International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 05 | May 2020 www.irjet.net p-ISSN: 2395-0072

Intelligent IoT based System for Agriculture

Abhishek Dhekane[1], Akshay Chavan[2], Rahul Chavan[3], Payel Thakur[4]

[1,2,3]B.E Student, Dept. of Information Technology, Pillai College of Engineering, Navi Mumbai, Maharashtra, India
[4]Professor, Dept. of Information Technology, Pillai College of Engineering, Maharashtra, India

---

Abstract - *Agriculture is one of the major parts of a country's economy.[7] But recently, weather change has affected crop growth adversely and farmers are suffering. In such a situation, it is necessary for us to get smarter and be able to use the resources we have intelligently. We propose a method of farming wherein a farmer's job is reduced immensely and resources are used adequately. We aim to develop an IoT based project which will automatically do the work of irrigation on the basis of an FC-28 soil moisture sensor.[2] We will be using machine learning to detect if a crop is getting affected by a disease and what disease it is.[3][6] This system will also provide suggestions to the farmer on how to prevent these diseases and if at all the crop gets infected, what all can he do to solve this issue. Farmer will also be notified regarding the health of the soil, on the basis of which required fertilizers can be suggested. All the sensor data can be extracted using Raspberry Pi. The farmer can get all the measured data (soil humidity, temperature, pH etc.) on the android application.[4][5] This app also provides him with the ability to control the irrigation. The main target of this system is to provide farmers with a system which can help him grow a high yield of healthy crops with adequate use of resources.*

Key Words: Irrigation, Fertilizers, Crop disease, Arduino, Raspberry Pi and Sensors

1. INTRODUCTION

Agriculture has been one of the major contributors to the GDP of India. Around 60-70% of our population depends upon agriculture as their source of livelihood, out of which 50% is the direct workforce.[9] Even after huge enhancements in technology in almost every sector, farmers have been using manual methods to monitor and manage all the agricultural processes. This is the reason that Indian farmers face huge issues related to the productivity. There might be problems like excess or reduced irrigation, or improper fertilizer utilization without proper knowledge about soil's current state and crop's requirement. The climate change has affected average rainfall severely. Many farmers have not been able to irrigate crops adequately leading to reduced or no productivity. Automated systems can help farmers cope with such issues by using available water and resources intelligently.

2. PROPOSED MODEL

2.1 Overview

The system will be designed to control and monitor the present environmental conditions of the agricultural plot using sensors. These sensors and the chips will the controlled by Raspberry Pi 3 to implement IoT. All the data fetched by sensors will be processed and actions will be performed accordingly. The complete system is automated and very minimum human interaction is needed. This system can also be managed manually using Android application. The environmental parameters to be checked are temperature, moisture, humidity, pH and light. The user can set threshold values for the parameters and get alerts on the mobile phone whenever the parameters deviate from threshold value.

2.2 Existing System

The existing intelligent agricultural system consists of two sensors for irrigation purpose, i.e. Temperature sensor and soil moisture sensor. The temperature sensor continuously monitors the soil temperature whereas a soil moisture sensor collects the data regarding the soil's moisture. Both of these data are time to time sent to the microcontroller. In this system, Arduino is used to collect the data. This data is then sent to edge level processor called Raspberry pi 3 using serial communication for further processing. In raspberry pi3, K-NN Machine learning algorithm been employed for predicting the soil condition based on Moisture and Temperature level. The data is processed there and decisions are made on the basis of a trained model. The predicted output is then used for sending the control signal to Arduino for controlling water pump for watering the field accordingly. The last and final component is recording the soil moisture and Temperature level. This stage also does prediction with date and time in the cloud server. The farmer can access this cloud data remotely to have good knowledge and understanding on field being irrigated. If the field shows dry status, farmer can instantly turn on the irrigation facility and turn on when soil has enough water. Though this system provides farmers a continuous update regarding soil's status but that increases manual work of farmers. [1]

