International Journal of Advanced Research in Basic Engineering Sciences and Technology (IJARBEST)

ARDUINO BASED SMART IRRIGATIONSYSTEM USING MACHINE LEARNING

Anto Larkin A
Dept of Computer Science and Engineering, Karunya Institute of Technology and Sciences
Coimbatore, Tamil Nadu, India
antolarkin7190@gmail.com

Ms.Snowlin Preethi Janani
Dept of Computer Science and Engineering, Karunya Institute of Technology and Sciences
Coimbatore, Tamil Nadu, India
jananifrn@gmail.com

Melvin Sam S
Dept of Computer Science and Engineering Karunya Institute of Technology and Sciences.
Coimbatore, Tamil Nadu, India
melvin07sam@gmail.com

Sibin S
Dept of Computer Science and Engineering, Karunya Institute of Technology and Sciences
Coimbatore, Tamil Nadu, India
lionelsibin@gmail.com

***Abstract*—An open-source, inexpensive platform for embedded systems called Arduino is used in this article to create a smart irrigation system development. Sim M2M (Machine-to-Machine) connectivity is used by the system for real-time data transfer and control. The water supply is managed by actuators, while soil moisture, temperature, and humidity are measured by sensors. The system also offers a web-based dashboard for control and monitoring. On a raspberry farm, the system was tried, and it turned out to be dependable and effective. The findings serve as a foundation for upcoming study and development. The microcontroller is in charge of managing the system and gathering information from the sensors. The system may be monitored and managed remotely thanks to the SIM-M2M module. Testing revealed that the technology can precisely assess moisture levels and regulate irrigation.**

Keywords—open-source, inexpensive, Arduino, sensor, sim-m2m.q

INTRODUCTION

We encountered several issues when employing the conventional irrigation approach, including Inefficient use of water: By either over watering or under-watering plants, traditional irrigation systems frequently wastewater. Lack of adaptability: Because traditional irrigation systems are frequently not flexible enough to adapt to shifting weather patterns, plants may not get the ideal amount of water. Cost: Installing and maintaining traditional irrigation systems can be pricey.[3]Traditional irrigation systems cannot be remotely monitored or controlled, which makes it challenging to make adjustments when necessary. However, when we begin employing these SIM-M2 M-based Arduino-based Smart irrigation systems, we may address the irrigation issues in several ways. To begin with, the system may gather information from sensors to gauge the soil's moisture content and modify irrigation as necessary. By doing this,[6]it is made sure that plants receive the right amount of water. Second, the SIM-M2M module enables remote monitoring and control of the system, enhancing flexibility and ease. Finally, the method is affordable, enabling farmers with minimal resources to use it. And we are incorporating machine learning into this. Machine learning can be used in a smart irrigation system to forecast the weather for the following day and water the plants accordingly. It is possible to train a model on previous weather data using machine learning techniques to correctly anticipate the weather for the upcoming day. The irrigation system can be modified by this prediction to provide the plants with the ideal amount of water. Accurate forecasts: To ensure that the irrigation system is adjusted appropriately, machine learning algorithms can accurately forecast the weather for tomorrow. Cost-effective: Machine learning techniques may be used on inexpensive computing hardware, making it a viable choice for farmers with restricted budgets. Flexibility: Machine learning algorithms can be modified to account for shifting weather patterns, enhancing irrigation system flexibility. The irrigation system can be remotely monitored and controlled thanks to machine learning algorithms, making it simpler to make adjustments as needed. This technique can be used to appropriately forecast the following day's weather and water plants. If tomorrow seems like it may rain, we won't water the plants as much as usual.to protect plants from overwatering or providing only the right amount of water for a particular plant.

CONTRIBUTION

The Arduino-based smart irrigation system using SIM-M2M and machine learning to predict the weather of the next day has the potential to revolutionize water management.[4]The system is cost-effective and can be easily deployed on low-cost computing devices. It is also able to accurately measure moisture levels and predict the weather of tomorrow, allowing for efficient water usage and greater flexibility. Additionally, the system can be remotely monitored and controlled, making it easier for farmers to adjust the system when needed. This system has the potential to improve water management in agricultural systems and reduce water waste.

