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Original Article

Smart Irrigation System Using IoT

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Abstract: *Agriculture has always been the most significant human activity because it involves the permanent modification of the natural environment through the reproduction of living things. You could buy some land and take care of B instead of owning and devouring the crops around you. Both flood types and overhead sprinklers are ineffective. Due to excessive soil wetness, they cause significant water waste and can also encourage illnesses like fungal development. A farm's indirect profitability as well as water conservation depends heavily on an automated irrigation system. The only use of the world's water resources is for irrigation, which accounts for about 85% of the total. This need is projected to rise in the coming years as the population expands. Adopting new technologies that reduce water is required for irrigation at a rate of necessary to meet this requirement. Sensors in automated systems keep track of the water that is available to plants, and controlled irrigation is used to water the plants as necessary. Cloud computing is a desirable choice for handling the huge volumes of data being recommended because of its nearly infinite possibilities for storage and processing, as well as its quick elasticity. Temperature and soil moisture are excellent ground truth measurements to use as a starting point. To fulfilthis goal, innovative technologies that lower the amount of water required for irrigation must be adopted. Controlled irrigation is used to water the plants as needed. Sensors in automated systems monitor the water that is available to plants.Because of its practically limitless possibilities for processing and storage, as well as its fast elasticity, cloud computing is a suitable option for managing the enormous volumes of data being advised. Excellent ground truth metrics to utilise as a starting point include temperature and soil moisture.*

Keywords: *IoT, Agriculture, Cloud Computing.*

I. INTRODUCTION

The primary industry in India is without doubt agriculture. Due to population expansion, agricultural productivity must be increased. To sustain rising levels of agriculture output, the quantity of fresh water required for irrigation also grows. Currently, agriculture uses 83% of all the water used in India [1].

Unintentional water waste results from unplanned water consumption. This suggests that technology must be created right now those reduce water loss without placing farmers under stress. Through the use of computers and software tools, farmers have improved the administration of their commercial partnerships with other parties, the organising of their financial information, and the monitoring of their crops during the past 15 years. [2].

Farmers must gather and analyse a tremendous quantity of data from a variety of tools (e.g., sensors, farming equipment, etc.) to improve productivity and communicate important information. Agriculture is gradually becoming into a sector that uses a lot of data [3].

Knowledge is vital to people's lives in the age of the Internet. It is now feasible to construct tools that can monitor the moisture content of the soil and water farms or the landscape as necessary thanks to open-source Arduino boards and affordable moisture sensors. The recommended solution, which uses the ATMEGA328P microcontroller on the Arduino Uno platform and IOT, allows farmers to remotely monitor the condition of sprinklers planted on their fields, substantially easing their work and enabling them to concentrate on other agricultural activities. Water is still a precious resource, not just in the planet's arid regions but also in many other locations. It must thus be used cautiously and efficiently. Despite the many irrigation system solutions that have been suggested, there is still water waste that affects electricity consumption. Several researchers have tackled the issue. [4] Depicts a smart irrigation system that analyses environmental data to determine when and where watering is needed.

The transfer of water to the field's dry areas determines how effective the solution is a system is shown in that prioritises irrigation operation by deciding how many pumps should be running at any one time and where they should be [5]. So, depending on the crops' water requirements, they can be irrigated. This article presents a microcontroller-based smart irrigation system as a cost- effective water management strategy. A microprocessor, a humidity sensor, a relay block, and a water pump make up the majority of the system's components. By altering various characteristics, like as humidity, the system can be altered to suit the requirements of a certain site. Humidity sensor 1 delivers a signal to the microcontroller when the humidity in zone 1 drops below a preset level, the water pump should be turned on and solenoid valve 1 should be opened until the humidity reaches the desired level. The data from the humidity sensor 2 causes the solenoid valve 2 to open and the pump to turn on until the target humidity is reached if the humidity in zone 2 drops while the system is in operation. The system enters "stand-by" mode when the humidity level exceeds the threshold and remains there until the microcontroller receives new data from the sensors, at which point it resumes its regular operation cycle.

