LEAF DISEASE DETECTION USING DEEP LEARNING AND AUTOMATIC PESTICIDE DISPENSING USING SIX WHEEL ROBOT

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Abstract— India is a land of agriculture and mainly known for growing variety of crops. Majority of the population in India depend on agriculture. Even though India is agricultural country, the farmer experiences a lot of challenges and huge losses in every year due to pest infestation in crop and this in turn affect his way of life. These losses are basically due to discontinuous monitoring of farm, various diseases on crop, limited knowledge on pesticides used for plant diseases and improper management of pesticides. Plant disease reduces quality of product as well as its quantity. The spots on the leaves are the main indicator of the plant disease. So fast detection of plant disease is of more vital. In order to overcome above problem, in this work a robot has been build, which detects the leaf condition using image processing and deep learning technique, and automatically sprays the required pesticides for the unhealthy leafs based on the data set to achieve good yield in crops. The Robot has been build using an Arduino microcontroller with ATmega 328p processor, which is integrated with deep learning model. The image processing is trained with Convolutional Neural Network using an algorithm Alexnet. The robot movement is controlled by joystick. The build robot can be used to dispensing the pesticides for nursery and small plants and also robot has been successfully tested for corn and tomato crops.

Keywords— **Deep learning, Convolutional Neural Network, Robot, microcontroller, Image processing, Arduino.**

I. INTRODUCTION

India is well known for agriculture and around 60% of the population depends on it. It contributes a majority to the economy of India. In this situation the yield of the crops must be high and of good quality which leads to a good amount of income in agriculture. Diseases may affect to the crops both in qualitative and quantitative manner. Crop diseases are of mainly three types viz. bacterial, fungal and spots [1]. Traditional methods were used to detect the diseases which lead to the use of large amount of pesticides harming the fertile soil and also the nature. A solution to this is to use modern methods in agriculture that helps the farmers to detect the diseases faster and increase the crop yield [1-2].

The management of plants requires close monitoring especially for the disease that can affect production significantly and subsequently the post-harvest life. The naked eye observation of experts is the main approach adopted in practice for detection of plant diseases. But this requires continuous monitoring of experts which might be expensive in large farms. Automatic detection of plant diseases is an essential research topic as it may prove benefits in monitoring large fields of crops and thus automatically detect the symptoms of diseases as soon as they appear on plant leaves. Therefore looking for fast, automatic, less expensive and accurate method to detect disease by robot using image processing and deep learning technique through MAT LAB software platform. This robot also monitors the quality of leaf and sprays the required pesticides for achieving the good yield in agriculture [2-3].

Image processing is a procedure to convert images in a digital way or either goes for image enhancement or extraction of some useful information. In that sense, a form of digitally processed images, called digital image processing, makes efficient use of algorithms to process the image in a better way. Hence, image processing is that area of computer science which is used in various applications in agriculture starting from identification of diseases of fruits, leaves, stem, etc. of different plants, which can be viral, bacterial, or fungal in nature. MATLAB is a high performance language for technical computing where problem and solutions are expressed in familiar mathematical notation[4].

Deep learning constitutes a recent, modern technique for image processing and data analysis, with accurate results and large potential. As deep learning has been successfully applied in various domains, it has recently entered also the domain of agriculture. So we will apply deep learning to create an algorithm for automated detection and classification of plant leaf diseases [5-6].

In this work build the six wheel robot to detect the diseases using MATLAB software. By using this system we maintained regular vigilance of crops. Such a system automatically detects the various diseases and after detection it automatically spray the pesticides. It helps in minimizing the loss to the formers because of improper management of pesticides. A data base is created for each disease of different plant(crops). The image processing is accomplished by using MATLAB integrated with Deep learning technicque using an expert system trained with Convolutional Neural Network using an algorithm Alexnet.

II. METHODOLOGY

2.1 Overview of the proposed system

The system consists Six wheel robot made for agricultural purposes for detection of leaf diseases and automatic dispensing of pesticides as shown in fig 1. It reduces the effort of farmers in addition to increasing the accuracy of the work. It will perform disease detection and spraying. It increases agricultural production and enhance working safety. A robot system is developed to manage crops and for identifications and monitoring of crops diseases and pesticides. In this system the captured images from camera processed in MATLAB using image processing technique with deep learning and the detection of disease is done and corresponding signal is given to the microcontroller unit to spray the corresponding pesticides.

