

Real Time IoT Application for Classification of Crop Diseases using Machine Learning in Cloud Environment



Tanilal Bhavsingh Thakur, Amit Kumar Mittal

Abstract: India is an agricultural country. A total of 61.5% of the people cultivate in India. Due to lack of agricultural land and change of weather, many types of diseases occur on crops and insects are born. Therefore, the production of crops is coming down. To reduce this problem, Internet of Things technology will prove to be an important role. In this system, a sensor network will be created on agricultural land using Raspberry Pi 3 model. The images of the crops will be taken by sensor cameras and these images will be sent to the cloud server via Raspberry Pi 3 model. In this proposed methodology, various image processing techniques will be applied on acquired images for classification of crop diseases using k-means clustering algorithm with unsupervised machine learning.

This paper will also show the method of image processing technique such as image acquisition, image pre-processing, image segmentation and feature extraction for classification of crop diseases. In a bad natural environment, the farmers can produce quality crops and people will get healthy food by this proposed methodology and make more profit. In real time treatment of crop diseases, farmer will increase quantity of their crops.

Keywords: Crop Diseases, Image Processing, Internet of Things, Machine Learning, Raspberry Pi 3 and Sensors.

I. INTRODUCTION

The Internet of Things is the network of various electronic devices that communicate and sense of their internal or the external states. Internet of Things deals with ordinary objects which is used in daily life is connected to the internet shown in Fig.1. Internet of Things has some components for data communication such as sensors or devices, connectivity, data processing and user interfaces.



Fig. 1. Internet of Things

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Machine learning is the concept of artificial intelligence which provides automatic learns to machine without any instruction. Machine learning is used for two reasons in IoT. First reason is the analysis of massive stored big data to obtain for smart data and second reason is related to prediction of some specific output using algorithms. In machine learning, algorithms process some inputs to generate logical outputs.

Image processing is playing a very important role in IoT. IoT based this methodology will provide the best solution for increase the crop productivity using image processing. The image processing is used for classification of image, image segmentation and feature extraction.

If someone provides service through internet, it is called cloud computing. This service can be anything like off-side storage or computing resources. Cloud computing is a style in which massively scalable and flexible IT related capabilities are provided as a service with the help of internet technology.

In this system, by creating a sensor network on agricultural land and acquired the images of crops from the sensor camera will be sent to the cloud server through internet using Raspberry Pi 3 module. In real time IoT application for classification of crop disease, there will be various image processing techniques apply for classification of crop diseases on acquired images using k-means clustering algorithm with unsupervised learning in cloud environment.

II. RELATED WORK

Dusan Markovic, Ranko Koprivica shows the application of IoT for monitoring and controlling of agricultural production. They develop a system which is based on Arduino platform using IoT sensor nodes/devices [3].

Amandeep, Arshia, Paboni [4] develop the system for smart farming using IoT. The purpose of this paper is smart farming like smart monitoring, smart irrigation, temperature and humidity sensing using ZigBee module with different blocks, temperature sensor, humidity sensor, moisture sensor, ultrasonic obstacle sensor.

Mat, I., Mohd Kassim, M. R., Harun, A. N., & Mat Yusoff, Create the wireless moisture sensor network for IoT in precision agriculture applications. The Wireless Sensor Network is a network of sensor nodes that are capable of collaborating with one another and measuring the parameters of environment (i.e. light, temp, sounds, humidity etc.).



This paper presented Green House Management System is based on Wireless Sensor Network (WSN) using Moisture Sensor [5].

[6] In this paper the image processing techniques is used for detection and classification of plant disease. The image processing is consists of some basic steps image acquisition, image preprocessing, image segmentation, feature extraction, statistical analysis and detection and classification. The K – Means clustering technique is used for Detection and classification of plant disease using MATLAB.

[7] In this paper the feature extraction plays an important role for identification of objects such as color, texture, morphology etc, can be used in plant or crop disease detection.

[8] Leaf disease detection and climatic parameter monitoring of plants using IoT, authors gives thought for climatic parameter such as temperature, humidity, pH and dry for plant and leaf sickness discovery.

[9] In this paper the authors generate the Integrated Pest Management system for prevent pest risk in effective method. Ontology is the best option for storing the information about biological, chemical etc for management of pest for controlling of plants diseases.

