Automatic Farm Covering System in Unfavourable Conditions Using Iot & Machine Learning

Swati Nawange
Student
D.Y. Patil College of Engineering, Akurdi, Pune, India

Akash Palhade
Student
D.Y. Patil College of Engineering, Akurdi, Pune, India

Hemant Patil
Student
D.Y. Patil College of Engineering, Akurdi, Pune, India

D. G. Khairnar
Project Guide
D.Y. Patil College of Engineering, Akurdi, Pune, India

Prashant Titare
Project Guide
D.Y. Patil College of Engineering, Akurdi, Pune, India

Abstract

India is the country where 70% of the population depends on farming. Farming is the primary resource income in rural parts of India. As the population is increasing day by day, the need for huge Raw materials is also required for processing food. So there will be a huge constraint on the farming sector. Nowadays, due to global warming and other drastically changing environmental conditions like heavy rains, the crops get damaged at the yielding stage and cause a significant loss to the farmers. There is also a need for advanced farming adaption techniques in the fast-changing technology world. Every farmer believes in good results at yielding stage and excellent quality. For fulfilling the above conditions, an Automatic farm covering system in unfavourable Conditions and parallel a Smart irrigation system is developed. These will help to reduce effects at the yielding stage also provides irrigation smartly. The project consists of Raspberry Pi as a controller, three different sensors (DHT 11, humidity, moisture, soil) as input. The output is connected to Raspberry Pi which consisting Driver IC and high torque DC motor, valve. The output is activated by the developed App. It takes required inputs from the user, uploads them to the server. It has a client-server architecture. The raspberry pi processes data as per intelligence given to it by the Machine Learning model. Machine Learning algorithm (Random forests Classifier) works on sensor data for predicting the mechanism of automatic ON / OFF system. The predicted result is given as output to the Motor driver and Valve for Automatic ON and Off purposes. The farmer can able to do an Automatic Shut/Open system by using an App (Mobile application controlled through Internet). All processes such as irrigation, covering the system in unfavourable conditions can be held remotely with the help of App and a Smart automation system.

Keywords: Random Forest Classifier, DHT 11, Automation, Soil, and Moisture Sensor, Data Modelling

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I. INTRODUCTION

This project has been designed for surveillance of irrigation systems and automatic farm covering in unfavorable conditions without the need of manual checking of irrigation systems. For example, if a person is staying in Bangalore, and have a farm in Andhra Pradesh or elsewhere and it is not possible to go to the farms every time to keep an eye on the plants. The proposed project idea will definitely solve the purpose. The basic idea is demonstrated in block diagram as shown in Figure 1. Sensors are connected to the Raspberry pi which identifies the condition and processes the output and give input to the Controller which does operations and enables the automatic mechanism to cover the farm with covering sheets. Also, there is app, which is used for on/off and monitoring purpose of different activities related to it. [1]-[5]

This system consists of hardware and software components. The hardware part consists of different sensors like soil moisture sensor, DHT11 sensor, soil sensor whereas the software part consists of a Mobile application connected to the Raspberry pi and other hardware components using Internet of Things. Also, by using the supervised machine learning model, like Random forest technique, the prediction of different activities can be captured and notified. The Mobile application consists of Monitoring and controlling the System. The improvement in irrigation system using wireless network is one of the solution to achieve water conservation as well as improvement in irrigation process.[6]-[9]

The further paper is summarized as description of system, followed with experimental procedures, algorithm, dataset values, flowchart, Simulation output, Hardware output and then concluded with API based output and conclusion.

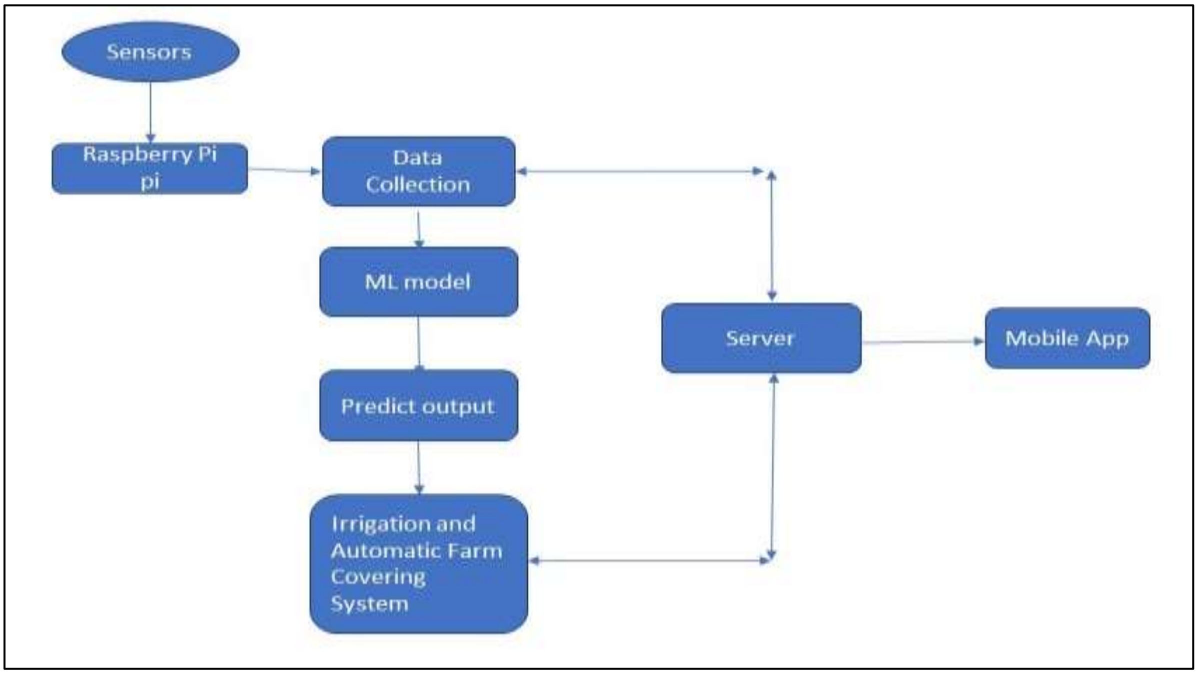


Fig. 1: Block Diagram

II. LITERATURE SURVEY:

A. *Smart Gardening Automation using IoT with BLYNK app. [10]*

Abstract: In this world, everyone wants his/her life to be easy, comfortable, fast and efficient. The idea is to advance our traditional system to a sensible Automated System for supplying water in home gardening, farms fields, etc.
In this system, soil wetness detector, temperature detector and humidity detector are mounted at the root space of the plants.
They collect all the data and transfer it using Wi-Fi to notify the user about levels with reference of set point. and shows the result using Blynk App.

