REMOTE-CONTROLLED IRRIGATION SYSTEM

Abstract

Water is essential for plant growth. Watering the plants is done by the irrigation process. Irrigation is the process of adding regulated amounts of water to land to support the growth of lawns, ornamental plants, and crops. The main objective of this system is that it doesn't need human intervention. This system seeks to satisfy water requirements of the crops, by nursing the soil moisture using soil moisture sensor and other environmental parameters such as humidity and temperature using DHT11 sensor. By providing plants in gardens with water according on their needs rather of having to travel out into the field to water the plants, it also aids in water conservation. This irrigation system will reduce manpower, save time and enhance effectiveness at minimal cost. The feature of an animal detector is also added in case of animal movement onto the field and the notification of animal detection will be sent to the farmer by the warning message using the Blynk app which is also an IOT app.

Keywords: IOT, DHT11 sensor, Blynk app, Arduino IDE, Soil Moisture sensor, NodeMCU

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I. INTRODUCTION

Water is a necessity for all living things, and agriculture uses 70% of the freshwater that is used globally. Therefore, smart irrigation systems are essential to meet future demands for reducing water consumption and manpower. The irrigation system is essential for crop yield, as over-irrigation and under-irrigation can lead to decreased productivity and power and water wastage. Precision irrigation reduces power and water wastage while increasing productivity. The old-style irrigation systems used in past years are Basin Irrigation Method, Strip Irrigation Method, Check Basin Method and Furrow Irrigation Method. These methods use aquifers and canals to channel water into the fields, ensuring good seed germination, higher crop yields and faster growth in agricultural production. Indian farmers use these methods to ensure good seed germination, better crop yield and faster growth in crop production. Modern methods are cheaper, but not as efficient due to human or animal labor and uneven distribution of water. IoT provides a powerful way to monitor various processes, and real-time data transparency creates clearer visibility for innovative technology. In agriculture, IoT makes it possible to monitor and manage microclimate conditions, thereby increasing yields. For crops, devices using IoT technology can detect soil moisture. This avoids wasting a valuable resource and increases soil fertility

Smart irrigation methods reduce outdoor water use by watering plants according to their water needs.This methodology can be used to create a smart controller by adding a sensor to an existing irrigation timer. It uses weather data and soil moisture to determine landscape irrigation needs. Smart irrigation systems are important for water conservation in agriculture; this advancement could play a critical role in reducing water usage. Farming and agricultural techniques are also linked with IoT and automation, to make the whole process much more efficient and effective. Irrigation systems have been identified as positive contributors towards improved irrigation systems that can improve the use of constant research and growth aimed at improving the sustainability of operations and cost reduction. We can make every drop of water count at your facility to improve the irrigation method.

Since irrigation is important to yield good quality crops in the seasonal or non-seasonal period, we can use modern agriculture. An automated irrigation system is one of the greatest ways for increasing output in the shortest amount of time. To a large extent, this smart irrigation system is developed and entirely automated to reduce agricultural labor. One of the benefits is that the concept of IoT and sensors for smart irrigation is easily comprehensible for users or farmers. Animal detection plays a very important role in the agricultural field. Very important applications are used to prevent crops from harming animals, knowing locomotive behaviors of animals and many more. Animal detection due to a wide range of real-world applications. Numerous animals finding methods and notice systems are used to indicate the presence of animals on roads or residential areas and agricultural fields. This project added a feature of an animal detector in case of animal movement onto the field. An animal detection system detects the presence of animals and issues a warning.

II. LITERATURE SURVEY

1. **Sensor Based Irrigation:** Smart irrigation is implemented by using sensors [1]. Here, the spray gun is attached to a hose that is then connected to a water pump and the other end of the hose is near the base of the tree. The signal will be sent through the microcontroller

when opening and closing of the valve is done. The procedure is done by watering the root of the plant drop by drop by means of a rain gun. The valve will be closed according to the humidity level. The microcontroller will send the signal to the mobile according to the sensor level which activates the buzzer to indicate the valve is open or not. Both mobile phones are connected via GSM. GSM and microcontroller are coupled using MAX232.

