ISSN (Online): 2455-3662
EPRA International Journal of Multidisciplinary Research (IJMR) - Peer Reviewed Journal
Volume: 10| Issue: 4| April 2024|| Journal DOI: 10.36713/epra2013 || SJIF Impact Factor 2024: 8.402 || ISI Value: 1.188

A SOIL MOISTURE-BASED IRRIGATION SYSTEM BASED ON AI AND IOT

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ABSTRACT
An important industry that uses a lot of water resources for irrigation is agriculture. Water utilisation in agriculture must be optimised due to the rising demand for food and the growing worry over water shortage. The effective and efficient use of water in agriculture may be increased via the combination of artificial intelligence (AI) and the Internet of Things (IoT) technologies. This study suggests a smart irrigation system that optimises agricultural water consumption by utilising IoT and AI technologies, notably the Partial Least Squares Regression (PLSR) algorithm.

I.INTRODUCTION
The technology makes use of Internet of Things (IoT) sensors to gather information on soil moisture and meteorological conditions. The PLSR algorithm then analyses this data to calculate how much water is best for the crops. Based on the data, the device can automatically adjust the irrigation system, minimising water waste and boosting crop output. Water utilisation in agriculture might be completely changed by using a smart irrigation system that uses the PLSR algorithm. This could result in a more sustainable and effective use of water resources.

II. EXISTING SYSTEM
IoT and AI-powered smart irrigation systems have gained popularity as a study topic because of their potential to increase irrigation's efficacy and efficiency. A review of the literature in this area shows that a range of methods and tools, such as cloud computing, sensor networks, and machine learning algorithms, have been employed to develop smart irrigation systems.
Numerous research have suggested using IoT and AI to analyse sensor data, including temperature, humidity, and soil moisture readings, to estimate crop water requirements. Based on this data, machine learning algorithms have been utilised to forecast and make choices. Furthermore, data has been processed and stored using cloud computing, enabling remote access to it.

Smart irrigation systems have been implemented using a variety of hardware platforms, including as Arduino, Raspberry Pi, and microcontrollers. Additionally, Android applications have been created to allow for remote irrigation system monitoring and control.

All things considered, IoT and AI-powered smart irrigation systems have the potential to drastically cut water usage while raising crop quality and output. To maximise these systems' performance, more investigation is necessary, especially with regard to power usage, data transfer, and security.

III.RESTRICTIONS OF THE CURRENT SYSTEM
High Cost: The price of sensors, hardware, and software might make the implementation of an IoT and AI-powered smart irrigation system expensive.

Complexity: The setup and upkeep of IoT and AI integration can be challenging and need for specialised knowledge.

Data Accuracy: The system's efficacy may be impacted by the data accuracy utilised to optimise irrigation schedules. This covers the precision of soil moisture sensors, meteorological data, and other sensors.

Algorithm Limitations: The PLSR algorithm might not be the best choice for all applications, and the calibre of the data it uses as input could affect how accurate it is.

Restricted User Control: Certain systems may offer very few ways for users to customise and exert control over the system, which limits the system's adaptability

Internet connectivity: Network failures or sluggish connectivity may have an effect on smart irrigation systems that depend on it.

IV.PROPOSED SYSTEM
a. The PLSR Algorithm

PLS regression aims to explain their shared structure and predict Y from X. If X is full rank and Y is a vector, then standard multiple regression can be used to do this. Regression analysis is no longer possible if there are many predictors relative to observations, which indicates that X is probably singular (owing to multicollinearity). Numerous strategies have been devised to tackle this issue. Eliminating some predictors (for instance, by applying stepwise approaches) is one strategy. Principal component analysis (pca) of the X matrix is another method that is known as principal component regression. Her principle

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components of X are then taken and the regressed variables are utilised. Y. The multicollinearity issue is resolved by the principal components' orthogonality.

Approach
In a nutshell, the system is composed of two main parts:
1.System implementation through Internet of Things.
2. Artificial intelligence to forecast soil moisture content and rainfall amounts.

