IoT based Automatic Drip Irrigation System with Plant Disease Detection

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***Abstract*— Agriculture is one of the main source of economy and it is also main occupation of large number of people in India this project a plant disease detection system and an automatic irrigation system, have been developed together these two systems would be of great help to farmers. The system identifies a plant disease called "leaf Blight" using image processing technique so that collective action can be taken if the detection is done easily. This is very important as this disease causes 30%-80% loss of agricultural crops in the many places in the country". The automatic drip irrigation system senses the moisture content of the soil and releases water whenever necessary. Drip Irrigation and Disease Detection processes are combined in to one system using RPi and ESP32 module, Blynk and DropBox apps are used both in desktop as well as in smart phones to update the disease detected and environmental conditions like temperature, humidity and also status of the irrigation and same can be viewed by farmer.**

Keywords*— *Smart Agriculture, Internet of Thing, image processing, diaease detection, RPi, ESP32, leaf Blight, Drip Irrigation

I. INTRODUCTION

IoT and smart phones this system has been proposed. In early days farmer use to diagnose using knowledge of books or by using their own experiences, sometimes this method my lead to misdiagnose and lead to huge losses, Image processing techniques will greatly help the former to detect any diseases correctly and avoids the possibility of expenditure to diagnose the disease.

"leaf Blight" is a fungus disease which can be found in most of the crops like Tomato, Potato, Maize, Rice plants, betel leafs, hibiscus etc which will lead to loss of 30-80% in yield, Blight disease is occasionally mistaken for "Septoria leaf spot" because the two diseases infect tomatoes at the same time and also the only solution to this disease in Tomato plants is to destroy the infected leaves. If Blight gets spread it becomes more resistant to bio fungicide. Hence there is need to diagnose this disease correctly in order to take precautions as early as possible. Since leafs are more prone to this disease as shown in figure 1 we can efficiently make use of image processing of leaf pictures to diagnose the disease.

Fig. 1. Leaf Blight disease on Tomato leaf

Irrigation is the basic need of agriculture, there are three classic irrigation methods channel irrigation, sprinkler irrigation and Drip Irrigation according to the need of crops these three methods are being used, among these three Drip Irrigation is the one where we can conserve more water as it will supply the water in the form of droplets directly on to the root zone as shown if figure2 of the plant on to the surface of the soil. But to irrigate the plants human continuous attention towards the crops is essential and also man power is needed to implement any irrigation method. To avoid this using sensors automatic method of Drip irrigation is implemented in this work and the status of the irrigation is updated to farmer using IoT. In order to implement these things RaspberryPi3 model B processor has been used with ESP32 module in order to avoid damage of RPi.

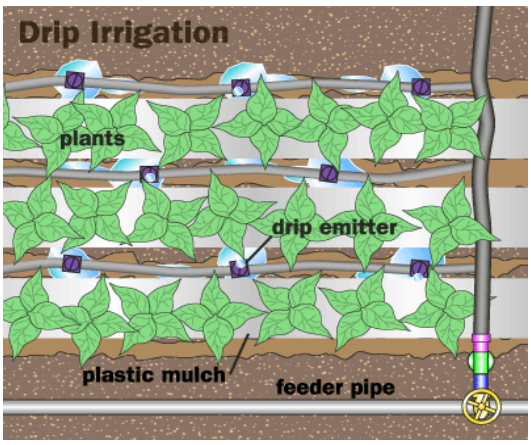

Fig. 2. **S**mart irrigation system

All the other objectives are listed below:

- Conservation of water
- To reduce Human intervention in agricultural field
- Irrigate the farm land with sufficient water
- To make an efficient use of image processing techniques
- To identify the diseased leaf
- Monitor the system through mobile from any where

II. LITERATURE SURVEY

Priyanka G. Shinde, et.al [1] has proposed a work for the detection and prevention of disease of plants from spreading, this paper discussed a system using raspberry PI. For the image analysis, the k-means clustering algorithm was used. It has many advantages for the use in big farms of crops and thus it automatically detects signs of disease whenever they appear on leaves of the plant.. This paper provides the best method for detection of plant diseases using image processing and alerting about the disease caused by sending email, SMS and displaying the name of the disease on the monitor display of the owner of the system. To upgrade agricultural products, automatic detection of disease symptoms is useful. The design and implementation of these technologies which is totally automatic and it will significantly help in the chemical application.