Other smart irrigation system is implemented by Data analysis methods [2]. By sensors and integrated circuits, it records functional circumstances such as temperature, humidity, light density and soil moisture. It controls various irrigation management practices by measuring various agricultural parameters such as soil moisture, soil pH, humidity and temperature. These structures permit farmers to screen and regulate their fields using easy-to-use mobile applications. The portable WSN is used here. Wireless satellites, mobile phones, sensors, Internet-based communications and microcontrollers record ecological parameters. The knowledge obtained from the sensors is transported straightly to the cloud servers by means of the Internet of Things technology.

2. **Microcontroller Based Irrigation:** In the ATMEGA 328 microcontroller-based irrigation system [3] the interrupt signal is sent to the motor and is automated to collect input signals indicating the fluctuating humidity state of the soil via the sensing procedure. Temperature and humidity sensors are associated to the inner ports of the microcontroller via a comparator. When there is a change in temperature and moisture in the environment, these sensors inspect the modification and pass an interrupt signal to the microcontroller, causing the motor to turn on. A buzzer is also used to specify that the pump is on. The project is proposed to function as an irrigation system, with the pump/motor turning on and off based on the wetness content of the soil. An op-amp is used as the comparator that acts as the interface between the sensing configuration and the micro controller.

IoT based smart irrigation system mount sensors for each plant in order to determine the soil's condition [4]. In order to supply water, each plant also needs a water pump. Blynk application on a smartphone is required, as well as hardware implementation that can detect the condition of the plant using the DHT11 sensor and moisture level detector is also required. A capacitive humidity sensor and a thermistor are used to measure ambient air temperature and humidity, and a digital signal is then sent to the data pin. Soil moisture sensors monitor the amount of water in the soil and can be used to calculate how much water is stored in the soil horizon. Soil moisture sensors do not detect water directly in the soil instead they track changes in another soil property that is related to water content in a predictable way.

For the efficient usage of water in smart irrigation system, embedded control system is used [5]. Remote monitoring and control were introduced due to the lack of availability of low-cost human resources. This system consists of an Arduino board which is used to interface dissimilar sensors including ultrasonic sensor, light ambient sensor, humidity sensor, temperature sensor and soil moisture sensor. It also controls a light, solenoid valve, water sprinkler and a cooling fan. Diverse sensors are used to quantity diverse constraints to turn the motor or fan or lamp involved on or off as the case may be. They proposed the use of Embedded control systems for automation. They elaborate the use of sensors to check the humidity of the soil for switching on the motor when essential.

Mobile application is also used to operate the water pump to turn ON/OFF without sensing the soil moisture level pouring the water anywhere with the help of IoT [6]. They will connect the device using Arduino. Arduino is the best part to help to conserve the water within a busy schedule. The node used to connect the system to your smart device controls the water flow from the pump and the shortness of the flow time. Farmers can monitor the process online through the website. Without monitoring the soil moisture levels, it will just pour the water for plants using Arduino. Users can operate the process in mobile applications.

In the smart agriculture model are lay act as an electrically operated switch [7]. The detection of the water vapour by DHT11 is based on the measurement of the electrical conductance between two electrodes. The soil moisture sensor measures the volume of water present in the soil. The solenoid controls the valve via an electrical current. It additionally records the real-time sensor parameters, enabling users to assess the status of different field parameters at any location and time. It can control the motor in the field using humidity, temperature and moisture level. The moisture level of the soil is measured or sensed by the sensors. These values are stored in Arduino Nano to execute the methods. The motor will be turned on and off automatically without human interaction according to the soil moisture levels. The solenoid valve regulates water flow by sensing moisture levels in the soil. We employ two moisture sensors for each of the two farms, which are linked to microcontrollers. These sensors consistently transmit moisture readings.

3. **Wireless Sensor Network:** Wireless sensor networks are becoming progressively essential within this system. [8]. This irrigation system must incorporate at least one specific type of sensor that plays a crucial role in determining soil moisture levels, as indicated by the values from the soil moisture sensor. If the sensed parameters, like temperature and humidity, fall below designated thresholds, they will decrease. Alternatively, an individual can opt for a smart irrigation controller, which permits automatic adjustments to irrigation schedules based on data from weather and soil moisture sensors.The use of sensors or water pumps equipped with solar panels can help resolve the problem of energy crisis.

