ISSN 2319 - 5975

Volume 8, No.3, April - May 2019

International Journal of Networks and Systems

Available Online at http://www.warse.org/IJNS/static/pdf/file/ijns04832019.pdf

https://doi.org/10.30534/ijns/2019/04832019

Intelligent Plant Disease Identification and Automatic Irrigation System for Agricultural Fields

Aleena Thampi [1], Anila V. R, [2]Anna Aneena M. G[3], Febiya Sabu[4], Bini M. Isacc[5]

UG Students [{1, 2, 3, 4}], Assistant Professor[5] Dept. of Computer Science & Engineering

Amal Jyothi College of Engineering, Kottayam, Kerala

APJ Abdul Kalam Technological University, Kerala, India

{aleenathampi0407[1], anilavr147[2],annaaneena2611[3],sabufebiyakt[4],binimissac123[5]}@gmail.com

ABSTRACT

In India, there are many people who are interested in growing, caring and monitoring the plants. This might be out of their interest in plants or to sell the fruits and flowers of the plants or to reduce the effect of global warming. The plants should be monitored properly and taken care because if the amount of water in the soil increases or decreases, then, it may harm the plant. The plant also needs a sufficient amount of sunlight, so that it can grow well. For this, we can develop a mobile application. This application can tell them that, the plant needs water by testing the moisture content of the soil using a sensor. The notification about the low moisture content in the soil is known to the user by using android application. Hence the motor is made automatically on and off by indicating the soil moisture. Here we also use the application of testing the disease affected leaf in a plant using image processing. This system will be very helpful for the people when they are not at home or when they are not well so that they can take care of their plant.

Key words: Android, Soil Moisture Sensor, Image Processing, IoT, Raspberry Pi, Leaf detection.

1. INTRODUCTION

Agriculture is one of the most important sectors in the Indian economy. Almost 18 percent of the gross domestic product of India is contributed by Indian agriculture. Most of the Indians are directly or indirectly related to agriculture in one or other way. The plants should be properly monitored and taken care of so that they can grow well. An artificial way of watering the plants is by irrigation. In olden days, the manual irrigation was using buckets and watering cans, by using sprinkler irrigation etc. But by using these techniques we can't predict the amount of water that is to be watered or the sufficient quantity of water that a crop need. Due to this, water logging will occur and may result in fungus disease due to excess moisture content in the soil. Whenever we go out of town for a few days, we always used to worry about our plants as they need water on a regular basis. Also, we need to check the physical condition of the plants whether it is disease-affected or not. So here we are making Automatic Plant Irrigation and Monitoring System, which automatically provides water to your plants and keep you updated by sending a message to your smartphone.

In this system, Soil Moisture Sensor checks the moisture level in the soil and if the moisture level is low then notification is sent to the user and a water pump is switched on automatically, to provide water to the plant. Water pump gets automatically off when the system finds enough moisture in the soil. Hence whenever the system is switched On or Off the pump, a message is sent to the user updating the status of the water pump and soil moisture. The plant's physical conditions are monitored by Image scanning via a camera. The pictures of the plant's leaves are taken at a regular basis and a notification is sent to the user's application saying whether the particular leaf is disease affected or not. After analysis, the user can take proper actions. The system is very useful in farms, gardens, home etc. This system requires only less human intervention. The main concept behind the project is receiving the send notification and processing it further as required to perform several operations. The type of operation to be performed depends on the nature of the notification sent. This system is not so expensive as we compare to other systems and is time-saving.

2. PROPOSED SYSTEM

Intelligent Plant Disease Detection and Automatic Irrigation System for Agricultural Fields is a system that helps a person to monitor the plants when he/she is away from home. The amount of water needed for each plant is different and if the amount exceeds, the plant may be spoiled. The embedded system helps the person to know the moisture content of the soil. The relay is used to control the on and off of the motor.

Hence, the pump will turn on automatically and irrigate when the soil gets dry and turns off automatically when the soil gets wet. The Embedded System connected to the application via a web server helps a user to know the operations within the embedded. The user can view the value of soil moisture sensor in the application. The plants may also get affected by various diseases that are caused by viruses, bacteria, fungi, lack of proper watering and care and sometimes it becomes difficult to identify the disease. The plant leaf disease is detected by the image taken using the Raspberry Pi camera and the image is processed by comparing it with the images in the dataset. After processing, the notification is sent to the user application, whether the leaf is normal or abnormal. Then the user can take appropriate action. The Proposed system consists of three phases, (1) The Embedded System, (2) The Web Server-Based API, (3) Image Processing.

