International Journal for Research in Engineering Application & Management (IJREAM)
ISSN : 2454-9150 Vol-07, Issue-02, MAY 2021

Automatic Drip Irrigation using IoT and Machine Learning

[1]Jeeni Patel, [2]Ashutosh Dubey, [3]Ashutosh Singh, [4] Bibin Mathew

[123]Student, Dept of EXTC, St. John College of Engineering and Management, Palghar, India

[4]Assistant Professor, Dept of EXTC, St. John College of Engineering and Management, Palghar, India

Abstract Maintaining an irrigation system may be a necessity in today's water scarcity environment. The economy being highly supported agriculture demands innovative and reliable methods of irrigation. Agriculture planning plays a big role in economic process and therefore the food security of agro-based country. Crop yield prediction and selection of crops are the foremost challenging tasks in agricultural domain. The shortcomings of manual methods of irrigation are often rectified using automated process. This paper presents the idea of Automatic Drip Irrigation using IoT and machine Learning method and the following research sustains this idea. The task of automatic drip irrigation is done through assistance of IoT (Internet of Things), apart from that Machine Learning is used for crop prediction which will help farmers to increase more productivity of the field.

Keywords* —Automation, Crop Prediction, *Internet of Things, Machine Learning, Random forest

I. Introduction

Around the globe, agriculture plays a vital role in farming up the economy. In India agriculture contributes approximately 23% of GDP and employed workforce percentage is 59%. Though, India is one among the most important producers of agricultural products, the expansion in agricultural products has been stagnant for past several years. The present scenario necessities the use of water resources efficiently thanks to various reasons like increase in population growth, rapid urbanization and climatic change. This has stressed for an effective management of resources on our planet. The mismanagement of water used for irrigation not only leads to shortage of water but also effects the agricultural production. Therefore, it is necessary to optimize the water consumption by providing a control system for drip irrigation process. The manual interpretation of soil water shows inaccurate results. Also, human interventions in monitoring the crops lead to wastage of time and energy. The proposed system Automatic drip irrigation using IoT and Machine learning aims to provide a sustainable solution by automatic control and monitor of drip irrigation through application by using Internet of Things (IoT). In this paper, Random forest algorithm is used which aids in prediction of crop based on certain parameters.

II. LITERATURE SURVEY

In [1] Anushree Math et al proposed a system that provides a web interface to the user so that the user can monitor and control the system remotely. In [2] Ravi Kant Jain et al developed a system to optimize water use for agricultural crops. The objective of this paper was to control the water motor automatically. In [3] Pontnuru Sai Nishant et al concluded how the old farming data can be utilized to depict the future expectation of harvests and yields. Errors were minimized by using advanced regression techniques. In [4] Yuthika Shekhar et al proposed a complete automation system where devices predict the soil condition to water the field by communicating among themselves. In [5] Nor Adni Mat Leh et al investigated the whole concept of smart irrigation using the sample data collected for 7 days and compared between normal and smart irrigation and proved that smart irrigation was more helpful to the user because the farmers can monitor the plant condition directly through their home. In [6] Rama Chidambaram RM et al proposed a system using Image processing algorithm that helps to identify the disease part of the plant along automation in the irrigation system using IoT. In [7] P. Priya et al researched data of rainfall, temperature, and season of major crops and suggests the farmer with suitable crop supported their site- specific parameters. The classification K- Nearest Neighbors algorithm is employees to classify this proposed system. In [8] Pavankumar Naik et al discussed an optimal solution to water crisis by implementing Automation in irrigation. THINGSPEAK web server was used to store and retrieve data using HTTP protocol. In [9] Ramesh Medar, et al concluded that Naïve Bayes and K-Nearest Neighbor method provides accuracy in crop prediction. This algorithm solves farmers problem by calculating yield rate of crop and suggesting crops for land and selected season. In [10] Aruvansh Nigam et al concludes that Random forest regressor is the best classifier when parameters are combined to predict the right crop in a

 DOI : 10.35291/2454-9150.2021.0222

particular season. In [11] Aisyah Rahma Kholifah et al concluded that solar panel energy will be the power source to run the system controlled by IoT. This research was supported by Ministry of Research Technology and Higher Education of the Republic of Indonesia. In [12] Anneketh Vij et al concludes that efficient approach on IoT was established to automate the irrigation and the algorithm SVR, Random forest Regressor were accurate to predict the crop type. Overall, the aim of this system would be designing an efficient automated drip irrigation system and also provide best suitable suggestion for cultivation.

