IoT Based Smart Irrigation System

A COURSE PROJECT REPORT
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BONAFIDE CERTIFICATE

Certified that this project report "**IoT Based Smart Irrigation System**" is the bonafide work of **Akshat Singamsetty (RA1911026010098), Harish Yarlagadda (RA1911026010111), Sharon Sujitha A (Ra1911026010124)**who carried out the project work under my supervision.

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1. ABSTRACT :

The irrigation system is a process used to supply water to the plants as uniformly as possible. IoT technology devices or sensors are connected through the internet and can be easily operated and monitored by the user. The objective of this paper is to implement a simulation for a smart irrigation system with the help of the Cisco packet tracer simulation software with the new version Cisco Packet Tracer 7.3.0 (64-bit). This technology is used to develop a smart irrigation system, which consists of components like a lawn sprinkler, temperature monitor, Humidity monitor, etc., to automate the watering system and easily monitor the environmental conditions for better growth of the plants. Most farmers lack knowledge on how well to cultivate the land in order to get maximum output and profits. This can be attributed to the use of outdated technology or no technology at all. The irrigation systems developed by these farmers have their own disadvantages which is they provide too much water for the crops that ultimately leads to wastage of water and subsequent insufficient harvest is produced or provide less water which also leads to insufficient produce from the crops. The present situation at hand is that most of the farmers estimate the amount of water they should irrigate to their crops which at most times is either not sufficient or too much therefore they get insufficient yields. The pre-defined solution is to work on an IoT project to come up with a way to allow the farmer to easily irrigate the land and get real-time data about the farm. The idea of this is to make a system, which will ensure that various crops receive the correct amount of water they need for maximum yielding. Our project also aims to provide the farmer with enough knowledge on land and the right crops that can live on the land according to the quality of soil that the land has. This project will lead to the development of an automatic irrigation system that will irrigate the land according to the crop's needs in terms of water. The farmer will also be able to turn on and off the irrigation system from the application with just one click from a nearby location. The main objective of the project is to enable remote irrigation of the farm.

All the components are connected to the home gateway and can be easily operated and observed using a Tablet/PC/Smartphone. Simulation results show that smart devices such as a sprinkler system and other essential devices for monitoring environmental conditions are connected to the home portal that can be successfully monitored, which helps the farmers/homeowners to grow and maintain plants with ease.

2. INTRODUCTION:

The agriculture sector is one of the most important sectors in the Indian economy. Every government is given an objective to ensure food security in the country and the agriculture sector is at the heart of it. Farming practices have been changing in Kenya over a couple of years. Long back ago, farming was not automated. The farmers had to manually plow and cultivate the land which was both labor-intensive and time-consuming. Later, the farmers adopted machines such as tractors for farming which made it easier for them. At present farmers have been operating pumps in their farms to ease the irrigation process. Irrigation is one of the problems that most farmers face. The irrigation methods opted by most farmers either end up providing less water or excessive water to the crops. This usually leads to lower crop yields. Irrigation systems that are developed by farmers provide either excessive water for the crops that leads to wastage of water and ultimately insufficient harvest or provide less water which may also lead to insufficient produce from the crops. The present situation at hand is that most of the farmers estimate the correct amount of water that they should irrigate to their crops which at most times is either not enough or too much therefore getting insufficient yields.

If the homeowners are not present in the house to take care of the plants, this technology can help them to easily monitor the devices and thus helps to overcome the disadvantage of manual monitoring. The Smart Irrigation system consists of many smart devices that automate the irrigation system and allow the homeowners to automate the lawn sprinkler/ watering system according to the water level shown by the water level monitor, which results in turning on and off the water drain accordingly. A smart Irrigation system provides different automating activities such as controlling the humidity levels of the plants. The humidity sensor monitors the level and turns the humidifier on or off accordingly after it reaches a certain level set according to the requirements of the owner. The simulation results show that smart components are connected to the home gateway and can be easily operated, monitored, and automated according to the requirements. Cisco Packet Tracer is a visual simulation tool developed by Cisco that provides the user a chance to make network topologies and imitate modern computer networks. It allows you to simulate routers and switches by using a simulated command-line interface.

3. REQUIREMENT ANALYSIS:

Requirements analysis is the process of determining user expectations for a new or modified product. These features are also called requirements and must be quantifiable, relevant and detailed.

3.1.1 Functional Requirements:

The proposed IoT irrigation system has the following functional requirements of the hardware:

i. The Monitors should gather Monitor data and pass it to the SmartPhone

ii. The actuators should receive inputs from the SmartPhone and translate those inputs into physical actions. For example : turn on the irrigation system.

The proposed android application should have the following functional requirements :

i. User Authentication - The user should be able to login into the android application in order to access the different functionalities that are available.

ii. The user should be able to view the status of the farm

iii. The user should be able to turn the irrigation system on and off remotely.

3.1.2 Non-Functional Requirements:

i. Security

ii. Security will ensure that the confidentiality, availability and integrity of the data produced is maintained. Authentication ensures that only allowed users can access the data at any time.

iii. User Support

iv. This section enables the user to learn more on how to use the system. It also ensures instant notifications for the user to make them aware of the events taking place in the system even when the user is away.