2.1 The Embedded System

The embedded system consists of Raspberry Pi, MCP3008, Relay, a Soil moisture sensor (FC28), Motor as shown in figure 1. In the embedded system, the soil moisture sensor which is connected to the Raspberry Pi is used to check the amount of moisture content that a plant need. The plants need different moisture as per the climatic changes. If it rains, the plant doesn't need to be irrigated as the plants will have the rainwater. But if it doesn't rain, the plants need more water. Raspberry Pi produces a digital output. But we are using a soil moisture sensor that gives an analog output. So, we use an ADC (MCP3008) to get the digital output on to our application. Hence, we can set the minimum and maximum limits such that the plant gets automatically irrigated (using a motor) when the moisture content level is less than the minimum value and the irrigation stops when the moisture content level reaches the maximum value. The notifications corresponding to these actions are sent to the user's phone. The moisture content of the soil can differ according to the climate, plants, and soil. A relay switch is used to control on or off of the motor.

Block Diagram Description

I. Raspberry Pi Camera

Raspberry Pi camera module is an 8-megapixel resolution high-quality image sensor with a fixed focus lens. It is directly attached to the Pi by way of a 15-pin header for camera interface. The images of the leaves are captured using this camera as shown in figure 6.

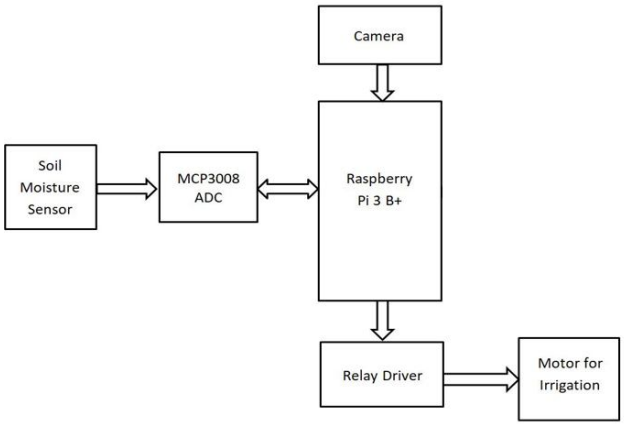

Figure 1: Block Diagram for Embedded system

II. Raspberry Pi 3 Model B+

Raspberry Pi is a small single-board computer. Model B+ has a faster 4GHz processor and 2.4/5 GHz dual-band Wi-Fi as shown in figure 2. The images of the plant's leaves are captured and sent to the Pi. In OpenCV library, this image is further processed and detected by the Raspberry Pi.

Figure 2: Raspberry Pi 3 Model B+

III. Soil Moisture Sensor

FC-28 Soil Moisture Sensor is used for measuring the moisture content in the soil.

IV. MCP3008 ADC

The MCP3008 is a 10-bit Analog-to-Digital Converter (ADC). It is used to convert the analog output produced by Soil Moisture Sensor and to get digital output in the application.

V. Relay Driver

The relay is used to turn on or off the motor.

VI. Motor

When the soil moisture content is less than the threshold value, the relay is turned on. As a result, the motor starts pumping, giving water to the plants.