III. METHODOLOGY

The diagram of the proposed system is shown below figure 1. Block diagram for automatic drip irrigation using IoT and Machine Learning shows the proposed method of project. The proposed system involves use of microcontroller Arduino Mega as the heart of the system along with NodeMCU ESP 8266 which connects our system to IoT Platform. Various sensors such as (Temperature sensor, Soil moisture sensor, pH sensor, ultrasonic sensor) will help to collect information from the land and the collected information will be stored in Firebase Database which will be connected to our Android Application where user can view all the parameters easily by signing in. The user will have option to select the manual mode or automatic mode if user selects automatic mode, then the Arduino will initialize and collect the real time data and display on the application screen where average parameters as well as individual parameters will be displayed if view all parameters is selected. After checking the parameters if the parameters are less than the set threshold values then the motor will turn on and the drip irrigation will start and when the requirements are fulfilled it will turn the motor off. If manual mode is selected so the user will not be using the IoT system to irrigate and will control the motor manually. The application will also predict which is the suitable crop to grow according to the parameters (soil moisture, temperature, pH). For this we have collected dataset of two crops Kidney Beans and rice and trained the model using Random Forest algorithm. Using Pyrebase the model is then interfaced to the application where the user will the suitable crop depending on the parameters.

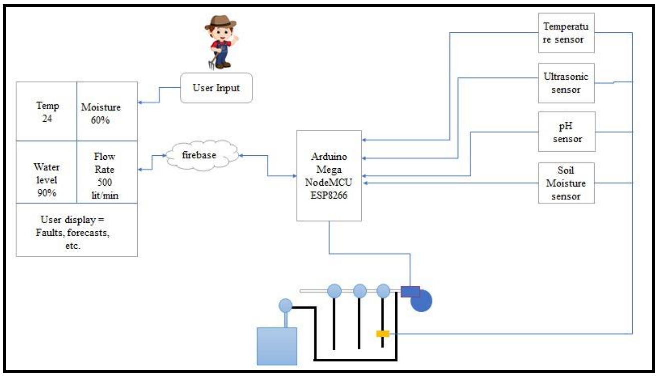


Figure 1 Block Diagram of Proposed System

The figure 2 below shows flowchart from the IoT part of the proposed system. The system starts when the user logins into the application. The user can select the mode that the application provides auto mode on/ off. If Auto mode on is selected then the filed parameters will be checked. Arduino will initialize and all the sensors (Soil moisture sensor, temperature sensor, pH sensor, ultrasonic sensor) will send the real time values to the database created in Firebase database. The average values will be displayed on the application screen also individual values of each sensors will be displayed when view all parameters is selected by the user. If the conditions are below the set threshold value, then the motor will turn on and the drip irrigation will start when the requirements are satisfies the motor will turn off automatically. The user can turn off the auto mode because during monsoons the fields are filles up with water and there is no requirement of irrigation so the user can turn off the auto mode. During monsoons when the fields are irrigated with the rain water and no water is required so no automation is required for particular time so the user can off the auto mode and just check the field conditions if required.