3.2 Component Requirements:

a) Home Gateway:

The devices can be turned on and off using the features of the home gateway. The home gateway provides internet access and wireless connectivity to the network and acts as a local connection. A gateway is a router in a computer network, which is a key stopping point for data on its way to or from other networks. Through gateways, communication and sending of data back and forth can be done. The Internet will be useless without gateways as well as a lot of other hardware and software. at a workplace, the gateway is the computer that routes traffic from a workstation to the outside network The basic Internet connection at home, is the gateway that will provide you access to the entire Internet.

b) Lawn Sprinkler:

A sprinkler is a garden device that sprays water onto your grass or plants. You can attach a small lawn sprinkler to a house in your yard or your field and prevent your crops or flowers from getting dropped. These sprinklers can also be connected through a mobile phone and can be operated from anywhere. The sprinklers are used for residential, industrial, and agricultural usage. It is useful on bumpy land where sufficient water is not available. They have a rotating nozzle on top, When water is pressurized through the main pipe it escapes from the rotating nozzles.

C)Water Level Monitor:

The water level monitor is used for water level detection. parameters can be set by the users for the water level monitor according to requirements. Water level monitoring can have a wide variety of environmental benefits, like improving visibility on potential flood situations. By using water level monitoring systems, it has become much easier to rapidly deploy countermeasures if levels become too high or low. Water level loggers are highly sensitive pressure sensors that can detect the small changes at the water level and can send alerts to preferred contacts alerting them to the situation.

D) Humidity Monitor:

Humidity monitoring is a crucial aspect of irrigation. Smart monitoring of humidity levels can increase the probability of getting good produce and smart irrigation. Humidity sensors are used to sense the humidity in the environment, This sensor is registered to the home gateways. A humidifier is a device used for increasing the level of moisture in the environment. The users can set the conditions accordingly. Humidity Sensors are low cost-sensitive electronic devices that are used to measure the humidity of the air. These are also known as Hygrometers. Humidity can be measured as Relative humidity , humidity sensors usually contain a humidity sensing element along with a thermistor to measure temperature.

E) Humidifier:

Humidifier is a device, which is primarily an electrical appliance, that increases moisture in a single room or an entire building. In the home, point-of-use humidifiers are commonly used to force air into a single room, which connects to a home's HVAC system, which provides humidity to the entire house. . Huge humidifiers are used in commercial, institutional, or industrial contexts, often as part of a larger HVAC system.

F)Smartphone:

Smartphones are used to monitor all the components present in the system. It is connected to the home gateway through wireless network connection. We can change the required conditions through smartphones.

3.3 Requirement Specification:

3.3.1 Hardware Requirements :

Processor : 2.4 GHz Clock Speed

RAM : 1 GB

Hard Disk : 500 MB (Minimum free space)

