



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

IJIRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 12, Issue 5, May 2023

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 8.423

9940 572 462

6381 907 438

ijirset@gmail.com

www.ijirset.com

Intelligent irrigation for agriculture fields using IoT and Logistic Regression

Padma Dev Mishra, Rachna K. Somkunwar

PG Student, Department of Computer Engineering, Dr. D. Y. Patil Institute of Technology, Pimpri, Pune, India

Associate Professor, Dr. D. Y. Patil Institute of Technology, Pimpri, Pune, India

ABSTRACT: Sustainable agricultural practices are required, especially for irrigation, to feed a growing population. About 85% of the freshwater resources in the world are used for irrigation. Therefore, for effective water use in irrigation, modern and intelligent systems using the Internet of Things, wireless sensor networks, and machine learning must either be adapted or replaced with traditional irrigation practices. Using the Internet of Things, wireless sensor network, and machine learning technique such as logistic regression, this paper suggests an intelligent system for precision irrigation that can be monitored and scheduled. The suggested method uses the soil and weather conditions to forecast how much water the crop would need. The suggested system has the capacity to estimate the demand for irrigation thanks to the application of machine learning techniques. Logistic regression, a machine learning algorithm is applied with a dataset of soil and weather conditions collected using sensors, and the optimal model with the highest efficiency in forecasting irrigation schedule is chosen. The most effective algorithm, with a prediction effectiveness of 93.5%, is logistic regression as analyzed.

KEYWORDS: Agriculture, irrigation, IoT, machine learning, logistic regression

I. INTRODUCTION

The economies' demands for food production are met by agriculture. However, the farmers have challenges during the irrigation process, including a lack of groundwater, floods, under- or over-irrigation, irregular rainfall, etc. Over-irrigation results from inadequate management and distribution, which wastes water and causes water contamination by washing chemicals off plants. On the other side, under-irrigation occurs when the crop receives little water, leading to a build-up in the soil's salinity. In this case, leaching and adequate drainage are needed to remove the hazardous salts that have collected on the soil's surface, especially in arid locations with high rates of evaporation. If there is enough rainfall, irrigation may be avoided and water can be stored for later use, but if there isn't enough rainfall, the soil will need to be watered more often.

An automated watering system is used in this effort to address some of these issues. It is a smart system because machine learning (ML) and the Internet of Things (IoT) enable it. Various sensors for detecting temperature, humidity, potential of hydrogen (pH), and pressure are among the hardware components of the deployed system. These sensors are controlled by an Arduino Mega board and a BoltWi-Fi module. These parameters' detected values indicate when the soil needs to be watered, and the water pump is therefore turned on and off automatically. To determine when irrigation will be required, future values may also be forecasted using ML [1].

A technology called the Internet of Things (IoT) aims to enable pervasive computing by extending Internet connectivity into everyday physical things. [2]. In order to provide access and interaction through the web for remote monitoring and controlling reasons, these devices also have Internet connectivity as well as sensors, actuators, or other hardware/electronics like processing units, etc. Embedded systems, machine learning, real-time data analytics, cloud computing, wireless sensor networks, and control systems have all been integrated to allow IoT, which has grown through time[3]. It is most frequently associated with smart homes, smart grids, and other automated daily tasks where appliances and devices support some form of sensing, actuating, controlling, or processing of data over time to aid in making decisions with minimal user involvement [4]. It has a wide range of applications in various fields.

The scientific study of statistical algorithms and models that computers use to carry out certain tasks without having to explicitly express instructions, relying instead on patterns and inferencing techniques, is known as machine learning (ML), and it is a subset of artificial intelligence (AI). Without needing to be explicitly programmed for carrying out the specific job, ML supervised algorithms create a mathematical model for decision-making and formulating predictions on



the basis of sample input data that is referred to as "training data" [5]. ML algorithms are used in a wide range of applications, such as spam filtering and facial recognition, when it is impossible to develop a standard algorithm for effectively carrying out a task [6].

Tracking water consumption precisely can help prevent overwatering. Due to thorough water monitoring, water flow meters may be efficiently used to assist farmers in cost reduction. using drip irrigation to manage the supply of fertilizer and water to plants. The amount of water required for irrigation may be greatly decreased with this fine control. More wells need to be drilled in order to capture and use groundwater for agriculture. To satisfy the sustainable pumping levels and the water requirements of the plants, new wells can be planned and dug even when the groundwater level drops. Application of cutting-edge software tools for data analytics on the enormous amounts of input data accessible and drawing inferences from these sensor readings to notify farmers of crucial information to aid them with future decisions [7].

The next subsequent sections of this research article is focusing on the literature review of the existing methodologies , proposed architecture of the research work related to smart irrigation, the nature of data to be used, followed by summary insights of the work.

