleware to manage interaction with a variety of devices in four functional components, namely (1) interface protocols, (2) device abstraction, (3) central control, context detection & management, and (4) application abstraction (shown in Fig. 2.2). In the following, we explain these components in detail. IoT middleware is a software layer that acts as a bridge between IoT devices and applications. It provides a set of services and APIs that enable communication, data processing, and management of IoT devices and data. These middleware components provide APIs and tools for developing IoT applications. They abstract away the complexity of device integration and data management, enabling developers to build applications quickly and efficiently.

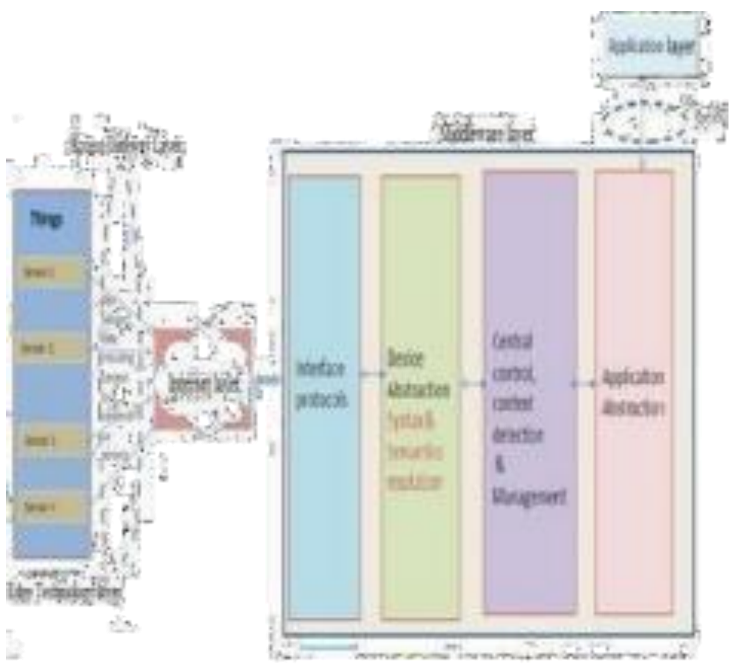


Figure 2.2 Functional components of a middleware for IoT-basedsystem

3.5 Interface protocols

This component oversees providing technical interoperability. Interoperability in the context of Interface protocols means: the ability of two systems to interoperate by using the same communication protocols. According to ETSI (European Telecommunications Standards Institute) [14] technical interoperability is defined as the association of hardware or software components, systems and platforms that enable machine-to machine communication to take place. This kind of interoperability is often centered on (communication) protocols, and the infrastructure needed for those protocols to operate [14]. To cope with the heterogeneity of devices, we can use a wrapper for each device to translate the protocol supported by the device to a common protocol. This wrapper can be placed either on the device side or the middleware side. If we want to havedirect interaction with devices, we should place the wrapper in the middleware side. Devices usually have limited capability of computational process, so this would be a reason to implement wrapper on the middleware side. In contrast, in case of indirect interaction with devices we can develop an intermediary wrapper between the middleware and the devices.

Interface protocols are crucial in modern computing and communication technologies as they enable interoperability between different systems and devices. Without standardized protocols, it would be much more difficult for devices to communicate with each other, leading to a fragmented and inefficient technology landscape. Examples of interface protocols include USB, Bluetooth, Wi-Fi, Ethernet, and HTTP. Each of these protocols has its own set of rules that define how data is transmitted, what types of data can be transmitted, and how devices should respond to various commands or signals. The interface protocol component is responsible for allowing the middleware to support both direct and indirect interactions.

3.6 Device Abstraction (DA)

This component is responsible for providing an abstract format to facilitate the interaction of the application components with devices. This abstraction provides syntactic and semantic interoperability, which are defined by ETSI [14] as follows: Syntactic interoperability is associated with data formats. The messages transferred by communication protocols must have a well-defined syntax and encoding format, which can be represented by using high-level transfer syntax such as HTML and XML. Device abstraction refers to the process of hiding the details of a hardware device and presenting a more simplified and standardized interface for software applications to interact with the device. This is done by creating a layer of software, known as a device driver, that sits between the operating system and the hardware.

Semantic interoperability is usually associated with the meaning of the content of a message which is understandable for humans. Thus, interoperability on this level means that there is a common understanding among people on the meaning of the content (information) being exchanged among them. However, since DA does not communicate directly with humans, semantic interoperability in the context of DA oversees providing this common understanding for applications. Semantic interoperability relies on semantic models which tend to be domain specific. For example, one way to provide semantic interoperability in Service Oriented (SOA) [15] based middleware is by using Devices Profile for Web Services (DPWS) [16]. In this context, each device type refers to a distinguished service type. This makes it easier for software developers to create applications that work with a widerange of hardware devices, without needing to create specialized code for each individual device.

3.7 Application Abstraction

This functional component provides an interface for both high-level applications and end users to interact with devices. A. Malara's. et. al. proposes a SOA-based middleware to perform data management and data monitoring services [18]. The goal of application abstraction is to provide a simplified view of the software that hides unnecessary complexities, making it easier for users to interact with and use the application. This approach can improve the user experience, increase productivity, and reduce the amount of training required for users to become proficient with the software. This approach can improve the user experience, increase productivity, and reduce the amount of training required for users to become proficient with the software.

This middleware uses a Restful interface to facilitate the interaction of high-level applications with sensors, which can communicate with Wireless Sensor Network (WSN) through the HTTP operations:

GET to issue a query on an existing resource, (2) DELETE to remove an existing resource, (3) POST to create a new resource, and (4) PUT to update an existing resource For instance, a client application gets the result of a domain task by sending a GET request through the URL: „http :// {hostname}/REST/ {version}/DomaintaskResult/id'. In this URI that reference to an „id leads to a unique result. In the Tiny DB middleware [19], an end-user can use a query language to interact with devices. For instance, a user can send the following query to get the id of a sensor.

Overall, application abstraction is an important technique for simplifying complex software systems, making them more user-friendly, and facilitating their integration with other software applications.

NODE MCU

NodeMCU is an open source IoT platform.[4][5] It includes firmware which runs on the ESP8266 Wi-Fi SoC from Espress if Systems, and hardware which is based on the ESP 12 module.[6][7] The term "NodeMCU" by default refers to the firmware rather than the development kits. The firmware uses the Lua scripting language. It is based on the Elua project and built on the Espress if Non-OS SDK for ESP8266. It uses many open-source projects, such as lua-cjson[8] and SPIFFS. The NodeMCU firmware is built on top of the Lua programming language and provides a simple and easy-to-use API for controlling the ESP8266.t includes support for a variety of sensors and actuators, as well as built-in support for popular IoT protocols like MQTT and REST.

NodeMCU was created shortly after the ESP8266 came out. On December 30, 2013, Espress if Systems [6] began production of the ESP8266.[10] The ESP8266 is a Wi-Fi SoC integrated with a Tensilica Extensa LX106 core, [citation needed] widely used in IoT applications (see related projects). NodeMCU started on 13 Oct 2014, when Hong committed the first file of nodemcu-firmware to GitHub.[11] Two months later, the project expanded to include an open-hardware platform when developer Huang R committed the gerber file of an ESP8266 board, named devkit v0.9.[12] The development board includes a USB-to-serial converter, power regulator, and all necessary components to get started. Later that month, Tuan PM ported MQTT client library from Contiki to the ESP8266 SoC platform,[13] and committed to NodeMCU project, then NodeMCU was able to support the MQTT IoT protocol, using Lua to access the MQTT broker. Another important update was made on 30 Jan 2015, when Devasura's ported the u8glib [14]to NodeMCU project,[15] enabling NodeMCU to easily drive LCD, Screen, OLED, even VGA displays.

Figure 2.3: Node MCU

NodeMCU is an open-source LUA based firmware developed for ESP8266 Wi-Fi chip. By exploring functionality with ESP8266 chip, NodeMCU firmware comes with ESP8266 Development board/kit i.e., NodeMCU Development board

NodeMCU Development Board/kit v0.9 (Version1)

Since NodeMCU is an open-source platform, their hardware design is open for editing/modifying/building. NodeMCU Dev Kit/board consists of ESP8266 Wi-Fi enabled chip. The **ESP8266** is a low-cost Wi-Fi chip developed by Espress if Systems with TCP/IP protocol. Overall, NodeMCU is a powerful and versatile platform for building IoT projects, and its open-source nature makes it easy for developers to modify and extend its capabilities. It is based on the ESP8266 Wi-Fi module, which provides a low-cost way to add Wi-Fi connectivity to a project. In addition to the firmware, NodeMCU also includes a development board that makes it easy to prototype and develop IoT projects. The development board includes a USB-to-serial converter, power regulator, and all necessary components to get started.