3.3.2 Software Requirements :

Operating System : Windows 7

Platform : Cisco Packet Tracer

Server : Wireless Internet

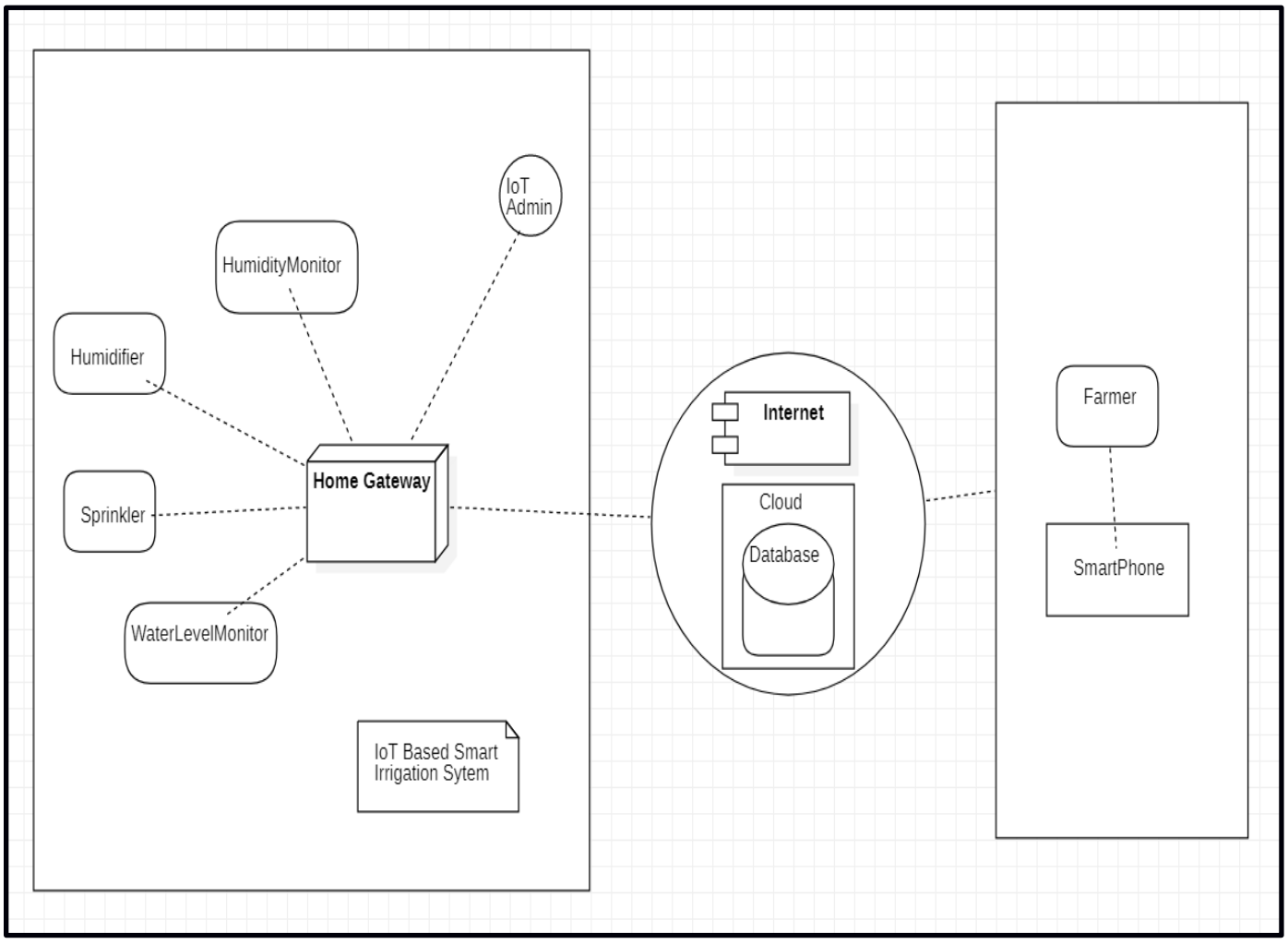
Technology : Internet of Things

4. ARCHITECTURE & DESIGN:

The system will consist of the hardware and software components. The hardware part of the system consists of a Water Level Monitor, a humidity Monitor and a LED. These Monitors will be constantly collecting data and sending the readings to the cloud platform and then display on the Farmer's side. The software part of the system consists of the SmartPhone(Android) application that the farmer will interact with in order to take advantage of the functionalities that the system is expected to have.

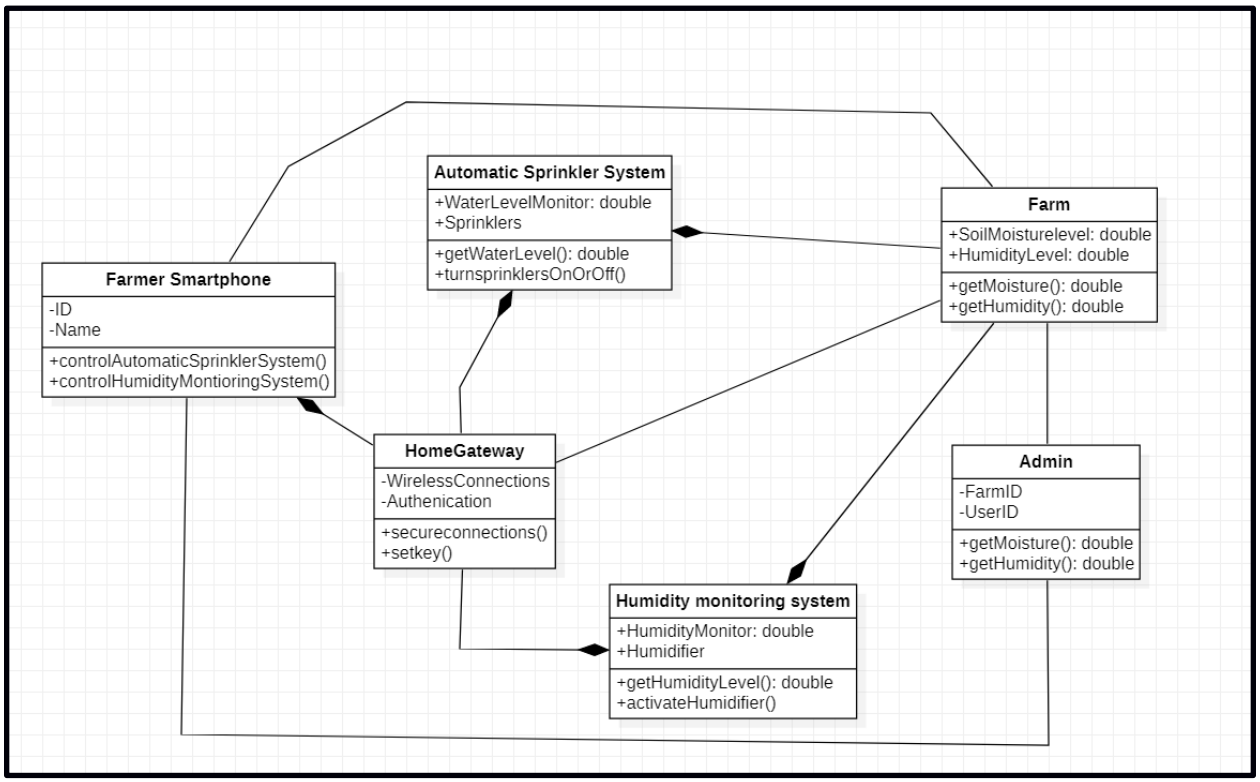
The user will first be required to log in into the android application to ensure authentication. The user will then be able to see the Monitor data in real-time. In addition to this, the farmer will be able to turn the irrigation system on and off remotely using the android application. The system is also expected to be autonomous in nature whereby the irrigation system turns on and off automatically according to some thresholds set (Conditions)

