GREEN LEAF DISEASE DETECTION AND INFECTION IDENTIFICATION USING RASPBERRY PI

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Abstract - *Image processing is a technology that carries out automatic processing ,manipulation and interpretation of such image information, and it plays an increasingly important role in many aspects and fields in science and technology. And Internet of Things(IoT) being a newly emerging field with a vision of connecting 'things', humans and machines together making them a integral part of internet. Viruses and Fungal attacks lead to crop losses upto 30% of total production. Delayed responses often reaches farmers too late which are useless. Here we develop Mobile app for automatically detecting plant disease through Image Processing technique. In this paper an automated system has been developed for detection and identification of infected plant leaves and also spray pesticides accordingly if the plant is diseased. Also watering of plants is done automatically based on the color of leaf. Health monitoring and identification of plant is very difficult manually. It requires more processing time. Hence, Image processing is used. The normal growth of the plants, yield and quality of agricultural products is seriously suffering from plant disease whose symptoms is majorly shown through color, shape and presence of leaf. An automated model is developed using IoT technology where sensors like temperature sensor (Resister Temperature Detector, RTD), humidity sensor(MCP3008), color sensor(RGB Model), Motion sensor(PIR Motion sensor), moisture sensing. This project includes features like server based remote monitoring system, Humidity and temperature sensing. To control all the other sensors, we make use of raspberry pi (RPI). Leaf disease can be detected based on the color and presence of leaf where the image is captured using camera interfacing with RPI.*

***Key Words*: Resister Temperature Detector(RTD), Humidity sensor(MCP3008), Color sensor(RGB Model),Motion sensor(PIR Motion sensor)**

1. INTRODUCTION

Agriculture is main occupation for productivity& development factor in tropical countries like India. India is a cultivated country and nearly 68% of the population depends on agriculture. Agriculture shares one-third of the country's GDP (Gross Domestic Product) and is its single largest contributor. India is also the second largest country in the world for producing and exporting farm output. It also contributes one-fifth of the total exports of the nation. The agriculture yield is not very much distinctive for developing countries like India and other and thus giving a scope for research in this area. Farmers have a wide range of diversity for relatively various crops and finding the suitable pesticides, weedicides etc. for plants to increase the quality and quantity of the yield. Illiteracy, lack of socio-economic progress, inadequate or inefficient finance for farm production, lack of its sales and marketing facilities and plant diseases, insects and pest attack are some of the causes for low productivity in agriculture. However, due to population and corresponding environmental issues such as climate changing, pollution causes many problems to farming such as disease & pests attacks. Such pest attacks affect food productivity which causes food shortage. So, for this reason, monitoring of health and disease detection of plant plays a vital role in successive cultivation of crops in the farm. From the arrival of agriculture, there has been much mechanical and chemical advancement that has occurred to enhance the yield and help farmers tackle issues like agriculture and crop diseases. But there has been little to less digitization done in this field. In order to improve the food productivity & sustainability there are lots of schemes was introduced by the government. One of the them is to avoid the pest attacks and identify the disease affected leafs and prevent it from spreading to whole cultivation. Information Technology has a key role to play in all facets of Indian agriculture. Nowadays there are lots of technologies like remote sensing, geoinformatics, wireless sensor networks and digital image processing etc. which are providing the support to Indian agriculture and farming sector. Both image processing and VOC(Volatile Organic Compounds) profiling techniques have proven to be very effective in accurately classifying diverse types of plant diseases. Not only do these techniques give a good indication on overall plant health but also can accurately distinguish healthy plant from unhealthy plant. Also to avoid human interference, image processing module embedded with robotics where it can be work as automated. Plant and leaf disease techniques mostly use simple digital cameras for image capture of leaves and crops. In most of the plants the infection takes place on plant leaves. Hence, in the proposed work we have considered detection of plant diseases which symptoms are shown on leaves. The discrimination of normal and affected plant leaf can be measured based on variation in color. The present study focused on the integration of sensor monitoring techniques with IOT. It has been achieved by interfacing different sensors to Raspberry Pi module. To avoid severe loss in agriculture various Sensors like soil moisture, temperature, and humidity are deployed in the field. Image processing module which is a automated model setup will move over the land. First the camera is enabled then it starts to capture the plant leafs. Then these images are forwarded for Pre-processing, Feature Extraction, Segmentation and Classification. After completing the identification process, the disease is analyzed using the software developed and the necessary solutions is provided to the farmer & alert them if plant is infected otherwise it moves forward to the next plant.