   A water pipeline is an important structure used to transport potable water over long distances for consumption or irrigation. The wireless sensor network technique is for monitoring the water pipelines. The ZigBee wireless protocols are used for consumption and communication. As a result, in order to address the shortcomings of existing WSNs in terms of energy efficiency, this proposed model includes high-performance information that serves as a platform for WSNs to better support agricultural production.

4. **Solar Renewable Energy:** The solar powered water pump in the smart irrigation can also be connected to a water flow controller using a moisture sensor[22]. Solar power stands as the most abundant energy source on this planet. A photovoltaic generation is used here. The solar power will first drive the water pumps to pump water from bore wells then driven into a tank. To optimize the use of water, the outlet valve of the tank is controlled using a controller. The purpose of the moisture sensor is to regulate the water flow rate from the tank to the irrigation field. Solar panels are used to pump water from a bore well directly into a ground level storage tank.

The valves are controlled using smart algorithms to adjust the flow of water to the fields according to the moisture needs of the soil.

Fuzzy logic, sensors like soil moisture and DHT sensor can also be used to analyze conditions of the soil [22]. Solar energy was harnessed to provide power for both the Arduino units and the sensors. They use an Arduino microcontroller. These sensors are linked to the control unit, which controls and monitors the entire irrigation process, and depending on the weather, a decision is made based on haphazard logic about whether or not the soil needs to be irrigated.

Another method monitors soil moisture, humidity and temperature levels, pumping water to the field and providing real-time information to the farmer's smartphone to take necessary action [27]. For the most part, it relies on wireless sensors placed in the field to collect real time data, with a master controller built in to receive and send the data to the required controllers for immediate action. The agricultural field is encircled by electric fencing. The farmhouse and electric fencing are powered by Solar Power. The system will provide power to street lights and fencing at night and power will automatically turn off during daytime. The user can fully observe the activity without the interference of the farmer in the environment.

5. **Machine Learning:** Machine learning concepts can also be used with this smart irrigation. A transmitter and receiver circuit is connected to a water pump through an actuator for carrot growth and yield.[20]. The sensor circuit was responsible for reading the soil moisture content and sending that information wirelessly to the receiver. Based on the received soil moisture data, the receiver decided whether to turn the pump on or off. On a carrot farm, 16 beds were built in the first block. 8 beds were irrigated manually in the first block and 8 beds were irrigated via machine-to-machine communication in the second block.M2M is the use of any communication channel, including wired and wireless, to communicate directly between devices.

Sensor node inter-connectivity system can also be used to monitor the field thoroughly [26]. The Internet of Things and machine learning algorithms help to classify and predict the amount of soil, crop type and yield required by the crop. In order to monitor all areas of the field, a wireless sensor network field must be set up throughout the farm, or even in the home garden. It is based on open source databases which are available online and Machine Learning algorithms. These solutions are based on microcontrollers such as Raspberry pi 3 and Arduino Mega, choice of microcontroller depends on computing power, price and availability. By using various sensors, the constant difference for water that is appropriate and specific to the type of crop will be analyzed continuously.

The next method uses the discipline of machine learning and data mining. This system uses numerous sensors which are used to gather data for real-time analytics on the weather forecast, soil moisture, air temperature, pH and humidity [18]. Ration-based data analysis is a data-driven model-based approach to data analysis in which several models and algorithms are used to directly train data. This way of integrating automated data treatment, data capture and decision-making machine learning is known as a full ration-based model-based model. It enhances the level and quality of production. The survey can assist farmers in learning the most up-to-date information so that they can apply machine learning techniques using irrigation action systems according to their requirements and improve their productivity.