4.1 Architecture diagram



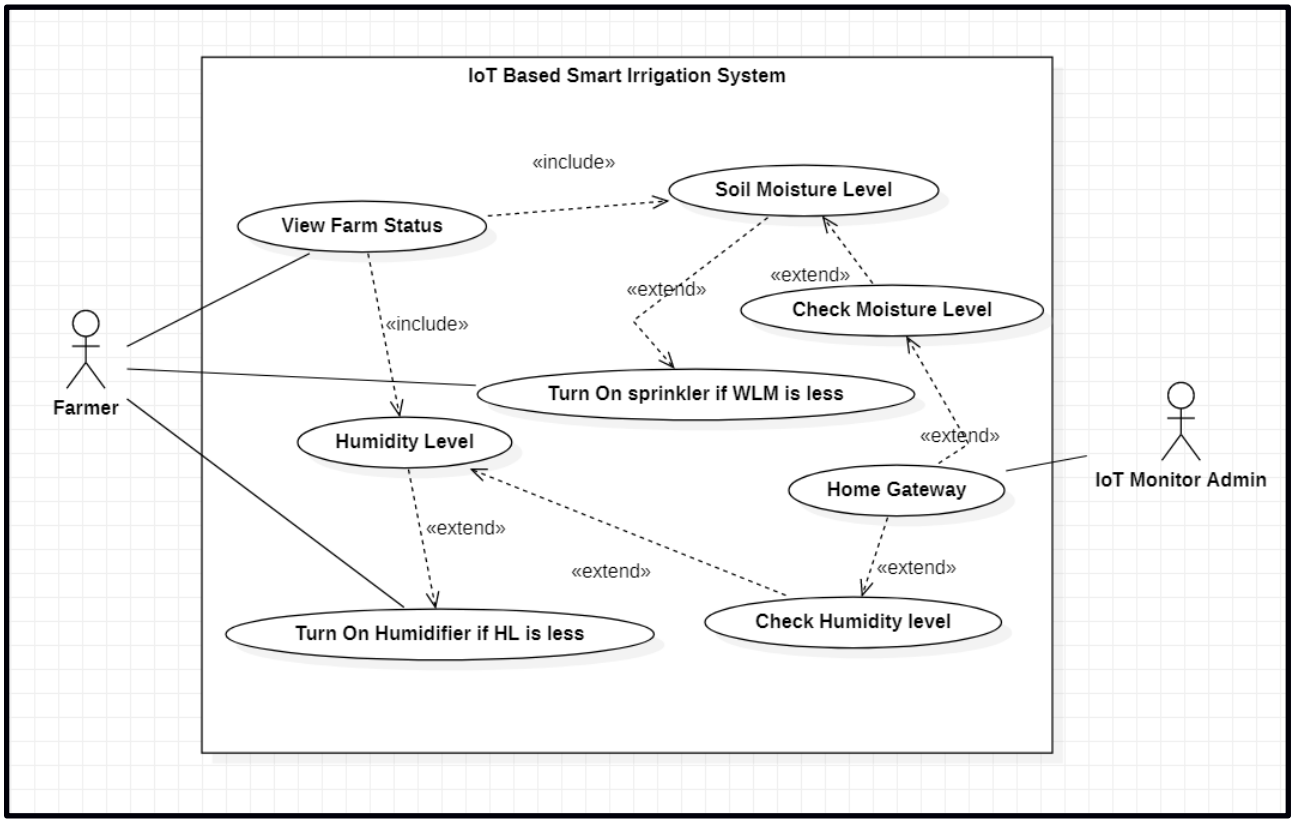
4.2 Design

4.2.1 Class Diagram



The system will consist of Two actors. The farmer and the IoT Monitor . The systems/monitors will be responsible for collecting as much data as possible and sending it to an IoT SmartPhone. The data will be stored in the IoT SmartPhone and can be analyzed from there. The farmer will be able to view the data collected by the systems/monitors on an android application and ultimately be able to turn on the irrigation system remotely.