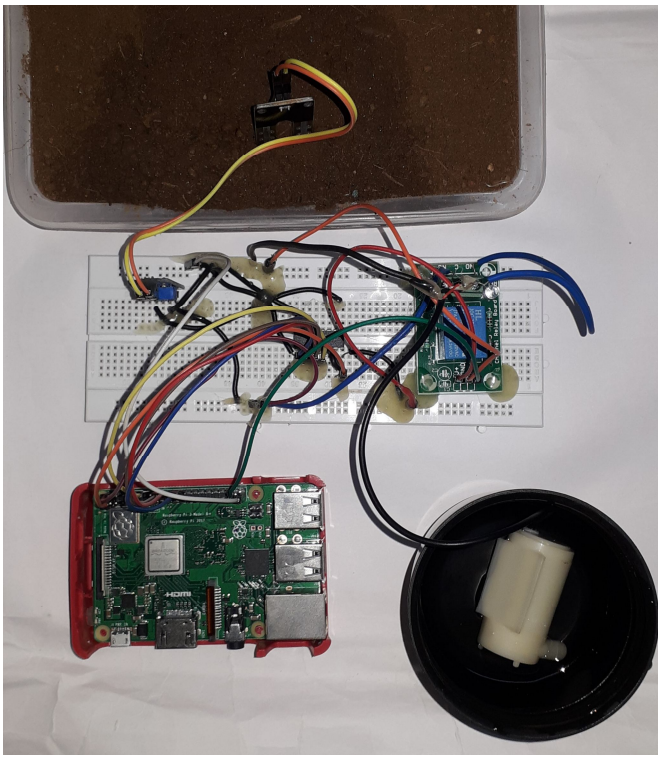

Figure 3. Embedded System

2.2 The Web Server-Based API

Mobile application sends the request for login to the home page via the internet and it passes through web service API as shown in figure 4. And collect the details of the person to whom for login from the database. And the response is sent back to the mobile application. If a person has an account in an application, he/she can register to the application by giving details about he/she. And the details are stored in a database.

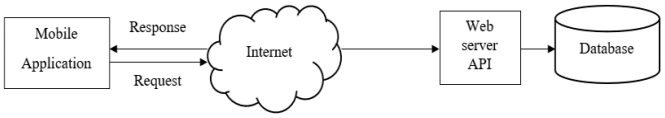

Figure 4: Architecture of web server API

2.3 Image Processing

Image processing is the most important method to perform some operations on an image, in order to get an enhanced image or to extract some useful information from it. Image processing is among rapidly growing techniques as shown in figure 5. The image processing includes the following steps:

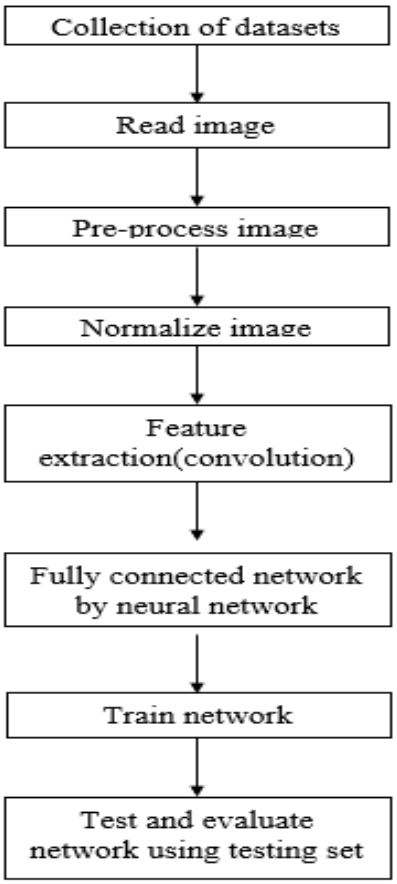

Figure 5. Image processing

The first step in image processing is the collection of the required number of data sets sample are shown in figure 6. Data set list values for each of the variables, such as weight, the height of an object. The dataset required for image processing is collected. Around 50-100 images are required. Figure 6 gives a summary of our dataset. Then the dataset is prepared for training and testing set. For this, each of the images is read and they are passed through pre-processing steps. The unwanted noises are removed. Then normalize the image inputs. Data normalization is a process of encoding categorical data and normalizing numeric data is sometimes called data standardization. Normalization means adjusting values measured on different scales to a notionally common scale, often prior to averaging. Some type of normalization involves only rescaling to arrive at values relative to some size variable. Data normalization can do by subtracting the mean from each pixel and then dividing the result by the standard deviation. This is then added to the dataset. One of the most frequently used deep learning methods within image

processing is the convolutional neural networks. They are used as feature extractors since they do not use the predefined kernels.

