Smart Farming: IoT Based Plant Leaf Disease Detection and Prediction using Deep Neural Network with Image Processing

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Abstract*: Agriculture plays a major role in human life. Almost 60% of the population is involved directly or indirectly in some agriculture activity. But Nowadays, farmers have quit agriculture and shifted to other sectors due to less adoption of automation and other reasons like increase in the requirement of agricultural laborers. So, Farmers now largely depend on adoption of cognitive solutions with technological advancements to acquire the benefits. Image processing and Internet of Things jointly produces new dimensions in the field of smart precision farming. This proposed methodology aims to create an approach for plant leaf disease detection based on deep neural network. This approach combines IoT and image processing which runs pre-processing and feature extraction techniques by considering different features such as color, texture, size and performs classification using deep learning model that expands to help identification of plant leaf disease.

Index Terms*: Deep Convolutional neural network, Image Processing, Internet of Things, Plant leaf disease detection.

I. INTRODUCTION

In Agriculture field, Presence of Plant disease and organic deficiency causes substantial harm and loss to farmers. Traditionally, All the diseases and harms will be identified with visual inspection by experienced people who may use certain features like color, texture and shape to analyze which in turn leads to expensive cost and less efficiency. By considering this issue as a challenge, we aimed to provide a solution technically with combined method of Internet of Things and Image Processing. Application of Internet of Things in agriculture includes agricultural monitoring and control, controlled environment agriculture, open – field agriculture, livestock applications, food supply chain tracking [3]. Benefits of smart farming using Internet of Things improves agriculture in different ways like tons of data collected by smart sensors, provides better control over the internal processes. Use of Internet of Things in agriculture produces cost management, waste reduction, process automation and enhanced product quality and volumes. Precision agriculture mainly depends on image-based recognition. Automating this analysis is especially beneficial for those a farmer to which expert knowledge and advice is not readily available or affordable.

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To monitor crops, various sensors, camera and IT unit are used to capture images at regular intervals and then integrated into imaging system (uses advanced Machine learning and Artificial Intelligence techniques) to get better yield and reduces crop failure. In future, machines integrated with Internet of Things and Image processing could entirely replace the need for humans to manually weed or monitor crops [5].

II. RELATED WORK

In past years, various traditional machine learning algorithms have been used to disease diagnosis and analysis. Recently, several researchers have studied plant leaf disease detection and classification with neural network algorithms and image processing. Also, the research studies showed that convolutional neural network have been used majorly for plant disease recognition and showed good results.

The proposed approach combines the techniques of Internet of Things and Image processing concepts to get expected output.

This paper mainly discusses on a conceptual framework that certainly uses image processing model and deep learning neural network for classification.

III. METHODOLOGY

As discussed earlier the Internet of Things system includes sensors and cameras to capture the image of the plant leaf which can be divided as 80-20 ratio for training and testing the images. The color, shape, texture and the leaf size are the attributes used for diagnosis.

a. Acquisition of Image

In this conceptual approach, this stage indicates the input. The images are retrieved by using camera. The leaf image is extracted and gets saved in the database for further process.

b. Image Pre-processing

In this stage the noise removal and data normalization are used as pre-processing model in which all features are normalized from vector to unit space.

c. Image Analysis

In this step, segmentation of images is done to find the region of interest. In segmentation, the technique used is region-based segmentation which separates healthy and diseased region of the plant leaf by using the color of the leaf [4].

The features extracted from the image includes color, texture and shape. Color feature contains information about boundary, spot and broken area. Likewise, the shape attribute includes percentage of lesion and its type. Texture feature contains uniformity, contrast, probability, variance and correlation. With the identified features, the database is divided into two sets of images for training and testing.

IV. BLOCK DIAGRAM OF PROPOSED APPROACH

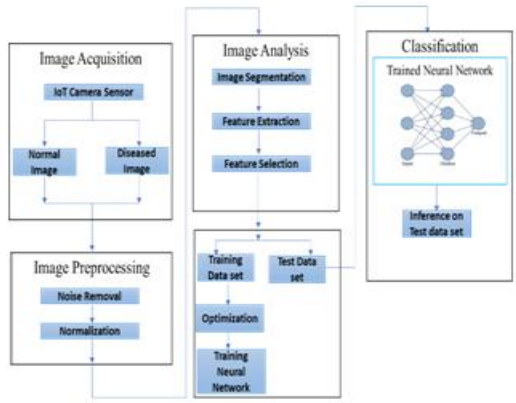

Fig: - Block Diagram

V. CONVOLUTIONAL NEURAL NETWORK

Training images are used to build deep convolutional neural net-work to extract the macro information about the image[1]. The structure of convolutional neural network model contains convolutional layer, pooling layer, activation function and softmax layer. There are various CNN architectures which are available that can be used in this approach concerning the identification of plant leaf disease were: Alex Net, Google Net, VGG [2]. The training process of CNN includes optimization stage
where the feed forward and back propagation pass will be performed to minimize the error.

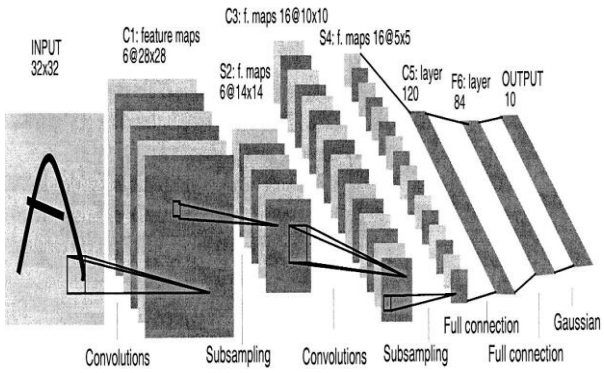

Fig: - Structure of Convolutional neural network

VI. RESULTS AND DISCUSSIONS

The objective of this proposed approach is to implement modern technologies of image processing with deep neural network model. Usage of Internet of Things system makes the process easier which is extended to some level of automation for capturing the images at regular intervals. The captured image is used further for applying image processing technique for monitoring and analysing the conditions of healthy and diseased leaf.

Fig: - Test Picture

VII. CONCLUSION

The proposed approach is a conventional framework to identify the plant leaf disease, which can discover the features of leaf disease automatically. This approach turns the traditional methods of farming to modern methods which makes easy and economically productive. By applying the techniques of Internet of Things bring automation in the field of agriculture and when it gets integrated with image processing, the end user will find satisfactory results. This in turn helps the end user to monitor the environmental factors easily in spite of getting into field physically. Automating this approach helps the farmers to monitor the field by working at their own places without being present physically in the field. In future the camera module can be placed as a drone to capture the fields at different direction.

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