B. *Design and Implementation of a sustainable IOT enabled greenhouse prototype. [11]*

Abstract: As per the population the production of food is not sufficient. solution to this problem is to use improved GREEN HOUSE in farming. This project automates greenhouse farming by regulating climate within the greenhouse consistent with the plant specified from the database. The plants are kept at optimum temperature, humidity, light and soil moisture levels with little or no input from the user. The controllers can be activated directly by the regular updates and monitoring of data.

C. *Farm Automation based IOT. [12]*

Abstract: In smart agriculture, losses of irrigation water and fertilizer are minimized and create a Suitable climate in terms of humidity and temperature to enhance the crops produced on the farm. The main aim is to establish the agricultural field control system using soil moisture, and climate sensors. By observing the changes in these parameters, the irrigation system, temperature, and humidity are often monitoring via the web and automatically controlled if certain criteria differ from reference values.

III. EXPERIMENTAL PROCEDURES:

Initial process is to get the signal from different sensors about the parameters like humidity, rain, moisture percentage and temperature. Sensor data will be given to Raspberry Pi and accordingly to the input parameters of the machine Learning model. The input to the predict function is moisture content, Crop type and age of the crop. The Machine learning model will predict the output for those parameters and according to output of Machine Learning model, Raspberry pi control the all-irrigation System of Farm. By evaluating these signals some sort of output in the form of pulses is given to the microcontroller which is the most important component of the system.

For covering mechanism, there is a semi-circular structure with the covering sheets. As conditions get abnormal, the senses data from the sensors triggers the raspberry pi which gives instructions to IC drivers to Turn on the Covering mechanism via high torque DC motors. The Covering mechanism starts working automatically with the intelligence given to raspberry Pi. The covering mechanism can be operated by the Smartphone App at remote locations.

We need a smartphone or a remote access system for monitoring and controlling the system by means of an application. Raspberry Pi sends sensors data to server to monitor and control the system from mobile App. The mobile is also work like an admin panel for a system which is responsible for to add the crop details for enhancing the accuracy of the machine learning model.

IV. RANDOM FOREST CLASSIFIER:

The purpose of Machine Learning is to optimizes water usage and provides essential amount of water and fertility to field improves yield production, reduces manual intervention, and diminish crop diseases. Random Forest is technique based on supervised machine learning algorithm. Mainly used to for huge dataset. Before using Random Forest classification scaling is needed to be done. This action is to improve the accuracy of model, decreasing the overlap between decision trees and make it simple by reducing complexity. Random forest may be a adaptable, easy to use machine learning algorithm that produces, even without hyper-parameter tuning, a superb result most of the time. The dataset has to be divided into training and test set for prediction. The output of the model accurately should be predicted as per trained by the train datasets. The accuracy can be determined by the confusion matrix.

To explain the effectiveness of the Smart Irrigation System based on Random-Forest, the dataset as training and test Dataset is being selected.

1) Training: To recognize various Condition of Temperature and Moisture in the soil. In the research it is done by calculating best suitable moisture percentage for a crop.
2) Testing: It is similar to the training. After training the system is tested using a test dataset. This dataset is smaller than the training dataset to ensure that the network can detect intrusions it was trained to detect.

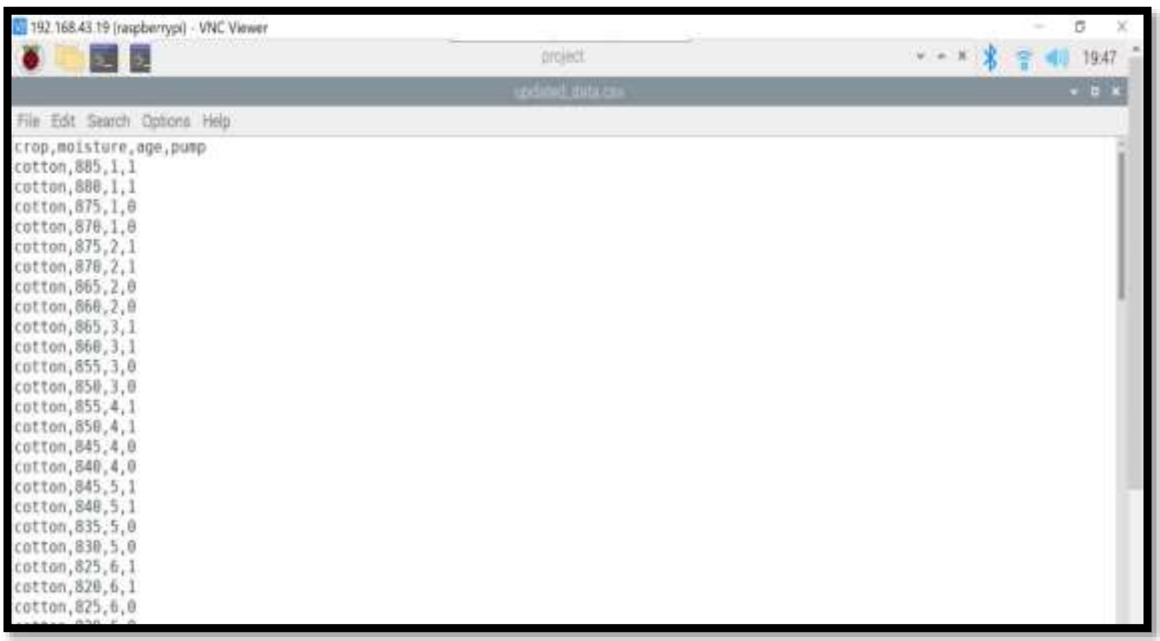


Fig. 2: Dataset Train/Test

It is the Real Time Database of 400 Entries. This dataset is divided into train dataset (75%) and test dataset (25%) after feature selection.