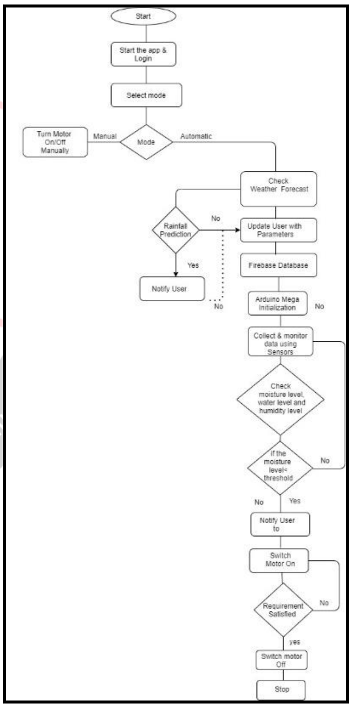


Figure 2 IoT Flowchart

The figure 3 below shows flowchart from the Machine Learning part of the proposed system. The application will provide crop prediction to the user. The dataset having parameters (temperature, humidity, pH) of two crops rice and kidney beans is collected. Using the Random forest algorithm, the model is trained. Using Pyrebase then the trained model is being interfaced with the application where the user can see the results according to the parameters which crop would be suitable to grow. Several algorithms will be tested and the best suitable algorithm will be used for the prediction of our crops.

 DOI : 10.35291/2454-9150.2021.0222

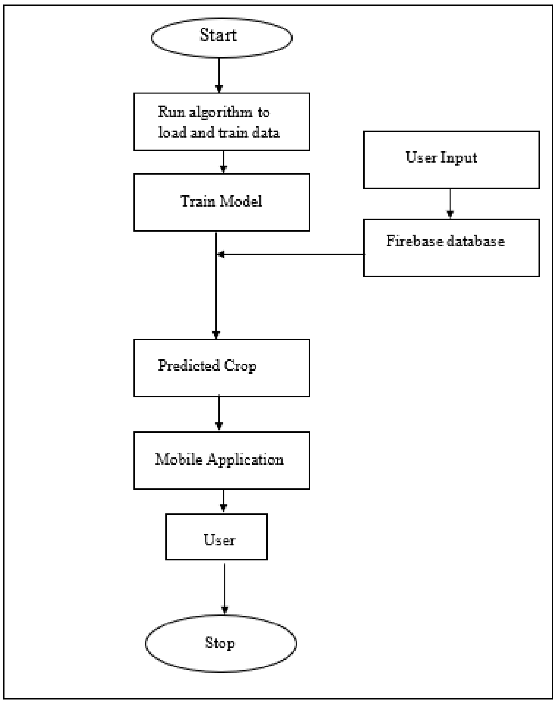


Figure 3 Machine Learning Flowchart

IV. RESULTS

The circuit of the above proposed system was designed in Proteus Professional Software.

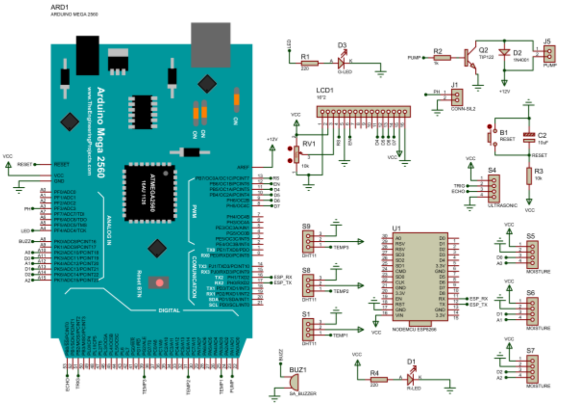


Figure 4 Circuit Diagram of the proposed system

The Circuit Diagram comprises of total 16 components they are Arduino Mega, NodeMCU, Lcd Display, DHT 11, Soil moisture sensor, pH sensor, ultrasonic sensor, Led, buzzer, Dc pump, Reset. Overall, 25 pins of Arduino Mega are used 9 analog and 14 digital and the 2 basic Vcc and Gnd pins. The two pins od NodeMCU is connected to Arduino mega along with Gnd and Vcc. 3 soil moisture sensors are used these sensors are connected to the analog pin of the Arduino Mega and the common pins are cone ted to Gnd and Vcc. 3 Temperature sensors, 1 ph sensor, LCD Display and 1ultrasonic sensor are connected to the digital pins of the Arduino Mega and the common connection Gnd and Vcc. Buzzer is added to circuit so if there is any problem in the circuit the buzzer will ring so we would come to know that there is any problem with the circuit. Led is used when the system will start the Led will keep blinking indicating that the system is On. Libraries of all the components are downloaded and installed in the Proteus Professional software after which the circuit is designed. The code for NodeMCU and Arduino Mega is written in the Arduino IDE Software. After designing the circuit diagram, we implemented the circuit on breadboard to check the working of the circuit. According to the circuit all the pins we connected to Arduino and using Arduino cable the code is uploaded to the board after which it is verified and shows successful results of implementation. All the sensors we working and the results were displayed on the LCD Display.

