Smart Irrigation System Using Iot

Mr.M Prabhakar
Computer Science and Engineering
CMR Engineering College
Hyderabad,India
prabhakar.m@cmrec.ac.in

BejugamKusumita
Computer Science and Engineering
CMR Engineering College
Hyderabad,India
kusumitabejugam@gmail.com

AbdulHaarishKhan
Computer Science and Engineering
CMR Engineering College
Hyderabad,India
228r1a0502@cmrec.ac.in

Dr.D.Nagesh
Computer Science and Engineering
CMR Engineering College
Hyderabad,India
drdnag999@gmail.com

A.LaxmiPrasanna
Computer Science and Engineering
CMR Engineering College
Hyderabad,India
228r1a0504@cmrec.ac.in

B.Akash
Computer Science and Engineering
CMR Engineering College
Hyderabad,India
228r1a0513@cmrec.ac.in

How to Cite this Article:

Prabhakar, M., Kusumita, B., Khan, A. H., A.LaxmiPrasanna, & B.Akash, (2026). Smart Irrigation System Using Iot. International Journal of Creative and Open Research in Engineering and Management, <i>02</i>(04). https://doi.org/10.55041/ijcope.v2i4.049

https://doi.org/10.55041/ijcope.v2i4.049

Abstract— Smart Irrigation System with DHT11 sensor, Soil moisture sensor and AC motor is an automated system which was designed to increase the productivity of agriculture and control of water consumption. A microcontroller (Arduino) of system plays a major role of control element in the system which continuously sees the environmental conditions and soil conditions. The sensor DHT11 will measure the temperature and humidity of the atmosphere that will influence on the water requirements of crops The soil moisture sensor is the sensor that measures the water content in the soil. When the soil moisture level drops at a specific level established by the parameters, sustain of Arduino the accessories of AC motor linked to water pump is turned spontaneously providing water to the crops. The motor is then switched off so that there is no unnecessary irrigation as soon as the soil attains a good moisture content. This system removes the labor of manual operations, consumes less water, less power and irrigates uniformly. It can be used in farms, gardens and green houses since it is cheap and its design is simple, facilitating sustainable and efficient agricultural activities.

Keywords—Internet of things(IOT) ,Arduino Micro Controller, Soil Mositure Sensor , DHT11 Sensor,Automated water management

I. Introduction

Agriculture has been very important in the global food security situation and the economic progression of a particular country, land use on the other hand have been a challenge; however, they have been challenged by water scarcity, ineffective irrigation techniques and growing climatic variability. The traditional irrigation systems are highly dependent on manual labor or time schedule and this leads to either excessive or less irrigation [1]. Such ineffective activities lead to wastage of water, degradation of soil, use of more energy as well as decrease in crop yields. As the demand on sustainable and resource efficient irrigation techniques is increasing, the intelligent irrigation solutions are highly demanded that are able to minimize the consumption of water resources by considering the real-time field conditions instead of estimating and relying on the human judgment [1], [2].

The innovation of the Internet of Things (IoT) has made possible to combine sensors, embedded solutions, and communication networks in order to automatize the work of the agriculture [2]. Smart irrigation systems based on IoT constantly sense the surface condition and the environment and determines the irrigation need on its own. These systems can also provide precise irrigation using sprinkling of crops with the assistance of soil moisture sensors and environmental sensors, that makes sure the crop get enough water at the right time [2]. DHT11 is a usually sensor that can be used to estimate the temperature and humidity that defines the rate of evaporations and the water requirement per crop and soil moisture sensors are used to test the real water content of the soil [3].

Arduino microcontrollers are important in data processing and the control of the irrigation parts due to their low price and versatility and its easy to program [4]. Communication modules such as ESP8266 enable wireless data transmission between sensors and cloud platforms for remote monitoring [5], while single-board computers like Raspberry Pi can also be used for advanced processing and system expansion [6]. The collected data can be transmitted using lightweight communication protocols such as MQTT for efficient IoT messaging [7]. Also, ThingSpeak and Blynk IoT platform can be used to visualize data in real-time and remotely control the system, which makes it easier to use and monitor the system [8], [9]. Cloud-based services such as AWS IoT Core further support secure data storage, device management, and scalability of smart irrigation systems [10].