II. LITERATURE REVIEW

The greenhouse's internet monitoring and management system Building a GSM-SMS base station for a PC-based database system and coupling it to a GSM-SMS remote measurement and control system for greenhouses was the proposed solution. [6]. A CPU, a GSM module, sensors, and actuators are used in the construction of base stations. Actually, a GSM module is used by the central station to send and receive messages. The requirements for the parameters that must be monitored in each base station are set by the central station, and these parameters include the surrounding temperature and humidity. Reviews of the technologies used for remote monitoring and control, as well as any potential advantages, are the main emphasis of Indu et al's (2013) [7] research. The study proposes a novel GSM and Bluetooth-based integrated irrigation system. When no one is watching, the system may autonomously water the field, choosing when to water it based on sensor readings of the crop type, temperature, and humidity. The designed system and the remote end communicate via SMS over the GSM network. A Bluetooth module connected to the primary microcontroller chip prevents when a user is only a few meters away from an authorised system, SMS costs apply. The system alerts users to a variety of factors, such as the state of the electricity, whether a motor is running or not, an increase in temperature, the amount of water in the via Bluetooth or SMS on the GSM network, soil and smoke. R. Suresh et al [8] (2014) discussed the use of an automatic microcontroller-based rain gun irrigation system. When irrigation only takes place when there is a big need for water, saving a lot of water in the process. These methods reimagine how to handle field resources. They created an operating system, middleware, and significant device apps under the name Android. The Java APIs and tools necessary to begin developing Android applications are provided via the Android SDK. Mobile phones, which have essentially become a part of us, satisfy almost all of the different needs of humans. This application controls irrigation by using the GPRS capabilities of a mobile phone. These systems were expensive and covered less useful agricultural area. A SIMCOM Company module-based IOT alarm system for greenhouses was developed With a SIM900A- based SMS alarm system, IOT [9]. The system may gather environmental data like temperature and humidity of the air. The AT commands allows thissystem to may also automatically send and receive SMS, generate alarms for environmental parameter overrun and insufficient balance, and more. No matter where the user is, the system is configured to transmit the warning message right away to the specified mobile phone. As a typical IOT application in agriculture, this system has produced some positive operational outcomes. Based on a wireless sensor network, for farmers, this method produced an automated watering system. Soil's moisture content, humidity, and temperature are all continuously monitored by this technology. The constant maintenance of the threshold soil moisture values was done using an algorithm. Depending on the soil's moisture content, the irrigation system either starts or stops. For an automated watering system, this method provides a low-cost moisture sensor-based data collection system. The authors have developed an impedance-based moisture sensor. Sensors alter the impedance between two electrodes that are buried in the ground.

III. PROPOSED SYSTEM

The primary application is freed from the load that communication stacks overhead places on the CPU thanks to the ESP32's ability to work totally independently or as a slave device to a host MCU. The ESP32 may link to other systems to offer Wi-Fi and Bluetooth functionality via its SPI/SDIO or I2C/UART interfaces. The ESP32 is made up of filters, power management pieces, an RF balun, a power amplifier, a low-noise receive amplifier, and antenna switches. A minimal quantity of printed circuit board (PCB) is all that is required for ESP32 to significantly improve your applications' versatility and potential. When utilized as a slave device to a host MCU, the ESP32's capacity to reduce communication stack overhead lessens the strain that it exerts on the main application. Lessens the burden that the communication layer overhead puts on the primary application CPU. The ESP32 may link to other systems to offer Wi-Fi and Bluetooth functionality using its SPI/SDIO or I2C/UART interfaces.

A. Implementation

The system includes a number of sensors, including a soil moisture sensor and a temperature sensor, to track the soil's moisture level, respectively. A vehicle powered by a DC motor is intended for irrigation. In soil is placed the soil moisture electrode. It will read the temperature sensor value and check the value of that sensor. Temperature and soil moisture sensors have set points of 1000 and 35, respectively. It is the Arduino board that receives data from the sensors.

The microprocessor ATMEGA328P on the Arduino board is in charge of managing the on/off switching of the motor that water sprinklers can be attached to connected. The Arduino transmits sensor data to the GSM-GPRS SIM900A modem. This modem receives a 3G data pack for a sim, which gives the system access to IOT functionalities. The IOT component then receives values via the modem. With a high degree of flexibility for direct and simple integration with RS232 applications, the GSM modem is a quad band, plug and play SIM900A GSM modem. Supported features include phone, SMS, data/fax, GPRS, and a built-in TCP/IP stack. The rx and tx of a GSM modem are linked to the tx and rx pins of an Arduino board, respectively.