Fig 2: The four values crop, moisture, age, pump are the data inputs given to the machine learning model. These four values possess the predict function and gives the output based on decision trees. The decision tree gives 1 or 0. 1 meaning to start irrigation and 0 meaning to stop irrigation.

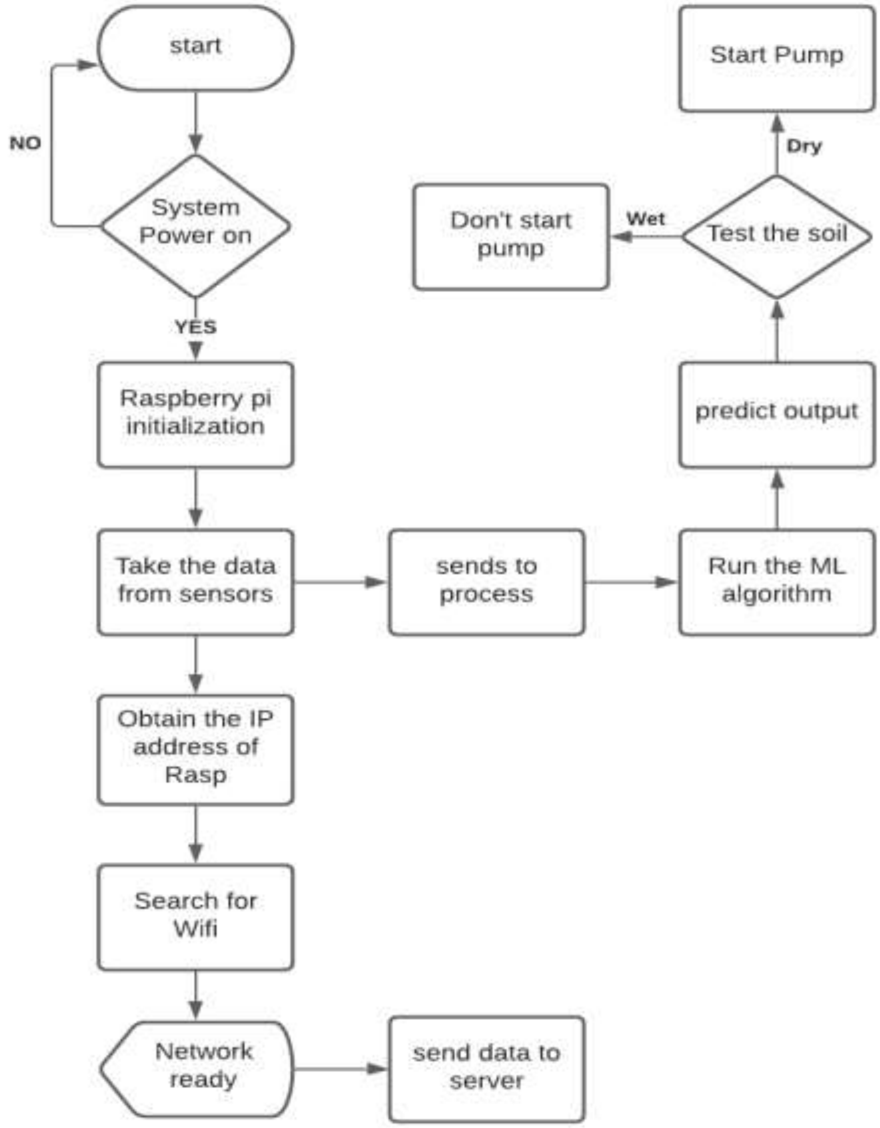


Fig. 3: Flow chart

The flow chart shows the steps of execution. It exhibits the algorithm in serial order.
The ADC converts the analog output of soil moisture to digital value. The moisture content in terms of percentage is displayed on the screen. The output of the soil moisture sensor changes within the range of ADC value from 0 to 1023. This can be showed as moisture value in terms of percentage using formula given below.
Analog Output = ADC Value / 1023
Moisture in percentage = 100 – (Analog output * 100)
For zero moisture value, we get maximum value of 10-bit ADC which is 1023. This in turn gives ~0% moisture.