II. Related Work

A. Arduino-based Automated Irrigation System

Authors: S. Ramesh, P. Kumar, V. Rao [11]. Description: The authors propose an automatic irrigation system using Arduino to control water supply based on soil moisture conditions. The system reduces manual intervention and optimizes water usage by activating irrigation only when required. The study highlights the effectiveness of microcontroller-based automation in improving irrigation efficiency and crop productivity.

B.GSM-based Smart Irrigation System

Authors: A. Sharma, R. Gupta [12]. Description: This paper presents a GSM-based smart irrigation system that uses soil moisture sensors to monitor field conditions and communicate information to the user via mobile networks. The system allows remote monitoring and control of irrigation, making it suitable for agricultural applications in rural and remote areas. The proposed approach improves water conservation and system reliability.

C.Zigbee-based Wireless Sensor Network for Irrigation

Authors: K. Kumar, S. Verma, A. Patel [13]. Description: The authors introduce a wireless sensor network-based irrigation system using Zigbee technology for data communication. Multiple sensor nodes are deployed to collect environmental and soil parameters, enabling efficient irrigation decisions. The study emphasizes low power consumption and scalability of Zigbee-based irrigation systems.

D.Sensor-based Automated Irrigation using Arduino

Authors: A. Singh, D. Mehta [14]. Description**:** This research focuses on a sensor-based automated irrigation system implemented using Arduino. Soil moisture sensors are used to monitor water levels and control irrigation automatically. The system demonstrates improved water management, reduced human effort, and enhanced agricultural productivity.

E.IoT-based Smart Irrigation for Sustainable Agriculture

Authors: N. Patel, R. Shah, K. Mehta [15]. Description: The paper presents an IoT-based smart irrigation system aimed at sustainable fertilization and irrigation practices. The system integrates sensors, IoT platforms, and data analytics to provide real-time monitoring and control. The study highlights the role of IoT in achieving efficient resource utilization and sustainable agricultural development.

F.Existing System

The current approach adopted with respect to irrigation which is bearing much throughout the agricultural industry is mostly manualizing or automation by time. Manual irrigation systems require farmers to use water pumps according to his/her personal preferences or after seeing the condition of soil or on the set schedule of watering. Even though the approach is low-cost and does not require a big infrastructure, it is not accurate and consistent because it does not suggest real-time monitoring of the soil and the environment. This has resulted in surplus or lack of water on crops thus wasting of water, more power and eroding the soil and the crops grow unevenly.

To have less time spent in manual works, timer based irrigation system was implemented where pumps are switched on at an interval of time. Although these systems provide an elementary degree of automation, this is not dependent upon the actual moisture levels of soil or weather conditions. Alteration of temperature, humidity, rain, and seasonal variations is not factored in and thus, making the system inefficient. As a result, irrigation can occur, and it replaces the already existing moisture in the soil resulting in over-irrigation, soil erosion, and degradation of soil quality. Other installed systems use a combination of simple soil moisture sensors or GSM to alert or notify farmers with SMS. Even though such systems improve awareness of the conditions in the field, it still takes a human hand to turn on or off irrigation. Also, their adoption is prevented by communication delay and poor sensors. Most of the automated irrigation systems offered in the market are expensive, difficult to set up and demand technical skills and are therefore not suitable to be used by a small and medium sized farmer. These restrictions suggest the need for an irrigation system based on sensors which is low cost and fully automated and can respond dynamically to the current situation in the field.

III. METHODOLOGY

A. Proposed System

The offered solution will be an IoT Based Smart Irrigation System which will be created to make the irrigation process automatic and optimize it using the real time soil and environment information. Compared to the traditional irrigation processes which are either operated manually or in a set timetable, due to this system water is available when it is needed; this will help save water resources and save on electricity and human interference. The Arduino Uno microcontroller is in the center of the system and it is the central control unit. It is continuously receiving and processing the information of soil moisture sensor and DHT11 temperature and humidity sensor. The soil moisture sensor is used to find out the amount of water present in the soil, and the DHT11 sensor is used to measure the ambient temperature and humidity present that affects directly the water requirement of the plant and the rate of evaporation.

