# Applicability of IoT in Agricultural Irrigation System

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***Abstract*-Most of the countries of the world specially third world countries are facing adversity with issues concerning poverty, food shortages, and poor agricultural waste management practices, mostly. Intelligent technological innovation is on the rise to effectively manage resources in agricultural development, leading to increased investment in biodiversity. Smart farming and internet of things (IoT) driven agriculture are setting the framework to the use of information and communication technology (ICT) in tandem. IoT technology aids in the better control of agricultural processes, lowering production risks and improving the ability to predict with Reduced cost. The main aim of this work is to develop a fully automated IoT based smart irrigation system. The proposed system, based on IoT sensors and smart platform, focuses on smart farming operation in term of irrigation. The intelligent irrigation system utilizes a variety of sensors, including temperature, humidity, and soil moisture sensors. In this work, Arduino Uno R3 microcontroller is used for getting efficient output and proper utilization of the system. The Blynk app is utilized for this purpose. Considering the present global initiatives for agricultural development, our work will be a good better option to contribute to faming system.**

**Index Terms— Internet of things, Smart farming, IoT based irrigation, Smart platform, Sensors**.

## I.INTRODUCTION

Farming renders vital role in society in many ways, including: supporting livelihoods through food, habitat, and jobs; providing raw materials for food and other products; and building strong economies through trade. Smart farming" is an emerging concept that refers to managing farms using technologies like IoT, robotics, drones and AI to increase the quantity and quality of products. The Internet of Things (IoT) has designed ways to improve product quality and quantity, agricultural sustainability, and consumer experience with reduced cost. Increased production control leads to improved cost management and waste reduction. With the advance of technology IoT based smart faming comes into account. Internet of Things based smart farming technology is envisioned to enable producers and farmers to reduce waste and improve productivity by optimizing the usage of modern tools to boost the efficiency of plants. IoT based farming system makes use of wireless sensor networks that collects data from different sensors deployed at various nodes and sends it through the wireless protocol. It is a high-tech system of modern Information and Communication Technologies to grow crop cleanly and sustainably for the masses. Using this technology automatic adjustment of farming equipment is ensured by linking information like crops/weather and equipment to auto-adjust temperature, humidity, etc [1,2].One of the most talked-benefit of smart farming using IoT is improved level of precision and accuracy compared to traditional system. It also provides improved fuel efficiency. Moreover IOT based farming system is potential to save time.This system confirms reduced consumable. Traditional farming system results in significant under and over application of sprays but IOT based farming system has the potential by reducing automatically switching of prayer. In a brief smart farming based on IoT technologies enables growers and farmers to reduce waste and enhance productivity and enabling efficient utilization of resources such as water, electricity, etc. Smart irrigation system, unlike traditional irrigation controllers, monitors weather, soil conditions, evaporation and plant water use to automatically adjust the watering schedule to actual conditions of the site. This technology operates on a preset programmed schedule and timers [3,4].

The SMART irrigation system enhances the performance of agricultural productivity .This emerging technique automates irrigation systems and conserves water usage. This technique adjusts irrigation based on actual soil and weather conditions, therefore filling up the demands of farmers by IoT [5].

Smart irrigation systems use sensors for real-time or historical data to inform watering routines and modify watering schedules to improve efficiency The other major advantages of a smart irrigation system is that precision watering in smart irrigation also deals with efficiencies in the delivery of the water. It confirms timely irrigation — plants being watered when needed. management of higher flow rates. accurate cut-off of water compared to manual checking. reduced runoff of water and nutrients[6].

In this paper, the proposed system uses sensors like soil moisture sensor, temperature and humid sensor which gives the information about the amount of moisture in the soil, the humidity and temperature of the region. All these sensors along with AUDRIUNO microcontroller are connected to the internet and a smart phone. In this paper, section II represents literature review, section III gives an idea about internet of things –IOT, section IV describes the methodology and functionality of our proposed system, section V outlines the implementation process, section VI discusses about result and section vii concludes this work.