Edge computing can also be used with IoT for smart irrigation system [28]. The sensors used here are soil moisture sensor, humidity and temperature sensor and light sensor. To make decisions for water requirements the k-nearest algorithm which is based on highly required, not required, highly not required, average required and required. The DHT22 sensor is used for humidity and temperature sensor, the BH1750 sensor is used for light sensor and the HL-69 sensor is used for hygrometer which is used for the humidity of the soil and the soil moisture from the field. It is implemented in Anaconda and it uses an Arduino UNO ATmega328P controller. The microcontroller layer is the perception layer, the edge server is the first processing layer and the GSM SIM808 is the transport layer and the main IoT is the second processing layer.

III. PROPOSED SYSTEM

1. **IoT-Based Irrigation System:** The proposed irrigation system fulfills the farmer's requirements. This system is based on the internet of things which achieves its objectives much faster. The irrigation will be done automatically with the real time values of soil moisture of the soil, temperature and humidity of the atmosphere of the plant in this system. It's super straightforward and easy to use. In the current system, irrigation is done manually by farmers, but in our system, there is no farmer intervention to do the irrigation process instead the irrigation will be done automatically. In the existing system, the irrigation can be done automatically but with only the help of mobile applications using the button present in the application which is to control the motor. The motor controls the water pump to turn on and off so the mobile application gets control over it. But in this system the automatic irrigation process is used. The IoT application Blynk app also used here. First of all, if the soil is dry, the sensor will sense it and give the real time values of the soil moisture to the NODEMCU. The NODEMCU will send the values to both the LCD display and the Blynk app. Both of them will display the values of those sensors.

2. **Animal Detection:** The special feature called animal detection is used in this system. In this animal detection, the detection will be based on the movement of animals. To detect the animal movement in the field, a PIR sensor is used. The PIR sensor is connected to the microcontroller i.e., NODEMCU. In the existing system there is no notification for the indication of animals, but in this system, we will send a warning message to the farmer in the Blynk app. The warning message is to alert the farmer to indicate there is an animal movement in the field. We also have a buzzer which makes the animals get out of the field by the sound. The PIR sensor will detect the animal's movement within 10 to 12 meters range. Depending upon the size of the PIR sensor, the distance for the motion detection will be varied. PIR sensor is controlled by the button in the Blynk. The user can use it according to their convenience. To indicate the ON and OFF, the button itself has a name in it. If any animal movement is detected, there will be an indication in the Blynk app by producing a red color button like symbol in it. After a few seconds, the warning message will appear. It also detects the movement of the humans since it is a motion detecting sensor.

IV. SYSTEM ARCHITECTURE

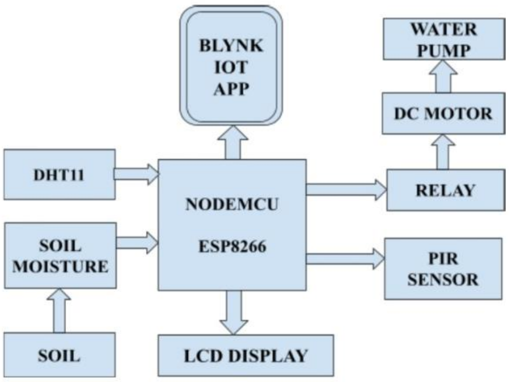

Figure 1: Block Diagram

System architecture is a description of an arrangement that comprises the recording of functionality to hardware and software components, the mapping of software architecture to hardware architecture and human interaction with these mechanisms. The purpose of system architecture is to define a wide solution based on interrelated and consistent principles, concepts and attributes. The System architecture describes how the system works and interacts with other systems and the outside world.

1. **Soil Moisture Sensor:** Water in the soil is measured or estimated by soil moisture sensors. The soil moisture sensor is used in our project since the water is pumped out using its real time values. The fork-shaped probe consists of two exposed conductors. The probe is inserted into the soil or wherever the moisture content is determined. A fork-shaped probe is equipped with two exposed wires that act as variable resistors whose resistance increases with the soil moisture content.

Figure 2: Soil moisture sensor

There are 4 pins in the soil moisture sensor namely Analog Output, Digital Output, VCC and GND. Analog output voltage (AO) is proportional to soil moisture level. Digital output voltage (DO) indicates whether soil moisture level is within the limit. VCC supplies power to the sensor and the sensor is powered from 3.3V to 5V. The sensor creates an output voltage based on the resistance. We can measure how much water is in the soil. The sensors are located in the field’s root zone. Trees or shrubs measure the position of moisture in the soil directly and pass this information to the controller. The controller then adjusts the predetermined watering schedule as required.