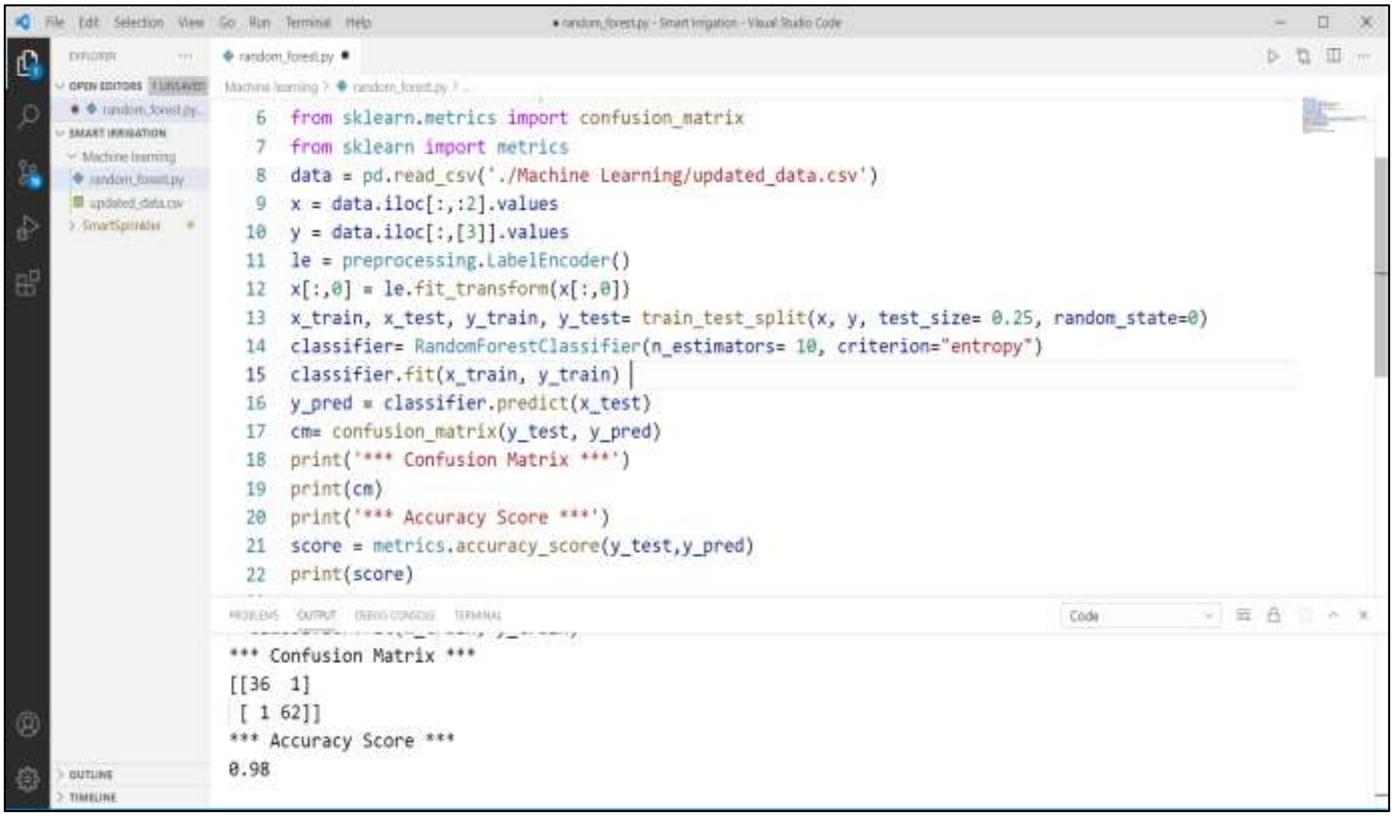


Fig. 4: Output of Random-Forest Algorithm

The algorithm gives 98% percent accurate results for test data. The confusion matrix results in 36 True positive and 62 True Negative. The false-positive and false-negative ratio is very less i.e. 1

Results:

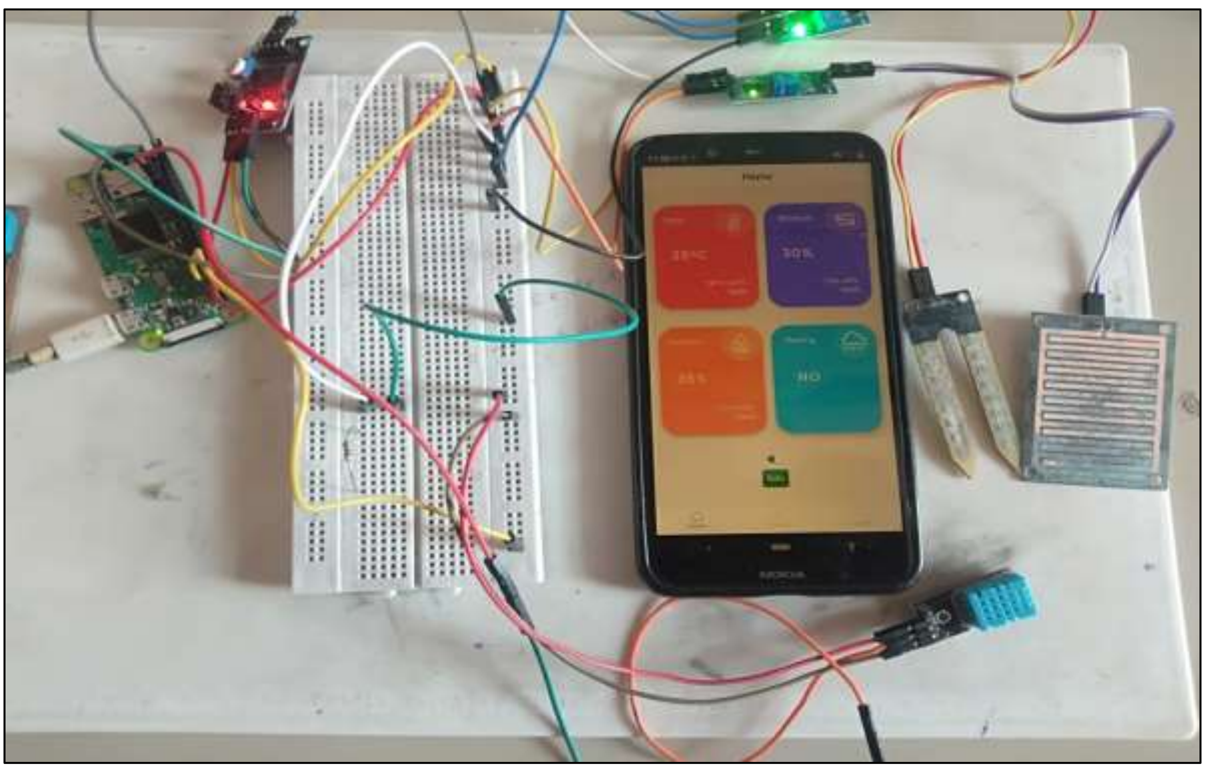


Fig. 5: Sensors data (Dry soil and not rainy)