## II. LITERATURE REVIEW

Various researches have been worked on IoT based on smart irrigation system B.Parvath," IoT based smart irrigation management system for environmental sustainability in India" had involved an intelligent agriculture management system to produce agricultural benefits and crop production. The hybrid remote-controlled device used the Global Positioning System (GPS) with Radial Function Network (RFN) was proposed to control the irrigated system, predict the temperature, maintain the air pressure, and reduced the humidity in water content. It uses IoT sensors and the Internet of Everything (IOE) environmental data for managing and monitors intelligent solar irrigation systems [7].Aakash Bhandari, "Smart Irrigation System using IoT" had designed an automated irrigation system which is cost effective and time saving using Node microcontroller. Their proposed system automatically would water the plants when the soil moisture sensor would detect insufficient amount of moisture in soil using as the centre core. Their work aimed to connect the system with internet using IOT so that it could also manually be operated by smartphone app from anywhere-anytime [8]..Luis Miguel Samaniego Campoverde," An IoT based Smart Irrigation Management System using Reinforcement Learning modeled through a Markov Decision Process had proposed a system, based on IoT sensors and smart platforms such as Raspberry PI and Arduino. They declared that it would be able to manage farm operations in term of irrigation. The control of water pumps for irrigation would be driven by two important parameters: soil moisture and evapotranspiration. The system had used a Reinforcement Learning approach based on Markov. Their conducted experiments had shown the water and energy saving by the use of the proposed Smart Irrigation system [9]. Srishti Rawal ," IoT based Smart Irrigation System" had proposed an automated irrigation system using IoT. .Microcontroller ATMEGA328P on arduino uno platform was used to implement the control unit. IoT was used to keep the farmers updated about the status of sprinklers. Information from the sensors is regularly updated on a webpage using GSM-GPRS SIM900A modem through which a farmer could check whether the water sprinklers are ON/OFF at any given time. Also, Thing speak channel was used to generate graphs from the sensor readings [10].

## III. INTERNET OF THINGS (IOT)

Our proposed work is entirely related to with IOT. The Internet of Things (IoT) interrelated the network of physical objects—"things"—that are embedded with sensors, software, and other technologies for the purpose of connecting and exchanging data with other devices and systems over the internet. The IoT based system allows objects to be sensed or controlled remotely across existing network infrastructure, creating opportunities for more direct integration of the physical world into computer-based systems and resulting in improved efficiency, accuracy and economic benefit with the added merits of minimum human effort [11].

A complete IoT system integrates four distinct components: sensors/devices, connectivity, data processing, and a user interface. The flow Chart of working procedure of Iot [12] is represented below

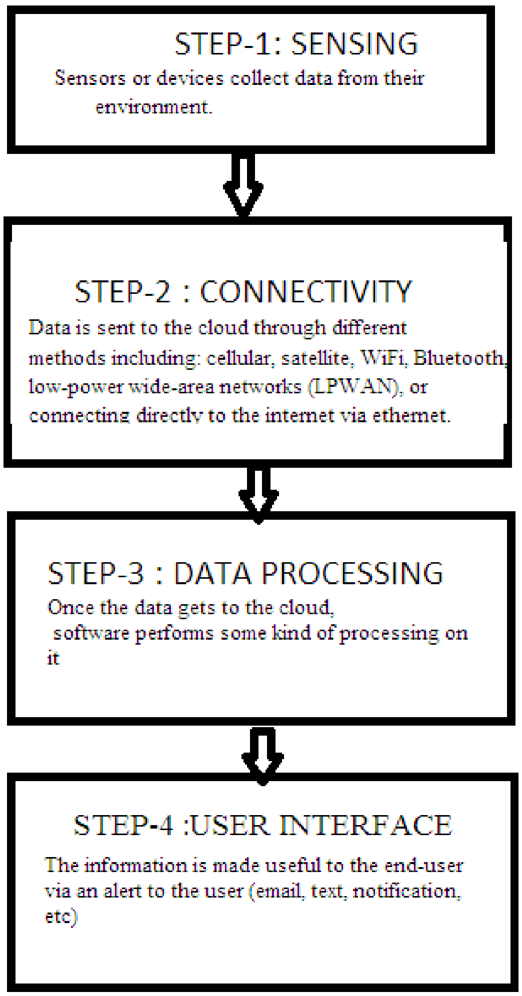


Fig.1: Working procedure of IOT

IoT is a boon for modern world in different sectors like smart agriculture, health monitoring, security purpose, pollution monitoring, traffic management etc. It showers the following blessings [13-14]as shown in Fig.2 :