[10] In this paper authors developed k-means clustering algorithm for detection and classification of plant diseases using MATLAB software.

III. PROPOSED METHODOLOGY

Existing work does not use any machine learning algorithm to classify massive data for classification of crop disease. The current methodology does not provide a cloud environment for storing large amounts of data with deep sensory processing to capture live data with the latest technology in agricultural productivity.

The proposed methodology will provide the real time IoT application for classification of crop diseases using machine learning algorithm in cloud environment. The objective of the proposed method is classification of crop disease using image processing techniques to remove diseases of crops.

The various types of learning methods are used in machine learning such as supervised, unsupervised and reinforcement. K-means clustering algorithm is unsupervised learning. In this system k-means clustering algorithm is used for allowing input from IoT and process on it. The block diagram of proposed methodology is shown in Fig. 2.

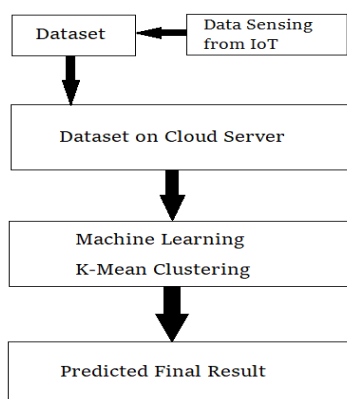


Fig.2. Block diagram of system

In this system, a sensor network will be created on agricultural land using Raspberry Pi 3 model. The images of the crops will be taken by sensor cameras and these images will be sent to the cloud server via Raspberry Pi 3 model. Raspberry Pi 3 Module will be used to capture live images of crops by sensor camera from agricultural land. Raspberry Pi 3 Module will be installed with Raspbian operating system with Noobs and create cloud server using Tomcat Apache WAMP for store live data. Java based web application code will be develops for data fetching and also configure in Raspberry Pi 3 Module. Cloud server will be configuring for computing and gathering live data from agricultural land.

IV. RESULT ANALYSIS

In this proposed methodology, various image processing techniques will be applied on acquired images for classification of crop diseases using k-means clustering algorithm with unsupervised machine learning.

The K-means algorithm is used to fragment the image and obtainsome specific fragments of different colors for predict output. K-means clustering is a method in which large datasets are divided into clusters of similar data using Euclidian distance function with centroids. Each datasets is a set of color points of imageand can be represented in RGB primary color model. The ‘k’ is refers to the number of cluster desired in the final output. There are some steps to the algorithm perform for desired output:

1. Initialize k centroid;
2. Assign datasets to clusters;
3. Update clusters centroid;
4. Repeat steps 2 and 3 until stop condition;

Image processing techniques is used to perform some operation on image for obtains some useful information from image using k-means clustering algorithm with unsupervised learning. The image processing is consists of followingsbasic steps shown in Fig. 3.

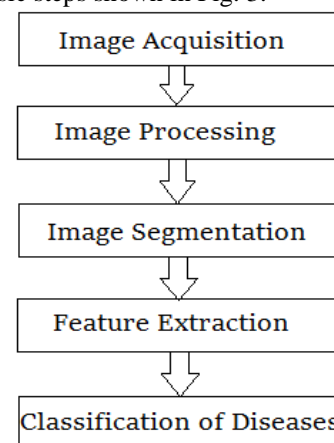


Fig. 3 Basic steps of image processing

A. Image Acquisition

The first step of image processing is the acquisition of image of crops by sensor camera from agricultural land using IoT network. The internet will provide to the IoT network by GSM standard.

B. Image Pre-Processing

Pre-processing of image is the technique for identifying the infected part of leaf image using primary RGB color. In pre-processing the primary RGB color converts into gray color shown in Fig. 4, using the Histogram equation in Java:

$$\text{imGray2} = \text{uint8}(0.299 * \text{double}(\text{imR1}) + 0.587 * \text{double}(\text{imG1}) + 0.114 * \text{double}(\text{imB1})); \quad (1)$$