2. **PIR Sensor:** An infrared sensor, also known as a passive infrared sensor or PIR sensor, is an electronic device that is mainly used in motion detectors. PIR sensors enable the detection of animal movement and are also used to detect whether the animal has moved into or out of range of the sensor. PIR sensors allow for motion detection, almost always used to detect if a person has moved into or out of range of the sensor. PIR sensors detect changes in energy levels in the surroundings. PIR sensors are capable of detecting animal/human motion within the specified range. Most PIR sensors are used in PIR based motion detectors. It can also be used in alarm systems and auto-brightness systems.

Figure 3: PIR sensor

The PIR sensor consists of 3 pins- Pin 1, Pin 2 and Pin 3. Pin1 is associated with the drain terminal of the device, which is linked to the 5V DC positive supply. Pin2 is aligned with the source terminal of the device, connecting to the ground terminal via a 100K or 47K resistor. It functions as the sensor's output pin. Pin3 will be connected to ground. We can adjust the timing and direction of the pins in the sensor which are available on the side of the sensor. It absorbs the infrared energy from the animal’s body to generate the alarm signal. Any object that has a temperature is constantly emitting infrared radiation to the environment. Most of the radiant energy is located in the 8-12 micrometer range.

3. **DHT11Sensor:** DHT-11 Digital temperature and humidity sensor is a simple, low-cost digital temperature and humidity sensors. It uses capacitive humidity sensors and thermistors to measure the air in the environment and outputs a digital signal to the data pin. The sensor detects the ambient air humidity and temperature, measures soil moisture, and also recommends the appropriate watering of the crops at the appropriate time and for a specified period of time. The DHT11 sensor prevents the motor from shutting down. It can turn off the motor if it detects high temperature and thermal values.

Figure 4: DHT11sensor

DHT11 sensor can be available in the form of a sensor or a module. This sensor is used in a variety of applications such as humidity and temperature measurement in heating, ventilation and air conditioning systems. The DHT11 humidity sensor consists of 4 pins namely VCC, Data Out, Not Connected (NC) and GND. The VCC pin has a voltage between 3.5V and 5.5V. A 5V supply would be sufficient. The Data Out pin carries serial digital data, representing compound temperature and humidity information. This digital sensor provides pre-calibrated digital output. Featuring an 8-bit connection, the single-chip microcontroller ensures swift responses and improved output quality, resulting in cost-effectiveness. It employs a single bus data format, facilitating two-way communication for both input and output transmission. A single data unit comprises 5 bytes (40 bits). The transmission and reception communication time reaches a maximum of 3 ms. Power consumption is minimal, with a supply voltage of approximately 5V and an average maximum current of around 0.5 mA. The DHT11 Humidity Sensor is utilized for detecting airborne moisture levels.

4. **Node MCU ESP8266:** The Node MCU also known as A extremely affordable System-on-a- Chip (SoC) called the ESP8266 (ESP stands for electrostatic precipitator), which is a low- cost Wi-Fi microchip, forms the foundation of the open source Node Microcontroller Unit, which is a software and hardware development environment.

Figure 5: Node MCU ESP8266

Its operational voltage is 3.3V, and its input voltage ranges from 7 to 12V. It contains 1 Analog Input Pin (ADC) and 16 Digital I/O Pins (DIO). Additionally, there are 1 UART, 1 SPI, 1 I2C, 4 MB of Flash Memory, and 64 KB of SRAM. Due to its simplicity of use and quick programming time of only 5 to 10 minutes, the Node MCU Development Board may be readily programmed with the Arduino IDE. All we require is the Node MCU hardware itself, the Arduino IDE, and a USB wire.

The ESP8266 module makes it possible for microcontrollers to connect to 2.4 GHz Wi-Fi, and it may also be used with ESP-AT firmware to give external host MCUs Wi-Fi connection. We are choosing the ESP8266 Node MCU development board because it is a true plug-and-play option for less expensive Wi-Fi solutions.