`For more information about ESP8266, you can refer to ESP8266 Wi-Fi Module.

There is Version2 (V2) available for NodeMCU Dev Kit i.e., **NodeMCU Development Board v1.0 (Version2)**, which usually comes in black colored PCB.

Figure 2.4: NodeMCU Development Board/kit v1.0 (Version2)

For more information about NodeMCU Boards available in market refer to NodeMCU Development Boards NodeMCU Dev Kit has **Arduino-like** Analog (i.e., A0) and Digital (D0-D8) pins on its board. It supports serial communication protocols i.e., UART, SPI, I2C etc. Using such serial protocols, we can connect it with serial devices like I2C enabled LCD display, Magnetometer HMC5883, MPU-6050 Gyro meter + Accelerometer, RTC chips, GPS modules, touch screen displays, SD cards etc.m The NodeMCU board has built-in WiFi, which makes it easy to connect to the internet and interact with cloud services. It also has GPIO pins, analog inputs, and serialcommunication interfaces, making it possible to interface with a wide range of sensors, actuators, and other electronic components. The board is compatible with the Arduino IDE, which means you can program it using the same programming language and development environment as an Arduino board. Additionally, there are many libraries and examples available that can help you get started with your projects quickly.

How to start with NodeMCU?

NodeMCU Development board features Wi-Fi capability, analog pin, digital pins and serial communication protocols. To get started with using NodeMCU for IoT applications first we need to know about how to write/download NodeMCU firmware in NodeMCU Development Boards. And before that where this NodeMCU firmware will get as per our requirement. There are online NodeMCU custom builds available using which we can easily get our custom NodeMCU firmware as per our requirement. To know more about how to build custom NodeMCU firmware online and download it refer Getting started with NodeMCU.

How to write code for NodeMCU?

After setting up ESP8266 with Node-MCU firmware, let’s see the IDE (Integrated Development Environment) required for development of NodeMCU.

NodeMCU with Explorer IDE

Lua scripts are generally used to code the NodeMCU. Lua is an open source, lightweight, embeddable scripting language built on top of C programming language. For more information about how to write Lua script for NodeMCU refer Getting started with NodeMCU using ESPlorerIDE. NodeMCU with Explorer IDE is a programming environment and development kit that simplifies the development process for NodeMCU-based projects. It provides an integrated development environment (IDE) that includes a text editor, a compiler, and a debugger, as well as libraries and example code that can be used to get started quickly.

THERMOCOUPLE:

It is a type of temperature sensor, which is made by joining two dissimilar metals at one end. The joined end is referred to as the HOT JUNCTION. The other end of these dissimilar metals is referred to as the COLD END or COLD JUNCTION. The cold junction is formed at the last point of the thermocouple material. If there is a difference in temperature between the hot junction and cold junction, a small voltage is created. This voltage is referred to as an EMF (electro-motive force) and can be measured and in turn used to indicate temperature.

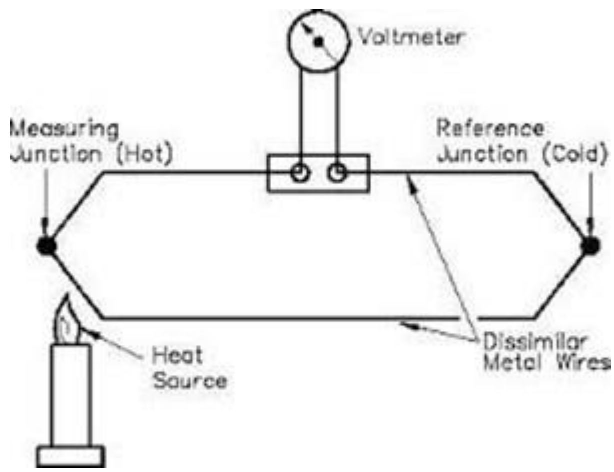


Figure 2.5: Thermocouple

The RTD is a temperature sensing device whose resistance changes with temperature. Typically built from platinum, though devices made from nickel or copper are not uncommon, RTDs can take many different shapes like wire wound, thin film. To measure the resistance across an RTD, apply a constant current, measure the resultingvoltage, and determine the RTD resistance. RTDs exhibit linear resistance to temperature curves over their operating regions, and any nonlinearity is highly predictable and repeatable. The PT100 RTD evaluation board uses surface mount RTD to measure temperature. One advantage of thermocouples is that they can measure a wide range of temperatures, from very low (-200°C) to very high (over 2000°C), depending on the type of metals used.

An external 2, 3 or 4-wire PT100 can also be associated with measuring temperature in remote areas. The RTDs are biased using a constant current source. To reduce self-heat due to power dissipation, the current magnitude is moderately low. The circuit shown in the figure is the constant current source uses a reference voltage, one amplifier, and a PNP transistor.

Thermistors:

Like the RTD, the thermistor is a temperature sensing device whose resistance changes with temperature. Thermistors, however, are made from semiconductor materials. Resistance is determined in the same manner as the RTD, but thermistors exhibit a highly nonlinear resistance vs. temperature curve. Thus, in the thermistors operating range we can see a large resistance change for a very small temperature change. This makes for a highly sensitive device, ideal for set-point applications.

Semiconductor sensors:

They are classified into different types like Voltage output, Current output, Digital output, Resistance output silicon and Diode temperature sensors. Modern semiconductor temperature sensors offer high accuracy and high linearity over an operating range of about 55°C to +150°C. Internal amplifiers can scale the output to convenient values, such as 10mV/°C. Semiconductor sensors consist of a semiconductor material, such as silicon or germanium, that is doped with impurities to create a p-n junction. When exposed to changes in temperature or other physical parameters, the electrical properties of the semiconductor material change, resulting in a change in the voltage or current that can be measured and used to determine the physical parameter being measured. They are also useful in cold-junction compensation circuits for wide temperature range thermocouples. A brief detail about this type of temperature sensor is given below.

SENSOR ICS

There are a wide variety of temperature sensor ICs that are available to simplify the broadest possible range of temperature monitoring challenges. These silicon temperature sensors differ significantly from the above-mentioned types in a couple of important ways. The first is the operating temperature range. A temperature sensor IC can operate over the nominal IC temperature range of -55°C to +150°C. The second major difference is functionality.

A silicon temperature sensor is an integrated circuit and can therefore include extensive signal processing circuitry within the same package as the sensor. There is no need to add compensation circuits for temperature sensor ICs. Some of these are analogue circuits with either voltage or current output. Others combine analogue-sensing circuits with voltage comparators to provide alert functions.Sensor ICs can be used in a wide range of applications, including automotive, medical, industrial, and consumerelectronics. For example, temperature sensor ICs can be used to measure the temperature of a processor in a computer or a power supply in a factory, while pressure sensor ICs can be used to measure the pressure inside a tire or a pipeline.

Some other sensor ICs combine analogue-sensing circuitry with digital input/output and control registers, making them an ideal solution for microprocessor-based systems. A silicon temperature sensor is an integrated circuit and can therefore include extensive signal processing circuitry within the same package as the sensor. There is no need to add compensation circuits for temperature sensor ICs. Some of these are analogue circuits with either voltage or current output. Others combine analogue-sensing circuits with voltage comparators to provide alert functions. Some other sensor ICs combine analogue-sensing circuitry with digital input/output and control registers, making them an ideal solution for microprocessor-based systems.

About DHT11 sensor

The DHT11 sensor comes in a single row 4-pin package and operates from 3.5 to 5.5V power supply. It can measure temperature from 0-50 °C with an accuracy of ±2°C and relative humidity ranging from 20-95% with an accuracy of ±5%. The sensor provides fully calibrated digital outputs for the two measurements. It has got its own proprietary 1-wire protocol, and therefore, communication between the sensor and a microcontroller is not possible through a direct interface with any of its peripherals. The protocol must be implemented in the firmware of the MCU with precise timing required by the sensor. The following timing diagrams describe the data transfer protocol between a MCU and the DHT11 sensor. The DHT11 sensor has a temperature range of0 to 50 degrees Celsius with an accuracy of +/- 2 degrees Celsius, and a humidity rangeof 20% to 90% RH with an accuracy of +/- 5% RH. It operates on a voltage range of 3.5V to 5.5V and consumes very low power.The DHT11 sensor is commonly used in applications such as home automation, weather stations, HVAC systems, and more.