2. METHODOLOGY

In existing system mainly, we started by using Plant Village dataset. We analyse 54,306 images of plant leaves, which have a spread of 38 class labels assigned to them. Each class label may be a crop-disease pair, and that we make an effort to predict the crop-disease pair given just the image of the plant leaf. They resize image the images to 256 × 256 pixels, and we perform both the model optimization and predictions on these downscaled images. We have used three types of versions of datasets. First we have started with the color images dataset. Then we have used grey-scaled version of the Plant Village dataset. Final version they have used segmented version of dataset. Extra background information of image which might have the potential to introduce some inherent bias in the dataset. It should be notice that in many cases, the Plant Village dataset has multiple images of the same leaf (taken from different orientations), and we have the mappings of such cases for 41,124 images out of the 54,306 images. these test-train splits, we make sure all the images of the same leaf go either in the training set or the testing set.

1.Choice of deep learning architecture:

• AlexNet,

• GoogLeNet.

2. Choice of training mechanism:

• Transfer Learning,

• Training from Scratch.

3. Choice of dataset type:

• Color,

• Gray scale,

• Leaf Segmented.

4. Choice of training-testing set distribution:

• Train: 80%, Test: 20%,

• Train: 60%, Test: 40%,

• Train: 50%, Test: 50%,

• Train: 40%, Test: 60%,

• Train: 20%, Test: 80%.

They runs for a total of 30 epochs, each of these 60 experiments. And they used the following hyper-parameters in all of the experiments:

• Solver type: Stochastic Gradient Descent,

• Base learning rate: 0.005,

• Learning rate policy parameter:

Step (decreases by a factor of 10 every 30/3 epochs),

• Momentum: 0.9,

• Weight decay: 0.0005,

• Gamma: 0.1

2.1 PROPOSED WORK

Proposed work is to find the crops which are grown in local region (INDIA) and list the disease which affects on those crops. Next step is to make pair of crop-disease and train the model again. After identifying the new pair of crop-disease obtain accuracy again. For that we also prepared a architecture which is called as "CropDiseaseNet". "Crop Disease Net" architecture is specially designed to identify the disease from crop leaf image. As a shown figure of Crop Disease Net Architecture, an image of crop image converts into 224 x 224 x 3, where 3 is for a color image. Crop Disease Net contains 5 convolutional layers and 3 fully connected layers. In Crop Disease Net, Relu is applied after very convolutional and fully connected layer and dropout are applied before the first and the second fully connected year. This network has 62.3 million parameters and needs 1.1 billion computation units in a forward pass. As we can also see convolution layers, which accounts for 6% of all the parameters, consumes 95% of the computation. The main aim is to design a system which is efficient and which provide disease name and pesticides name as fast as possible. For that purpose we use two phase: 1st is training phase and 2nd is testing phase. In 1st phase: Image acquisition, Image Pre-processing and CNN based training. In 2nd phase Image acquisition, Image Pre-processing, Classification and disease identification and pesticides identification. For experimentation purpose we have used Plant Village datasets. The data records contain 54,309 images. The images spend 14 crop species: Apple, Blueberry, Cherry, Corn, Grape, Orange, Peach, Bell Pepper, Potato, Raspberry, Soybean, Squash, Strawberry, Tomato. It contains images of 17 fungal diseases, 4 bacterial diseases, 2 mold(oomycete) diseases, 2 viral disease, and 1 disease caused by a mite. 12 crop species even have images of healthy leaves that aren't visibly suffering from a disease. The following figures show the overall model of the system and sample images from dataset.

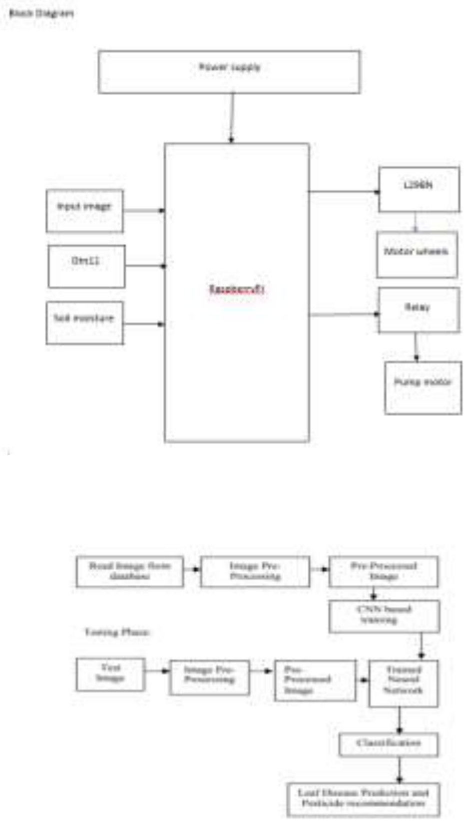

Fig - 1 :- Block Diagram

Image Acquisition:

For training, Image is taken from database. And for testing, you can take image from camera at real time but in this project, we made a particular folder on desktop from that image will be fetched by GUI screen and send through java web services i.e. tomcat server to server side system on which pre-processing is done and later on algorithm test that particular image.