Shivani K. Tichkule and Prof. Dhanashri [2] have presented a paper. This paper presents an overview of using image processing methods to detect various plant diseases. Image processing provides more efficient ways to detect diseases caused by fungus, bacteria or virus on plants. Mere observations by eyes to detect diseases are not accurate. Overdose of pesticides causes harmful chronic diseases on human beings as not washed properly. They have also proposed a system called “Agrobot” which is very use full for both disease detection and also irrigation. It is a prototype which will perform both the tasks in one system or a processor and this prototype will use IoT sensors and web cameras as inputs and water pump as output in agricultural area and also updates the messages to the user. Ramkumar.R, et.al [3] Here they have proposed a automated irrigation system to conserve the water and by using Internet of Things technology by which particular plant variety is selected based on the plant’s unique ID to select which plant are using in the farm land and day by day processes information will update to the web server. Here camera is used to surveying the farm land and growth of the particular plant. If the plant is affect by any disease then immediately alert message is sent to the farmer. Ranjith, et.al [4] have implemented system is simple and cost effective. The embedded system designed consists of soil moisture sensor and temperature sensor. As the embedded system is connected to the cloud, the user can also interact and view the current, readings of the sensors with the help of an android application which is also connected to the cloud. The user can also detect the plant leaf disease by taking the picture of suspected leaves and sending them to the cloud

III. METHODOLOGY

To implement the idea if combining image processing and irrigation we have followed the methodology used in figure3and system block diagram is as shown in figure 4. DropBox server is server host to private data and it is freely accessible for limited amount of storing data with authentication. We are using this in Desktop with windows OS and also in smart phone in order to give storage of disease detected images to the former. Blynk Server is an IoT platform to control and monitor the processors like Arduino, RasberryPi and ESP32; here we are making use of this server to monitor the Irrigation process by giving updates of environmental factors like Temperature and Humidity with status of Drip Irrigation process of the system to farmer.

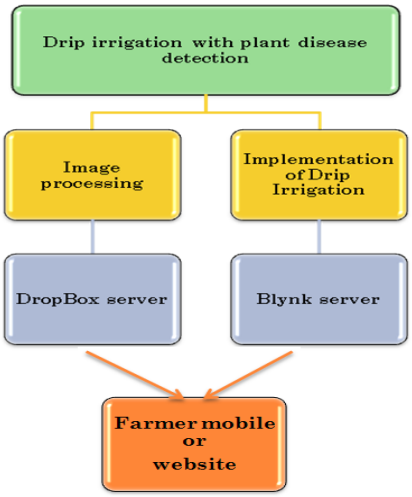

Fig. 3. Methodology of proposed system

A. *Image processing*

We make use of image processing system efficiently to detect the disease called “leaf Blight” especially in tomato plant. In order to implement it in remote place we can make use of RasberryPI3 module which has a build-in WiFi, a Pi camera is also used to take the clear pictures and to process it. Figure 5 will show the flow of Disease Detection using Pi camera, programming has done in Python in Rasbian OS. Algorithm for Image Processing is as follows:

- Import the libraries (OPENCV, Numpy) needed to complete the task
- Take the picture with preview of 10 seconds and save it in memory
- Reshape the image and make it to 32bit format
- Apply K means clustering by keeping k=4 for original image
- Convert RGB image to HSV
- Define range of diseased colour in HSV
- Threshold the HSV image to get only diseased colour
- Mask the image by AND operation with original image
- Show the resultant images
- Upload the final resultant image which shows the affected part of the leaf into the Drop Box