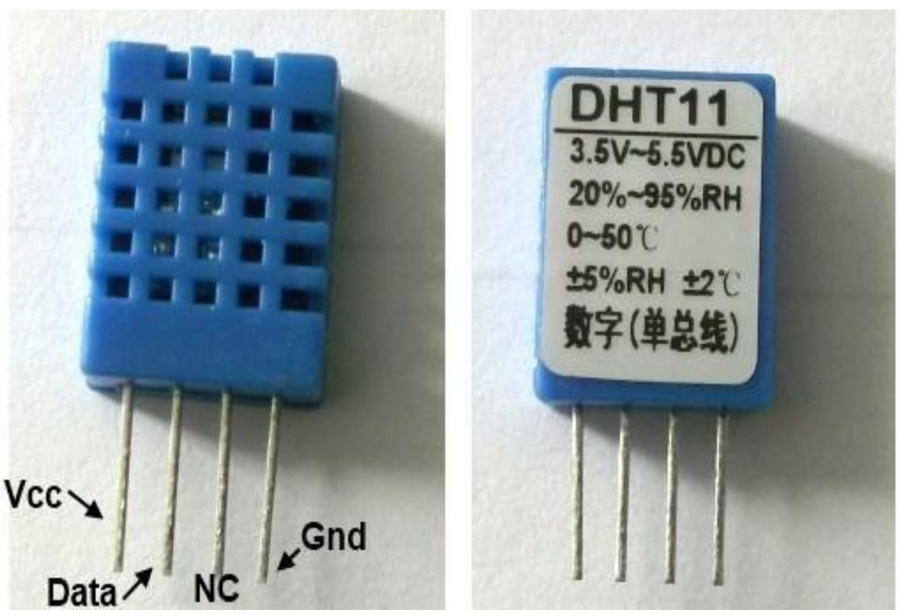


Figure 2.6: DHT11 sensor comes in a single row 4-pin package

Next, the sensor responds to the MCU “Start "signal by pulling the line low for 80? s followed by a logic high signal that also lasts for 80? s. Remember that the MCU pin must be configured to input after finishing the “Start "signal.

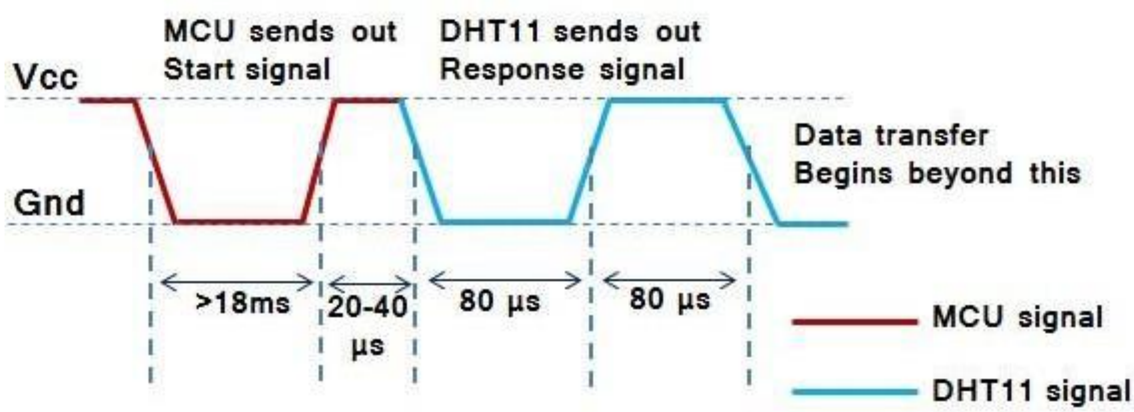


Figure 2.7:”Start" and "Response" signals

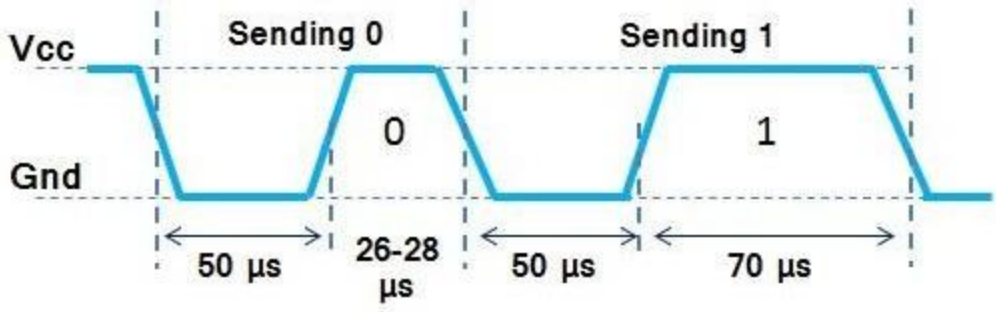
The 40-bit data from the sensor has the following structure.

Data (40-bit) = Integer Byte of RH + Decimal Byte of RH + Integer Byte of Temp. + Decimal Byte of Temp. + Checksum Byte For DHT11 sensor, the decimal bytes of temperature and humidity measurements are always zero. Therefore, the first and third bytes of received data give the numeric values of the measured relative humidity (%) and temperature (°C).. If all the five bytes are transferred successfully then the checksum byte must be equal to the last 8 bits of the sum of the first four bytes, i.e.,

Checksum = Last 8 bits of (Integer Byte of RH + Decimal Byte of RH + Integer Byte of Temp. + Decimal Byte of Temp.)

To send a bit of data, the sensor first pulls the line low for 50? s. Then it raises the line too high for 26-28? s if it must send “0", or for 70? s if the bit to be transmitted is “1". So, it is the width of the positive pulse that carries information about 1 and 0.

However, it should be noted that the accuracy of the sensor may not be sufficient for some applications, and other more precise sensors may be required.The sensor is small and easy to use, and can be interfaced with a variety of microcontrollers such as Arduino, Raspberry Pi, and others.



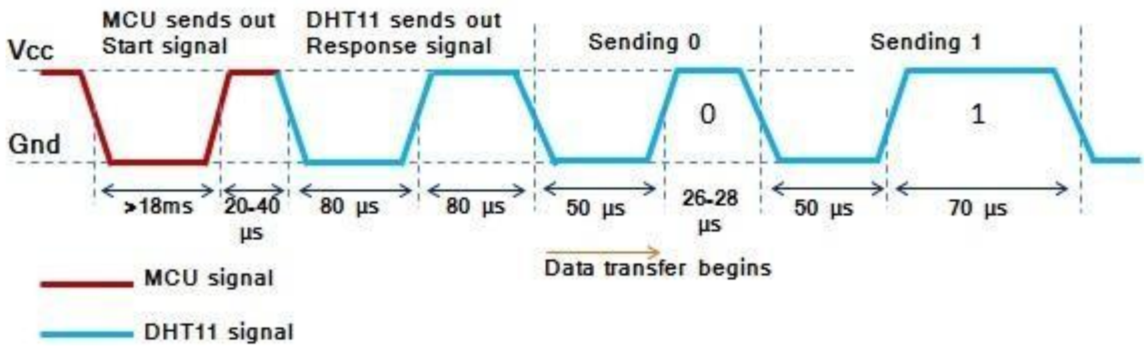


Figure 2.8: Timing difference for transmitting "1s" and "0s"

Start, Response and Data signals in sequence

The sensor operates by using a thermistor to measure temperature and a capacitive humidity sensor to measure humidity. It provides a single-wire digital output, which can be read by the microcontroller using a simple protocol.

At the end of the last transmitted bit, the sensor pulls the data line low for 50? s and then releases it. The DHT11 sensor requires an external pull-up resistor to be connected between its Vcc and the data line so that under idle condition, the data line is always pulled high. After finishing the data transmission and releasing the data line, the DHT11 sensor goes to the low-power consumption mode until a new “Start” signal arrives from the MCU.These sensors are normally used to check volumetric water content, and another group of sensors calculates a new property of moisture within soils named water potential.

Soil Moisture Sensor Pin Configuration

Figure 2.9: The FC-28 soil moisture sensor includes 4-pins

Working Principle

Soil moisture sensors typically consist of two or more metal probes that are inserted into the soil. These probes are connected to an electronic circuit that measures the resistance between them. When the soil is dry, the resistance between the probes is high, and when it is wet, the resistance is low. The sensor measures the resistance by applying a small electrical current between the probes and then measuring the voltage across them. The resistance is then calculated using Ohm's Law, which states that resistance is equal to voltage divided by current. This sensor mainly utilizes capacitance to gauge the water content of the soil (dielectric permittivity). This sensor makes it perfect to execute experiments within science courses like environmental science, agricultural science, biology, soil science, botany, andhorticulture.