Image Pre-Processing

Image should be processed before sending to the algorithm for testing and training purpose. For that purpose, in this project image is scaled or resize into 150 x 150 dimension. As we used color image so that we don't need any color conversion techniques and that pre-processed image is directly passed to algorithm for training and testing purpose.

Image Classification:

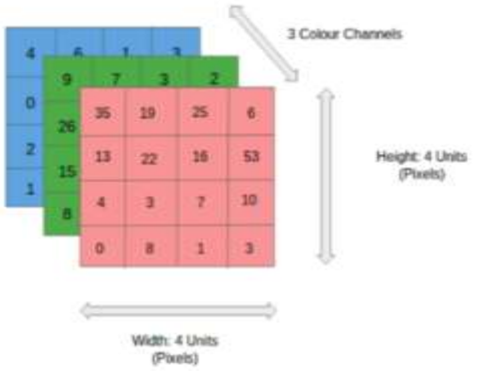

Fig:Image as pixel matrix

We used CNN for image classification. We proposed an explanation for the way in which mammals visually perceive the world around them using a layered architecture of neurons in the brain, and these in turn inspired engineers to aim to develop similar pattern recognition mechanisms in computer vision. For the implementation of CNN, we have used keras library on top of tensorflow. CNN receives the image as a matrix of pixel values. A sequence of convolution, maxpooling and normalizationis done in several layers of CNN and is finally regularized. Image datasets Every image is a matrix of pixel values. The range of values which will be encoded in each pixel depends upon its bit size. Most commonly, we've 8 bit or 1 Byte-sized pixels. Thus the possible range of values one pixel can represent is [0, 255].

Convolution:

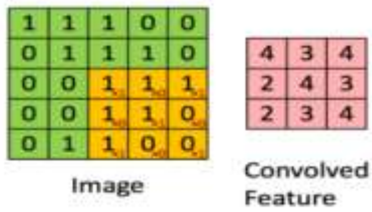

Fig: Convolved Feature of Image

A convolution is an orderly procedure where two sources of information are intertwined. A kernel (also called a filter) may be a smaller-sized matrix as compared to the input dimensions of the image, that consists of real valued entries. Kernels are then convolved with the input volume to obtain so-called 'activation maps' (also called feature maps). We compute the dot product between the kernel and the input matrix. The convolved value obtained by summing the resultant terms from the scalar product forms one entry in the activation matrix. The patch selection is then slided (towards the proper, or downwards when the boundary of the matrix is reached) by a particular amount called the 'stride' value, and the process is repeated till the whole input image has been processed.

Pooling:

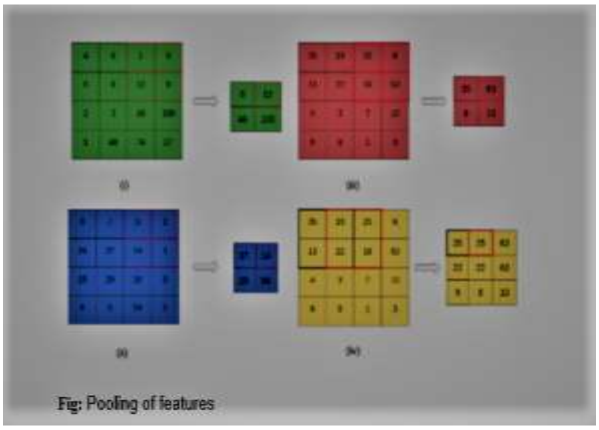

Fig: Pooling of features

Pooling reduces the spatial dimensions (Width x Height) of the Input Volume for the next Convolutional Layer. It doesn't affect the depth dimension of the quantity. The transformation is either performed by taking the utmost value from the values observable within the window (called 'max pooling'), or by taking the typical of the values. Max pooling has been favored over others due to its better performance characteristics.

Normalization

Normalization turns all the negative values to 0 so that a matrix have no negative values. We have used ReLU activation in our case.

Regularization

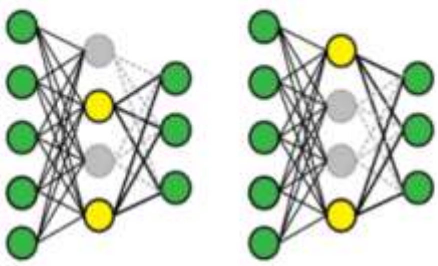

Fig: Regularization

Regularization is a vital feature in almost every state-of-theart neural network implementation. To perform dropout on a layer, you randomly set a number of the layer's values to 0 during forward propagation. Dropout forces a man-made neural network to find out multiple independent representations of an equivalent data by alternately randomly disabling neurons within the learning phase.