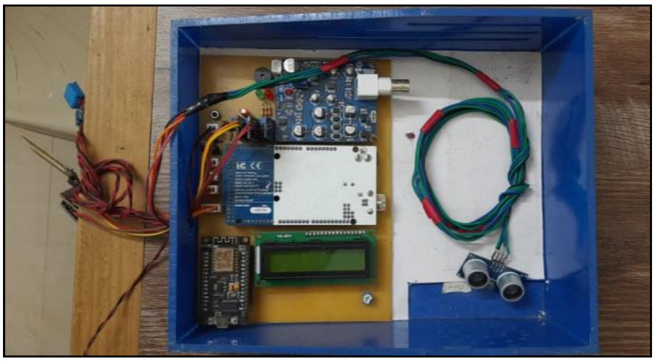


Figure 5 Final PCB

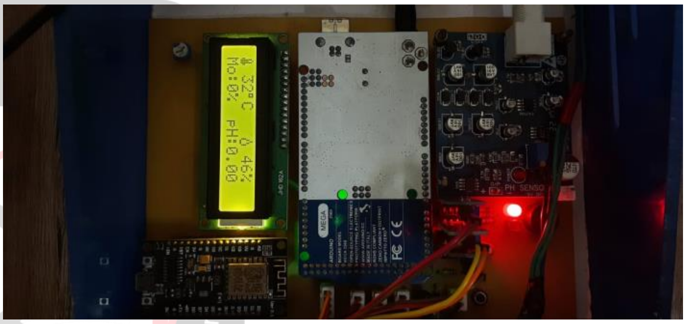


Figure 6 IoT interfacing

After soldering all the components, the code for Arduino Mega and NodeMCU was uploaded and verified. The blinking of LED tells us that the system is On and shows the various parameters on the LCD Display successfully. The figure 6 shows the Working of the System.

Figure 7 Final Model

The above figure 7 shows the model designed to test the working of our model.

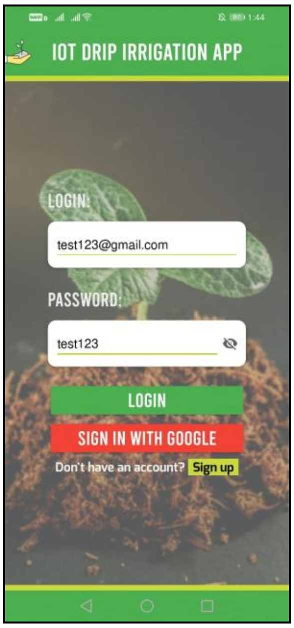
 DOI : 10.35291/2454-9150.2021.0222

ISSN : 2454-9150 Vol-07, Issue-02, MAY 2021

```
In [19]: #Import scikit-learn metrics module for accuracy calculation
         from sklearn import metrics
         # Model Accuracy, how often is the classifier correct?
         print("Accuracy:",metrics.accuracy_score(y_test, y_pred))

         Accuracy: 1.0

In [20]: import joblib
         # save the model to disk
         filename = 'finalized_soil.pkl'
         joblib.dump(clf, filename)

Out[20]: ['finalized_soil.pkl']

In [21]: # Use the loaded model to make predictions
         x = [[18.09551014,18.29318436,5.625096446]]
         x1=[[23.05804872,83.37011772,7.073453503]]
         predict = clf.predict(x1)
         print("Your Predictions:")
         if predict[0] == 0:
             print('Kidney Beans')
         elif predict[0] ==1:
             print('Rice')

         Your Predictions:
         Rice
```