Specifications

- The specification of this sensor includes the following. • The required voltage for working is 5V.
- The required current for working is <20mA.
- Sensing range: This refers to the range of moisture levels that the sensor is capable of measuring. The sensing range can vary from sensor to sensor, but typically falls between 0 to 100% moisture content.
- Accuracy: This refers to the degree of precision with which the sensor can measure the moisture content of the soil. Accuracy can be affected by various factors such as temperature, salinity, and soil type. Typically, a good soil moisturesensor should have an accuracy of at least ±2% moisture content.
- Response time: This refers to the time it takes for the sensor to provide a readingonce it comes into contact with the soil. A fast response time is desirable in someapplications, while a slower response time may be acceptable in others
- Operating voltage: Soil moisture sensors are typically powered by batteries or other sources of low voltage DC power. The operating voltage of a sensor can vary, but it is typically between 3 to 5 volts.
- Type of interface is analog
- The required working temperature of this sensor is 10°C~30°C
- Output signal: Soil moisture sensors may provide an analog or digital output signal. Analog signals can be read using a voltmeter or other analog measuring device, while digital signals can be read using a microcontroller or other digital device.
- Probe length: The length of the probe of a soil moisture sensor is an important factor to consider. The probe should be long enough to reach the root zone of theplants being monitored, but not so long as to be difficult to install or use. Typically, soil moisture sensors have probe lengths between 2 to 8 inches.

Soil Moisture Sensor Applications

- Soil moisture sensors can be used to optimize irrigation scheduling by providing real-time information about the water content in the soil. This allows farmers and gardeners to irrigate their crops only when necessary, reducing water waste and improving crop yield.

The applications of moisture sensors include the following

- Moisture sensors are commonly used in agriculture to measure soil moisture content. This information is used to optimize irrigation, prevent water waste, and improve crop yield.

- Agriculture: Agriculture is the practice of cultivating land, raising animals, and producing food, fiber, and other products to meet the needs of people. It is the backboneof human civilization, providing the basic necessities of life. Agriculture includes a wide range of activities such as crop production, livestock rearing, forestry, fisheries, and agro-processing.

- Landscape irrigation: Landscape irrigation refers to the process of providing water to plants, trees, and other vegetation in outdoor spaces such as lawns, gardens, andparks. The goal of landscape irrigation is to ensure that the plants receive the right amount of water to thrive and remain healthy.

- Simple sensors for gardeners: This type of sensor measures the moisture level in the soil, which is essential for the proper growth of plants. You can use a soil moisture sensor to determine when to water your plants, which can help you avoid overwatering or underwatering. This type of sensor measures the moisture level in the soil, which is essential for the proper growth of plants. You can use a soil moisture sensor to determine when to water your plants, which can help you avoid overwatering or underwatering.

CHAPTER 4
REQUIREMENTS ANALYSIS

- Home Gateway
- Temperature Monitor
- Humidity Monitor
- Wind Detector
- Siren
- Water Level Monitors
- Sprinklers

4.1 Feasibility Studies/Risk Analysis of the Project

In agriculture, proper irrigation is crucial for the healthy growth and development of crops. Different plants have different water requirements at different stages of growth, and failure to irrigate properly can result in reduced crop yield or even crop failure. The crops or plants are irrigated with respect to the water requirements at different stages of their growth. The DHT11 is a basic, digital temperature and humidity sensor. Ituses a capacitive humidity sensor and a thermistor to measure the surrounding air and spits out a digital signal on the data pin (no analog pins needed). It is simple to use but requires careful timing to grab data. Humidity sensors are used for measuring moisture content in the atmosphere. The current temperature and humidity values are sent to the microcontroller, those values will display in the user's android app.

With more advancement in the field of IoT expected in the coming years, these systems can be more efficient, much faster and less costly. In the Future, this system can be made as an intelligent system, where in the system predicts user actions, rainfall pattern, time to harvest, animal intruder in the field and communicating the information through advanced technology like IoMT can be implemented so that agricultural system can be made independent of human operation and in turn quality and huge quantity yield can be obtained.

4.2 Software Requirements Specification Document

Home gateway, Temperature Monitor, Humidity Monitor, Wind Detector, Siren, Water Level Monitors, Sprinklers those are the software requirements for the project. Water sprinkler, soil moisture, humidity, and temperature sensors. The smartphone module is used for communication. In the proposed work, crops or plants are considered along with their water requirement at different stages.

4.3 System Use Case

Automatically control environmental conditions within the greenhouse allowing any type of plants to be grown all year round Eliminates the risk of the greenhouse not being maintained at specific environmental conditions due to human error Customers are able to define specific greenhouse conditions “Plug-and-play” products. By using automated systems, the risk of human error in maintaining specific environmental conditions is greatly reduced, which can result in improved plant growth and yield. Customers can define specific greenhouse conditions through pre-set parameters, or through customization options provided by the manufacturer.

CHAPTER 5
DESCRIPTION OF PROPOSED SYSTEM

The proposal consists of the Nodemcu, Water sprinkler, soil moisture, humidity, and temperature sensors. The smartphone module is used for communication. In the proposed work, crops or plants are considered along with their water requirement at different stages. Whenever physical conditions change rapidly, these allow for real-time data processing at a minimal cost. The scientific community increasingly considers Sensor Networks (SNs) as the future of Environmental Monitoring. Providing at a low cost the possibility to gather and process all sorts of data with aspace and time resolution which was inconceivable before, these networks are viewed as a critical element of the revolution of ubiquitous computing.

5.1 Selected Methodology or process model

The main objective of this project is to provide an automatic irrigation system thereby saving time, money & power of the farmer. The traditional farmland irrigation techniques require manual intervention. With the automated technology of irrigation, the human intervention can be minimized. Automating the irrigation system can also help farmers save water and reduce water waste, as the system can be programmed to apply water only when and where it is needed. This can be especially beneficial in areas with limited water resources or duringdrought conditions.

Overall, an automated irrigation system can help farmers optimize their crop yields, reduce manual labor, and conserve resources.

5.2 Architecture / Overall Design of Proposed System

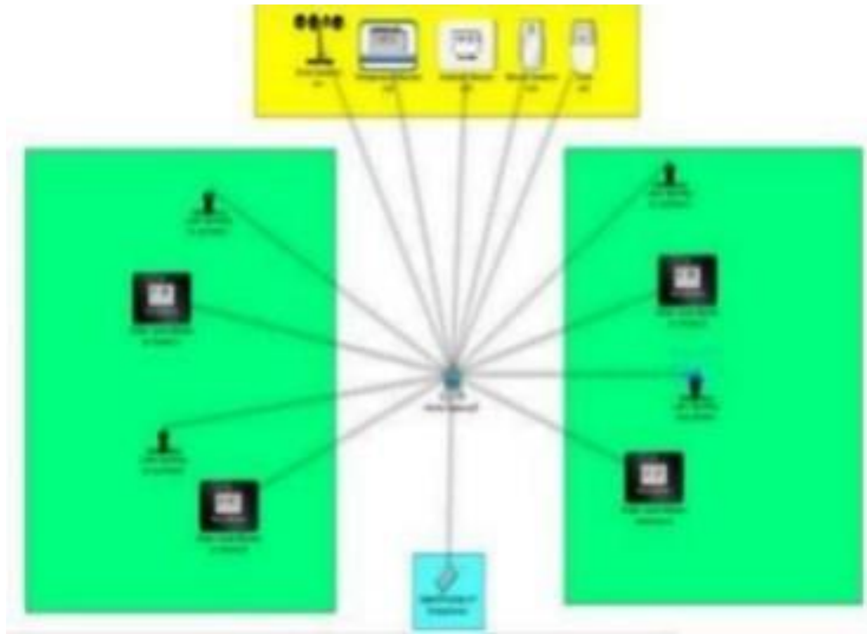


Figure 3.1: System Architecture

5.3 Description of Software for Implementation and Testing plan of the Proposed Model/ System

The proposed consists of the Nodemcu, Water sprinkler, soil moisture, humidity and temperature sensors. Smartphone modules are used for communication. In the proposed work, crops or plants are considered along with their water requirement at different stages. The crops or plants are irrigated with respect to the water requirements at different stages of their growth. The system appears to be designed to monitor the water requirements of crops or plants at different stages of their growth, and irrigate them accordingly.

The use of smartphone modules for communication suggests that the system is designed to be remotely controlled and monitored, perhaps through a mobile app. This could provide farmers or growers with greater flexibility and convenience in managing their irrigation system.Overall, such a system could have several potential benefits, such as optimizing water usage and improving crop yields.