4.2.2 Use Case Diagram



5. IMPLEMENTATION

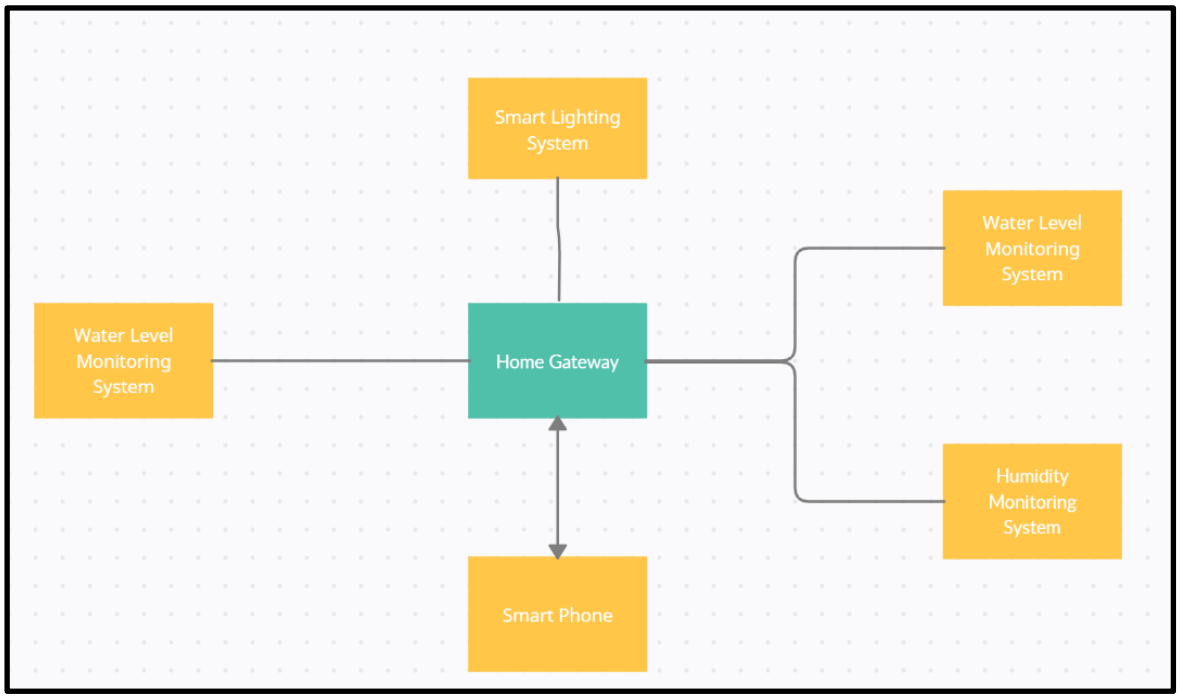
The main functionalities of the system is to enable remote monitoring of the water requirements in the farm/garden and autonomous irrigation of the farm/garden. The system has been made using the Cisco Packet Tracer Platform. Packet Tracer is a cross-platform visual simulation tool designed by Cisco Systems that allows users to create network topologies and imitate modern

computer networks. The software allows users to simulate the configuration of Cisco routers and switches using a simulated command line interface.

A network is formed by connecting the sensors and the information about the environmental parameters can be monitored through smartphones. Water

Level monitor is used for water level detection present in the soil, Humidity monitoring sensors are used to sense the humidity present in the environment.

5.1 Block Diagram



This is the block diagram for an IOT based smart irrigation system. The block diagram contains Water Level monitoring System, Humidity Monitoring System, Smart Lighting System, Home Gateway and Smartphone.

All the devices are connected using wireless network connectivity. A smart phone is used to monitor the devices present in the Smart Irrigation System.

5.1.1 Water Level Monitoring system

Water level monitoring system contains lawn sprinklers, water level monitors.Water level monitor measures the water content present in soil which is the indication for moisture content in soil. Particular amount of moisture has to be maintained in soil for healthy plant growth. When the moisture content falls below the preset value water sprinkler is activated. In this paper a water level monitor is used to measure the moisture in soil and when the moisture level falls below a certain value lawn sprinkler is turned on so that the moisture content in soil is well maintained.

5.1.2 Humidity Monitoring System

Humidity monitoring system contains humidity sensors, humidifiers and Humiture monitor.

Humidity sensors measure the amount of water (humidity) content present in the air. Humidifier is used to maintain the moisture content in the air. Humidifier is activated when the humidity percentage in the greenhouse falls below the desired value.

A Humiture monitor measures both the temperature and humidity present in the atmosphere, it shows the value similar to (temperature + humidity) /2.