II. LITERATURE SURVEY

The authors conducted an extensive study of several existing smart irrigation systems and came to the following conclusions for each system.

Ashwini et al recommend using a Bluetooth-based microcontroller system to remotely operate an irrigation servo motor [8]. A low-cost Arduino microcontroller, inexpensive temperature, humidity, and soil moisture sensors that can track changes in those variables in real time, and an Android application that enables users to examine the status in real time make up the system. The user may choose a temperature, humidity, and soil moisture threshold value below which a signal is sent from the user's phone to the microcontroller in order to send water for irrigation. The decision to switch the motor on or off is autonomous and taken without the user's input, yet doing so would only need a few easy steps. The user's phone may save and show the values that the sensors have collected. The Naive Bayes algorithm, which bases its judgment on a frequently occurring characteristic not being zero, determines whether to turn the motor on or off.

A WiFi-enabled system that employs an Arduino to collect temperature, humidity, and soil moisture measurements is suggested by Anitha, Sampath, and Jerlin [9]. For networking purposes, the Arduino is connected to the Node MCU (ESP8266). A third analytics service called Thing Speak receives the data gathered by the sensors and uses it to produce real-time visualizations and act as a platform for data storage. This device also includes a water level sensor that may be used to measure soil moisture. If the soil moisture level is low and moisture is detected by the water level sensor, the Arduino module sends a signal to the Node MCU to switch on the motor.

Naik, et al suggest an Internet of Things (IoT) system that uses a DHT11 and soil moisture sensor to provide temperature, humidity, and soil moisture measurements to an Android application on the user's phone [10]. When the moisture level falls below a predetermined threshold, the Arduino microcontroller sends a signal to the relay connected to it to switch on the motor. The user can check the motor's status as well as the current temperatures, humidity levels, and soil moisture levels using an Android app.

A system consisting of an Arduino microcontroller and soil moisture sensor is proposed by Mishra, Khan, Tiwari, and Upadhyay [11]. The soil moisture sensor gauges the soil's humidity level, and if it falls below a set threshold, a pump is activated. Depending on the crop that must be grown, the threshold value for soil moisture can be altered.

A soil moisture sensor, an Arduino microcontroller, and a GSM GPRS module for internet access make up the IoT system that Rawal has suggested [12]. In this method, the soil moisture sensor continuously records soil moisture levels and publishes them online. The Arduino microcontroller signals the relay module to turn on the motor if the measured soil moisture value falls below a predefined threshold value. A signal to switch off the motor is sent by the Arduino microcontroller if the moisture level has been restored. A website allows you to examine the motor status and soil moisture. Additionally, real-time data is sent to the ThingSpeak server, a third-party analytics service, for the purpose of displaying real-time graphs.

A crop suitability method based on machine learning is proposed by Doshi, Agarwal, Nadkarni, and Shah in order to address the issue of precise crop selection based on environmental characteristics [13]. Additionally, this



system has a linear regression-based rainfall prediction system that forecasts the quantity of rain that will fall in the farmers district each month of the year. Neural networks are used in the system since they were discovered via experimental research to be the most accurate machine learning model for crop suitability. The system accepts as inputs the season, soil type, soil pH, and properties of the soil. The model is trained using these parameters, and suitable crop suggestions are then made. 20 distinct types of crop recommendations are made by this approach. Additionally, it displays the region of the world most suited to cultivating the suggested crop.

According on historical data regarding crop productivity, Vaishnavi et al. present a crop recommendation system that suggests a crop for a specific season or year [14]. The designers of this approach used a machine learning model to anticipate the best crop to grow in a given year in order to maximise profit by analysing data of crop output by district. For instance, it was shown that there are very little possibilities of a farmer in Tamil Nadu's Coimbatore area losing money if he chose to plant bananas. A crop recommendation system based on machine learning has been suggested by Jadhav, Riswadkar, Jadhav, and Gogawale [15]. It takes climatic and soil attributes from the dataset as input and suggests the most suited for that specific climate and soil. The Random Forest method is used by the system because, in comparison to other machine learning algorithms, it was proven to be the most accurate. For using this technology, the authors have additionally created a web interface.

A crop recommendation system based on machine learning algorithms has been suggested by Gosai, Raval, Nayak, Jayswal, and Patel [16]. It suggests the optimum crop based on a range of soil and environmental data. The system uses data from the soil and environment to select a crop using a specific machine learning model. The authors used Decision Tree, Naive Bayes, SVM, Logistic Regression, RF, and XGBoost in this system. It was discovered that the XGBoost algorithm produced the best accurate results after training and testing the dataset on various methods.