The DHT11 is a basic, digital temperature and humidity sensor. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air, and spits out a digital signal on the data pin (no analog pins needed). It is simple to use, but requires carefultiming to grab data. Humidity sensors are used for measuring moisture content in the atmosphere. Then current temperature, humidity values are sent to the microcontroller, those values will display in the user's android app. With more advancement in the field of IoT expected in the coming years, these systems can be more efficient, much faster and cost less. In the Future, this system can be madeas an intelligent system, where in the system predicts user actions, rainfall pattern, time to harvest, animal intruder in the field.

The DHT11 is a simple yet effective digital temperature and humidity sensor that uses a capacitive humidity sensor and a thermistor to measure the surrounding air. Unlike other sensors, it generates a digital signal on the data pin, eliminating the need for analog pins. However, it requires precise timing to collect data accurately. Humidity sensors play a crucial role in measuring moisture content in the atmosphere. Thisdata is vital in various fields such as agriculture, meteorology, and HVAC systems. The DHT11 is an affordable option for collecting this data, making it a popular choice for hobbyists and professionals alike. Collecting temperature and humidity data is only one part of the process. It is equally important to transmit and process this data to make it useful. Microcontrollers are commonly used to collect and transmit this data to various devices. In this case, the temperature and humidity values are sent to an Android app for easy access and analysis.

With more advancements in IoT technology, we can expect these systems to become more efficient, faster, and cheaper. Future sensors may have better accuracy, higher resolution, and longer lifetimes. This would enable professionals to make more informed decisions based on real-time data.

As IoT systems continue to evolve, they will likely become more intelligent. One possibility is predictive analytics, where the system can predict user actions based on historical data. For example, an agriculture IoT system could predict when it's time to harvest crops based on temperature, humidity, and other data.

5.4 Project Management Plan

FIRST REVIEW	SECOND REVIEW	THIRD REVIEW
ABSTRACT	SAMPLE CODING	FINAL DOCUMENT
MODULES	SAMPLE SCREENSHOTS	COMPLETE SOURCE CODE
SYSTEM ARCHITECTURE	SOFTWARE INSTALLATION & EXPLANATION	SOFTWARE INSTALLATION & EXPLANATION
LITERATURE SURVEY	POWERPOINT PRESENTATION	POWERPOINT PRESENTATION
ALGORITHMS & TECHNIQUES		
POWERPOINT PRESENTATION		

5.5 Financial report on estimated costing

Actually, at first, we decided to complete this project by using the hardware setup only. As IoT sprinklers are very cost effective so that is why we have decided to complete this project by using very efficient software that is Cisco packet tracer. It is completely low cost and very useful for the farmers. In this project, the aim was to create an efficient and cost-effective solution for irrigation for farmers. Initially, the plan was to complete the project using hardware setup only. However, after careful consideration, we decided to explore other options and chose to use a software called Cisco packet tracer. The reason for choosing the software option was due to the low cost and efficiency of IoT sprinklers. By utilizing the software, we could create a solution that would not only be cost-effective but also very useful for the farmers.

5.6 Transition/ Software to Operations Plan

We used the cisco packet tracer for operating the components in the workspace provided. All the components are connected to the home gateway. The entire setup is connected to the smartphone. By using the smartphone, we can operate this system from anywhere in the world by having a stable internet connection. This tool is commonly used in networking and telecommunications to simulate and test different network configurations. In this case, the components are connected to a home gateway, which acts as the central hub for the network. The paragraph ends by stating that the entire setup can be controlled through a smartphone, which allows for remote operation from anywhere in the world, as long as there is a stable internet connection.

CHAPTER 6

IMPLEMENTATION DETAILS

6.1 About Cisco Packet Tracer

Cisco Packet Tracer is a network simulation software developed by Cisco Systems that allows users to create a simulated network environment. It is used for teaching and learning purposes by students, educators, and network engineers to design, configure, and troubleshoot network infrastructure. Packet Tracer provides a virtual representation of a network, including devices such as routers, switches, and computers, as well as cables, hubs, and wireless access points. Users can create and configure a variety of network topologies and test them in a virtual environment before implementing them in the real world. Packet Tracer is available for free to Cisco Networking Academy members, and it can also be downloaded and used by non-members for non-commercial purposes. It is compatible with multiple operating systems, including Windows, macOS, and Linux, and is regularly updated to reflect the latest networking technologies and protocols.

6.2 Temperature Monitor

A temperature monitor is a device or system that is used to measure and display the temperature of a given environment. Temperature monitors can be found in a variety of settings, including homes, workplaces, hospitals, laboratories, and industrial facilities.

There are several types of temperature monitors available, each with its own unique features and applications. Some of the commonly used types are thermometers, temperature sensors, infrared thermometers, thermocouples, and resistance temperature detectors (RTDs).

Temperature monitors are essential in many industries, such as food processing, pharmaceuticals, and healthcare, where maintaining a particular temperature range is critical to the safety and quality of products. They can also be used in homes to monitor the temperature of refrigerators, freezers, and HVAC systems. Here we use the temperature monitor to sense the temperature in the soil. By calculating the accurate temperature, we can easily predict the suitable conditions for the plant to grow.

6.3 Working Process:

The Lawn sprinklers, Water Level Monitors, Wind Detector, Motion Detector, Siren, Temperature Monitor are connected to the Home Gateway. The entire setup is connected to the smartphone. We have to assign login credentials for the browser to login to the cisco packet tracer work space. After successful login to the work space we can monitor the reading levels of the water level monitors. Based on those water level monitor readings the sprinklers are going to work. We have to assign the conditions for both the sprinklers top and bottom, For Wind detector, Motion Detector, Siren and also for the temperature monitor.

The monitors provide readings that determine when the sprinklers are going to work. Based on these readings, the sprinklers will turn on and off accordingly. This setup allows for more efficient and effective watering of the lawn or garden. These conditions will dictate when the sprinklers will turn on and off based on the water level monitor readings. For example, the top sprinklers may turn on when the water level is low, while the bottom sprinklers may turn on when the water level is high. The other devices connected to the Home Gateway, which include the wind detector, motiondetector, siren, and temperature monitor. Each of these devices serves a different purpose and requires specific conditions to be set. The user can monitor various readings remotely through their smartphone and set specific conditions for each device.

CHAPTER 7

RESULTS AND DISCUSSION

After registration of the devices with the home gateway, control the IoT devices remotely using a tablet. The registered IoT devices can be viewed on the tablet. The devices can be manually operated as well as the values can be viewed and monitored in real-time. Figure8. IoT devices displayed on Table Figure9. The numerical values of the sensors Fig9. shows the numerical values of the sensors that are displayed on the Tablet. It shows the status of the IoT devices registered with the home gateway. These devices can be manually as well as automatically monitored.

The advancement of technology has allowed us to control various electronic devices remotely using our smartphones and tablets. One such application of this technology is the Internet of Things (IoT). IoT allows us to connect and control various devices wirelessly, making our lives easier and more comfortable. In this context, registering the IoT devices with the home gateway enables remote control through a tablet. By registering IoT devices with the home gateway, users can control and monitor the connected devices remotely. After the devices are registered, they can be viewed on the tablet, providing a centralized platform for all connected devices. This makes it easy to keep track of all connected devices and manage them remotely from a single point of access.

In addition to remote control, users can also view and monitor the values of the IoT sensors in real-time. The tablet provides a user-friendly interface to display the numerical values of the sensors, allowing users to monitor the status of the IoT devices registered with the home gateway.

CHAPTER 8
CONCLUSION & FUTURE WORK

8.1 CONCLUSION

A smart irrigation system is implemented using the Cisco packet tracer. A home gateway to register the devices and control them using a tablet. All the IoT devices connected to the home gateway can be monitored manually as well as remotely by the user. The results prove that there is an opportunity of applying this model in real life. The implementation of the automatic irrigation system can be used to reduce the use of water. The system can be manually monitored, it can increase energy efficiency and savings. It also makes it convenient for the user to access all the devices through the smartphone.

8.2 FUTURE WORK

In the field of IoT, ensuring security should be a priority. Since the IoT devices are interconnected to each other, the network should be secured. In this system, an authentication gateway is designed that requires a password to check the authenticity of the home user for security purposes. To extend this system to be more robust and efficient in the future, modifications can bemade to make the system more secure. If abnormalities in the system are detected, the system should send an SMS or an Email to alert the user. The Internet of Things (IoT) is a technology that enables devices to communicate and interact with each other over the internet. In IoT, security is a critical concern as the devices are interconnected and can potentially be accessed by unauthorized entities. Therefore, ensuring the security of the network is essential to prevent cyber-attacks and safeguard sensitive information. One way to secure the network is by implementing an authentication gateway that requires a password to verify the authenticity of the home user.