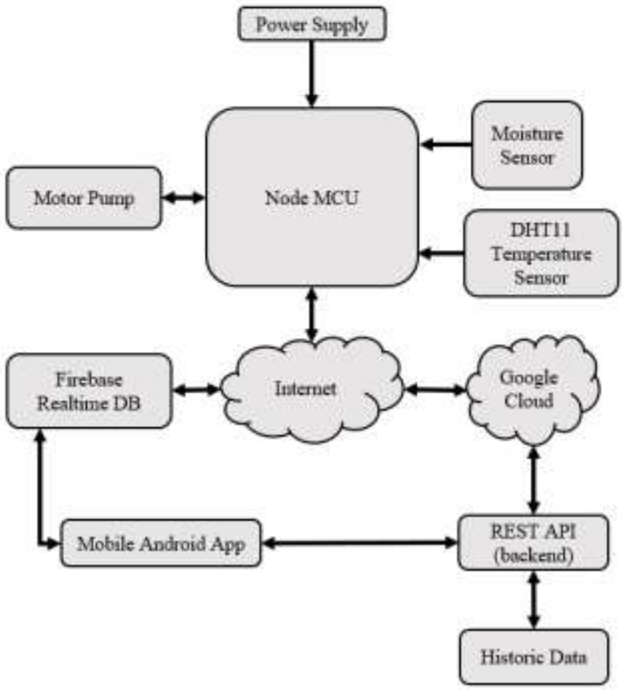

Fig.1. System implementation utilising the Internet of Things

The nodes are managed by a central system, which uses a Cloud API controller to decide when to switch on the pumps connected to each individual node. All of the controller's operations are carried out via JAVA and Python3 scripts. The control logic imports the support script into the main script and invokes the hardening script's methods when appropriate. The PLSR algorithm is used for inference, data preprocessing, and node communication.

After training on a powerful computer, the trained model is introduced into the producing environment.
The IPv4 protocol is used by the nodes to connect to the central controller through a shared WiFi access point. A client-server architecture is used for communication between the nodes and the central controller. There is no communication between nodes.

On the central controller, this implementation makes use of a cloud server. The URL is expanded by the server into a webhook. Using this webhook, the node establishes a connection with the server and provides data.

The sensor data is sent to the server via an HTTP GET request following post-computation. Two messages are sent to the requesting node by server replication by default. 1. Whether or not the pumps attached to a specific node need to be turned on, and 2.

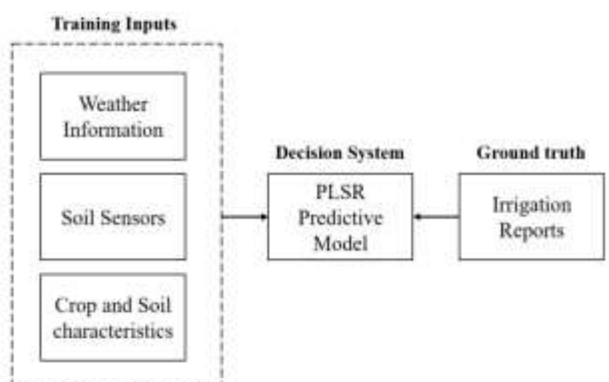

Fig.2 Artificial intelligence to forecast soil moisture content and rainfall amounts

Under typical circumstances, crop evapotranspiration can be computed using the single crop coefficient calculation below:

$$ET0 = K.\ ETc$$

Here, the crop coefficient is shown by Kc. It is dependent upon several elements, including the type of crop, crop evaporation, crop growth stage, and meteorological data.

The machine learning decision model was created using the partial least squares regression (PLSR) algorithm . It is a

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statistical technique that finds the essential connections between the variables that are input and output.

Visually verifiable variables that are quantified to feed data into the decision model are known as predictor (input) variables, and they are denoted by an X.

The outputs for which the specified inputs need to be evaluated are represented by the duplicated variable designated Y.

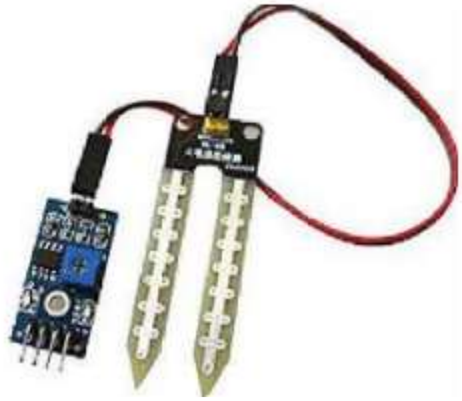

Fig.3.Sensor of Soil Moisture

Displays the many kinds of soil moisture sensors. This consists of two tests where an electric current is used to enter the soil. After that, the soil is examined for obstructions and its moisture content is measured. We are aware that dirt conducts electricity more easily when it is near water. This indicates that these kinds of soils have lower strength conductivity and lower resistance, or that dry soils hold more insurance than wet soils. This strength characteristic forms the basis of the sensor. To convert resistance to voltage, a point is required. The sensor's internal circuit, which changes resistance to voltage, accomplishes this.

Fig.4.ESP8266 NodeMCU

Demonstrates A low-cost, open-source Internet of Things platform called NodeMCU ESP8266 is built around the ESP8266 Wi-Fi microcontroller. It combines Wi-Fi functionality with a microcontroller to facilitate the easy connection and control of devices via the internet. It is a small and low-power option for Internet of Things projects since it features integrated voltage regulation and on-board flash memory. In addition to offering a development kit and support for multiple programming languages, NodeMCU enables users to rapidly prototype and test their creations.

The composite sensor DHT11 has a calibrated digital signal output for humidity and temperature. To guarantee that the product has great reliability and outstanding long-term stability, temperature and humidity sensor technologies as well as a collection of specialised digital modules are utilised. The sensor is coupled to a high-performance 8-bit microcontroller and consists of a resistive sense of wet component and an NTC temperature measurement device.