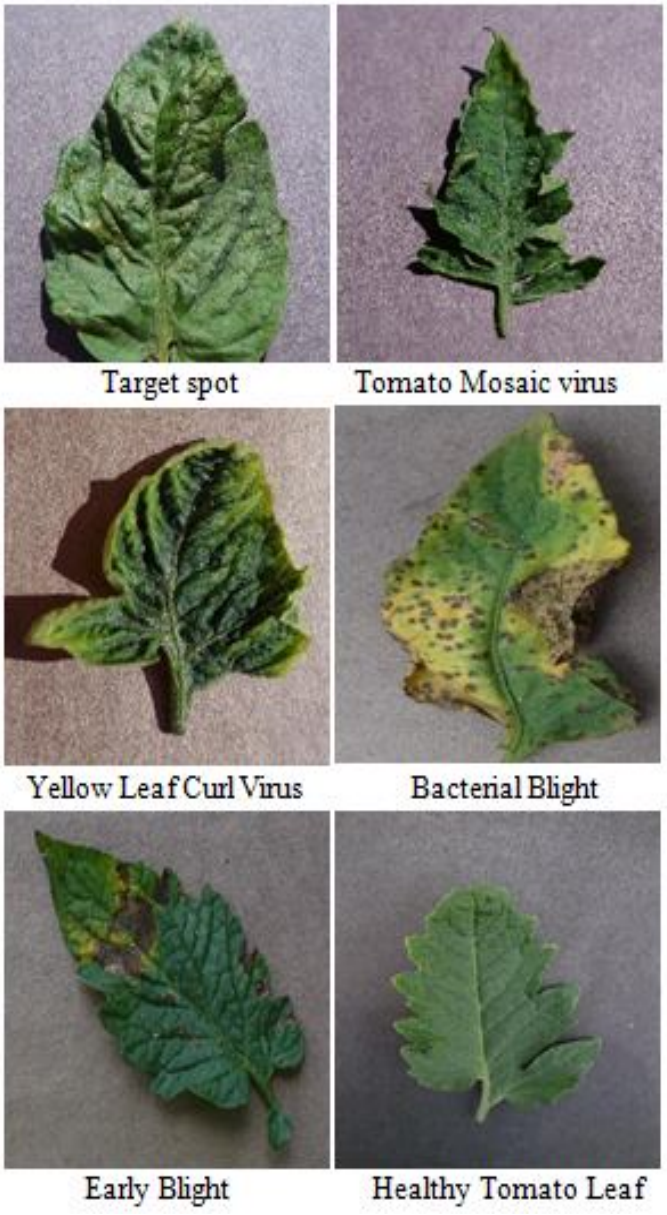

Figure 6. Images from dataset

Alex Net, a convolutional neural network is created which has 60 million parameters and 650,000 neurons. Alex net architecture is given in Figure 7. It has eight convolutional layers out of which five of them are convolutional layers and three fully connected layers with a final 1000-way SoftMax. The convolutional layers are responsible for feature extraction. The full connected layers act as neural networks. Then Alex Net is implemented and trained using Keras. The leaves images taken by the Raspberry Pi camera is being considered as the testing test. These are processed by comparing it with the trained dataset. After processing, the notification is sent to the user application, whether the leaf is normal or abnormal.

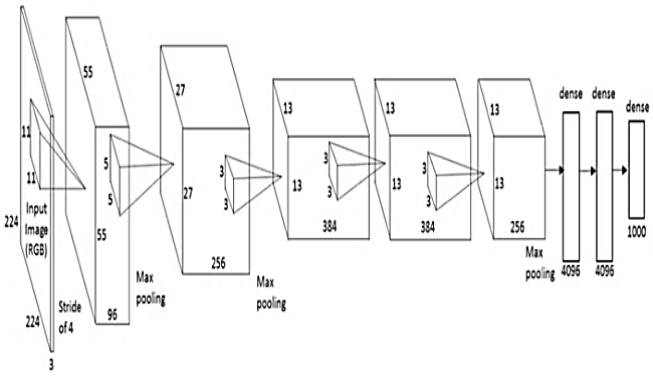

Figure 7. Alex Net Architecture

2.4 References

In [1], the system uses an Arduino interfaced camera to capture the image of leaf and process using image processing and determine disease-affected leaf and check the moisture content in the soil. In [2], the system consists of a device, Beagle bone black interfaced with a digital camera to detect the disease in the leaf. After capturing the image, it is treated with a technique called image processing. If it is infected, this device automatically turns on the valves and supply medicine to the infected area. In [3], the system the images of the plants are captured using an Arduino interfaced camera. The image processing is performed using Kekre Transform and variance method and the disease is determined. Then the appropriate amount of water is automatically provided to plants.