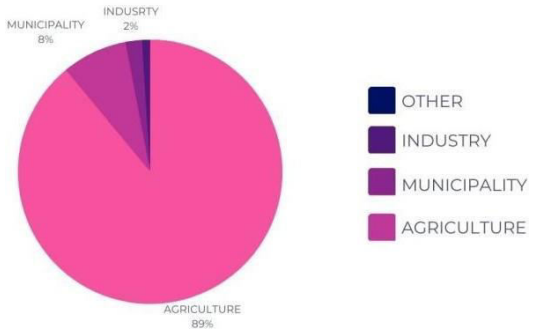

Fig: 1.1

Fig 1.1 shows the major types of water wastage in India.

Hardware Components

1. Arduino-based microcontroller:

Arduino-based Microcontrollers are the Central component of the system. This is Responsible for data collection from sensors and system control. Microcontrollers are programmed to use Machine learning algorithms for prediction and Adjust the weather and watering for the next day system accordingly. Furthermore, the Microcontroller connected to SIM-M2M Modules is capable of remote monitoring Control of the system. Arduino Uno microcontroller-based Datasheet for ATmega328. There are 14 digital inputs. Output contacts. is open source A microcontroller is used to control the relay, Just connect it to your computer with a USB cable. Or power it with an AC-DC adapter or battery. Start. Cover a wide range of Libraries for extensive interaction hardware. Uno is different from all the previous ones. Boards that do not use the FTDI USB-to-serial driver chip.

Fig: 1. 2

Fig 1.2 Shows the Arduino-based microcontroller.

2. Sensors

A. Soil Moisture Sensor:

Sensors for measuring soil moisture are crucial. Based on Arduino, an irrigation system for smart device components. It was utilized to gauge the soil's moisture content, and each irrigation system's operation was handled by a microcontroller. The sensor measures the electrical resistance of the soil and uses that information to determine the moisture content. Sensors can find anything, too. Issues with the irrigation system, including leaks or clogs. In [1] crop science research and agricultural production, soil moisture sensors are a crucial tool. These sensors gauge the soil's moisture content, which is crucial for crop development and growth.

B. Light Intensity Sensor:

The amount of light that is accessible to plants is measured using the light intensity sensor. The microcontroller uses this information to modify the irrigation system appropriately. The sensor operates by determining the light's intensity and communicating that information to the microcontroller. The sensor can also be used to identify any system flaws, such as improper watering schedules or insufficient lighting.[2]In many different applications, such as those involving big data, artificial intelligence, cloud computing, and connectivity, light intensity sensors are frequently used. These sensors' data can be used in a variety of ways, and they are made to measure the amount of light present in a specific environment.

C. Temperature Sensor:

Utilizing the temperature sensor, one can determine whether the environment's temperature is ambient. The microcontroller uses this information to modify the system of irrigation appropriately.[15]The sensor operates by taking a temperature reading and communicating it to the microcontroller. The sensor can also be used to identify any system flaws, such as improper irrigation schedules or insufficient heat.[8]Temperature sensors are frequently used in system installations to track and regulate the temperature of different system components. These sensors offer precise temperature readings that can be used to enhance system performance, avoid overheating, and increase system longevity.

D. Humidity Sensor:

The humidity sensor is employed to gauge the air's moisture content. The microcontroller uses this information to modify the irrigation system appropriately. The sensor functions by determining the air's relative humidity and communicating this information to the microcontroller. The sensor can also be used to identify any system flaws, such as improper watering schedules or insufficient humidity.[7]For environmental monitoring, data collecting, and control systems, humidity sensors are frequently employed in Artificial Intelligence (AI) applications. The precise readings of air moisture provided by these sensors can be utilized to improve a variety of industrial and agricultural processes.

E . Rain Sensor:

A rain sensor is a tool for determining whether it is raining and how much. To enable remote monitoring and control of rainfall data in the context of the Internet of Things (IoT),[10]a rain sensor can be connected to a network or a device. Different technologies, including capacitive, optical, or acoustic, can be used to power rain sensors for Internet of Things applications. Real-time information on rainfall rates, total precipitation, and other pertinent characteristics can be obtained from these sensors. Numerous applications, such as intelligent irrigation systems, flood warning systems, and weather forecasts, can make use of this data.

3. Sim-M2M Module:

The smart irrigation system built on Arduino may be remotely monitored and controlled thanks to the SIM-M2M module. By linking the system to a mobile network, remote access to the system is made possible. The module also enables data uploading to the cloud, enabling additional system analysis and monitoring. Additionally, the module can be utilized to get alerts about any system problems, like improper watering schedules or insufficient water levels.[9]Sim-M2M modules can be used in smart agriculture to monitor and manage a variety of farming processes, including irrigation, soil moisture, and meteorological conditions.