8.3 RESEARCH ISSUES

We have done so much research while we have the idea of implementing this project. The main aim of the research is to help farmers for better yield production and make them adopt new technologies.

8.4 IMPLEMENTATION ISSUES

We have faced so many challenges during the implementation of this project. At first, we decided to do this project by using hardware components. But unfortunately, because of the heavy cost of components as well as smart IoT sprinklers are very costeffective. So, we decided to do this project by using software. At the beginning We have faced so many problems because we don't know the basics of farming. As thedays go on, we gain knowledge on farming and implement this project.I Hope that this project will reduce at least some of the problems of farmers. One of the primary goals of agricultural research is to help farmers increase their yield. With the growing population, the demand for food has increased, making it essential to find ways to produce more food sustainably. Through research, we can identify techniques and technologies that can help farmers increase their yield, such as precision farming and crop rotation. By implementing these strategies, farmers can produce more food, reduce waste, and improve their income.

In conclusion, agricultural research is essential for improving productivity and yield in the industry. By conducting research, we can identify areas that need improvement, create solutions to overcome challenges, and encourage farmers to adopt new technologies. Furthermore, the knowledge gained from research can help us address issues such as food insecurity and promote sustainable agricultural practices.

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A. SCREENSHOTS

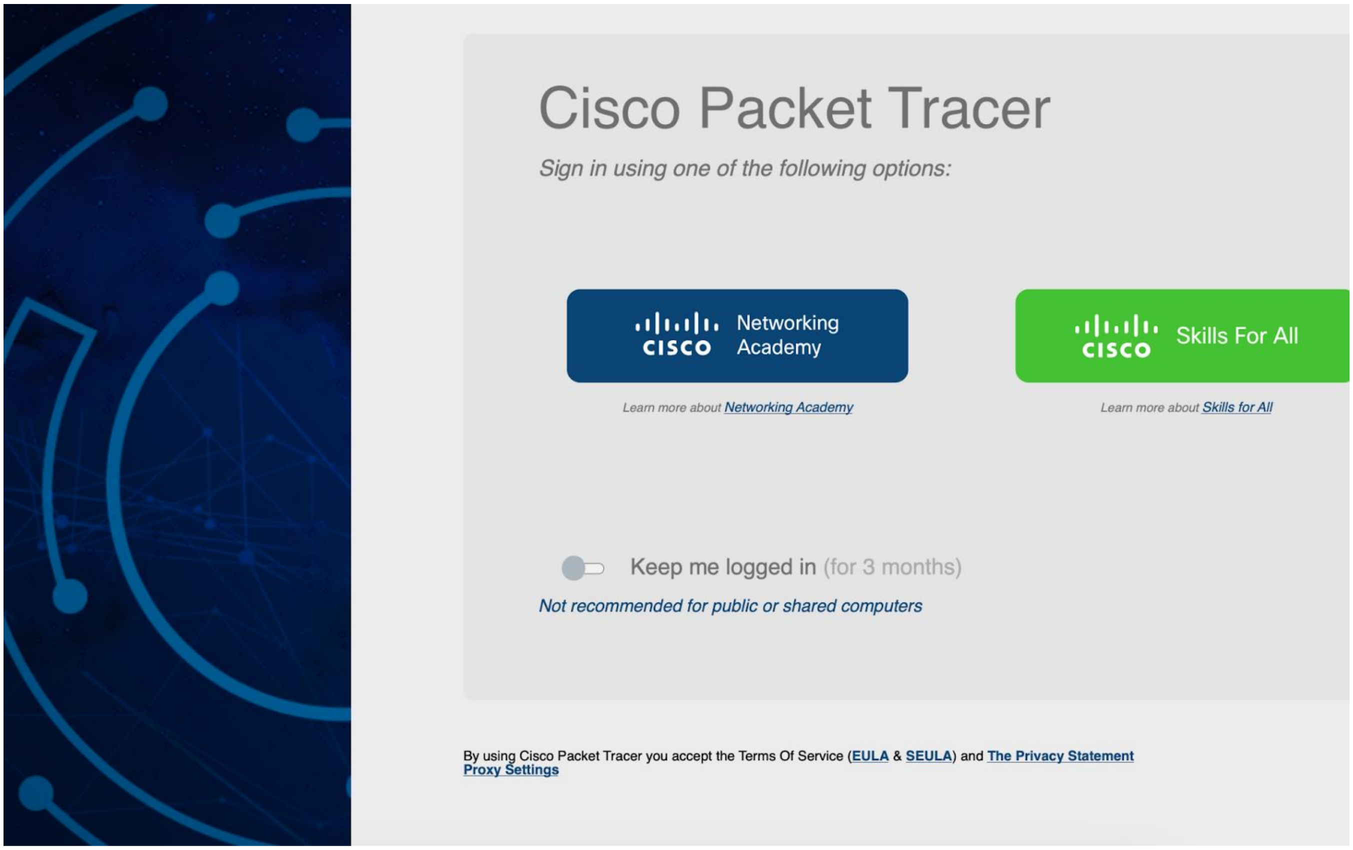

Fig A.1: Cisco Packet Tracer

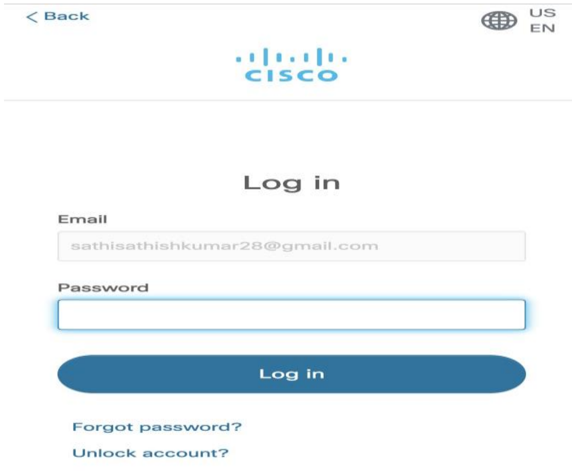

Fig A.2: Cisco Portal

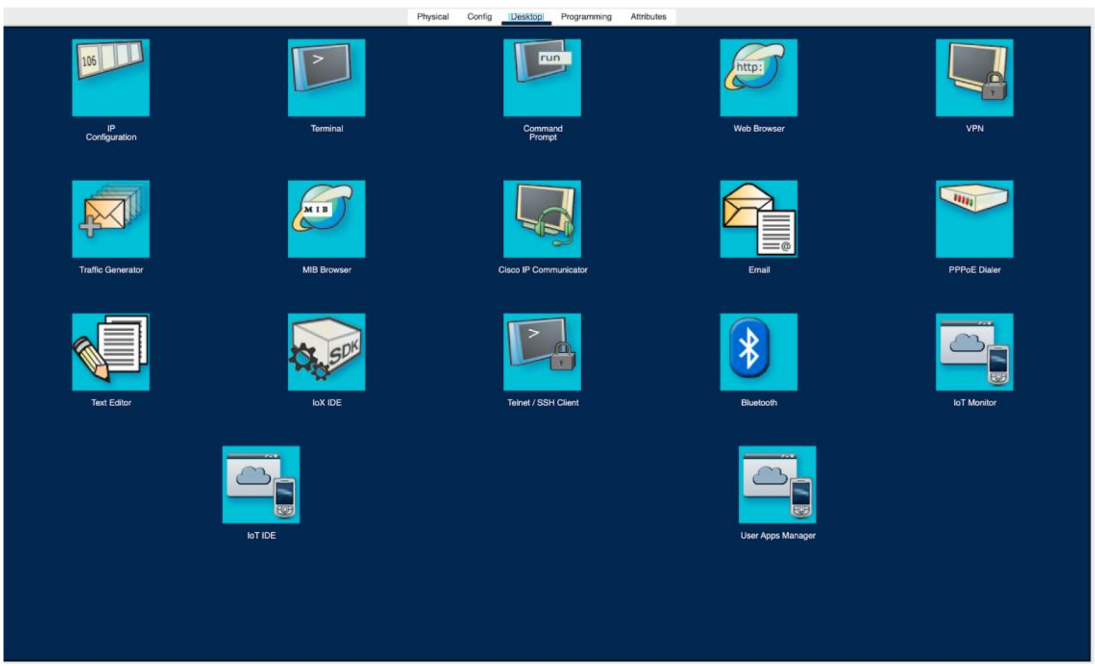

Fig A.3: Desktop Site

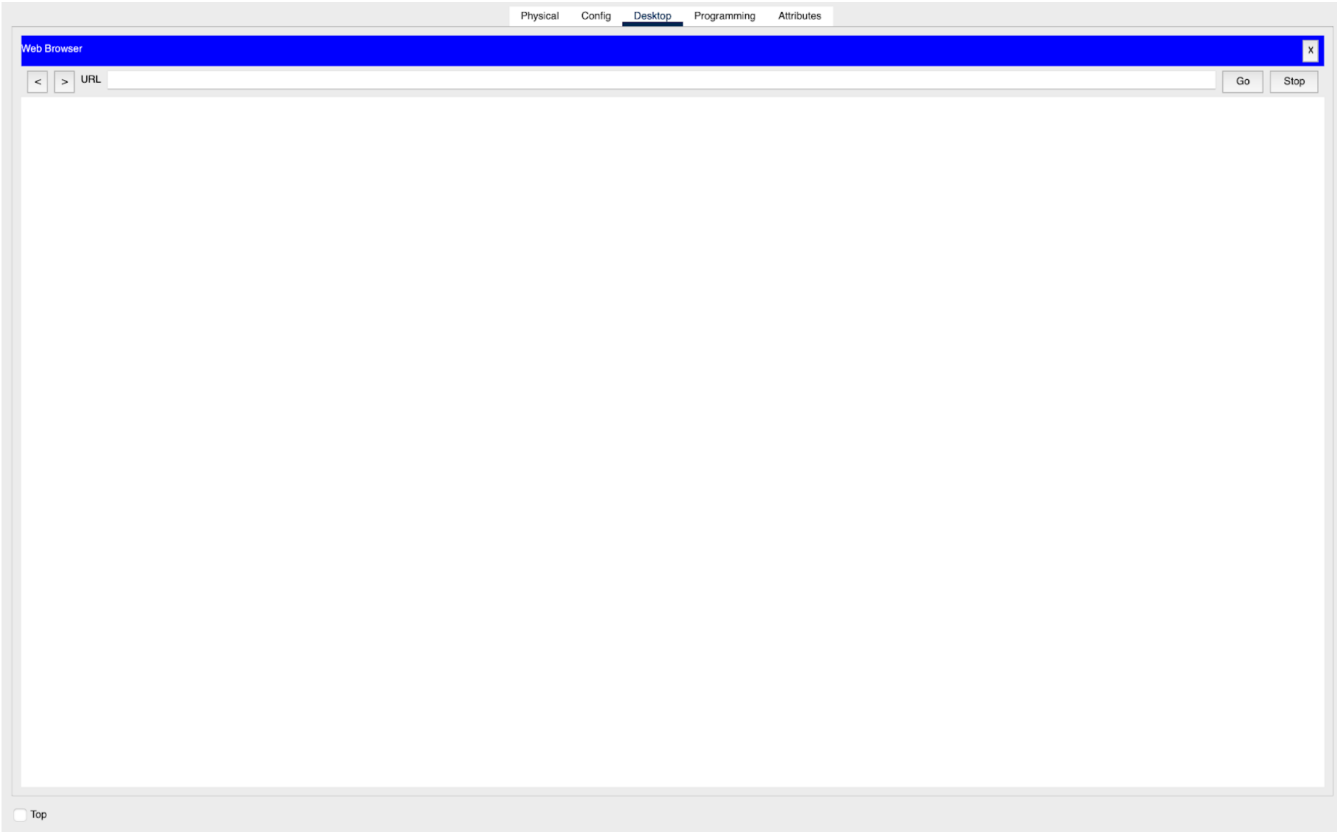

Fig A.4: Web Browser

Fig A.5: Login Page

RESEARCH PAPER

IoT Based Smart Irrigation System Using Cisco Packet Tracer

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***Abstract*— A system of irrigation is used to provide water to plants as evenly as feasible. Consumers can remotely control and monitor technology devices or sensors linked to the Internet of Things (IoT). The model of an intelligentirrigation purposes (64-bit) is carried out in this researchstudy and use the Cisco Packet Tracer simulation software) With this technology, an intelligent irrigation system may be created that manages the irrigation process and wirelessly monitors the weather conditions for optimal plant growth. Such a system might include tools like an autonomous sprinkler, thermometer sensor, moisture monitor, and others.. The home gateway is connected to all the equipment that can be controlled and monitored remotely using a tablet, laptop, or smartphone. According to the simulation results, smart equipment for monitoring environmental conditions, such as watering systems, can be connected to the home portal and effectively monitored, making it easier for farmers and homeowners to cultivate and manage their plants.**

***Keywords*— Farmer, Yield, Home gateway, Humidity Monitor, Temperature Monitor, Wind Detector, Siren, sprinklers.**

I. INTRODUCTION