Fig.5.DITH Sensor

It features an input circuit, sometimes known as an input, and a control system. It is widely utilised in circuits for automatic control. In short, it's an automated switch that uses a low-current signal to operate a high-current circuit.

Fig.6.Jumper Wire

A wire or those corporate connections in his connection is known by several names (jumper wire, jumper interface, Dupont wire, or Dupont interface, named after one of the founders). or any end that is frequently used to join a breadboard, other model, or portion of a test circuit to other hardware or parts without the need for soldering paste (or, in certain cases, without them at all) (basically "tinned"). By inserting the "end connector" into the original path and giving them access to a breadboard, printed circuit board header connection, or touch test fixture, individual bob wires are linked.

V.APPLICATION

Temperature and humidity data from the DHT, or soil moisture sensor, are gathered by the NodeMCU board. Artificial intelligence systems then process the data gathered from the sensors and other weather APIs to calculate the ideal water requirement for the plants. The water pump that provides the plants with water is managed by the relay module. Due to the system's internet connectivity, an Android app may be used to monitor and control it from any location.

STEPS:

• Use jumper wires to connect the DHT11 and soil moisture sensors to the NodeMCU board.
• Use jumper wires to connect the relay module to the NodeMCU board.
• Use jumper wires to connect the water pump to the relay module.
• Set up the NodeMCU 8266 board driver and the Arduino IDE on your PC.
• Launch the Arduino IDE, then start a fresh project.
• Select Sketch -> Include Library -> Manage Libraries in the Arduino IDE. Install the Firebase Arduino library by searching for it.
•Connect the NodeMCU board to the code.
• Establish a new Firebase Realtime Database and a Firebase project.
• Launch Android Studio and install OS X version 10 or above. To receive data, connect the Andrioid app to the Firebase Project; open the IDE and create a new project; add custom input for various plants and crops.

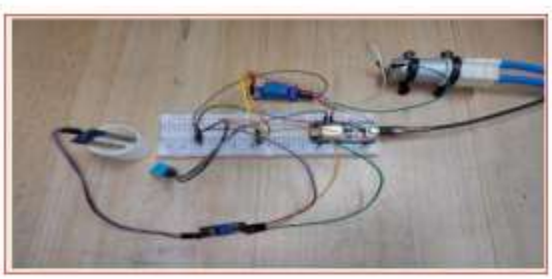

Fig.7.Circuit schematic for the suggested model

VI.OUTCOMES

As seen the water pump can be turned on and off in accordance with the soil moisture levels, automating the irrigation procedure.To prevent crop damage, the system irrigates the soil using data from the soil moisture sensor. This helps to prevent over- or under-irrigation of the soil. Farm owners can use a mobile application to monitor the process online.

Fig.8. Observing with an Android app

VII.CONCLUSION

IoT-enabled intelligent irrigation systems are a very efficient way to maximise yields while minimising water wastage. The technology facilitates precise and effective irrigation by combining IoT sensors, real-time weather information, and soil moisture measurements to optimise irrigation schedules. As a result, the local water supplies are less stressed, plant health is enhanced, and water costs are reduced. Furthermore, farmers find smart irrigation systems driven by IoT to be more convenient and easy to use due to its remote monitoring and control capabilities. All things considered, using intelligent irrigation systems with IoT technology is a step towards more productive and sustainable agriculture.

VIII.REFERRENCES

1. *Dr. S. Velmurugan, V. Balaji, T. Manoj Bharathi, K. Saravanan, 2020, An IOT based Smart Irrigation System using Soil Moisture and Weather Prediction, INTERNATIONAL JOURNAL OF ENGINEERING RESEARCH & TECHNOLOGY (IJERT) ECLECTIC – 2020 (Volume 8 – Issue 07),*
2. *Anitha, N. Sampath and M. A. Jerlin, "Smart Irrigation system using Internet of Things," 2020 International Conference on Emerging Trends in Information Technology and Engineering (icETITE), Vellore, India, 2020, pp. 1-7, doi: 10.1109/ic-ETITE47903.2020.271.*
3. *Kumar, A. Surendra, H. Mohan, K. M. Valliappan and N. Kirthika, "Internet of things based smart irrigation using regression algorithm," 2017 International Conference on Intelligent Computing, Instrumentation and Control Technologies (ICICICT), Kerala, India, 2017, pp. 1652-1657, doi: 10.1109/ICICICT1.2017.8342819.*
4. *J. H. Pornillos et al., "Smart Irrigation Control System Using Wireless Sensor Network Via Internet-of-Things," 2020 IEEE 12th International Conference on Humanoid, Nanotechnology, Information Technology, Communication*

and Control, Environment, and Management (HNICEM), Manila, Philippines, 2020, pp. 1-6, doi: 10.1109/HNICEM51456.2020.9399995.

5. *R. R. Agale and D. P. Gaikwad, "Automated Irrigation and Crop Security System in Agriculture Using Internet of Things," 2017 International Conference on Computing, Communication, Control and Automation (ICCUBEA), Pune, India, 2017, pp. 1-5, doi: 10.1109/ICCUBEA.2017.8463726.*