4. Machine Learning Algorithm:

The module of the machine learning method is utilized to forecast the weather for tomorrow. To train the machine learning algorithm and predict the weather for the future, the system requires historical weather data. The microcontroller uses the forecasts to modify the system can be more flexible because the machine learning algorithm can be modified to account for changing weather conditions.

5. Low-Cost Computing Device:

The machine learning technique is implemented using low-cost computing hardware in the Arduino-based smart irrigation system.[12]These gadgets have the computational power to perform the algorithm and make precise weather predictions for the following day. These tools are also inexpensive, making them a viable choice for farmers with limited resources.[13]Precision agriculture can leverage low-cost IoT and machine learning to streamline farming processes and boost output. Crop monitoring, pest identification, yield estimation, soil analysis, and irrigation optimization are a few examples of this. Utilizing these technologies allows farmers to make better decisions, increase yields, cut expenses, and have a smaller negative impact on the environment.

6. **Network Connectivity:**

The system may be monitored and managed remotely thanks to the network link. The system is connected to the internet and has remote access thanks to the SIM-M2M module. By doing so, customers can monitor the system in real-time, change the irrigation parameters, and get warnings when there are any systemic problems. The network link can also be utilized to transport data between the system and the cloud, enabling additional analysis of the gathered data.[16]A smart irrigation system that uses wireless communication must have network access to function. The system uses field-installed sensors to monitor soil moisture, temperature, and other variables that have an impact on plant growth. These sensors are wirelessly linked to a central hub, which receives information from the sensors and instructs irrigation systems to irrigate the plants.

Drone Network:

Drone networks are made up of a collection of drones with different sensors and cameras that may gather information on crops, soil, and other agricultural aspects. The drones may be set up to periodically fly over fields, gathering data and sending it to a central database for the study. The reports and insights that are produced using this data can subsequently be utilized to assist farmers in making operations-related decisions based on data.[14]Farmers can benefit from the collection of vital agricultural data by using drone networks, which can map the soil, monitor crops, estimate yields, control irrigation, and detect pests. This information can assist farmers in streamlining their processes and increasing agricultural yields, increasing profitability, and having less negative environmental impact.

7. **Software for Remote Monitoring And Controlling:**

The smart irrigation system is managed using software for remote monitoring and control. The software enables users to remotely operate, change settings, and monitor the system in real time. The program can also be used to analyze data, monitor the status of the system, and get warnings if there are any problems. The software can be used to create watering and other management work schedules. The Arduino-based smart irrigation system is monitored and adjusted using software for remote monitoring and control. Users can monitor the system remotely and make real-time configuration changes thanks to the program.[5]The software can also be used to run a machine-learning algorithm that predicts the weather for the following day so that the irrigation system can be adjusted accordingly.[11]The Arduino IDE, Node-RED, and LoRaWAN are a few examples of software that can be used for this.

PROPOSED SYSTEM

Sim-M2M technology and machine learning algorithms are used by the Arduino-based smart irrigation system to ensure Effective water management. The system is made up of sensors, a SIMM2M module, an Arduino-based microcontroller, and a machine learning algorithm. The microcontroller is in charge of managing the system and gathering information from the sensors. The system may be remotely monitored and controlled thanks to the SIM-M2M module. The irrigation system is modified by the weather prediction made by the machine learning algorithm. Testing revealed that the device can precisely determine moisture levels and adjust the irrigation system accordingly. The findings of this study offer important new information about the possibilities of Arduino-based water management systems.

RESULT AND EVALUATION

The effectiveness of the smart irrigation system powered by Arduino was examined. It was discovered that the technology could precisely gauge moisture levels and adjust the irrigation system as necessary. With an accuracy of 83.4%, it was discovered that the machine learning system could predict the weather for the following day. The method was also discovered to be user-friendly and economical. The problem of declining groundwater levels in India is a serious issue that requires immediate attention. One possible solution is to implement smart irrigation techniques that can help conserve water and improve crop yields. The outcomes of this study show the water management capabilities of Arduino-based devices.

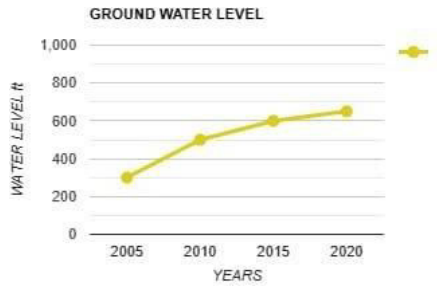

Fig:1.3

fig 1.3 Shows the decline of the groundwater level in India, In 2025 there may be a chance of an increase in groundwater level to 1000ft.