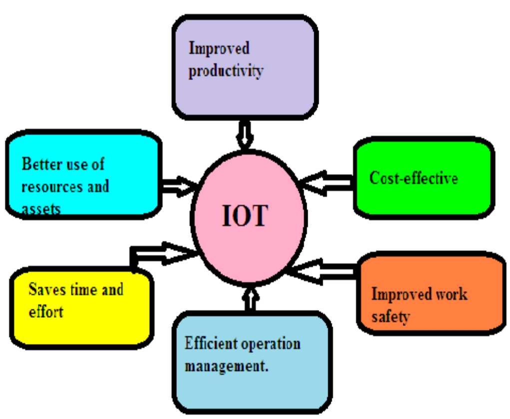


Fig.2: Blessings of IOT

Different Approaches for IoT-Based Systems are

i.Wi-Fi for IoT:

Wi-Fi technology employs various radio frequency bands to deliver data between devices. A device must have a wireless adaptor that converts between data and radio waves for Wi-Fi networking. Using a protocol such as UART or SPI, the device connects with the adapter's chip. The adapter then connects with an external router, which transmits the data to the Internet using an Ethernet cable.

ii.Cellular for IoT:

Cellular-enabled IoT devices connect to the Internet using the same networks as smartphones and other mobile devices. Cellular-capable devices must have a modem to communicate with the nearest cell tower and send and receive data. The device uses a low-level communications protocol, such as UART or SPI, to control the modem.

LTE-M (Long-Term Evolution for Machines) and NB-IoT are two of the most popular current cellular IoT technologies (Narrowband IoT). LTE-M is faster than the present LTE infrastructure and is compatible with it. NB-IoT, on the other hand, requires cellular operators to change their gear, which is why its spread has been slower than that of LTE-M to date. NB-IoT offers a longer range than LTE-M, however stationary devices are required.[15].

## IV. FUNCTIONALITY OF PROPOSED SYSTEM

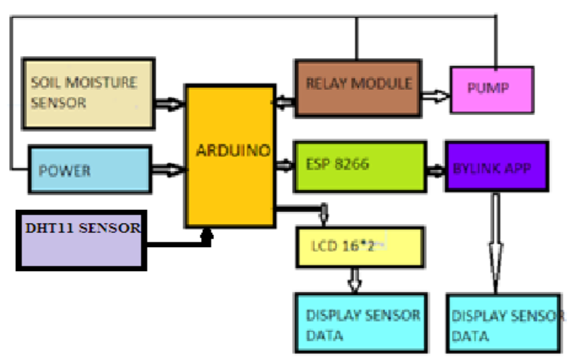


Fig.3: Block diagram of working procedure of proposed system

The objective of our proposed working diagram focuses on monitoring the farming conditions through sensors like soil moisture, temperature, and rain. to detect the moisture content of the soil and depending on it sprinkle water . This entire information will be sent to the user's mobile phone. This work consists of

Arduino as brain. and **soil** moisture sensors, temperature and humid sensor that are used to measure different environmental factors control crop's growth and The major components of proposed system and their functionality are represented here-:

Table I: Functionality of major components of proposed system

| Components | Function |
|---|---|
| 1.Arduino UNO R3 | Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs – sensor , a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online |
| 2.DHT11 Sensor | Digital Temperature and Humidity Sensor is both a temperature and humidity sensor. It consists of two distinct components: a capacitive humidity sensor and a thermistor. This delivers temperature and humidity measurements in digital format. The resultant digital signal is easily interpretable by any microcontroller |
| 3.Soil moisture sensor | The soil Moisture sensor is designed to measure the volumetric water content of the soil. The sensor is equipped with both analog and digital output |
| 4.Single Channel Relay Module | One type of electro-mechanical component that serves as a switch is the relay. To open or close contact switches |
| 5. ESP 8266 12F Node MCU | A highly integrated chip: small module with Wi-Fi on board that can connect an Arduino to the internet. |

The Arduino UNO board is used to connect the LCD, soil moisture sensor, rain sensor, Wi-Fi module, relay module, and water pump according to the connection shown in Fig. 3