5.1.3 Smart Light

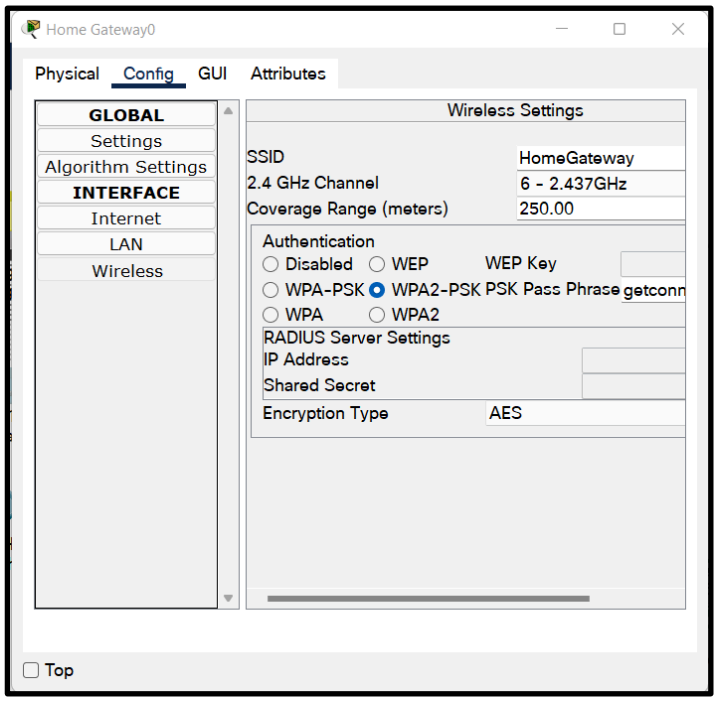
Smart light systems contain smart light. Smart lighting systems are implemented by using smart light. When the water level falls below a certain value smart light is turned on so that the owners know that watering is done for the plants.

5.1.4 Smartphone

Smartphones are used to monitor all the components present in the system. It is connected to the home gateway through wireless network connection. We can change the required conditions through smartphones.

5.2 Connectivity

Home gateway is connected to all the devices present in the system through wireless network connectivity. The IPv4 address is 192.168.25.1 and the subnet mask is 255.255.255.0 . The authentication for this is WPA2-PSK. With the help of password ‘get connect’ we will connect all the devices.

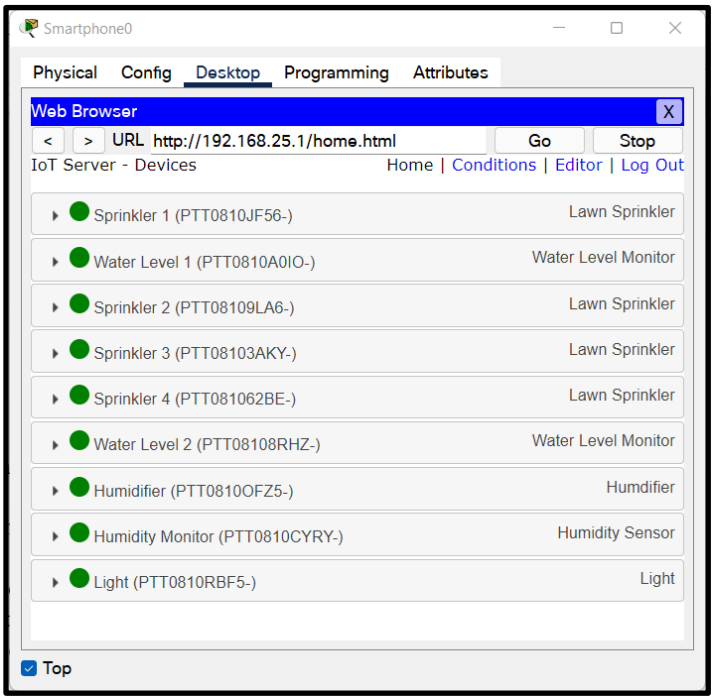


All the remaining devices are connected wirelessly with help of PT-IOT-NM-1W network adapter. With the help of password ‘get connect’ we will connect the devices to the home gateway.

5.2.1 Home Gateway

With the help of smartphones we will open the IOT monitor gateway . To open it we will go to the web browser and enter the IP address (192.168.25.1) in the URL. Now we will login using the Username (admin) and password (admin).

In the monitor gateway we will get the different types of devices that are connected to the home gateway.



5.2.2 Conditions

We will give certain conditions in the smartphone for the operations.

5.2.2.1 Water Level

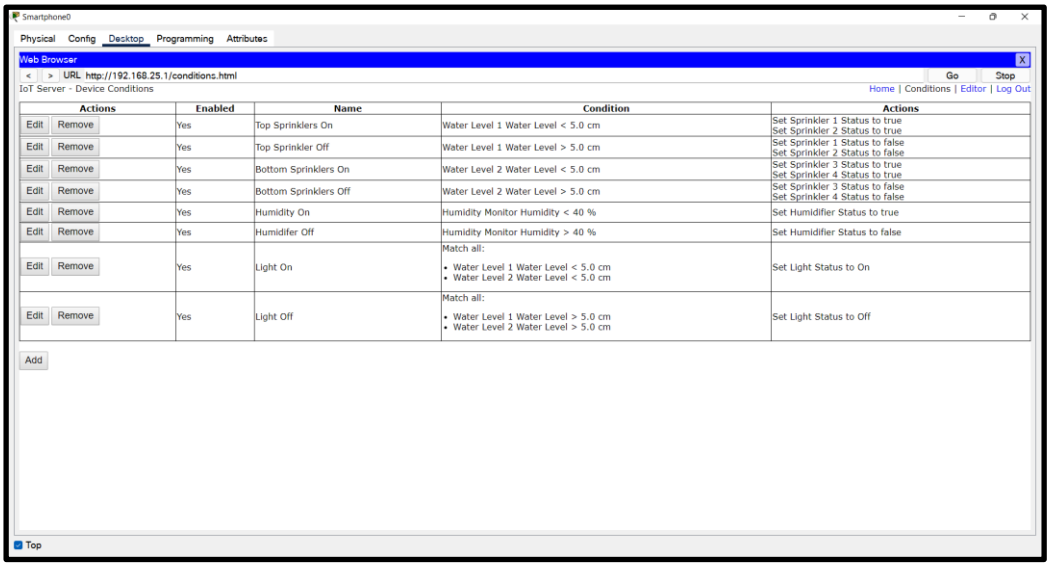
If the water level is less than 5.0 cm then all the sprinklers will be on. If the water level present in the soil is more than 5.0 cm then all the sprinklers will be off. We can change the values according to the requirements of the plants.