Figure 8 Machine Learning Algorithm

For Crop Prediction we have used dataset of two crops Rice and Kidney Beans. The dataset is of 200 columns based on 3 parameters i.e., soil moisture, temperature and pH value. We have used Jupyter Notebook to write Machine Learning Algorithm. To test the efficiency, we used Naïve Bayer's Algorithm, KNN Algorithm and Random Forest Algorithm and found that Random forest was the best classifier when parameters (soil moisture, temperature and pH value) come into picture. So Random Forest Classifier was used to predict the crop. Using this algorithm model was trained and stored. Pyrebase is a simple python wrapper for the Firebase API. Using Pyrebase we will interface Machine Learning Prediction to our Application. After creating a server file and running it will allow our server to authenticate with Firebase. We can check through command prompt whether the request file is interfaced with Firebase. If it is interfaced that means we have successfully interfaced out Machine learning Prediction to our Application. The above figure 8 shows prediction of rice



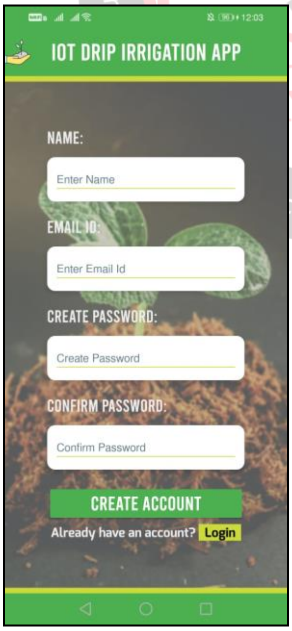
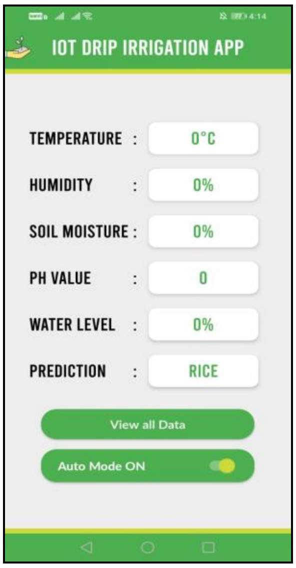


Figure 9 Login Screen **Figure 10 Sign Up Screen**

The above figures show the Final Result of our Application. Figure 9 and figure 10 shows the Login and Sign-Up Screen of our Application. The application is designed in Android Studio and interfaced with Firebase Database. If you are a new user then using the Sign-Up screen the user can register by entering Name, email and password and if the user has already sign up once then can login easily using the login id and password.



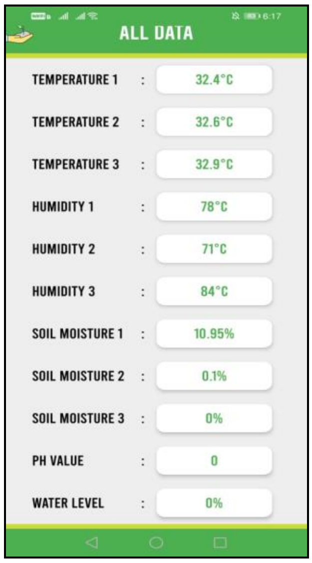


Figure 11 View Screen **Figure 12 View Parameter Screen**

After login in successfully the user can view the parameters (Temperature, Humidity, Soil Moisture, Ph, Water level) of the field and the predicted crop according to that parameters as shown in the above figure 11 View Screen. Also, there are two more buttons one to Select Auto Mode On/Off and the other button is to view all data. If the user selects view all data the all the values from the individual sensors will be seen on the screen as shown in figure 12. View all parameters screen. If Auto Mode is on then only the motor will turn on if the conditions are below the threshold value which will start the drip irrigation until the conditions are satisfied. If Auto mode is Off then the system will not start and the user can manually operate the motor pump.