2.3 Proposed System

In today's life, use of technology can be seen in almost every field. If agriculture or farming is combined with automation, it will reduce manual work to a greater extent. India being a tropical country relies on agriculture for large part of its GDP. But recent atmospheric changes have caused a huge issue in crop production. The proposed system's first focus is on automated irrigation. In this, multiple factors such as soil temperature, soil moisture, outer temperature, outer humidity, and water availability will be considered to predict the status of soil. Water availability is an important aspect when it comes to irrigation nowadays as there are very few water sources available at some places which needs to be used adequately. Once the soil's status if identified the actions such as starting or stopping irrigation can be done automatically by the system. Secondly, the soil pH will be

monitored time to time to inform farmer about the soil's health. pH of the soil tells a lot about future of plants. Every crop requires different kinds of soil pH levels, and farmer must put fertilizers in accordance to that. This system will also suggest the fertilizers to be used by farmers to maintain soil health, via the Android app. Another major functionality of this project is disease prediction. For this, it will use soil temperature, soil moisture, soil pH, outer temperature and outer humidity.

All the necessary sensors will be connected common device, say Arduino. The Arduino will send this acquired data to raspberry pi3 for further processing. Raspberry pi3 sends this data back to Arduino for performing proper functions. The system will also consist of an android application, which can be used to monitor all these sensors output. It will also notify the farmer about the diseases if any. If at all, a plant gets diseased, the android application can help farmer find the solution regarding it.

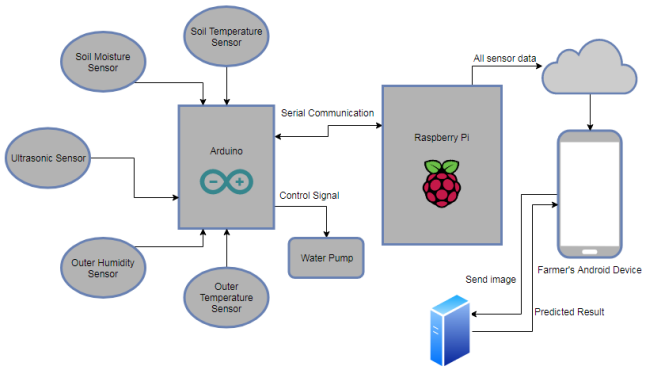

Fig-1: Proposed System Agriculture

2.4 Hardware and Software Specifications

The experiment setup is carried out on a computer system which has the different hardware and software specifications as given in Table 1 and Table 2 respectively.

Table-1: Hardware Details

Processor	2 GHz Intel
HDD	500 GB
Ram	4 GB

Table-2: Software Details

Operating System	Windows 10 Professional
Programming Language	JDK 1.8

3. CONCLUSIONS

Since the project consists of two different modules, i.e. IoT and image processing, the type of inputs and outputs are different for both. The IoT section or the irrigation and soil health section consist of sensors mostly and a motor, meanwhile the image processing for disease detection has images as the input and disease status as the output. To display and process all these things we chose android as the platform. We build a mobile application which could display all the sensor data and will also do disease detection.

Fig-2: Physical Model

3.1 Input Details

The project is implemented in two modules. The first module, i.e. the model for intelligent crop irrigation and soil health is implemented using Internet of Things. Various sensors like Soil Moisture sensor, soil temperature sensor, outer temperature & humidity sensor and rain sensor are used to collect information for proper irrigation and to notify farmer regarding the soil health. Apart from that, the ultrasonic sensor is used to check the water level in the well or the tank. All these sensors keep sending the collected information to raspberry pi.

The second module is based on image processing. When plants and crops are affected by pests it affects the agricultural production of the country. Usually, farmers or experts observe the plants with the naked eye for the detection and identification of disease. But this method can be time processing, expensive and inaccurate. Automatic detection using image processing techniques provide fast and accurate results.

3.2 Dataset description for Disease Detection

We have chosen a dataset consisting disease information of 12 plants and analyzed 54,306 images of plant leaves, which have a spread of 38 class labels assigned to them. Each class label is a crop-disease pair, and we make an attempt to predict the crop-disease pair given just the image of the plant leaf. The below figure shows an example of leaf images from the PlantVillage dataset, representing every crop-disease pair used.