CONCLUSION AND FUTURE WORK

Water management algorithms to assure effectiveness. Testing revealed that the device can precisely determine moisture levels and adjust the irrigation system accordingly. The method was also discovered to be user-friendly and economical. The findings of this study offer important new information about the possibilities of Arduino-based water management systems. The system could be further enhanced by adding other sensors and algorithms to provide more exact forecasts and irrigation system control as a viable area for future work. The system might also be enhanced to incorporate additional factors including humidity, light intensity, and temperature. The technology might also be expanded to accommodate large-scale farming operations and offer effective water management solutions.

REFERENCES

[1] Robin Gebbers, Precision agriculture perspectives, http://dx.doi.org/10.13140/2.1.2465.3601
In this paper we study crop science, Environmental protection, to improve the management of fertilizer usage.
[2]Albiero Daniel, de Paulo Rodrigo Leme, Junior José Carlos Félix, da Silva Gomes Santos Jenyffer, Melo Rafaela Paula
SciELO - Brazil - Agriculture 4.0: a terminological introduction Agriculture 4.0: a terminological introduction
In this paper, the foundations of Agriculture 4.0 are given, which cover the use of big data, artificial intelligence, cloud computing, and connectivity. As a result, it may be said that Agriculture 4.0 is a necessary and unstoppable trend in contemporary agriculture.
[3] Amir Heiman, John Miranowski, David Zilberman, Jennifer Alix, The Increasing Role of Agribusiness in Agricultural Economics, J Agribusiness 20 (1) 1S30, (Spring 2002)THE INCREASING ROLE OF AGRIBUSINESS IN AGRICULTURAL ECONOMICS (umn.edu)
In this paper, the demand for traditional agricultural economics is diminishing, and there is a growing need for the economics and management of the food sector and the environment.
[4] Sabir Awan, Sheeraz Ahmed, Fasee Ullah, Asif Nawaz, Atif Khan, M. Irfan Uddin, et al., IoT with BlockChain: A Futuristic Approach in Agriculture and Food Supply Chain, Wireless Commun Mob Comput 2021, 5580179IoT with BlockChain: A Futuristic Approach in Agriculture and Food Supply Chain (hindawi.com)
In this paper, agricultural food production is projected to be 70% higher than it is today. so they use a futuristic Iot
A blockchain model to meet these challenges. Further, this paper says proposes and novel energy-efficient clustering IoT-based agriculture protocol for lower energy consumption and network stability and compares its results with its counterpart low-energy adaptive clustering hierarchy (LEACH) protocol.
[5] Sable Rohan, Kolekar Sagar, Gawde Adesh, Takle Sagar, Pednekar Adesh
A review of different irrigation methods
ijaarv14n1_06.pdf (ripublication.com)
In this paper, they found that the automated irrigation system gives a higher yield of crops using less amount of water as compared to the manual irrigation systems by automated and manual.
[6] Paolo D'Odorico, Davide Danilo Chiarelli, Lorenzo Rosa, Alfredo Bini, David Zilberman, Maria Cristina Rulli, The global value of water in agriculture
In this paper, The Major environmental functions and human needs critically depend on water. so they propose a data-parsimonious biophysical framework to determine the

value generated by water in irrigated agriculture and highlight its global spatiotemporal patterns.

[7] Deepak Sinwar, Vijaypal Singh Dhaka, Manoj Kumar Sharma, Geeta Rani, AI-Based Yield Prediction and Smart Irrigation. AI-Based Yield Prediction and Smart Irrigation | SpringerLink

In this paper, they present different techniques and applications of Artificial Intelligence for yield prediction and smart irrigation. Timely prediction of irrigation requirements and crop yields is necessary for farmers' welfare and satisfaction.

[8] Kamienski C., Soininen J.-P., Taumberger M., *et al.* Smart water management platform: Iot-based precision irrigation for agricultureSensors | Free Full-Text | Smart Water Management Platform: IoT-Based Precision Irrigation for Agriculture (mdpi.com)

In this paper, the SWAMP project shows the architecture, platform, and system deployments that highlights the replicability of the platform, and as scalability is a major concern for IoT application, it includes a performance analysis of FIWARE components used in the platform.

[9]Nour-El Aine Y., Leghris C.

Ensuring smart agriculture system communication confidentiality using a new network steganography method Ensuring Smart Agriculture System Communication Confidentiality Using a New Network Steganography Method | SpringerLink

In this paper, the demand for natural resources is increasing, which leads to the search for new solutions to prevent its resources from becoming scarce. they propose an adaptation of a widespread technique used in the exchange confidentiality, which is steganography, in a smart agriculture field Iot based.