A machine learning approach is proposed by Parikh, Jain, Gupta, and Dabhade [17] that suggests the optimal crop to plant based on a range of soil and environmental data. On a dataset with the aforementioned parameters, the model is trained and tested. Support Vector Machines (SVM), Random Forest, and Logistic Regression are only a few of the algorithms that have been trained and tested on the dataset, and their accuracies have been compared. Random Forest method was discovered through experimental analysis to provide the maximum accuracy. As a result, it was applied to the system.

III. PROPOSED METHODOLOGY

Logistic Regression:

Utilising logistic regression, the suggested system's second component predicts water requirements. Therefore, we are explaining logistic regression in this part. Logistic regression is one of the Machine Learning algorithms that is most frequently employed in the Supervised Learning category [18]. It is used to forecast the categorical dependent variable using a specified set of independent variables. Logistic regression is used to predict the output when the dependent variable is categorical. A discrete or categorical value must thus be the outcome [19]. It offers the probabilistic values that lie between 0 and 1 rather than the exact values between 0 and 1. It can be either True or False, 0 or 1, or Yes or No. Using both continuous and discrete datasets to classify fresh data, logistic regression is a crucial machine learning technique. Following eq. (1) is the logistic regression formula:

log [y / (1 - y)] = b_0 + b_1x_1 + b_2x_2 + b_3x_3 + ... + b_nx_n

.....eq. (1)

The approach makes advantage of the hardware-based system architecture to gather information on the crop kind, weather, and soil moisture. The necessary sensors for the Arduino circuit, which senses the information pertaining to these properties, make up the hardware. The main goal of using IOT and machine learning to create a low-cost smart irrigation system was to make it simpler for farmers to understand how much water is necessary for producing nutritious, disease-free crops. The agricultural field's data is collected by the sensors, who then feed it to the model.

Logistic regression is used to drive the automated system and prediction model, which forecasts water requirements. The sensor data will be used as input to the logistic regression, which will then decide if the input results in the agricultural field's water demands or adequate water availability. When the logistic regression concludes that the water level is below the necessary level, it triggers the water pump switch to turn on, supplying the agricultural field with water. The water pump switch is automatically driven to turn off if the logistic regression model concludes that there is



sufficient water available in the agricultural field or has been reached, preventing water waste. The suggested proposed methodology algorithm is depicted as follows:

Algorithm smartIrrigation_LR_based (soil_moisture, weather_conditions)

```

{
x1=soil_moisture;
//collect soil moisture from sensors and send it to LR through arduino circuit
x2=weather_conditions;
// collect weather conditions from sensors and send it to LR through arduino circuit
if (Logistic_Regression_water_pred(x1,x2) = 1)
{
calculate_water_level_required();
Switch_ON_pump;
}
Else
No_water_requirement;
}
    
```

As mentioned in the above algorithm the pump will be on automatically by the arduino circuitary only when water is needed for crops.

IV. DATA REQUIREMENTS

One gets the Kaggle dataset. This dataset came from a system that use a wireless sensor network to continuously monitor and control an irrigation system. Temperature (C), humidity percentage, and soil moisture requirement are the variables in the dataset that were employed in the suggested methodology. Temperature, humidity, and soil moisture are dependent variables, but the amount of water needed is an independent element. Some systems use the pH value to filter the water when it is dirty to ensure good crop production.

V. RESULTS AND DISCUSSION

The smart irrigation system using arduino IoT circuit and logistic regression provides better automation scale and accuracy performance. The important aspect of the research work is, every time the water requirements are calculated, the correct predictions of under watering and over watering should be accurately raised. In any case system should not mistakenly classify the water levels to under watering conditions, if isn't. The figure 1 shows the accuracy comparison of the Logistic regression based approach with other existing approaches of smart irrigation.

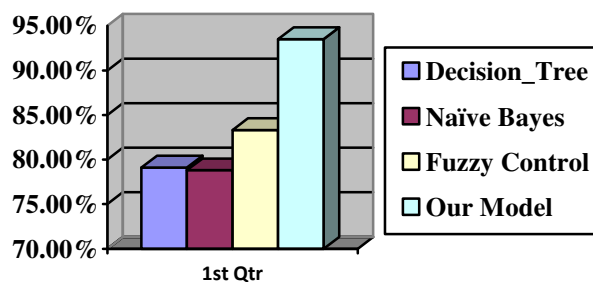


Fig. 1: Accuracy comparison

As shown in figure 1, the accuracy of the logistic regression based approach is 93.50%. This approach is also very fast in execution with better scale smartness of the system with minimal human intervention. The dataset from the kaggle site is used. Where, dataset for cotton crop is given. It has good number of various input samples which helps to improve the training and testing accuracy of the mentioned approach.