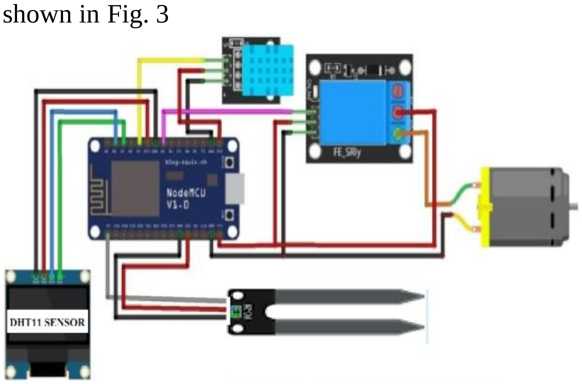


Fig.4: Connectivity of Proposed system

Using a data cable, we simultaneously connected the Arduino board to the IDE. This cable assisted in supplying the received voltage necessary to power the Arduino UNO hardware board and display the serial output. Once the code has been uploaded to Arduino UNO, hardware and connected to an Arduino IDE, the project began to function. The Arduino UNO board began displaying the operating status on LCD in response to the sensor's behavior. In addition, it transmitted data via the Wi-Fi module to the Blynk App server and monitored its status via a mobile phone.

The active root system portion of the plant row is where the soil moisture sensor should be placed.

The main mechanism at work in this system is the connection between the soil moisture sensor, which was previously embedded in the plant, and the Arduino, which is also connected to other electronic components. The soil moisture sensor uses an Arduino to drive the pump to send parameters and information about the soil moisture to the Arduino. The Arduino sends a signal to the relay module, which then runs a pump and delivers a specific amount of water to the plant if the soil moisture level falls below a predetermined value of less than the programmed value .The flow chart of working procedure of proposed system is shown in Fig.5:

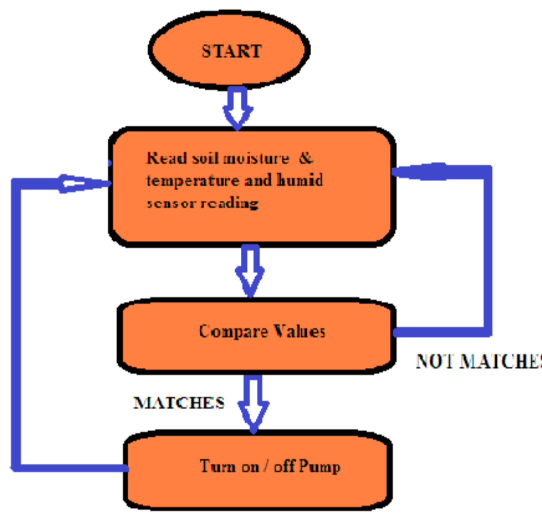


Fig.5: Flow chart of functionality of proposed system

## VI. IMPLEMENTATION

Different types of connectivity can be implemented for this purpose such as-

i. Manual Connection: For controlling hardware remotely, we used the Blynk app in our IoT-based Smart Irrigation System. In the Blynk app, the user can operate the ON and OFF switches to turn the pump on and off. This allows users to manually control the watering and temperature.

ii. Automatic Connection: In this system, the soil moisture sensor examines the soil's moisture level, and if it falls below the 80% threshold, Arduino automatically activates a water pump to water the plant. When the sensor system detects at least 80% moisture in the soil, the watering system turns off automatically. Similar action takes place for switch on and off the dc fan in case of temperature fluctuation

iii. Database Connection: Humidity and temperature are measured by the DHT11 sensor

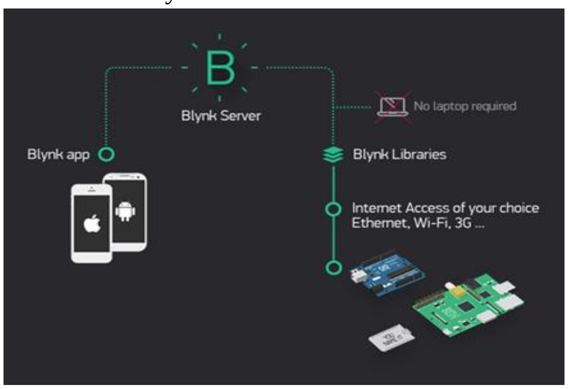


Fig. 6: Connection diagram between Blynk Server to Arduino.[16]

The LCDs display the temperature T in degrees Celsius as well as the moisture, “Moisture” and humidity H in percentages. A Wi-Fi module over the internet is used to communicate sensor data to the Blynk server. Blynk IoT app can remotely manage hardware, display sensor data, save data, and visualize data. Each time a button is pressed in the Blynk app, the message is sent to the Blynk Cloud, where it is miraculously delivered to our hardware [16].