Once the sensor content of soil moisture has been read, and a value that is lower than a preset value is detected, the Arduino assumes the control and activates a relay module. This relay is an electrical switch which will operate a safe control of an AC motor driven water pump and allows distribution of water to the irrigation field. The pump will continue until the soil moisture sensor reports the optimum level of moisture is achieved. At this stage, the Arduino will automatically switch off the relay and turn off the motor and cut off the water. This is a closed loop feedback system which ensures that irrigation is controlled with accuracy, over-irrigation is eliminated and crops are not subjected to water stress.

The LCD display is also included to enhance the interaction between the users to the system and offer real-time data of soil moisture level, temperature, humidity, and pump. Constant voltages are given to all the electronic parts to improve the system stability and durability. The system design is also modular allowing it to easily be maintained and increased in the future. The additional options are the Wi-Fi or GSM modules which could be used to facilitate remote monitoring, cloud data storage and control mobile application. In general, the proposed system can provide an affordable, efficient, and sustainable irrigation system, which can be used in farms, gardens and greenhouses, contributing to the effective water utilization, implementation of intelligent farming methods.

B. Implementation

The hardware aspect of the suggested system will require a combination of a number of sensors and control units using the Arduino Uno microcontroller. The analog cluster is further connected to Arduino with the help of soil moisture sensor using the analog output pin that is connected to an analog input pin, thus reading the moisture content in the soil accurately. The sensor is a DHT11 temperature and humidity sensor which is connected to one of the digital input pins of the Arduino to get the real-time information about the environment. A relay module is connected with Arduino that provides control high voltage device switching to provide safety to the ac motor running the pump.

The whole system is powered by a controlled 5V DC power point to constitute the system stability and performance. To minimize the AC mains voltage, stepping down transformer is used and finally the voltage is converted into DC with the help of bridge rectifier. A voltage regulator 7805 is used to maintain the output voltage at 5 V in order to ensure that the components not exposed to variations in voltage and voltage needed to drive the Arduino and sensor modules. There is proper insulation and grounding so that the operation of the motor circuit is safe.

The code for system hardware is programmed in Arduino Integrated Development Environment (IDE).

C. Block Diagram

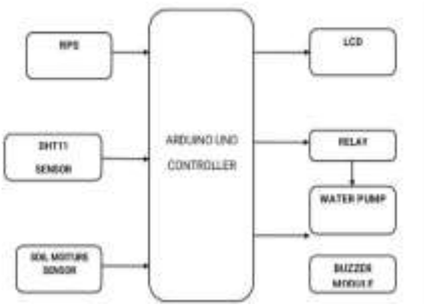


Fig 1: Block Diagram of Arduino Controller

D. System Architecture

The smart irrigation system works based on the continuous observing the soil and environmental conditions with the help of the soil moisture sensor and DHT11 temperature and humidity sensor. These sensors pass real time to Arduino Uno which is the core of control unit. Depending upon the values that are received the Arduino takes the decision as to whether irrigation is necessary or not. A controller is implemented to switch on the relay module which in turn, switches on the water pump which supplies water to the plants when the moisture in the water level in the soil becomes at a specific level. This system will automatically shut off the pump when the correct amount of moisture has been achieved. A LCD display shows real time values from the sensor, there is a buzzer to provide notifications and the optional Wifi or GSM can be used to remotely monitor and control the sensor.

IV. Results

A. Testing

The system is evaluated using a separate set of test data that is not involved in the training process, ensuring that the results obtained are fair and unbiased. The input data collected from different field conditions is processed using the same sensing and decision-making workflow, after which irrigation actions are determined. To assess the effectiveness of the system, commonly accepted performance measures such as accuracy, precision, recall, and F1-score are considered.