5.2.2.2 Humidity Level

If the humidity present in the atmosphere is more than 40% then the humidifiers are set to off. If the recorded values in the humidity sensor are less than 40% then the humidifiers are set to on. We can change the values according to the requirements of the plants.

5.2.2.3 Smart Light

If the water level is less than 5.0 cm then the smart light is turned on. If the water level present in the soil is more than 5.0 cm then the smart light is turned off.



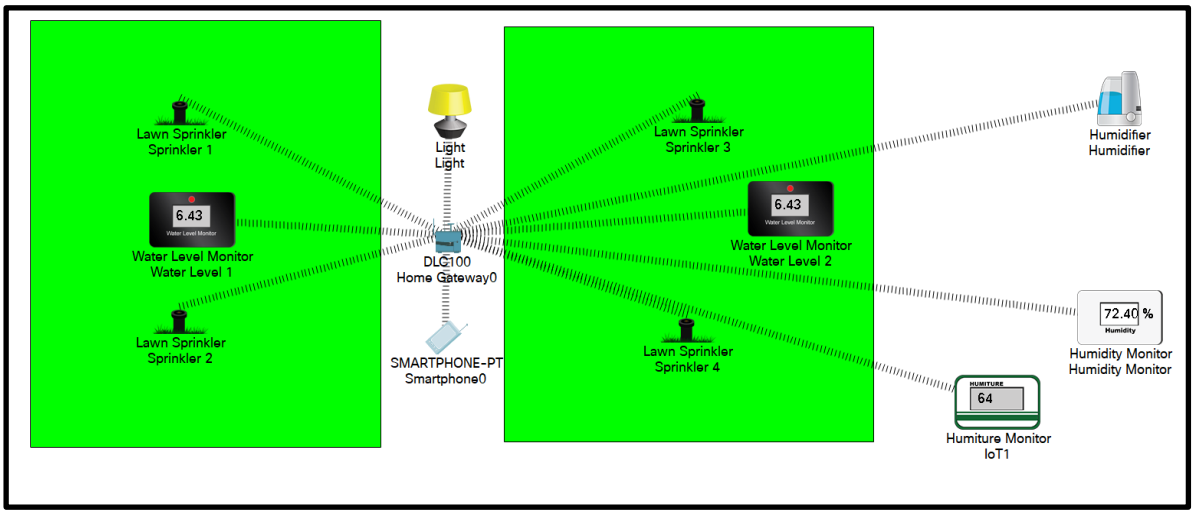
6. EXPERIMENT RESULTS & ANALYSIS

6.1. Results:

The Results of the smart irrigation system is shown using CISCO packet tracer. The project is done according to the requirement. All the devices are monitored through smartphones. The sprinklers are turned on when the water level present in the soil is less than 5.0 cm, and turned off when the water level is more than 5.0 cm . Similarly the humidity monitor is turned on when the humidity present in the atmospheres is less than 40% and turned off when the humidity present in the atmosphere is more than 40%.

Final network,

The values present in the water level monitor are more that 5.0 cm so the sprinklers are off, smart light is off. The humidity monitor records 72.4% since the humidity is more than the mentioned conditions i.e 40% the humidifier is off.



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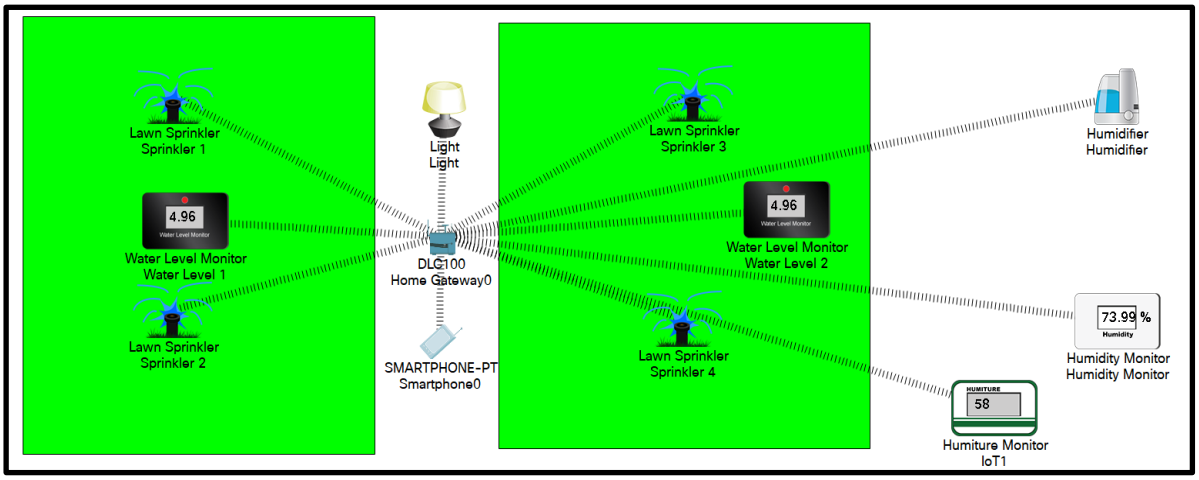