VI. CONCLUSION

Research on smart irrigation systems that employs machine learning and IoT-based circuits focuses on the completely automated method for watering farms and agriculture fields in this case. It details the method without personal involvement and accurately based logistic regression methodology estimates of water demands. Since only an Arduino board is required, the solution is also relatively inexpensive and accessible to everyone who owns farms. The effort required from farmers to operate this system is reduced because they are not required to physically access the agricultural fields or to operate any other component of the system. The automation in the model runs the water pump ON and OFF scenarios as needed once it is instantiated in the real world with the accuracy of 93.50%. The system's future scope allows for the consideration of more factors and the pursuit of quicker processing through the use of more sophisticated hardware circuits.

REFERENCES

- [1] Michie, D., Spiegelhalter, D. J., & Taylor, C. C. (1994). Machine learning. Neural and Statistical Classification, 13(1994), 1-298.
- [2] Géron, A. (2019). Hands-on machine learning with Scikit-Learn, Keras, and TensorFlow: Concepts, tools, and techniques to build intelligent systems. O'Reilly Media.
- [3] Raschka, S., & Mirjalili, V. (2019). *Python Machine Learning: Machine Learning and Deep Learning with Python, scikit-learn, and TensorFlow 2*. Packt Publishing Ltd.
- [4] MacKay, D. J., & Mac Kay, D. J. (2003). *Information theory, inference and learning algorithms*. Cambridge university press.
- [5] Chatterjee, C. C. (July, 2019). *The basics of CNN*. <https://towardsdatascience.com/basics-of-the-classic-cnn-a3dce1225add>.
- [6] Harley, A. W. (2015, December). An interactive node-link visualization of convolutional neural networks. In *International Symposium on Visual Computing* (pp. 867-877). Springer, Cham.
- [7] Megalingam, R. K., Indukuri, G. K., Reddy, D. S. K., Vignesh, E. D., & Yarasuri, V. K. (2020, June). Irrigation Monitoring and Prediction System Using Machine Learning. In *2020 International Conference for Emerging Technology (INCET)* (pp. 1-5). IEEE.
- [8] Ashwini, B.V., Study on Smart Irrigation System Using IoT for Surveillance of Crop Field, IJET, vol. 7, no. 4.5, 2018.
- [9] Anitha et al, Asha, Smart Irrigation system using Internet of Things, 2020, ic-ETITE, Vellore, India.
- [10] Naik et al, Automation Of Irrigation System Using IoT, IJEMS, vol. 8, no. 1, 2018.
- [11] Mishra, Dweepayan; Khan, Arzeena; Tiwari, Rajeev & Upadhyay, Shuchi, Automated Irrigation System-IoT Based Approach, 3rd International Conference On Internet of Things: Smart Innovation and Usages (IoT-SIU), Bhimtal, India, 2018.
- [12] Rawal, Srishti, IOT based Smart Irrigation System, International Journal of Computer Applications (IJCA), vol. 159, no. 8, 2017.
- [13] Doshi, Zeel; Agarwal, Rashi; Nadkarni, Subhash & Shah, Neepa, Agro- Consultant: Intelligent Crop Recommendation System Using Machine Learning Algorithms, Fourth International Conference on Computing Communication Control and Automation (ICCUBEA), Pune, India, 2018.
- [14] Vaishnavi, S; Shobana, M; Sabitha, R. & Karthik, S., Agricultural Crop Recommendations based on Productivity and Season, 7th International Conference on Advanced Computing & Communication Systems (ICACCS), Coimbatore, India, 2021.
- [15] Jadhav, Atharva; Riswadkar, Nihar; Jadhav, Pranay & Gogawale, Yash, Crop Recommendation System Using Machine Learning Algorithms, International Research Journal of Engineering and Technology (IRJET), vol. 9, no. 4, 2022.
- [16] Gosai et al, Crop Recommendation System using Machine Learning, IJSRCSEIT, vol. 7, no. 3, 2021.
- [17] Julien I.E. Hoffman, Chapter 33 - Logistic Regression, Editor(s): Julien I.E. Hoffman, Basic Biostatistics for Medical and Biomedical Practitioners (Second Edition), Academic Press, 2019, Pages 581-589, ISBN 9780128170847, <https://doi.org/10.1016/B978-0-12-817084-7.00033-4>.
- [18] Maalouf, Maher. (2011). Logistic regression in data analysis: An overview. International Journal of Data Analysis Techniques and Strategies. 3. 281-299. 10.1504/IJDATS.2011.041335.
- [19] Rymarczyk, T et al, 2019, Logistic Regression for Machine Learning in Process Tomography. Sensors, 19(15), 3400.



SJIF Scientific Journal Impact Factor

Impact Factor: 8.423



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

 9940 572 462  6381 907 438  ijirset@gmail.com



www.ijirset.com

Scan to save the contact details