5. **DC motor:** A DC motor is an electrical device that converts electrical power into mechanical power. In a totally enclosed housing, a wound armature, commutator, brushes, and magnets make up a DC motor. With a rectifier, it can run on AC mains voltage or DC power. The idea behind a DC motor is that a current-carrying conductor in a magnetic field produces a mechanical force. The left-hand rule determines the force's direction.

The idea behind a DC motor is that a current-carrying conductor in a magnetic field produces a mechanical force. Because the speed and torque characteristics of a DC motor are superior to those of an AC motor, alternating current (AC) is converted to direct current for big electrical applications like steel mills and electric trains. DC motors are just as common in industrial settings as three-phase induction motors

Figure 6: DCmotor

The power source is electric, with a voltage of 9 volts. It has a flow rate of 80-120 L/H. The aperture is 4.5 mm and the outer diameter is 7.5 mm. The operating voltage is 6 9V and the maximum elevation is 40 110 mm. This is a small, low-cost submersible pump motor.

It has a capacity of 120 liters per hour and a relatively low current consumption of 220mA. Simply attach the tube pipe to the motor outlet, immerse it in water, and power it up. Its intended use is household. If the soil becomes dry, the sensor detects it and activates the DC motor, which functions as a water pump to distribute water to the plant/plot. The DC motor automatically determines the direction of the water flow in the pipe, so we use it in our project. A DC motor determines the direction of the water flow in the pipe automatically.

6. **Relay:** Relay boards are electrical switches that enable circuits to be opened and closed by detecting electrical impulses from outside the system. Relays, which are built into electrical products, work by receiving an electrical signal and sending it to another device by flipping a switch on and off. A relay is an electromechanical switch that operates on relatively small currents and can control the switching action of high current control gears. An electro mechanical device that can be used to establish or dissolve an electrical connection is a relay. A relay resembles a mechanical switch in that it consists of a flexible moving mechanical component that can be electronically controlled by an electromagnet, as opposed to manually turning it on or off.

Figure 7: Relay

The relay also has two pins, normally closed and normally open (NC and NO). The normally closed pin is connected to the armature or common and the normally open pin is left free. Relays, which are built into electrical products, work by receiving an electrical signal and sending it to another device by flipping a switch on and off. When the power is off, COM automatically connects to NC, which is the default state of the relay. The relay will control the flow of water from the pump. The water pump will be connected by a pipe. When the pump is on, it will supply water from the pot through the connected pipe, so we use this in our project.

7. **Blynk Application:** Blynk is a simple, powerful, no-code app builder that you can prototype and deploy. Blynk's platform enables micro-enterprises to develop smart home solutions and agriculture equipment. The Blynk app allows you to create stunning interfaces for your projects with various widgets. Blynk is an IoT platform for iOS or Android smart phones to control Arduino, Raspberry Pi and NodeMCU over the internet. This software creates a graphic surface or Human Machine Interface (HMI) by using existing widgets to compile and provide the appropriate addresses. You can control your hardware remotely. It is capable of displaying sensor data, storing data, visualizing data, and performing many other useful functions.

Fig 8: Blynk App

8. **Arduino IDE:** The Arduino integrated development environment or Arduino software (IDE) includes a text editor for writing code, a text console, a message area, a toolbar with buttons for common functions, and numerous menus. Connect to Arduino hardware to upload programs and communicate. IDE applications are suitable for different operating systems such as Windows, Mac OS and Linux. Programming languages support C and C++. Here, IDE stands for Integrated Development Environment. A program or code written in the Arduino IDE is often called a sketch.

Figure 9: Arduino IDE

V. SYSTEM IMPLEMENTATION

Implementation of the system involves determining how the information system will be built, ensuring the operation and use of the information system and also ensuring that the information system meets quality standards. This phase begins after the system is tested and accepted by users. The implementation phase includes user notification, hardware setup, software installation and system integration. System implementation is the set of steps to complete the design of approved system design documents and begin testing, installing, and using a new or revised information system. The goal of system implementation is to create, test and document the necessary programs and procedures in an approved system design document.