Figure 1: Proposed System Design

B. Component Used

a) Rain Sensor

The operation of rain sensors is dependent on a wetting agent, and they function similarly to electrical switches. The use of detection agents for weather sensing is one of the main operational requirements for this sensor. The switch is often closed when it rains, turning on when moisture is detected and turning off when the air conditions return to normal. Below is a picture of the rain sensor module/board. Basically, this board uses the resistance concept and has nickel-plated lines. When the humidity threshold is exceeded, this sensor module produces a digital output and allows humidity monitoring through an analogue output pin.

Figure 2: Rain Sensor

This module is comparable to the LM393 IC in that it includes a circuit board in addition to an electrical module. Here, droplets are gathered on a PCB. The op amp calculates a parallel resistance route when it rains on the board. This sensor solely displays humidity-based resistance because it is a resistive dipole. Resistance, for instance, is high when it's dry and low when it's wet. The rain sensor's specs are as follows.

b) DHT11 Sensor

Capacitors that are sensitive to moisture Thermoplasty are a flexible, elastic polymer that forms an oscillator that adjusts capacitance values in reaction to variations in moisture content. It also has a moisture-resistant layer on it. The oscillator in the IC tracks these capacitance changes, analyses them, and transforms them to digital form. It also monitors the change in moisture level with the change in this capacitance value.

A capacitive humidity sensor and a thermistor make up the low-cost, digital DHT11 temperature and humidity sensor. Only one thermistor is used for measurement, and it is positioned close to the humidity sensor. A programming device uses its data pin to sample the air's temperature and humidity in order to acquire the data. Although it is pretty simple to operate, collecting the data requires careful scheduling.

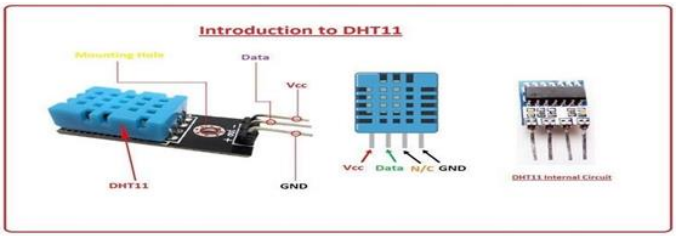

Figure 3: DHT11 Sensor

c) LDR Sensor

LDRs operate on the basis of photoconductivity, which is merely an optical phenomenon. The conductivity of a material rises when light is absorbed by it. Electrons in a material's valence band are drawn to the conduction band when light strikes an LDR. However, for an electron to hop from one band to another, a photon of incident light must have energy larger than the material's bandgap (conduction to valence electrons). Therefore, more electrons are stimulated into the conduction band as light's energy increases, reducing the number of charge carriers. The resistance of the gadget diminishes as the process proceeds and the current flow rises.

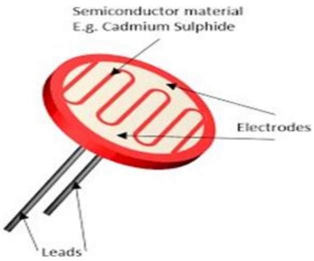

Figure 4: LDR Sensor

d) Soil Moisture Sensor

Utilising soil moisture sensors to monitor the soil's moisture content, it is possible to estimate how much water is stored in the soil layers. A soil moisture detector does not immediately calculate the soil's moisture content. Instead, it precisely records alterations in a variety of soil properties related to water content. The soil moisture sensor gauges or quantifies the soil's moisture content. These triggers might be stationary or mobile. Portable probe (B). Unmoving detectors First, module rootstock is planted in predetermined areas deep in the field. Plants growing on these sprouters must move substantial volumes of soil moisture. Soils might be saturated three metres or deeper. Moreover, soil moisture.

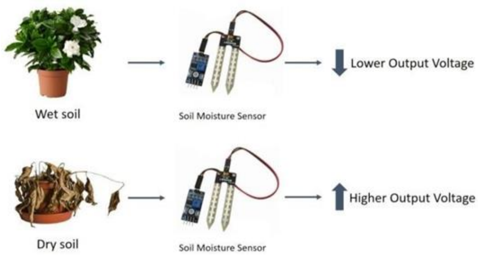

Figure 5: Soil Moisture Sensor

e) Relay module

Switches for electricity are relays. Typically, coils of electromagnets are utilised to activate internal mechanical switching mechanisms (contacts). The circuit is ignited when the coil is triggered with the relay contacts open. A relay' s operational diagram is shown below.