V. Conclusion

The implementation of the proposed system "Automatic Drip Irrigation using IoT and Machine Learning" has various benefits for the users. Installing the Automatic Drip Irrigation System will optimize the usage of water and reducing its wastage. The system architecture is designed for monitoring and controlling of the soil sensor, temperature, humidity and Ph. These are interfaced with microcontroller Arduino Mega and NodeMCU for wireless communications with the database. The firebase database can be accessed through the application designed in Android. The system will provide water only when the parameters are below the threshold value when the desired moisture levels are filled the system will halt automatically and the pump will turn off. The pump in the water tank is utilized for the purpose of transferring water to drip irrigation. Hence, IoT based drip irrigation method provides an appropriate solution for accessing the supply of water sources for agricultural application. It has been established that Random Forest Regressor gives the highest yield prediction accuracy. Results reveals that Random Forest is the best classifier when all parameters are combined. This will not only help farmers in choosing the right crop to grow

 DOI : 10.35291/2454-9150.2021.0222

but also bridge the gap between technology and the agriculture sector.

VI. Future Scope

Future work would be converting the whole system in user's regional language. Although the proposed Machine Learning produced reasonable error rates, it can be improved further by using larger and newer data inputs that take into account the real-time fluctuations in the climatic and soil conditions due to unfortunate events. Larger dataset could help the model to train and predict with better accuracy. Deep learning and AI can be implemented to detect pest and disease in the field through image processing.

References

[1] Anushree Math, Layak Ali, Pruthviraj U *"Development of Smart Drip Irrigation System Using IoT"* IEEE, 2018

[2] Ravi Kant Jain, Bikash Gupta, Mustaq Ansari, Partha Pratim Ray *"IOT Enabled Smart Drip Irrigation System using Web/Android Applications"* IEEE-49239, 11th ICCCNT 2020

[3] Pontnuru Sai Nishant, Pinapa Sai Venkat, Bollu Lakshmi Avinash, B. Jabber *"Crop yield Prediction based on Indian Agriculture using Machine Learning"* International Conference for Engineering Technology (INCET), June 2020

[4] Yuthika Shekhar, Ekta Dagur, Sourabh Mishra, Rijo Jackson Tom, Veeramanikandan. M, Suresh Sankaranarayanan *"Intelligent IoT Based Automated Irrigation System"* International Journal of Applied Engineering Research ISSN, Volume 12, 2017

[5] Nor Adni Mat Leh, Muhammad Syazwan Ariffuddin Mohd, Zuraida Muhammad *"Smart Irrigation System Using Internet of Things"* IEEE 9th International Conference on System Engineering and Technology (ICSET), 7 October 2019

[6] Rama Chidambaram RM, Vikas Upadhyaya *"Automation in drip irrigation using IOT devices"* Fourth International Conference on Image Information Processing (ICIIP), 2017

[7] P. Priya, U. Muthaiah, M. Balamurugan *"Predicting Yield of Crop using Machine Learning Algorithm"* International Journal of Engineering Sciences & Research Technology, April 2018

[8] Pavankumar Naik, Arun Kumbi, Kirthishree Katti, Nagaraj Telkar *"Automation of Irrigation System using IoT"* International Journal of Engineering and Manufacturing Science, Volume 8, November1, 2018

[9] Ramesh Medar, Vijay S. Rajpurohit, Shweta *"Crop Yield Prediction using Machine Learning Techniques"* 5th International Conference for Convergence in Technology (12CT), 2019

[10] Aruvansh Nigam, Saksham Garg, Archit Agrawala, Parul Agrawala *"Crop Yiels Predcition Using Machine Learning Algorithm"* Fifth International Conference on Image Information Processing (ICIIP), 2019

[11] Aisyah Rahma Kholifah, Kelvin Islami Albar Sarosa, Rurin Fitriana, Inna Rochmawati, Moechammad Sarosa *"Drip Irrigation System Based on Internet of Things (IoT) using Solar Panel Energy"*

[12] Anneketh Vij, Singh Vijendra, Abhishek Jain, Shivam Bajaj, Aashima Bassi, Arushi Sharma *"IoT and Machine Learning Approaches for Automation of Farm Irrigation System"* International Conference on Computational Intelligence and Data Science (ICCIDS), 2019

 DOI : 10.35291/2454-9150.2021.0222