6.2. Result Analysis

Test ID	Expected Results	Actual Results	Status	Remarks
T1	The Monitors work correctly collecting the	All Monitors work as expected and this was	Pass	The system consta ntly collect s the
	required data.	confirmed using the Iot Android Application monitor.		sensor data at predefin ed intervals.

T2	The Monitor data collected is sent to the SmartPhone via the internet.	Using an Home Gateway, the data collected by the Monitors is sent to the SmartPhone	Pass	The system alerts the user if there are challenges encountered when trying to send data to the cloud platform.
T3	The real time Monitor data collected is displayed on the Android application .	Monitor Data on the Internet is pulled and displayed on the Android application as expected.	Pass	The soil moisture content, Humidity value and Temperature values are displayed on the android application.
T4	The system autonomously controls the irrigation system based on some conditions that have been specified on the Systems	The system autonomously controls the irrigation system based on some conditions that have been specified on the System	Pass	Based on the three sensor values collected, the system autonomously turns the pump on and off appropriately ensuring that the

				farm is sufficiently irrigated.
T5	The android application should enable the farmer to control the whole irrigation system remotely from anywhere in the world.	The farmer is able to control the irrigation system remotely through the android application turning the Sprinklers on and off as he wishes.	Pass	The farmer is able to control the irrigation system remotely through the android application turning the pump on and off as he wishes.
T6	Use predictive analysis to forecast and predict the conditions of the farm in order to enable the farmer to make more informed decisions	Implementation of predictive analysis proved to be a challenge by the time this project is being presented	Fail	Implementation of predictive analysis proved to be a challenge by the time this

Result Analysis of Systems

A. Home Gateway

To connect to the network, either a home gateway is required or a registration server. After connecting the PC or a tablet to the home gateway, the devices are turned on and off using the features of the home gateway.

The home gateway provides internet access and wireless connectivity to the network and acts as a local connection to the IoT smart devices. The device has an internet port, four LAN ports, and multiple antennae. After connecting the home gateway to the existing network, the network settings are set that are configurable by clicking on the config tab. The IP addressing information can be seen under the internet settings tab after connecting the device to the existing network. The wireless settings need to be configured by entering the home gateway SSID and selecting WPA2-PSK PSK passphrase and a password for authentication and validation of the wireless network. The next step is to connect the IoT smart devices to the home gateway

B. Automatic Sprinkler System

The automatic sprinkler system consists of a lawn sprinkler, water level monitor, water drain, and a light indicator. The water level monitor is used for water level detection. The user can set the parameters for the water level monitor according to requirements. If the level of the water goes up to the minimum required level, it turns the lawn sprinkler off and turns the water drain on automatically. Similarly, it turns the Sprinkler on if the level of water is less than the required level. The light indication is provided when the irrigation system is on to alert the users. This feature of the Automatic lawn sprinkler system eliminates the disadvantages of manual monitoring of the irrigation system. The lawn sprinkler and other devices in the system can be controlled manually too.

C. Humidity Monitoring System

Humidity monitoring is a crucial aspect of irrigation. Smart monitoring of humidity levels can increase the chances of good produce and smart irrigation.. 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

6.3. Conclusion & Future Work

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.

Embracing new technologies is essential in the development, modernization and advancement of the agricultural sector in India. The Internet Of Things is playing a major role in the development of more advanced and efficient systems in agriculture. The smart irrigation system developed enables the farmer to remotely monitor the farm. This way, the farmer can keep track of the farm even when he or she is away from the farm. In addition to this, the farmer is able to remotely control the irrigation system easily as long as he has the android application and an internet connection. The system also autonomously controls itself thereby irrigating the farm when certain conditions are met. This simple implementation of the Internet of Things in agriculture is just an example of how powerful the IoT technology is.

The system can be manually monitored, it can increase the energy

efficiency and savings. It also makes it convenient for the user to access all the devices through the smartphone. 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.

Future Work:

The addition of a predictive model on the application that will give predictions based on the data being continuously collected by the sensors to enable the farmer to make more informed decisions about his or her farm.

In addition to this, integration of this system to a weather API that will provide weather forecast information to the farmer.

To extend this system to be more robust and efficient in the future, modifications can be made 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.

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