Figure 6: Relay Module

Relay modules switch relays able to handle loads up to 10 Amps using low-level data signals. Ideal for sensors and PIR detectors that produce low-level signals that must be used to turn on or off another device. Useful for Arduino and other microcontrollers.

f) DC Motor

A DC machine that transforms static electricity into kinetic energy relies on the fact that when an energised conductor enters a magnetic field, a mechanical force is applied to it. An energised manager forms beads and has a tendency to shift when it is held in an alluring environment. In other words, a mechanical force is created when electric and magnetic fields interact. The way DC motors operate is based on this idea.

Figure 7: DC Motor

A gadget that uses electricity to convert mechanical energy from electrical energy is a DC motor. Direct current, the electrical energy used as an input source in a DC motor, is converted into mechanical rotation.

g) Circuit Implementation

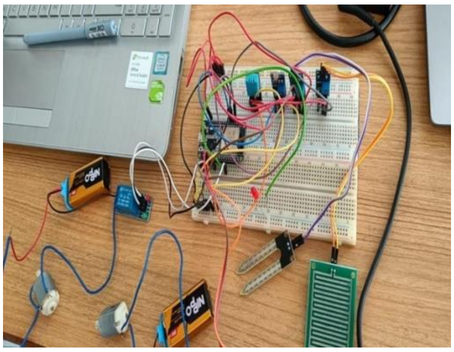

Figure 8: Circuit Implementation

h) Think Speak Output

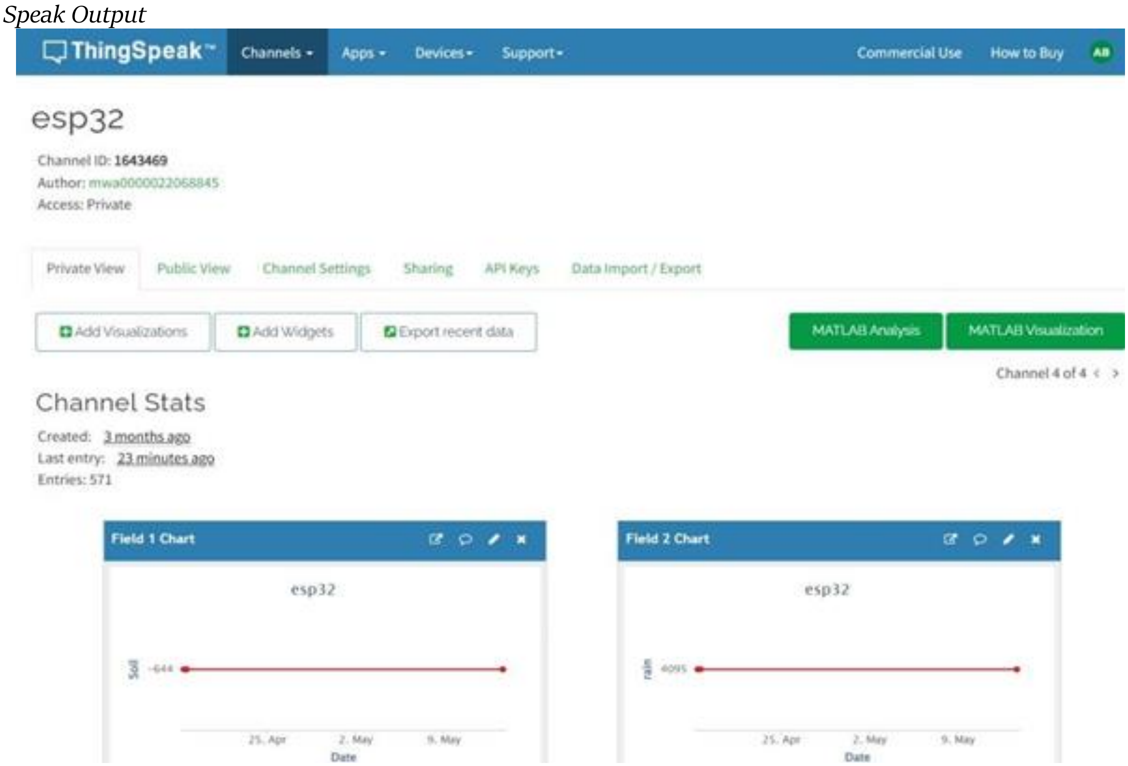

Figure 9: Think Speak1

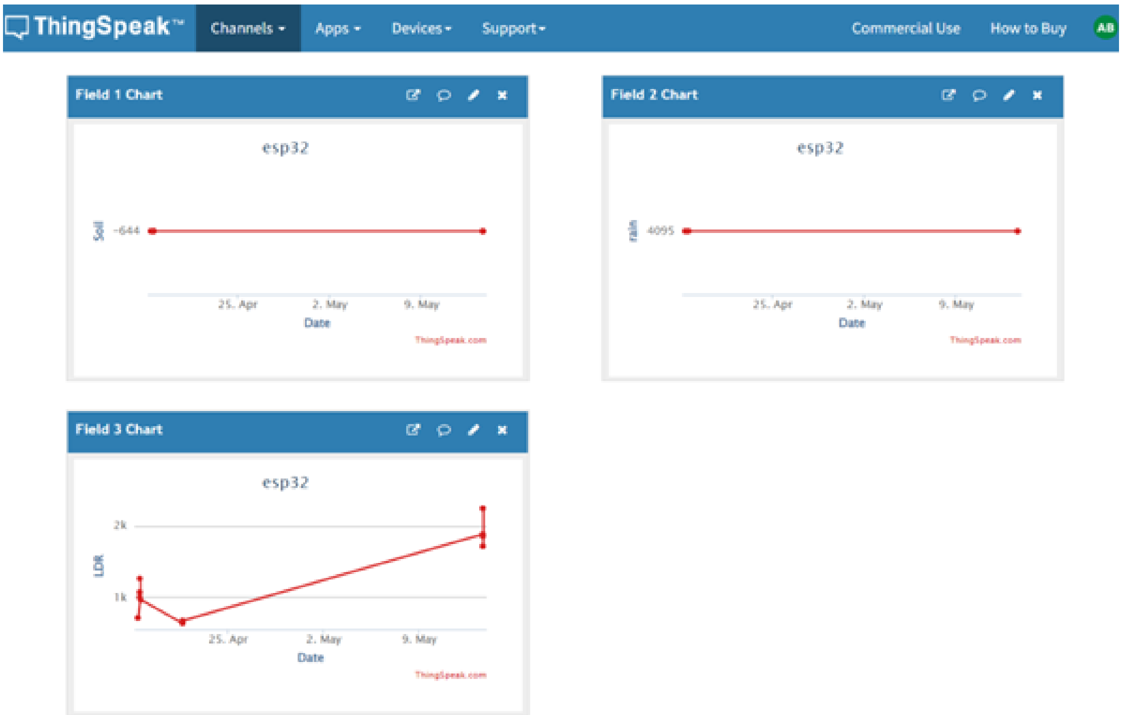

Figure 10: Think Speak2

IV. CONCLUSION AND FUTURE SCOPE

In this research, we successfully created a system appropriate for autonomous irrigation systems by measuring the soil moisture content. Since they automate and regulate watering without the need for human interaction, intelligent watering systems have shown to be useful. This project's primary goals are farmers and gardeners that don't have time to water their plants and crops. Farmers face major challenges in irrigating their fields. That's because they don't have an exact idea of when electricity will be available so they can pump water. Another pump removes water from the fields when it rains after watering the fields. Plant temperature and moisture content are measured via the moisture temperature sensor. when it is determined that the moisture content is lower than desired. The heater will receive a signal from the moisture sensor to increase the the air's temperature. This activates the water pump and hydrates the particular plant. Without going anywhere, you may access engine status, temperature, humidity, pressure, and rainfall on your phone or system. A system with an emphasis on energy efficiency has low component and construction costs. This system can be improved for use outside. The autonomous irrigation system that was constructed turned out to be practical and affordable for maximising the use of water resources for agricultural produce. With the use of this visualisation tool, farmers may help their crops grow more sustainably by enabling crop production in dry places. By facilitating more intelligent work, irrigation systems benefit farmers. Rephrase The Nest now uses 35% less water while consuming 35% less energy and power.

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