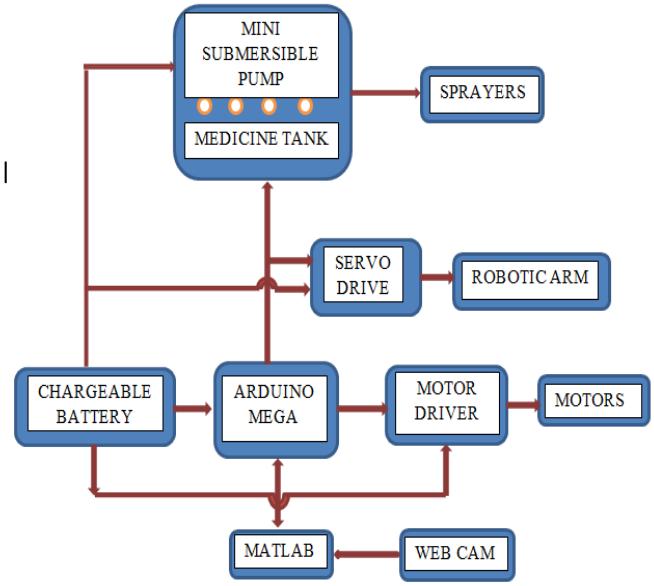


Fig. 1: Overview of the Proposed system

Here we use the deep learning and specifically Convolutional Neural Network (CNN) as an alternative approach for building a model of disease classification. Thus, features are constructed in a fully automated way and learned from the data in the training phase. The fig 2 shows the approach used for the training phase in deep learning technique to create network of data set.

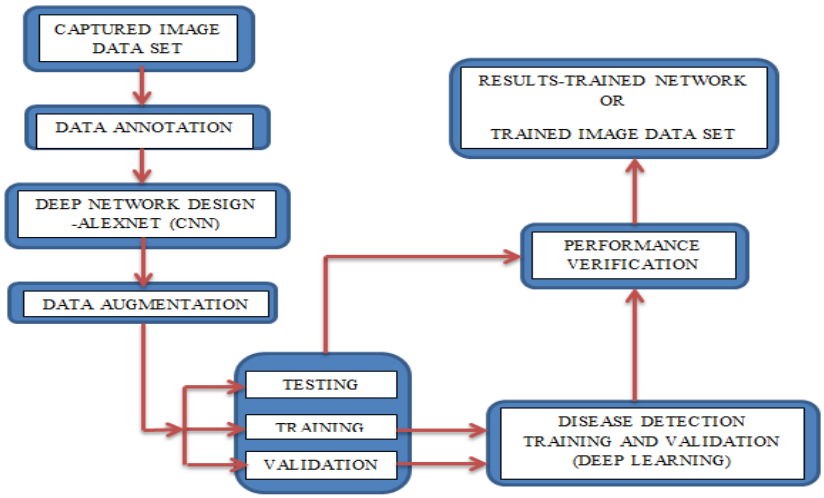


Fig. 2 Overview of trained dataset preparation

2.2 Spraying Technique

In this system the captured images from camera processed in PC using image processing technique on MATLAB platform and the detection of disease is done and corresponding signal is given to the microcontroller unit. In the microcontroller unit C language coding is used for programming to control the robot. According to disease the dispensing mechanism work. Dispensing mechanism consists of four bins along with mini submersible water pumps.

These motor are used to take the corresponding pesticides in the bin when rotate in clockwise direction. Pesticides spraying are done through pump. The control of spraying mechanism is done by the microcontroller unit. The DC motors are electronically controlled by microcontroller which receives input signals from program. By receiving the signal, DC motor is turned on and off to enable selective spraying of pesticides on plants. In this way DC motors help to spray the required pesticides on particular disease which is detected using image processing techniques.

2.2 Six wheel robot

Figure 3 and 4 shows the overview and pictorial view of the complete system (Six wheel Robot). In this system the captured images from camera processed by using image processing technique, the processed result are then converted into binary codes and given it to the microcontroller unit.