Convolutional Neural Network

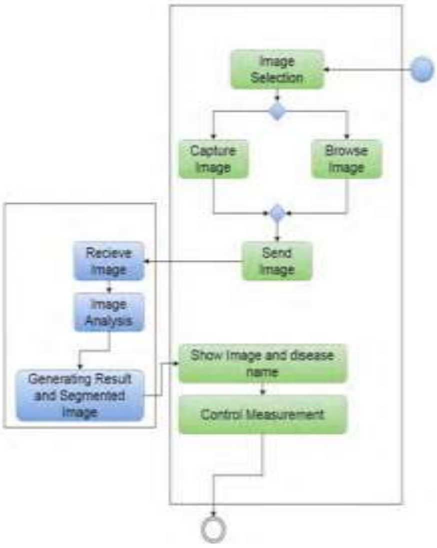

Fig: procedures of image processing

Once pre-processing is done, then CNN is used for training purpose and after that we get trained model. That CNN method is written with help of tensor flow. By using this model, we classify the image that system is getting after pre-processing of testing image. Then we get particular disease name or healthy leaf name if there is no disease on that leaf and that disease name is send to GUI screen and with the help of that disease name we get particular pesticide name which help farmer to take respective action in order to decrease percentage of disease.

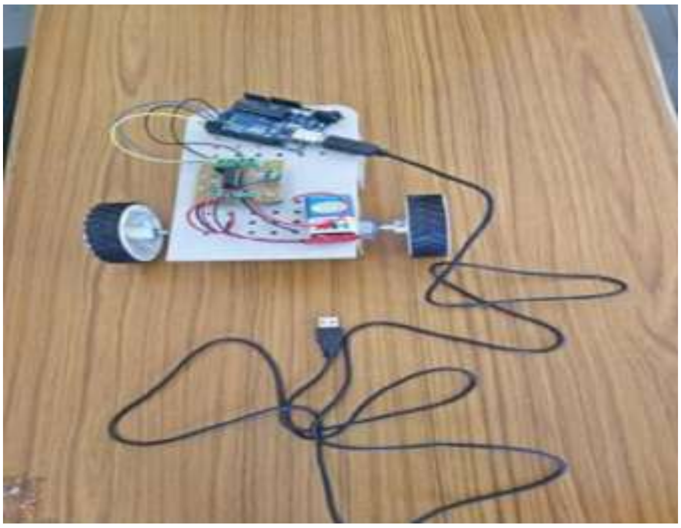

Fig-2:- A final model of project

3. CONCLUSIONS

The smart agriculture using IoT has been experimentally proven to work satisfactorily by monitoring the leaf diseases in the agricultural field. Mostly identification and curing of disease are going to be done manually. Then also disease is going to be identified at the severe stages only. The main objective of the project is to automatically detect and cure the plant disease by providing medicine through IoT. In agricultural field, the disease plays an important role to cause loss economically. The plant disease is identified by Image processing using the concept of CNN. The CNN concept is used to zoom the image and identified the affected part with more accuracy. Then the severity of the disease is identified by comparing value with the trained dataset and provides medicine accordingly. The proposed system will reduce the manual work and used to increase the yield by identifying the disease in earlier stage. Hence the loss will be saved and helps in agricultural field efficiently.

REFERENCES

[1] Sharath D M, Akhilesh, S Arun Kumar, Rohan M G and Prathap C, “Image based Plant Disease Detection in Pomegranate Plant for Bacterial Blight”, International Conference on Communication and Signal Processing, April 4-6,2019, India.

[2] Jagdish Kashinath Kamble, “Plant Disease Detector” 2018 International Conference on Advances in Communication and Computing Technology(ICACCT)Amrutvahini College of Engineering, Sangamner, Ahmedanagar, India. Feb 8-9, 2018.

[3] Hashem Rizk, Maki K. Habib, “Robotized Early Plant Health Monitoring System”.

[4] Apeksha Thorat, Sangeeta Kumari, Nandakishor D. Valakunde,” An IoT Based Samrt Solution for Leaf Disease Detection”, 2017 International Conference on Big Data, IoT and Data Science(BID), Vishwakarma Institute of Technology, Pune, Dec 20-22, 2017.

[5] S. Akash, M. Azlan Ahamed Habib, M. Harisudhan, S. Aaron, T. Bharani Prakash, “Smart Leaf Infection Identification and Fertilizer Spray”, 2019 5th International Conference on Advanced Computing and Communication System(ICACCS 2019).

[6] Fischer, G. World food and agriculture to 2030/50. In Proceedings of the Technical paper from the Expert Meeting on How to Feed the World in 2050, Rome, Italy, 24–26 June 2009; Volume 2050, pp. 24–26

[7] Chaves, M.M.; Maroco, J.P.; Pereira, J.S. Understanding plant responses to drought— From genes to the whole plant. Funct. Plant Biol. 2003, 30, 239–264.