Accuracy is measured by comparing the irrigation decision generated by the system with the actual water requirement of the soil and crop. Several test cases covering different moisture levels and environmental variations are examined to verify the reliability of the system. The outcomes indicate that the system is capable of making timely and accurate irrigation decisions with very little manual intervention. This confirms that the proposed smart irrigation system is suitable for real-time agricultural applications and efficient water management at the field level

B. Outputs

The applied Smart Irrigation System via the IoT was also tested under different soil moisture and environmental conditions in order to determine its performance and reliability. System was working fine in the monitoring the soil moisture, temperature and humidity in real time using soil moisture sensor and DHT11 sensor. The sensor data were properly processed by the Arduino Uno and the process of irrigation was ran automatically.In the testing the soil moisture level reduced to till less than preset level hence system triggered the relay part and triggered ON the water pump which was connected to AC motor. Water flow was then turned on till the moisture content in the soil was at the required level then the motor was turned off automatically. This indicated that this closed loop control mechanism was working correctly and preventing over-irrigation.

Fig 1 Arduino Software Download

Fig 2 Arduino IDE Libraries Directory with Added Library

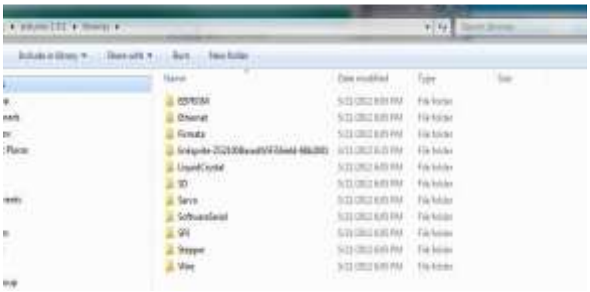


Fig 3 Arduino IDE Installation Folder

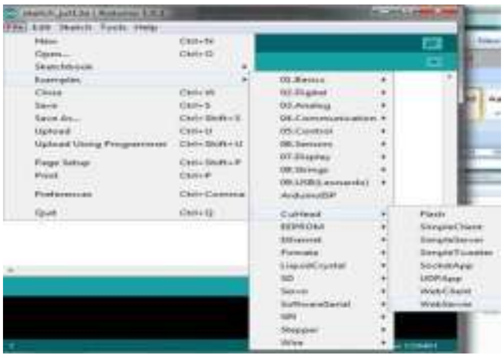
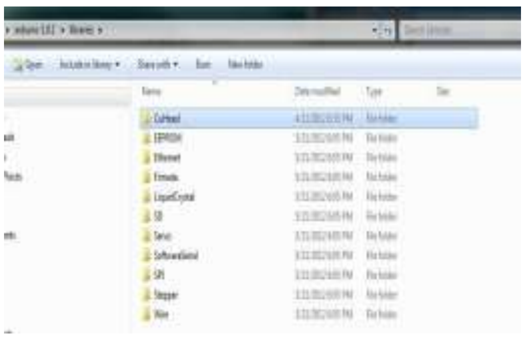


Fig 4 Arduino IDE Menu

Fig 5 WebServer Program in Arduino IDE



The IoT Based Smart Irrigation System that can be found in the given project manages to prove an effective and automated irrigation control with the help of real-time sensor data. The system is able to measure the environmental conditions by combining a soil moisture sensor and DHT11 temperature and humidity sensor with an Arduino microcontroller to regulate irrigation without involving a person all the time.

The findings have confirmed the hypothesis that the system will only deliver water when the level of soil moisture is below the set standard, which will prevent excessive use of irrigation which will result in substantial savings to water resources. Smart operation of the water pump which is powered by the AC motor is automatically operated by a relay module and ensures proper and efficient operation. The provision of LCD display provides a real-time feedback to and system is simple to monitor and may be easily handled.

The system proposed is overall a low cost, scalable and sustainable system which can be applied in farms, gardens and even green houses. It mentions the opportunities of IoT and automation technology to increase the productivity of agriculture, reduce the amount of resources wasted and enable smart and viable farming methods. With further such additions as IoT connectivity and further analytics, the system can be expanded towards assisting with precision farming and remote control of irrigation.