The microcontroller unit is programmed to control the robot. Dc motor used to spray the pesticide by using sprayer. The control of spraying mechanism is done by the microcontroller unit. The spraying system contain four tanks for keeping the pesticides, a sprayer and DC motor to direct the robot to spray the pesticides in desired spray area. The DC motors are electronically controlled by microcontroller with the help of L298D driver which receives input signals from input module on the robot. By receiving the signal, DC motor is turned on and off to enable selective spraying of pesticides on plants. Some DC motors help to spray the required pesticides on particular disease which is detected using image processing techniques

The Robot also have spraying mechanism, hence it is completely autonomous robot. These systems consist of camera placed on robot. This robot is made in such a way that it can move around the farm in space, in space between two rows of crops and camera take the images of plant. The camera is connected to PC on which main process of disease detection is run. PC is connected to robot through arduino. After the detection of disease a spraying system which is designed on robot automatically spray the pesticides where it required.

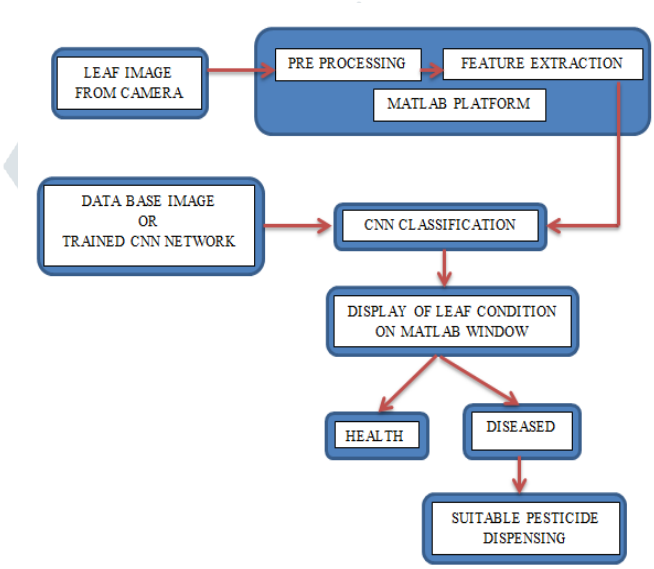


Fig. 3: Overview of the complete system

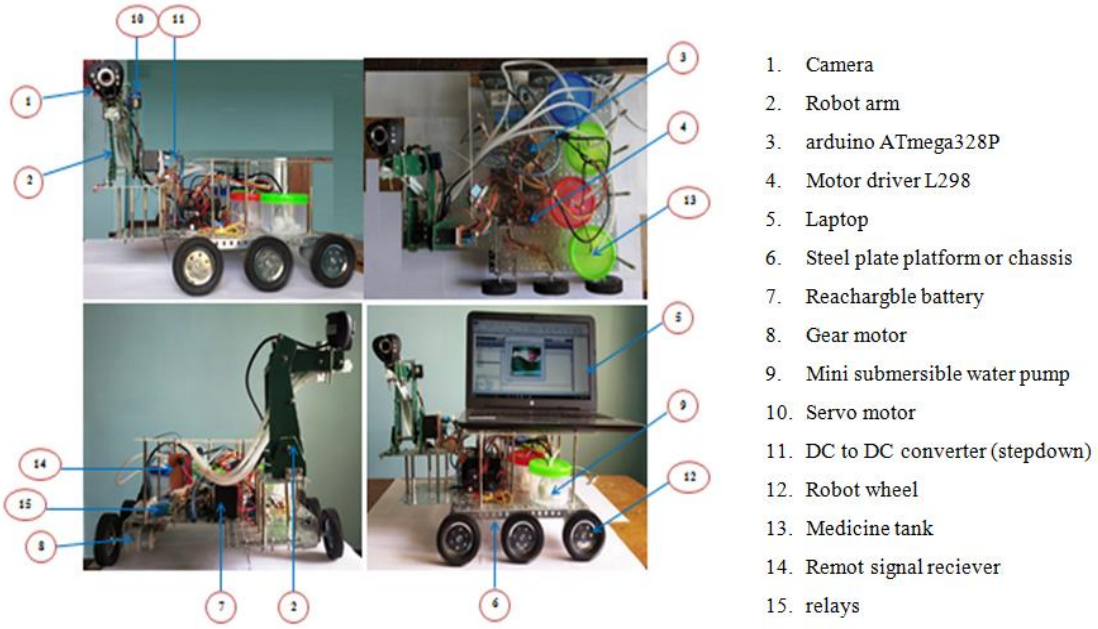


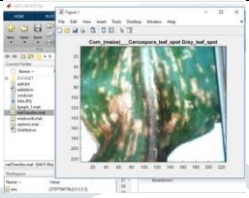
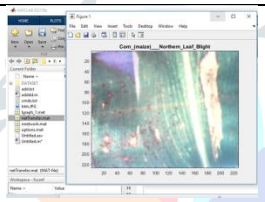
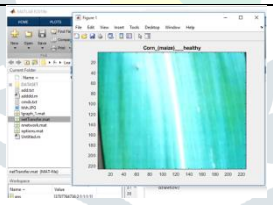
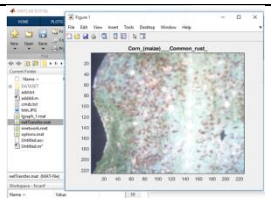
Fig 4: Pictorial view of the complete system

III. RESULTS

Testing has been done by apply all the steps of image processing in MATLAB on input samples. When the disease leaves are given as input data that result in detection of corresponding disease as shown in following table and corresponding pesticides is sprayed.

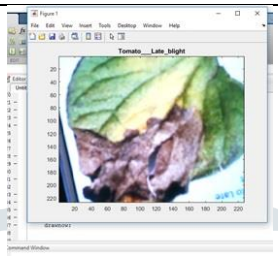
The four different types of Corn (Maize) leafs are tested using the developed six wheel robot by storing the pesticides in four bins. Among four one bin (Bin_4) contains general pesticide for continuous sparying. The bin_1, bin_2 and bin_3 contains pesticides for Common rust, Cercospora leaf spot Gray leaf spot and Northern Leaf Blight respectively.

Table 1 shows the results of the testing of Corn (Maize) leafs

Input image sample	Detection of disease	Pesticides that have to sprayed
 Plant Name: Corn (Maize)	 Disease Name: Cercospora_leaf_spot Gray_leaf_spot	Pesticide sprayed from Bin_2