Fig-3: Sample Leaves

3.3 Evaluation Parameters Details

The data collected from sensors is used to decide whether a to start irrigating plants or not. The irrigation of plants is decided on the basis of factors such as soil moisture, soil temperature, outer temperature and humidity. Once the system verifies the overall state of the soil, it decides whether to start the motor or not. Not only that, but the system also determines the amount of water to be irrigated depending on the outer temperature, humidity and rain conditions. For e.g. If the temperature outside are not so hot, it is understood that rate of precipitation is low, which means the soil can hold water for much longer times, so the crops will be irrigated on a medium level. The rain sensors are used to detect rains. The motor won't start even if there's slight drizzling. The whole aim of this system is to save as much water as possible.

For disease detection, we trained a deep convolutional neural network to identify 14 crop species and 38 diseases. We have used our own neural network architecture to train the model for disease detection. The open-source Deep Learning framework Keras is used for the entire training of the model. We have used Google Colab and Kaggle Kernels for training the model with the GPU.

As we have trained the Neural Network on a highly unbalanced dataset due to which the accuracy is not a good metric to measure the performance of the model. So, we have plotted the confusion matrix for evaluating the model performance.

3.4 Output Details

The output of this whole system is mainly seen on the android application. All forms of data collected from the sensors is sent to the firebase. Our android application 'Farmate', continuously gathers all the information from firebase on a regular basis. The moment a change occurs in the system, it is reflected on the app. The farmer is not needed to control the motor from the application as the irrigation occurs automatically as system decides it. But the farmer can force stop it if he wishes to via the application. The Farmate reflects all information such as soil moisture, soil temperature, outer temperature and humidity, weather conditions and motor status. Apart from that, the farmer also gets to know the level of water in his tank or well and the amount of water irrigated so far.

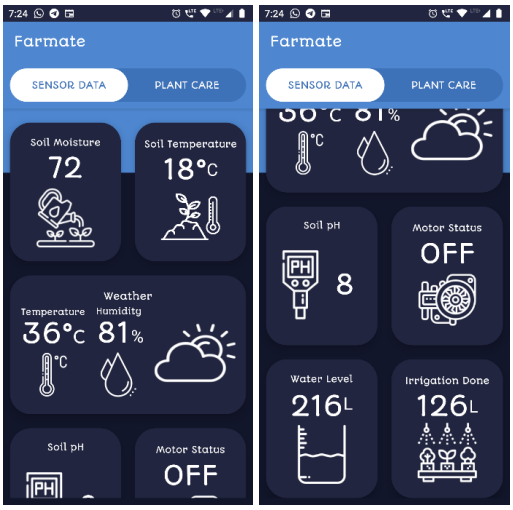

Fig-4: Sensor Data displayed on the mobile application

Disease prediction is an important part of this project. Our aim is to help farmers with easy and quick detection of plant diseases. Farmer can choose to click a picture and upload it or can upload it directly from the gallery and let the system detect the type of disease that the plant is suffering. The system evaluates and lets the farmer know the name of that disease. Along with that he is also suggested some fertilizers that he can use to get rid of that disease as soon as possible.