VI. FUTURE ENHANCEMENTS

Even though the proposed IoT-Based Smart Irrigation System has an effective and automated control on irrigation, there are a number of improvements that can be made in the future to enhance its functionality, scalability and smartness. The first enhancement is the addition of a sophisticated internet of things (IoT) connection by using a WiFi or GSM connection module that would allow to remotely control and monitor the device free of charge by a mobile or web-based application. This would help farmers to keep eye on the soil moisture, temperature, humidity and pump position at any place, without being physically on the farm.

The other improvement that is needed is the introduction of cloud-based data storage and analytics. Through the preservation of historical soil and environmental information in the cloud platforms, it can be used to analyse long term trends to optimise irrigation schedules, minimise water consumption and enhance crop productivity. Integration of weather forecasting APIs can also be used to make system more intelligent by allowing it to make predictive irrigation whereby watering decisions are modified as per the anticipated rainfall, variations in temperature and humidity levels.

More sensors could also be added to the system like pH sensors, light intensity sensors, water level sensors and nutrient sensors to facilitate crop specific irrigation and soil monitoring. Moreover, instead, machine learning algorithms can be used to forecast water need of the crops better and make irrigation choices adaptively and intelligently based on the current data and trends from the environment.

In a bid to improve sustainability, there are advents of solar energy which can be incorporated as an alternative energy supply and hence the system can be used on remote and off-grid agricultural regions. In general, these improvements will make the system as a very intelligent, scalable, energy saving, and intelligent farming system that can help precision farming as well as sustainable water management.

REFERENCES

[1] R. Kamal, Mathematical Methods in Engineering Illustrations with the Concepts, New Delhi, India: McGraw-Hill Education, 2017

[2] A.Bahga and V. Madisetti, , Hyderabad, India: Universities Press, 2015.

[3] Adafruit Industries, "DHT11 temperature and humidity sensor guide," Adafruit, 2025. [Online]. Available: https://learn.adafruit.com/dht

[4] Arduino. "Arduino documentation," Arduino. [Online]. Available: https://docs.arduino.cc/

[5] Espressif Systems,Service Documentation "ESP8266EX datasheet," Espressif Systems, 2025. [Online]. Available: https://www.espressif.com/en/products/socs/esp8266/resources

[6] Raspberry Pi Foundation, "Raspberry Pi documentation," Raspberry Pi Foundation 2025. [Online]. Available: https://www.raspberrypi.com/documentation/

[7] MQTT.org, "MQTT: The standard for IoT messaging," MQTT, 2025. [Online]. Available: https://mqtt.org/documentation/

[8] ThingSpeak, "IoT analytics platform documentation," MathWorks, 2025. [Online]. Available: https://thingspeak.com/docs

[9] Blynk Inc. "Blynk IoT platform documentation" Blynk, 2025. [Online]. Available: https://docs.blynk.io/

[10] Amazon Web Services, "AWS IoT Core--Developer guide," AWS 2025. [Online]. Available: https://docs.aws.amazon.com/iot/latest/developerguide/

[11] S.Ramesh, P. Kumar and V. Rao, "Automatic irrigation system using Arduino," , vol. 6, no. 4, pp. 112-116, 2017.

[12] Sharma and R. Gupta, "GSM based smart irrigation system based on soil moisture sensor", , vol. 178, no. 7, pp. 22-27, 2018.

[13] K. Kumar, S. Verma, and A. Patel, "Wireless sensor network based irrigation system based on Zigbee," in , vol. 11, no. 2, pp. 89-95, 2019.

[14] A.Singh and D. Mehta, "Sensor based automated irrigation system using Arduino," Op. cit, vol. 9, no. 6, pp. 321-325, 2020.

[15] N. Patel, R. Shah, and K. Mehta, "IoT based Smart Irrigation system for Sustainable fertilisation and Irrigation," in 2022, vol. 11, pp. 45678-45685.