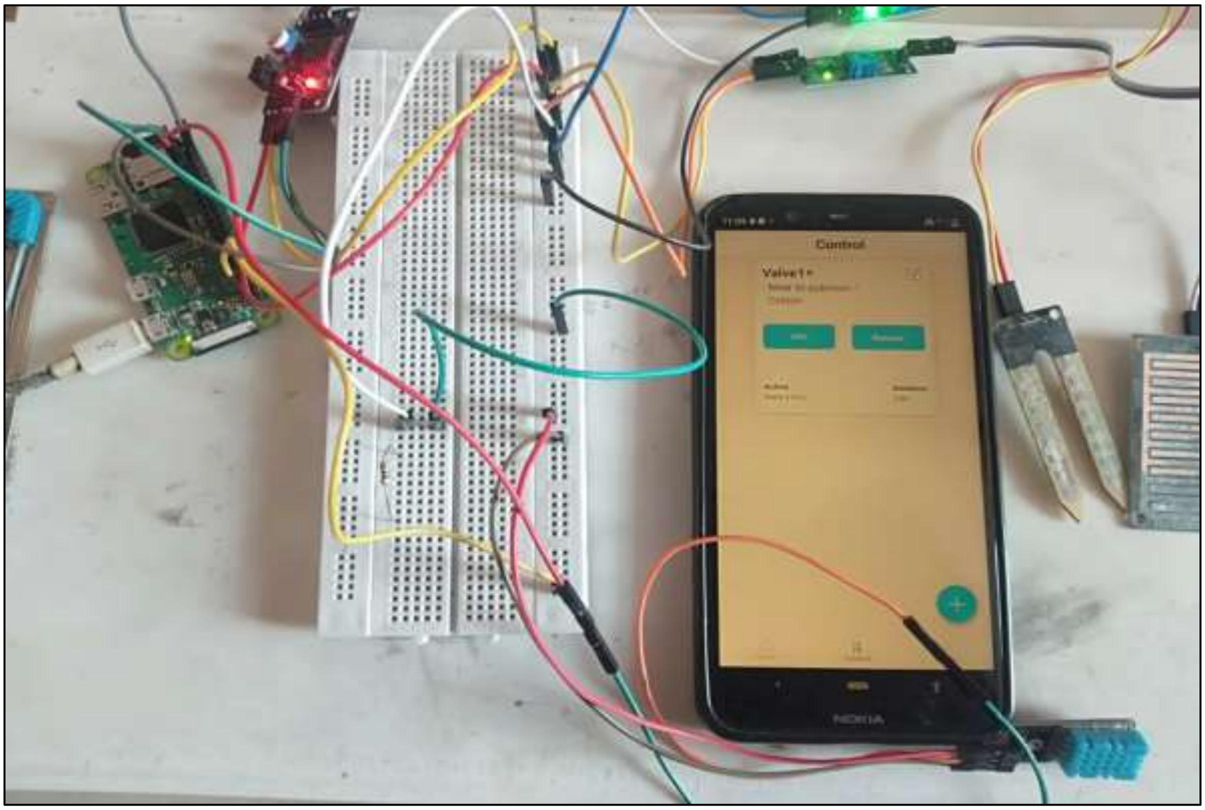


Fig. 6: Sprinkler status at dry soil

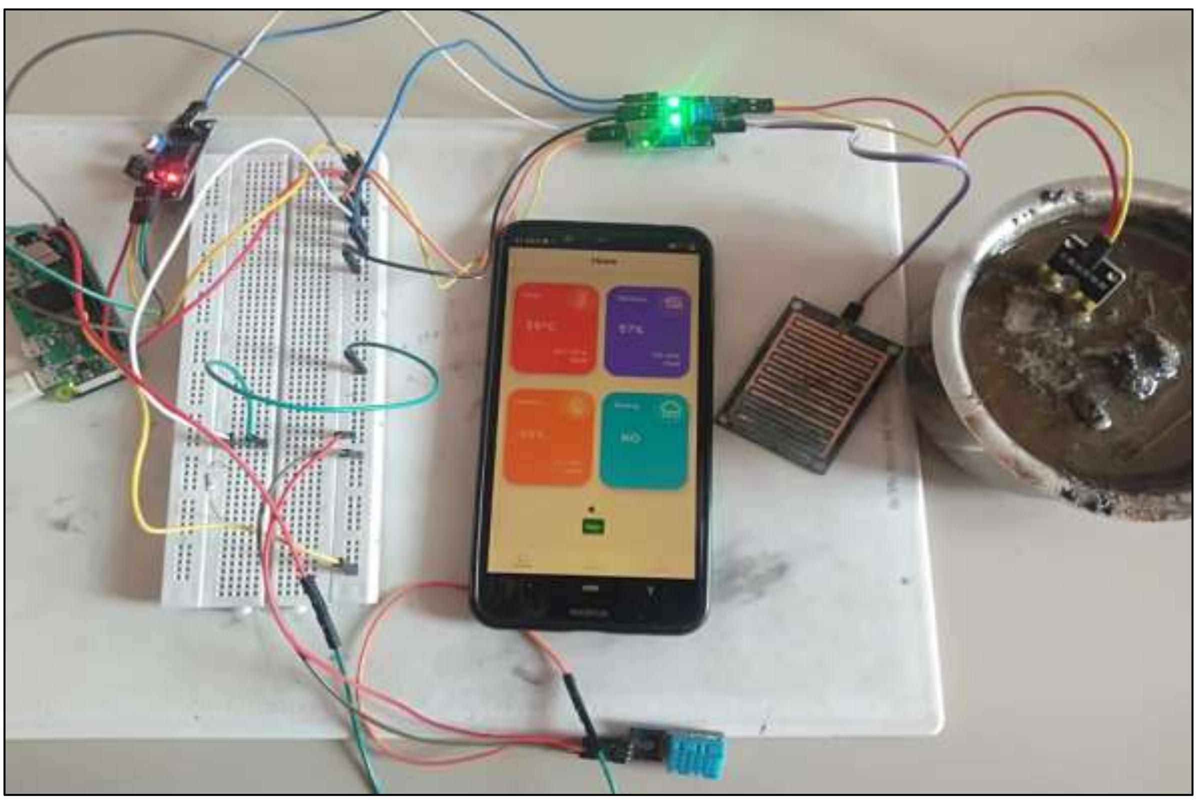