1. **Soil moisture and temperature sensing:** This module examines the soil's moisture content. The most important factor in agriculture is soil moisture. Plants may perish in conditions of water scarcity or excess. This describes the total amount of water present in the pores or on the surface of the ground. The weather, the type of land, and the plants all have an impact on the moisture content of the soil. The temperature of the surrounding and the soil's humidity is also analyzed here. According to the sensor values, further decisions are taken. It is essential to be aware of the most effective ways to measure soil moisture content.

2. **Send the results on Node MCU:** Once the temperature, moisture and humidity values are generated by the microcontroller (ESP866), the threshold value can also be self-notified. If the result of humidity, temperature and moisture is lower than the threshold value, then the pump will turn ON. If the moisture level rises up to the threshold level of the field, then the pumps will turn OFF.

3. **Displayed on LCD display:** The values which are obtained by the sensors will be conveyed and displayed in the LCD display. It will show the accurate real-time values of soil moisture, temperature and humidity. The Microcontroller will send the real time values of the moisture level of the soil and the humidity of the air. The temperature of the atmosphere will also be analyzed and displayed here. It also displays the indication whether the water pump is ON or OFF and also displays the indication whether the PIR sensor is ON or OFF.

4. **Watering using Water pump with the help of DC motor and Relay:** Relay module is used as a commander here. It is electromechanically a switch. This module is used to turn off the pipe by the values of the sensor sensed from the plant and the atmosphere. According to the real time values, the relay module will on or off the water using a dc motor which will be submerged inside the water. Anyways, the water will be pumped from the water pump to the soil. It will occur with the help of a relay and dc motor.

5. **Detection of Animal:** The PIR sensor will detect the movement of the animal if any animal enters into the field. The PIR sensor will detect the animal's movement within 10 to 12 meters range. The frequency range of the PIR sensor is about 7 Hz to 30 Hz.

6. **Mobile Application:** The IoT Blynk app is used as a mobile application. In this, we can see the real time values of the temperature, humidity and the soil moisture directly from the field. Also we have a button for turning off and on the water pump. We can also be

able to use the button in the app which is for animal detection to use it for the user's convenience. To indicate the watering process in the app, the app will show the soil moisture level as 0 to water the plants and 99 to stop watering. We can use the button in the app to do so.

VI. RESULTS& DISCUSSION

The results section contains a description of the main findings. In the results section, the research results must be presented in a logical sequence without any discrimination or explanation. In the results section the results of the study based on the methodology is reported. The Results section reports the findings of the research without assumptions. It brings all the previous chapters together and allows the reader to see the connections between each part of the research process.

The discussion section explains the results for the reader and provides the significance of the findings. The discussion session examines the results and puts them in the context of general research. The discussion should not repeat the results. The purpose of the discussion section is to explain the importance of the findings to the things that have been known about the research problem being investigated and to explain new views or views that emerged from your research.

1. Working of Smart Irrigation System

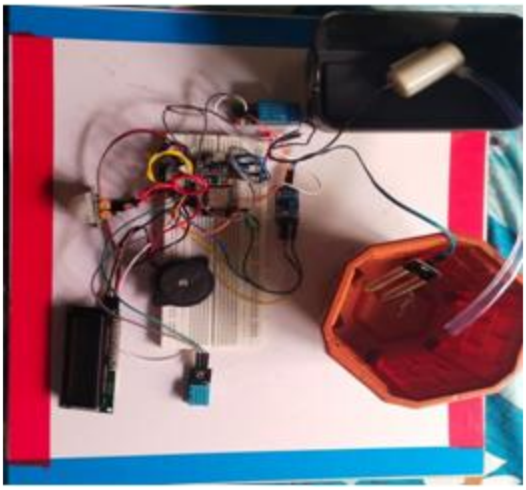

Figure 10: Smart Irrigation system

This is the smart irrigation system which has NODEMCU, DHT11 sensor, LCD display, PIR Sensor, relay module and DC motor**.**