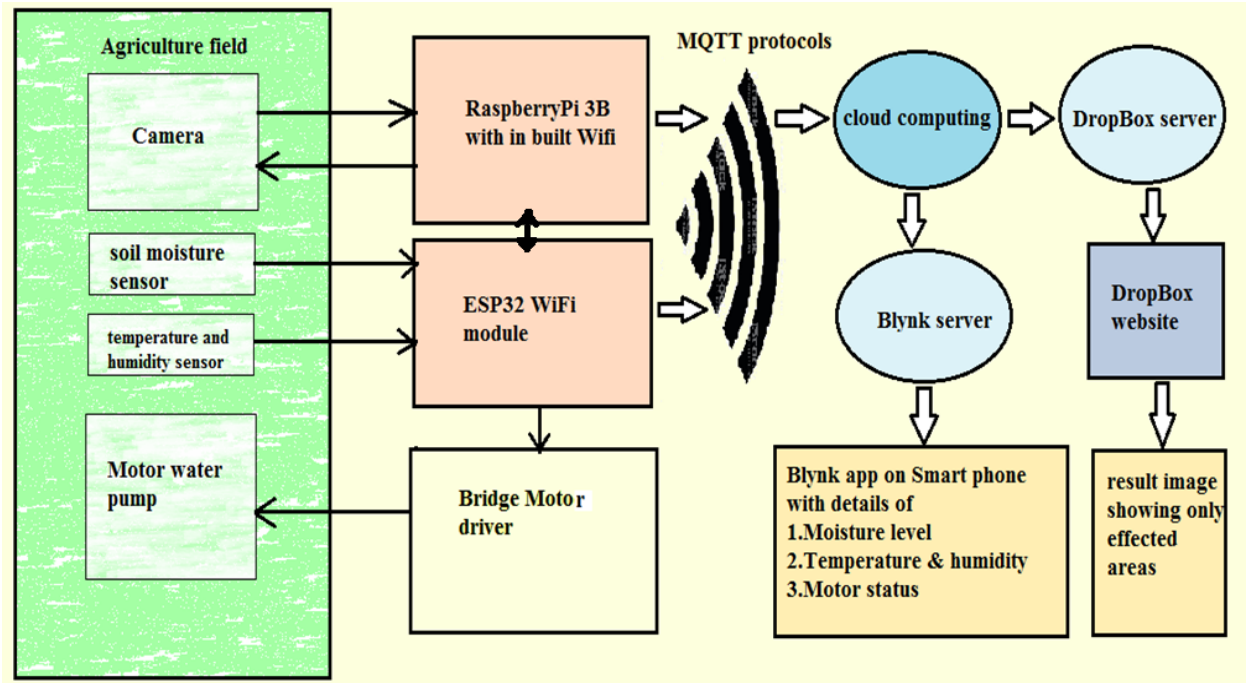

Fig. 4. Block diagram of proposed system

B. *Implementation of Drip Irrigation*

In order to design an automatic drip Irrigation system we have made use of RPi as a main processor and ESP32 as slave Processor because to avoid overhead caused by Irrigation Process and to protect RPi from damage. The design of the Drip Irrigation is shown in figure 6. Authentication process to connect RPi with ESP32 is done by using C++ programming in Arduino IDE by importing ESP32 libraries.