Farmers and households can benefit from IoT technology by maintaining a suitable A system of irrigation that is remotely monitored and programmable from any location around the world. In these fast moving and hectic days, this technology can assist homeowners in conveniently monitoring the devices and overcoming the drawback of manual monitoring if they are unable to be at home to care for the plants. The Smart Irrigation System in this work includes intelligent gadgets that enable users to manage their lawn watering and sprinkler systems. inaccordance with the Amount of water indicated by the water levelmonitor, with the result that the water drain is turned on or off accordingly. Intelligent irrigation systems allow for several automated tasks, including managing the vegetation's relative humidity. The moisture sensor controls whether the mister is onor off depending on the level. when the humidity achieves a predetermined level specified by the landlord's requirements. The use of multiple sensors to monitor the environment —including temperature, pressure, carbon dioxide, carbon monoxide, wind, and humidity sensors—is one of the other features. These sensors are essential for the vigorous and verdant growth of plants. A tablet, computer, or smartphone can be used to remotely control and keep track of the smart gadgets connected to the home network. Moreover, it contains an animal motion detecting alarm. It is controlled by a microcontroller and alerts the owner whenever motion is seen close to the irrigation field. Users can Apply Cisco Packet Tracer, an associated with the current tool, to build network architectures and simulate communications technology of today. With a virtual control interface, you can replicate switches and routers networks.

II. EXISTING WORK

In the previous system we must monitor each process which may lead to some wastage of water and lead to some crops going to rot. Now we're implementing an automated system in which we are going to set some conditions to every sensor prior and that will automate the system. There are various benefits to using automation systems with wireless technologies that wired systems cannot offer as there is less gear required and no need for wiring, wireless solutions lower installation costs. Scalable and extensible wireless systems are available. Another element that is essential for controlling devices from all around the world is internet access. The Home Gateway offers a Its development means is used to control smart devices.

III. APPROACH

Cisco Packet Tracer simulation software was used in the Automatic Irrigation system's layout. A creative and potent network simulator, Cisco Packet Using Tracer, you can establish a connection with wireless, router, ports, and far more. It enables testing of network activity, device settings, and data modeling.. A tablet and home gateway are included in the design of the smart irrigation system and are used to connect to various sensors, lawn sprinklers, temperature monitors, and other devices. The Home Gateway connects all of the smart gadgets, while the Device is utilized to converse with the connected phones.

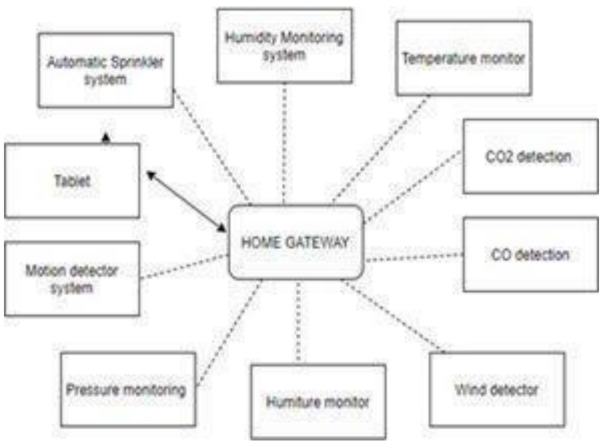

Fig 1. Components used in Smart Irrigation System

IV. DEVICES USED

A. Home Gateway

A home gateway or a registration server are both necessary to connect to the network. The functions of the home gateway can be used to turn on and off the devices after connecting a PC or tablet to it. The physical setup of the home gateway is shown in Fig. 2.