Fig. 7.1: Sprinkler status at Wet Soil

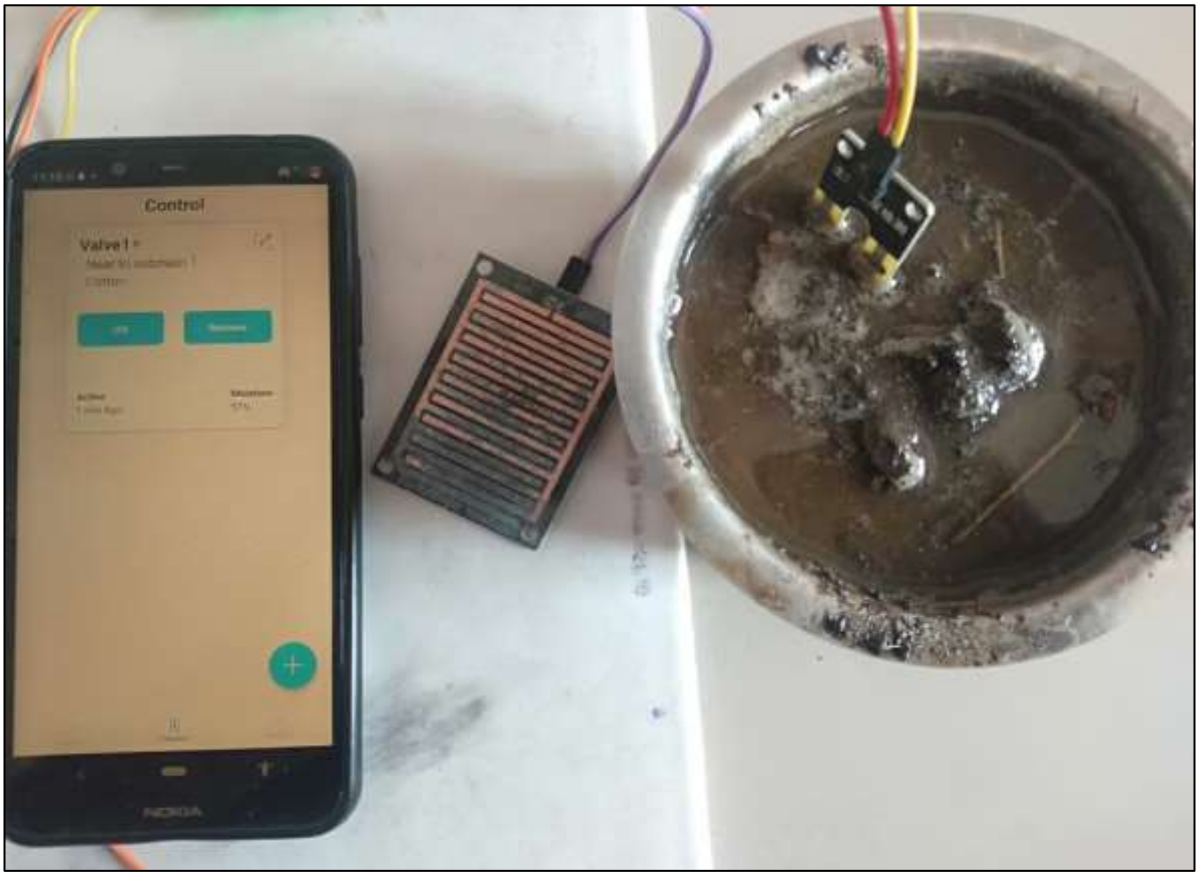


Fig. 7.2: Valve 1 is ON

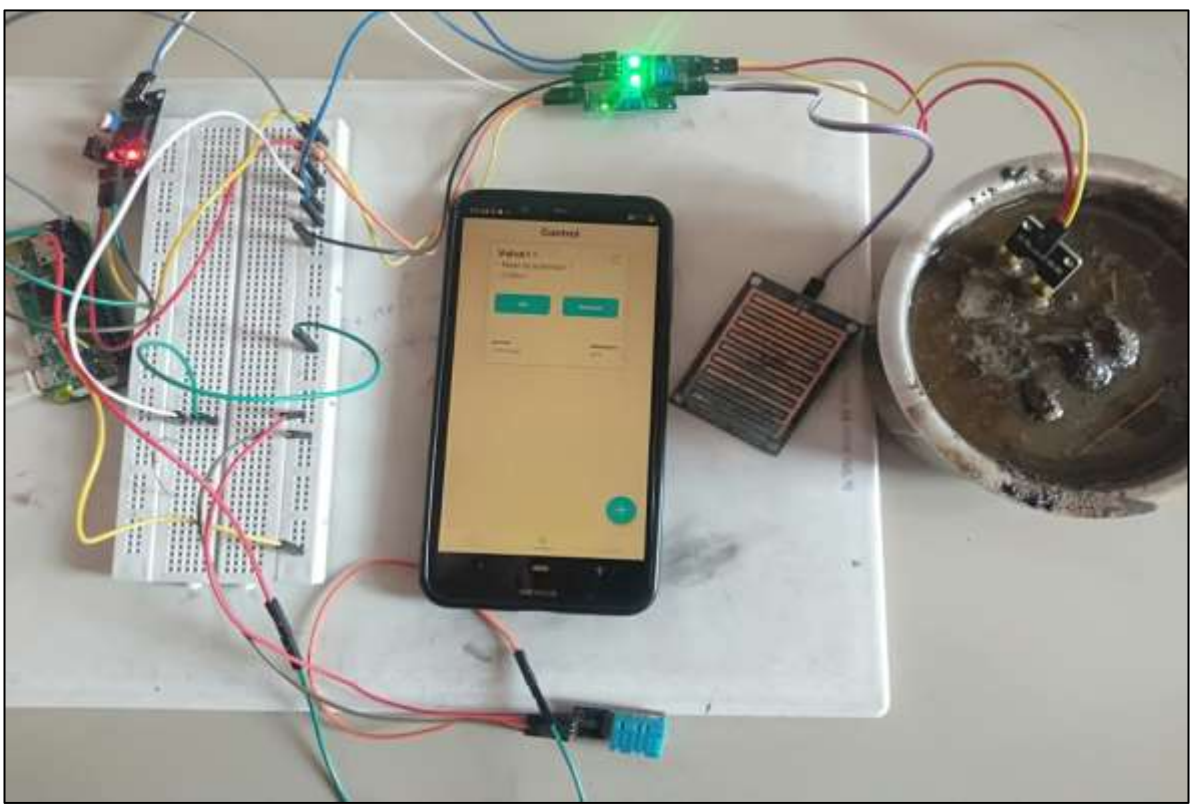