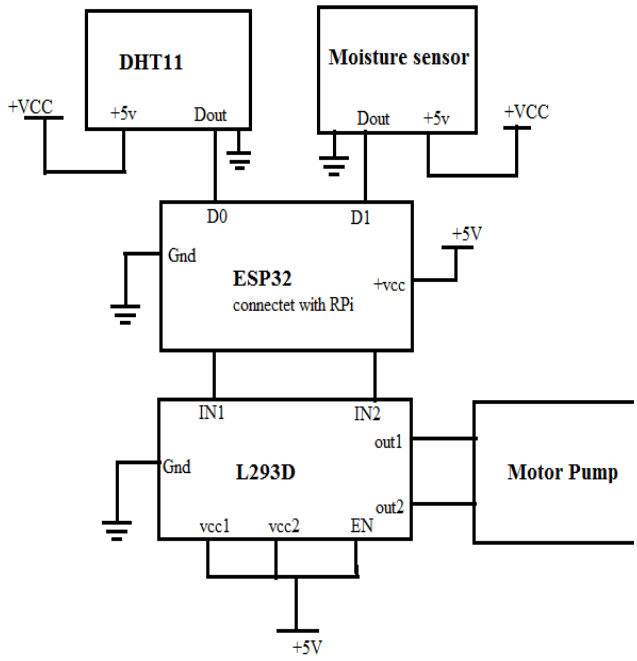

Fig. 5. Design of automatic Drop Irrigation system

DHT11 is a basic temperature and Humidity sensor, which measures temperature in the degrees and humidity in terms of percentage, moisture sensor will detect the moisture content in the soil. These parameters are uploaded to Blynk server.

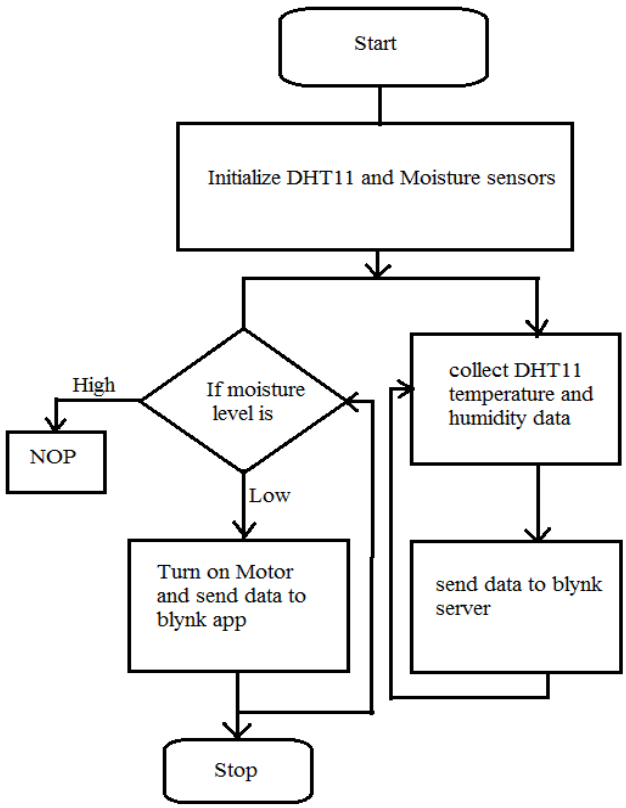

Fig. 6. Flowchart of Drop Irrigation system

IV. RESULTS OBTAINED

This designed model IoT based automatic Drip Irrigation system with Plant Disease Detection can be seen figure 6 with RPi and ESP32 boards. Experiment of disease detection has done in 90% luminance place to get efficient detection and accuracy.

Fig. 7. Experimental modal of designed system

A. *Disease detection*

Blight diseased leaves were collected and tested around 20 leaf samples, result was found to be more than 90% accurate. We have conducted tests using tomato leafs, Betel leafs and also hibiscus leaves. Disease detected image with processed image of Betel leaves are shown in figure below. The same image is also uploaded to Drop box so that a farmer can see it through his website or an app as seen in image in figure 8.