2. Notification of animal detection

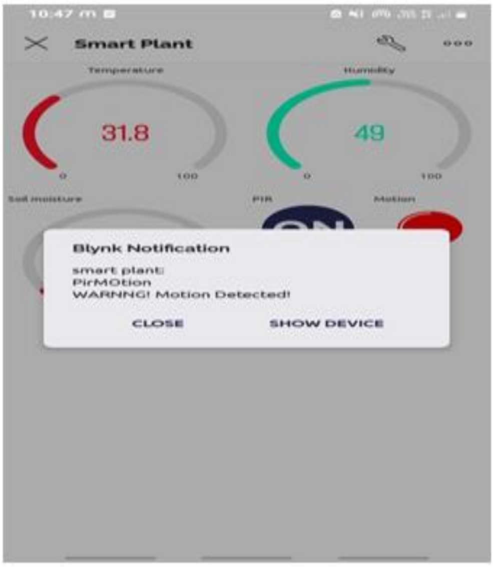

Figure 11: Notification of animal detection

The notification will be sent to the Blynk app if any motion is detected. It will be indicated by the Node MUC based on the detection of animals.

3. **LCD Display:** The LCD display will show the temperature, humidity, soil moisture level, PIR sensor indication whether it is on or off and the water pump is on or off.

Figure 12: LCD Display

4. PIR Sensor button

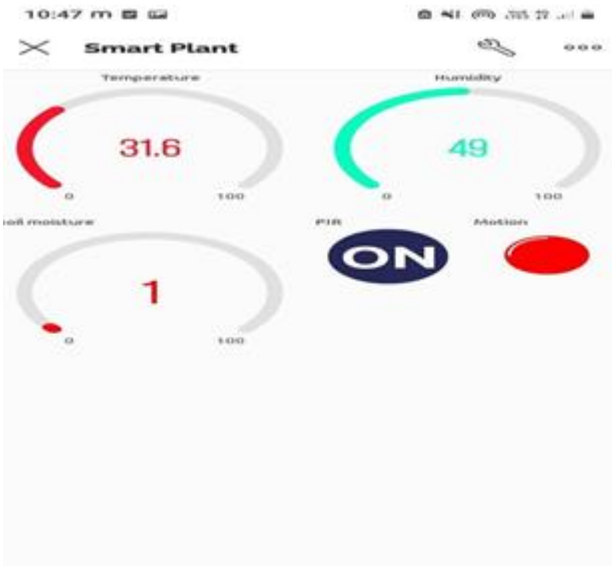

Figure 13: PIR Sensor button

The PIR sensor will indicate the animal detection in the IoT application by the red color button. We can turn on or off by the switch in the IoT application.

VII. FUTURE SCOPE & CONCLUSION

1. **Future Scope:** This system has a wide scope for future development. To keep abstract of technical improvements, the system may be further refined. So, this type of system is improved in further future development. This development is efficient and effective. In the future this work can be upgraded by adding several features on this system to fetch more data from many plants simultaneously. And also, to enhance the working of the animal detection, we will increase the length of the PIR sensor for sensing the animal which is coming far away from the field. Along with the SMS notification, in the future repellent system of Bright light and irritating loud noise can be added which is used simultaneously with an interval of 4 seconds is used upon the animal. The insect removal machine works continuously to better scare the animals.

2. **Conclusion**: The conclusion of the proposed system is to make the irrigation process easy by doing it automatically and also the system has the additional features of PIR sensor. The system automatically turns on and off the water pump without the intervention of the farmer by sensing the real time values of the temperature and the water content of the soil with the help of DHT11 sensor which is a digital temperature and humidity sensor and soil moisture sensor. The method helps the farmer by working automatically and smartly. It also helps with water conservation as it provides water to the plant/gardens according to their needs without having to go into the field to water the plants. This irrigation system will reduce the hardship of farmers, save time and enhance effectiveness at relatively minimal cost which is done automatically.

   A special feature of animal detection is also added in this work. With the help of the PIR sensor which is also known as passive infrared sensor, animal movement is detected in the field. By the help of this, we can reduce the harm of animals in the field. The notification of animal detection will be sent to the farmer by noting him with the warning message using the Blynk app. The main benefit of using the PIR sensor is that it saves farmer's time.

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