Fig. 7.3: System is ON and working

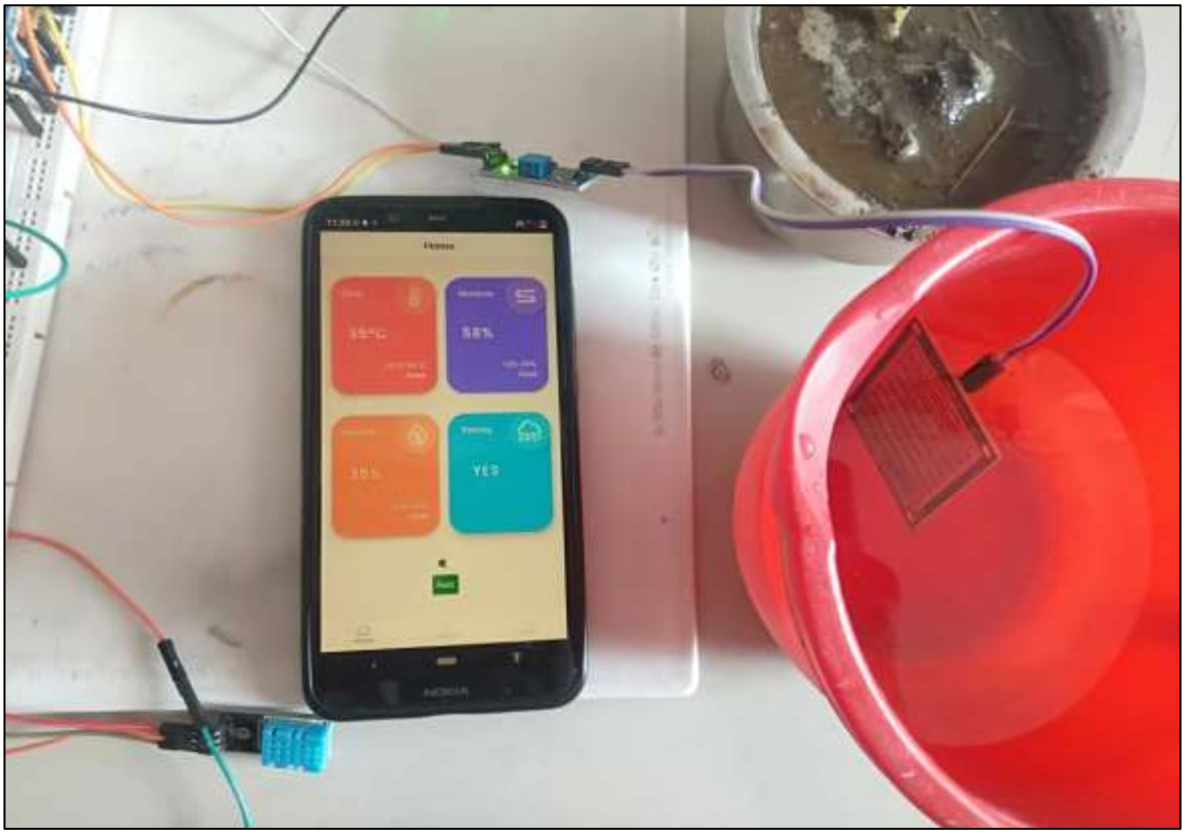
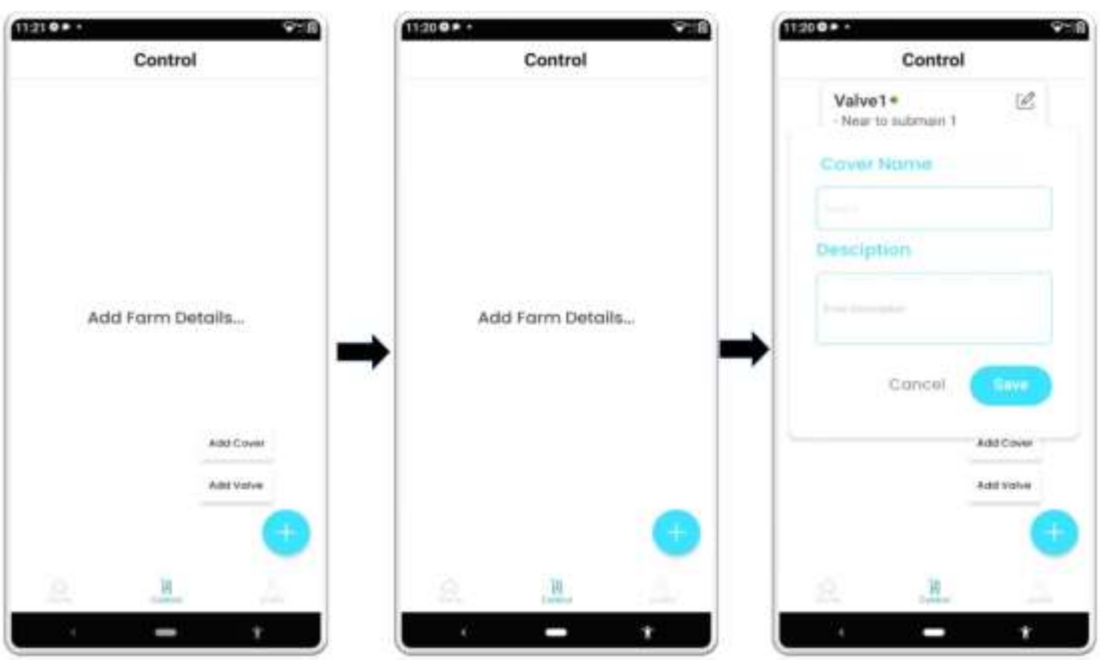