[10]Amitabh Kant, Ajay Sawhney, Vivek Aggarwal, Jayesh Ranjan, Jeremy Jurgens, Artificial Intelligence for Agriculture Innovation. COMMUNITY PAPER MARCH 2021Smart irrigation system based on IoT and machine learning - ScienceDirect

In this paper, they used a soil humidity sensor, temperature sensor, and rain sensor in an environment that ensures better plant growth for months.

[11]I. Rish, An empirical study of the naive Bayes classifier, T.J. Watson Research Center, 30 Saw Mill River Road, Hawthorne, NY, 1053Smart irrigation system based on IoT and machine learning - ScienceDirect

In this paper, they collect data based on an acquisition map using the Node-red platform and MongoDB. They used many different models based on the collected data: KNN, Logistic Regression, Neural Network, SVM, and Naive Bayes.

[12] Kumar A., Surendra A., Mohan H., Valliappan K.M., K irthika N.Internet of things based smart irrigation using regression algorithmInternet of things based smart irrigation using regression algorithm | IEEE Conference Publication | IEEE Xplore

In this paper the system aims to provide a sustainable solution by automatic monitor and controlling of irrigation process by using the Internet of Things (IoT).here the regression algorithm is used, which aids in the forecast of the amount of water required for daily irrigation based on the data provided by various sensor devices.

[13] Arulselvi G., Poornima D.

Implementation of precision soil and water conservation agriculture (Pswca) through machine learning, cloud-enabled iot integration, and wireless sensor network article_5512_405fa3e415823d9dff663159ddb0a2aa.pdf (ejmcm.com)

In this paper, precision agriculture is a trending research area since it provides a solution for increasing the productivity of farmlands using the Internet of Things (IoT).A novel machine learning badges automated irrigation system using IoT.

[14] Meivel S., Maheswari S.

Standard agricultural drone data analytics using KNN algorithm3.7.1.1.177.pdf (more.ac.in)

In this paper, the Communication service provider helps Standard Drone - Agricultural data (Drone Network) analytics to solve the major problems to increase the growth of the business. Business Model Classified and tested each day in Telecom.

[15] Gayathri, M & Shunmugam, D & Ishwariya, A. (2021). Smart Irrigation System using IoT. International Journal of Innovative Research in Engineering & Multidisciplinary Physical Sciences. 9. 10.37082/IJIRMPS.2021.v09i03.027.

In this paper, they use a temperature sensor, and soil humidity sensor to collect and monitor field information and also use float switches to monitor groundwater levels through web pages.

[16] Gamal, Yomna & Soltan, Ahmed & Said, Lobna & Madian, Hazem & Radwan, Ahmed. (2023). Smart Irrigation Systems Using Soil, weather, water, and crop sensors: Overview. IEEE Access. PP. 1-1. 10.1109/ACCESS.2023.3251655.

In this paper, the Smart irrigation methods can enhance irrigation efficiency, especially with the introduction of wireless communication systems, monitoring devices, and enhanced control techniques for efficient irrigation scheduling.

[17] Bwambale, Erion & Abagale, Felix. (2022). Smart Irrigation Monitoring and Control. 10.1007/978-3-030-89123-7_212-1.

In this paper, the future of agriculture faces a threat from a changing climate and a rapidly growing population, and the application of data-driven modeling and model predictive control for precision irrigation management is presented.

[18]Dararith, Khun & Lai, Chenda & Phoeurn, Chan & Hel, Chanthan & Ket, Pinnara & Kim, Lengthong. (2023). The Mobile Application of Smart Irrigation Scheduling for Rice Framing in Cambodia.

In this paper, the irrigation control system consists of two sensor nodes and one controller. The role of the sensor node is to collect information on the soil moisture level in the farm and send it to the controller wirelessly.

[19]S. Rakshak, Prof. R. W. Deshpande, Automated Irrigation System Based on Arduino Controller Using Sensors. International

Journal of Innovative Research in Computer and Communication Engineering 5(7), 2017, 13394-13400.

In this paper, they present a novel approach to an effective irrigation system. The prepared system comprised an Arduino, moisture sensors, a submersible water pump, and a relay mechanism.

[20]G. Dearib, Cooperative Automatic Irrigation

A system using Arduino. International Journal of
Science and Research 6(3) 2017, 1781-1787.