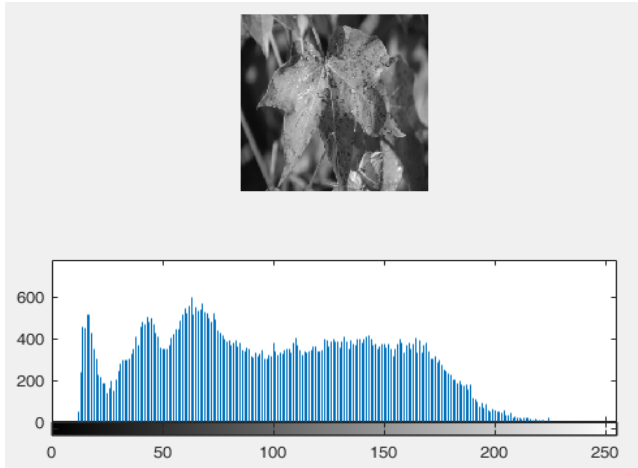


Fig. 4 Color conversion using Histogram

C. Image Segmentation

Image segmentation is the process of partitioning of image in various features. Segmentation is done by k-means clustering and converts primary RGB colors of image into HIS model shown in Fig.5. Segmentation is creating boundary of infected part of leaf image. K – Means clustering method is used to found similar cluster of pixels of infected part of image.

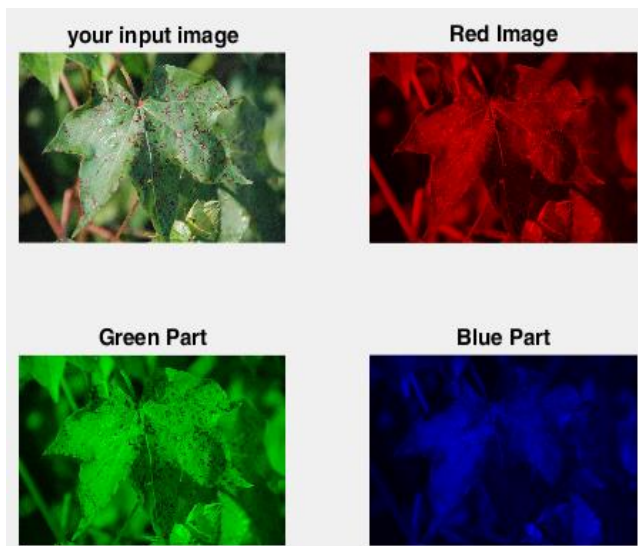


Fig. 5 Image color converted with RGB

D. Feature Extraction

Feature extraction is a technique which is used to representation of image matching and retrieving. Feature extraction is the most important step for extract features of leaf image of crops such as color, texture, and morphologyetc, shown in Fig. 6.

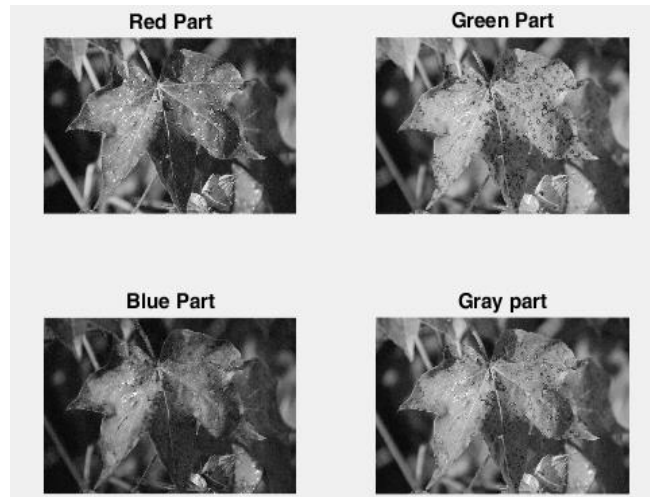


Fig. 6 Feature extraction using gray color

E. Detection and Classification

Detection and classification of diseases by the artificial neural network (ANN), back propagation network and testing of image using machine learning in cloud environment.

V. CONCLUSION

The complete study of real time IoTApplication is developed to classification of crop diseases using machine learning in cloud environment. In this system crop disease is classified and identified by image processing and machine learning using artificial neural network. In bad natural environment, the farmers can produce quality crops and people will get healthy food using this proposed methodology and make more profit. In real time treatment of crop diseases, farmer will increase quantity of their crops.

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