Fig. 8: Sensors Output During Rain

V. APP UI:



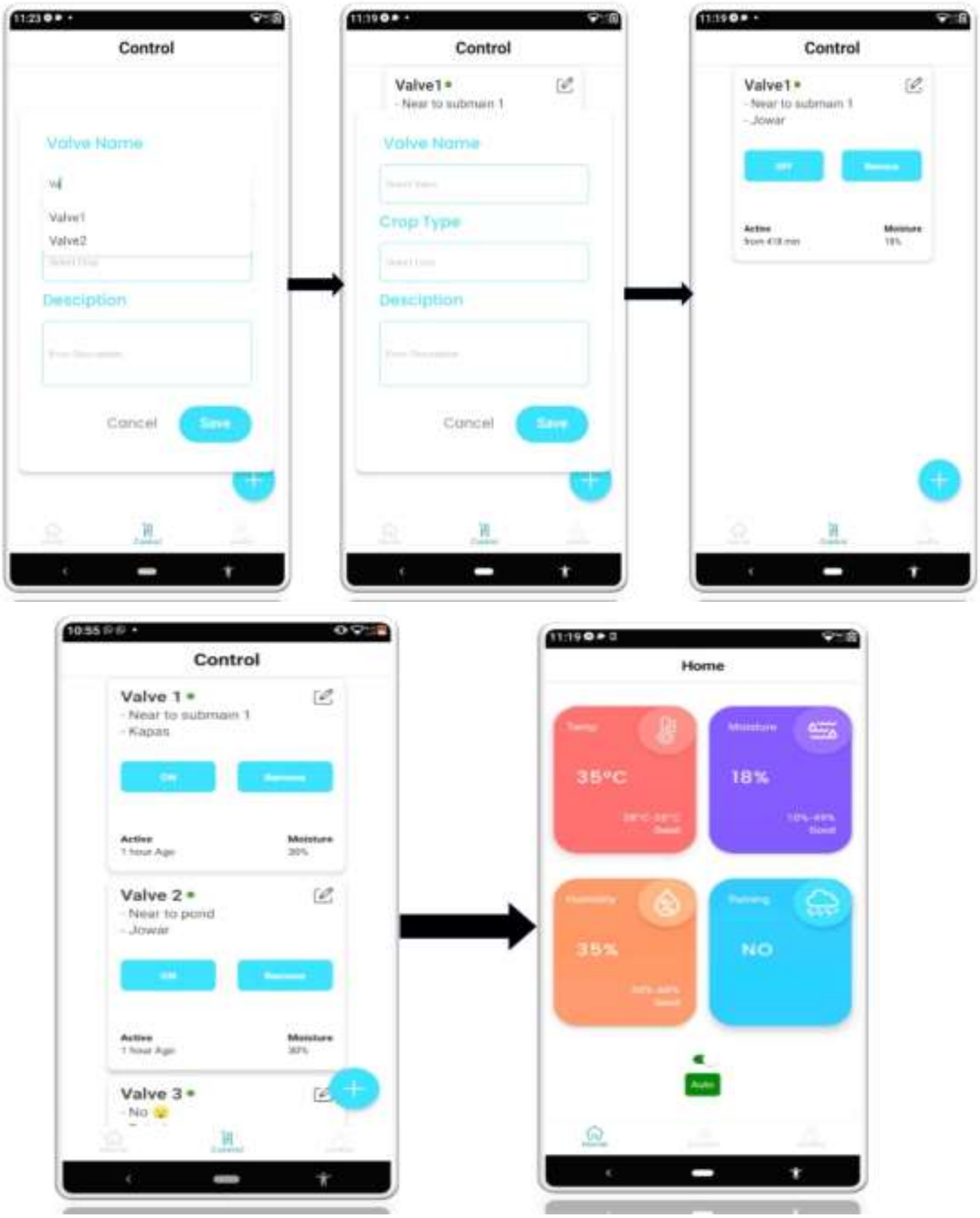


Fig. 8: Home and Control Page

Fig 7: The rain, moisture and DHT 11 sensors are working properly, showing correct output at App side. As the threshold level of moisture sensor crosses, initiates valve 1 opening at subdomain one.

Fig 8: When the rain occurs, rain sensor detects it and showing the status of raining on App side. The data is sent to server via raspberry pi and visible to the client.

Thus, using IOT based android app and machine learning algorithm of robust forest classifier, the farms can be covered automatically during unfavourable condition. Without adding sufficient amount if cost, the project proves to be like a safety guard for the crops. Hence implementation of such ideas is beneficial to farmers.

VI. CONCLUSION:

Farm automation system and smart irrigation system is developed and its experimentation is presented in this paper. The farm automation with integration of Machine learning will give best crop results in future. The scope of this project is to help farmers and to reduce the effects caused by the adverse environmental conditions. The smart irrigation leads to watering in whole field in efficient way. The App developed is easy to use and can be used as on/off purpose and also this app can be used as monitoring purpose. The use of different technologies in efficient way leads to improvement in final results and helping the nation. The use of future technologies will help the people to sustain with higher quality of life.

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