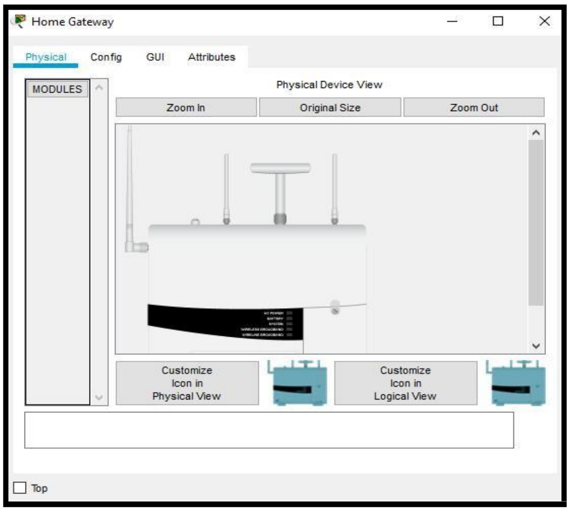

Fig 2. The physical setup of the home network

The default gateway serves as a local link to the Internet of Things smart devices. and offers wireless connectivity to the network and internet access. The gadget contains numerous antennae, four LAN connectors, and an internet port. It is necessary to configure the network settings after attaching the home gateway to the current network by selecting the config tab. The IP routing information can be seen under the internet settings tab after the computer has been connected to the existing network.

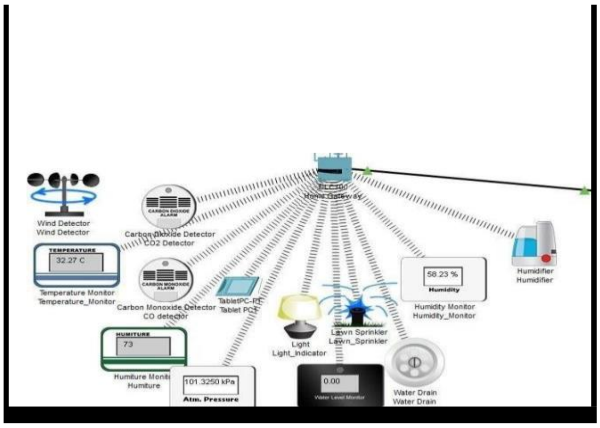

Fig 3. Devices linked to the home gateway

The connection in between the access point and the devices is demonstrated in Fig. 3. The following actions need to be taken in order to set up the smart IoT gadgets and register them with a home gateway. Choose the device, then choose wireless adapter from the network adapter selection list in the I/O configuration.

B. Autonomous water supply system

A field sprinkler, a moisture in the soil sensor, moisture condenses, and a led signal make up the automatic watering system. The moisture level is determined using the soil moisture gauge. The water level monitor's characteristics can be customized by the user to meet their needs. If the water level rises to the minimal necessary level, it automatically switches on the water drain and turns off the lawn sprinkler. Like that, it activates the Sprinkler if there is less water than necessary. To warn the users, a light is given when the irrigation system is running. The drawbacks of manually monitoring the irrigation system are eliminated by important elements of the autonomous sprayer for the lawn. Other devices in the system, such as the lawn sprinkler, can also be operated manually.

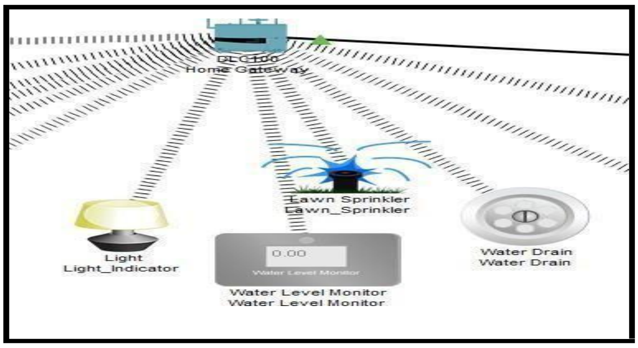

Fig 4. Autonomous Sprinkler System

C. Monitor System for Moisture

Monitoring humidity is an important part of irrigation. The likelihood of high-quality produce and effective irrigation can be improved with careful humidity monitoring. Figure 5 illustrates a component of an intelligent irrigation method called a moisture measurement system. A moisture measurement sensor is utilized in this system. Environmental humidity can be detected with humidity sensors. The home gateway has registered this sensor

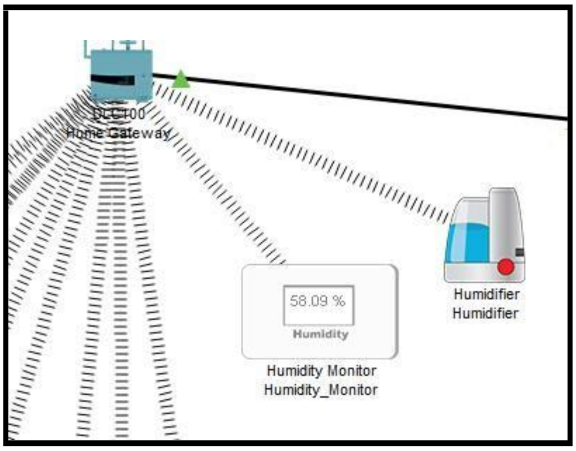

Fig 5. Humidity monitoring system

On the tablet, humidity sensor values can be viewed. Additionally, a humidifier is employed to increase its usefulness. Increase the amount of moisture in the air by using a humidifier. Users can adjust the conditions as necessary.

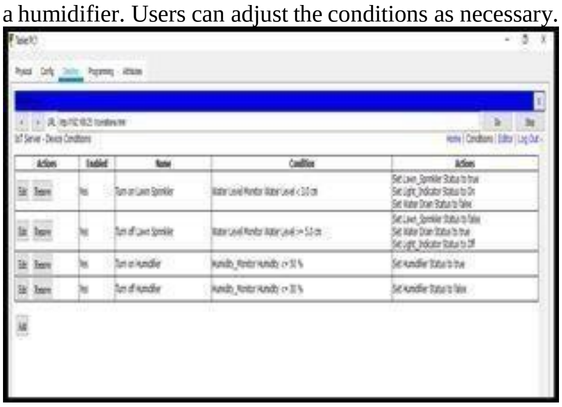

Fig 6. Demonstrates the settings for the moisture monitoring system and the automated sprinkler system.

D. Additional monitoring instruments

The rapid variations in air pressure may reduce the time needed for seeds and plants to germinate. For effective tracking of atmospheric conditions levels and taking necessary steps that may help, this system features an atmospheric conditions concentration can be determined. accelerate and massively boost root growth in plants. The Humiture meter, which aids in keeping track of both temperature and humidity levels, is another factor. The atmosphere's temperatures are detected by the temperaturemonitor. The Weather sensor senses airflow within immediate vicinity. Carbon monoxide and carbon dioxide, in their relative proportions, are used to measure the amounts of each gas.

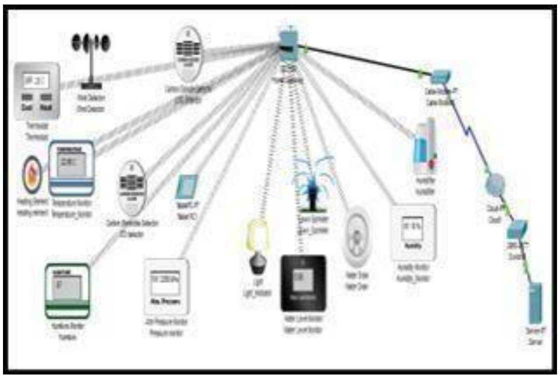

Figure 7. Broader Network

V.RESULTS AND DISCUSSION

Use a tablet to remotely operate the IoT devices after registering them with the home gateway. On the tablet, you can see the registered IoT devices. The devices can be manually controlled, and real-time viewing and monitoring of the values is also possible.

Fig 8. IoT gadgets are shown on the screen

VI. CONCLUSION AND FUTURE

SCOPE

The Cisco packet tracer is used to construct a smart irrigation system. a home gateway that allows the gadgets to be registered and controlled through a tablet. The usage of a home network allows for manual and remote monitoring of any Connected devices connected to it. r. The outcomes show that there is a chance to use this approach in the actual world. Water consumption can be decreased by using an automatic irrigation system. The system's energy efficiency and savings can be increased by manually checking on it. Also, it makes it simple for the user to utilize their smartphone to access all of their devices. Providing security should be a top focus in the IoT sector. Considering that IoT devices are connected to one another, The network needs to be protected. This system has a password-required authentication gateway that verifies the home user's identity for security reasons.Modifications can be made to this system to strengthen it and makeit more efficient and reliable in the future. Whenever the software notices any abnormalities, it should alert the user by email or text message.

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