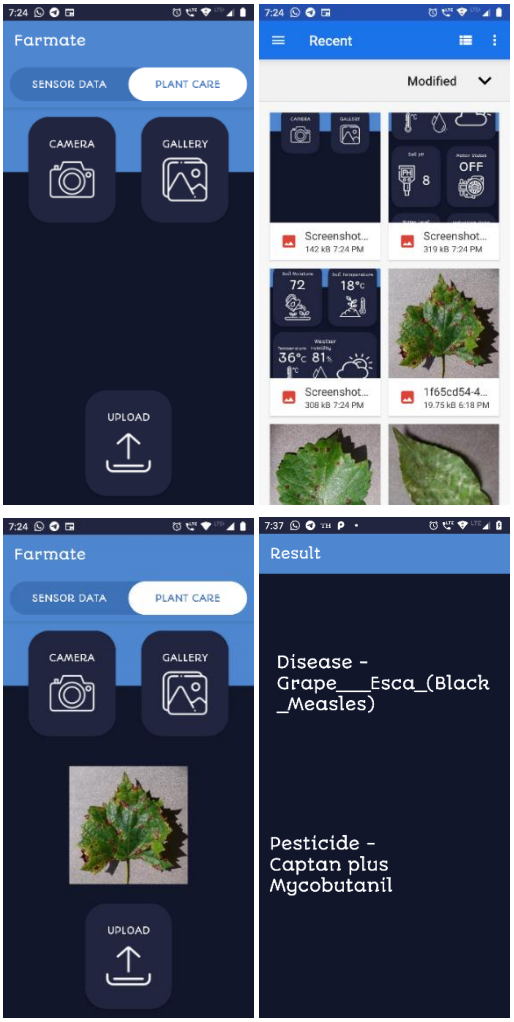

Fig-5: Steps of operation and output of disease detection

4. CONCLUSION

As we see, India is a country where major source of earning livelihood is agriculture, yet due to recent climate issues there have been major crop growth issues. If agriculture is combined with automation, it will reduce manual hard work to a great extent.[8] Our intelligent system senses various parameters by keeping all these factors in consideration while making decisions about irrigating the crops. We make sure that the crops are well irrigated as well as water is saved from getting wasted. We also make sure that the farmer does not find it difficult to detect if the plant is suffering any disease by using image processing. All this information or features can be accessed by the farmer via a single small mobile application. This whole system is user friendly and easy to install and will definitely make a huge difference in agricultural field.

5. FUTURE SCOPE

- Field management - Using high-definition images from airborne systems (drone or copters), real-time estimates can be made during cultivation period by creating a field map and identifying areas where crops require water, fertilizer or pesticides. This helps in resource optimization to a huge extent.
- Crop readiness identification - Images of different crops under white/UV-A light is captured to determine how ripe the green fruits are. Farmers can create different levels of readiness based on the crop/fruit category and add them into separate stacks before sending them to the market.
- Drone Based Technology - One of the most promising areas is agriculture, where drones have the potential to address major challenges. Drone technology is giving agriculture a high-tech makeover. It can be directly integrated with the mobile application. It can be used for soil and field analysis, planting, crop spraying, crop monitoring, irrigation and health assessment.
- Fertilizers suggestion – Once the disease has been detected, the farmer can be suggested certain fertilizers that he can use to cure the plant disease.

REFERENCES

[1] Intelligent IoT Based Automated Irrigation System, Yuthika Shekhar, Ekta Dagur, Sourabh Mishra, Rijo Jackson Tom, Veeramanikandan. M, Suresh Sankaranarayanan, IJAER, ISSN 0973-4562, 2018

[2] Smart Irrigation System Using IOT And Raspberry Pi, Swapnali B. Pawar, Priti Rajput, Asif Shaikh, IRJET, ISSN 2395-0056, 2018

[3] An Appropriate Model Predicting Pest/Diseases of Crops Using Machine Learning Algorithms, Hemantkumar Wani, Nilima Ashtankar, ICACCS, 978-1-5090-4559-4 IEEE, 2017

[4] IOT Based Smart Agricultural Monitoring System, Dr. G. Rajakumar, M. Saroja Sankari, D. Shanmugapriya, S. P. Uma Maheswari, AJAST, ISSN: 2456-883X, 2018

[5] Smart Farming – IoT in Agriculture, Rahul Dagar, Subhranil Som, Sunil Kumar Khatri, ICIRCA, ISBN: 978-1-5386-2456-2, 2018

[6] The Crop Disease and Pest Warning and Prediction System, Juhua Luo, Wenjiang Huang, Jihua Wang, Chaoling Wei, IFIP International Federation for Information, Z. Chunjiang, (Boston: Springer), pp. 937–945, 2009

[7] Smart Farming System Using Sensors for Agricultural Task Automation, Chetan Dwarkani M, Ganesh Ram R, Jagannathan S, R.Priyatharshini, TIAR, 978-1-4799-7758-1 IEEE, 2015

[8] Intelligent Greenhouse Monitoring System Based on Internet of Things Technology, Aradhana Potteth, Shweta Purushothaman, Jidnyesha Takle, Rohini Bridgitte Stanly, Payel Thakur, CTFC, ISBN 978-93-82626-27-5, 2019

[9] Google (https://www.google.com/)