The real connection of our IoT-Based Smart Irrigation System and temperature sensing project is given below:

Fig:8: Real connection of proposed system

## VII. RESULT

By the soil moisture content and crop requirements, the watering amount is determined. If soil moisture is below the threshold value of 80%, the water pump is activated, and if it is equal to or over the threshold value of 80%, the water pump is deactivated. The DHT11 sensor detects temperature and humidity. The LCDs show the temperature Tin the Degree Celsius scale and the moisture and humidity H in percentage. All the sensors give real-time data. Sensor data was transmitted to the Blynk server of smart phone using a Wi-Fi module through the internet.

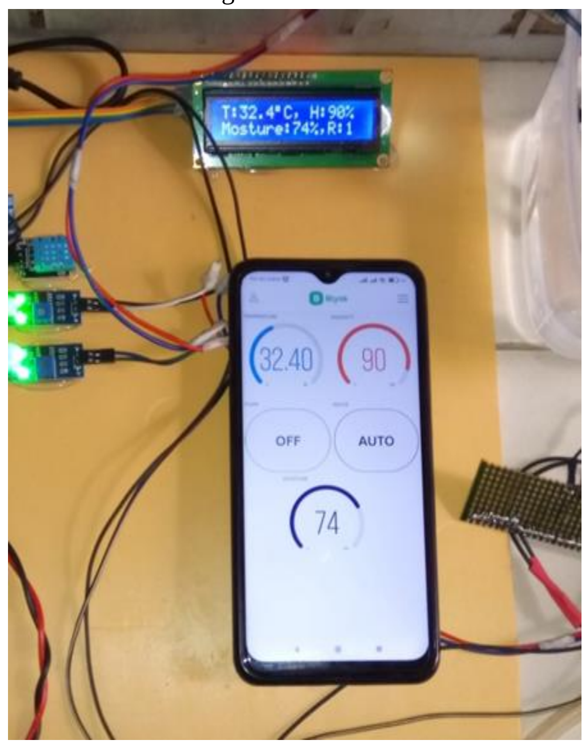


Fig. 8: The output of the project when the water pump is switched on automatically.

In figure 8, LCD shows the measured value of temperature T in the crop field is 32.40° C, humidity H is 90%, moisture level is 74% . In this case, the soil moisture level is 74% which is below of our programmed threshold moisture value of 80% that means the pump is irrigating the crop field. Our IoT-based irrigation system gives real- time sensor data which is transmitted to Blynk app using a Wi-Fi module through the internet and show the same result on the screen of smart phone as in fig.8.

Fig.9 shows the measured value of humidity H is 85%, temperature T in the crop field is 32.40° C, moisture level is 81% . In this case, the water pump has been switched off automatically because the moisture level has reached the programmed threshold value of over 80%. That's why the pump is not irrigating the crop field.


Fig. 9: The output of the project when the water pump is switched off automatically


Fig. 10: The output of the project when the pump is switched on manually

Fig. 10 and Fig.11 represent the output of project for manual option .In fig.10 and fig.11, the moisture level is 38% and 52% respectively. In both cases, Arduino checks and finds that the soil moisture value is below the programmed threshold value of 80% .So for both cases, the pump is activated by smart user manually using the manual option of smart phone and irrigation is started in the field exactly according to our programming.


Fig. 11: The output of the project when the pump is switched off manually.

Like the cases as shown by fig.10 and fig.11.The user of the project can stop the irrigation manually and if the soil moisture is equal to or over the threshold value of 80% with the help of the Blynk IoT app.

## VII. CONCLUSION

In this work, a smart irrigation system using the concept of Internet of Things has successfully designed and implemented. The proposed system can be used to switch on/off the pump according to soil moisture levels thereby automating the process of irrigation .This automated irrigation system is easily controlled using a computer. It behaves as an intelligent switching system that detects the soil moisture level and irrigates the plant if necessary. This system saves both time and energy, as well as minimizes energy loss. .Usage of low cost sensors and simple circuitry also lessens the cost, which can be affordable even by a poor farmer and it is also easy to implement. This paper can be concluded with decision that there can be considerable development in farming with the use of IOT and automation. Thus, the proposed system is a potential solution to the problems faced in the existing manual and cumbersome process of irrigation by enabling efficient utilization of water resources.

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