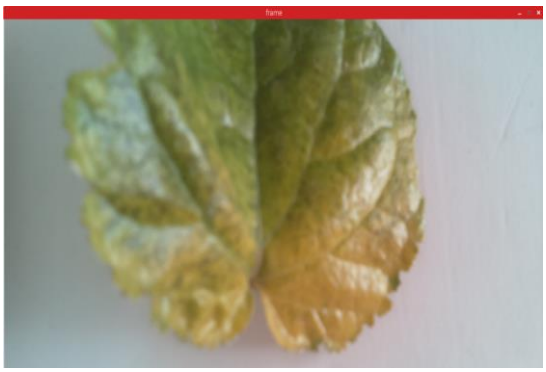

Fig. 8. Image captured

Fig. 9. segmented image using K-means clustering

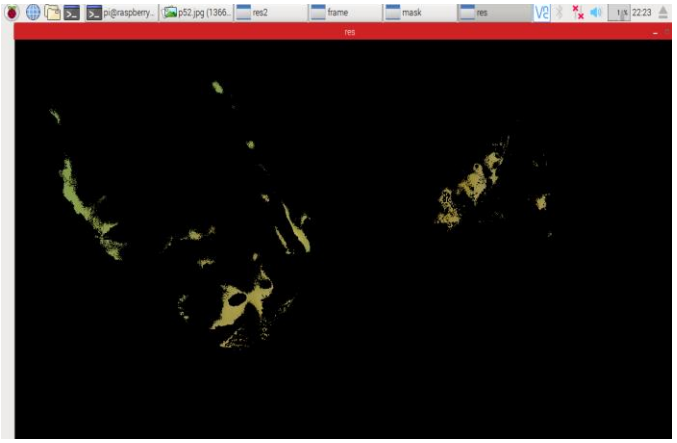

Fig. 10. resultant image showing disease affected part

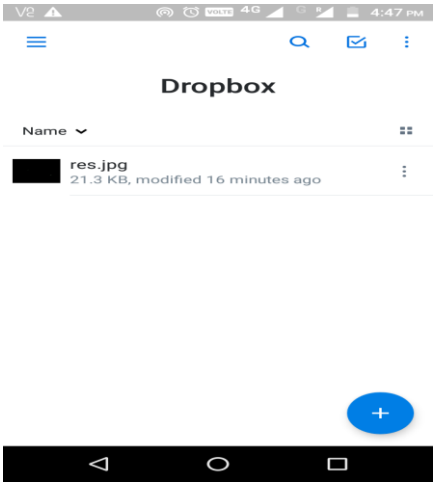

Fig. 11. mobile Screen of DropBox app with uploaded image

B. *Drip Irrigation*

The designed drip Irrigation system has been successfully working according to the presence of moisture content of the soil sensed by soil moisture sensor motor will get automatically get on and off. For designing of Power supply we have used L293 Motor Driver IC. All the environmental factors like Temperature and humidity will get updated to Blynk server along with the status of the water motor pump. Hence famer can easily make use it whenever he need monitor his land. Blynk app is shown in figure9 with all the updaters

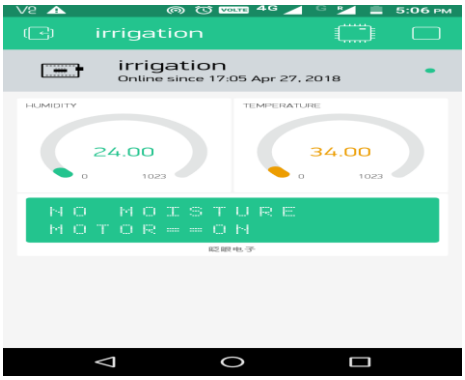

Fig. 12. Blynk applications on smart Phone showing values of Temperature and Humidity with status of water pump when RaspberryPi in connected with ESP32.

V. CONCLUSION AND FUTURE WORK

All the objectives have been achieved successfully and system can be used to implement drip Irrigation. We have tested around 20 samples of leaves to detect disease and around 90% of results appeared to be accurate. Main loop hole of the system is, it will detect disease only in 90% luminance (Bright natural light is needed) and since whole system is acting on IoT, an illiterate farmer may not be able to use this work. Using GSM subscription provided by service providers for RPi SMS alerts can be provided in future work.

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