In [4], they introduced a system for the identification of macronutrient content in the leaves. The dataset for deficient and healthy leaves is created using image processing approach for RGB color feature extraction, edge detection etc. This created dataset is given to supervised machine learning for further detection and identification of exact nutrient deficiency and healthy plants. It was introduced to help the farmers to get the idea about the health of their crops and the preventive measures to be taken. In [5], this system includes Raspberry Pi is used to interface camera and the display device along which the data is stored in the cloud. The captured images are analyzed by using steps like segmentation, clustering and preprocessing. The output gives the information about the disease affected plants with the control measures. By this way, the health conditions of the crops are monitored and necessary steps for prevention of diseases were taken.

3. CONCLUSION

As India is a developing country, our system is useful for farmers to irrigate their field in the best and perfect way. This paper demonstrates whether each plant gets proper water for its growth. The intelligent plant disease identification and automated irrigating system help in irrigating the plants automatically after analyzing the moisture content in the soil. The moisture sensors are used to measure the moisture level of the soil. If the moisture is less than the predefined value, the sensor sends the signal to Raspberry Pi and sends a notification which alerts the motor pump is ON and provide water to the respective plant. Hence the system provides provision to know the status of the motor on the motor, without physically visiting the field.

Also, the images of the plant's leaves are taken on a regular basis and processed further to send a notification to the mobile whether the leaf is normal or abnormal. The system is implemented in such a way that reduces the cost and is effective in nature. This system proves to be helpful for each farmer around global by providing them information about the health of their crops and prevention methods to be taken.

4. FUTURE WORK

The future work of this paper is that the users can identify the name of the disease that the plant is infected with. Also, the cure for the disease can be given in the application itself by predicting the pesticides and fertilizers that are to be used. The instructions for how to use each pesticide, what amount of pesticides or fertilizers are to be used and for how long they must be used can all be given in the application. The disease of the plant can be identified not only by the leaf of the plant but also by the flower, stem, and root. The users can also monitor the growth of the plant (length & height) and also identify the fruits and flowers in the plants. The temperature of the soil can be identified used by using specific sensors. In case of fire in the agricultural field, we can use the smoke sensors to send emergency notifications to the user.

REFERENCES

1. Kriti Taneja and Sanmeet Bhatia. **Automatic Irrigation System using Arduino UNO,** in *Proc. International Conf. on Intelligent Computing and Control Systems ICICCS*, Madurai,India, 2017, IEEE, pp. 132-135. https://doi.org/10.1109/ICCONS.2017.8250693

2. ChannmallikarjunaMattihalli, Edemialem Gedefaye, Fasil Endalamaw and Adugna Necho. **Real-time Automation of Agriculture Land, by automatically Detecting Plant Leaf Diseases and Auto Medicine**, in *Proc. 32nd International Conference on Advanced Information Networking and Applications Workshops*, Poland, 2018, IEEE, pp. 325-330. https://doi.org/10.1109/WAINA.2018.00106

3. K. Krishna Kishore, M. H. Sai Kumar and M. B. S. Murthy. **Automatic Plant Monitoring System**, in *Proc. International Conference on Trends in Electronics and Informatics ICEI*, Tirunelveli,India , 2017, IEEE, pp. 744-748. https://doi.org/10.1109/ICOEI.2017.8300802

4. Aditi Shah, Prerna Gupta and Prof.Y.M. Ajgar. **Macro-Nutrient Deficiency Identification in Plants Using Image Processing and Machine Learning**, in *Proc. 3rd International Conference for Convergence in Technology(I2CT)*, Pune,India, 2018, pp. 1-4. https://doi.org/10.1109/I2CT.2018.8529789

5. Prof. Bhavana Patil, Mr. Hemant Panchal, Mr. Shubham Yadav, Mr. Arvind Singh and Mr. Dinesh Patil. **Plant Monitoring Using Image Processing, Raspberry PI & IOT,** *International Research Journal of Engineering and Technology (JET)***,** Vol. 4, no.10, pp. 1337-1342, October 2017.