 Plant Name: Corn (Maize)	 Disease Name: Northern Leaf Blight	Pesticide sprayed from Bin_3
 Plant Name: Corn (Maize)	 Disease Name: Healthy	None of the pesticides sprayed
 Plant Name: Corn (Maize)	 Disease Name: Common Rust	Pesticide sprayed from Bin_1

The testing also has been carried out for tomato leafs; the corresponding results are tabulated as below.

Table 2 shows the results of the testing of Corn (Maize) leafs

Input image sample	Detection of disease
	
Plant Name: Tomato	Disease Name: Early Blight
	
Plant Name: Tomato	Disease Name: Late Blight

IV.CONCLUSION

The identification of plant disease and automatic spraying of suitable pesticides is very essential for the successful cultivation of crop and this can be done in this work by using six wheel robot which works on image processing integrated with deep learning technique.

- It is used to find the plant diseases which can be identified at early stage or the initial stage. It can also spray the required pesticides for the infected leaf.
- Based on the result obtained from the algorithms, a decision can be taken as which type of pesticides should be sprayed. This prevents unnecessary spraying of any type of pesticides on crops.
- This setup can be used for number of plant diseases for storing the data and identification of leaf diseases.
- At a time four different pesticides can be stored in the tank available in this robot.
- Deep learning technique has been successfully implemented for image processing and feature extraction.
- Present spraying mechanism of the system can only use for Smaller and Nursery plants.

REFERENCE

[1] Vijay Kumar V , and Vani K S, "Agricultural Robot: Leaf Disease Detection and Monitoring the Field Condition Using Machine Learning and Image Processing", International Journal of Computational Intelligence Research, Vol. 14, Number 7 , 2018.

[2] D. A. Shaikh , Ghorale Akshay G , Chaudhari Prashant A, Kale Parmeshwar L, "Intelligent Autonomous Farming Robot with Plant Disease Detection using Image Processing", International Journal of Advanced Research in Computer and Communication Engineering, Vol. 05, Issue-04, April 2016.

[3] Ashwin Dhakal and Prof. Dr. Subarna Shakya, "Image-Based Plant Disease Detection with Deep Learning", International Journal of Computer Trends and Technology (IJCTT), Vol. 61, Number 1 – July 2018.

[4] Arti N. Rathod, Bhavesh A. Tanawala, Vatsal H. Shah, "leaf disease detection using image processing and neural network", International Journal of Advance Engineering and Research Development (IJAERD), Vol. 1, Issue-6, June 2014.

[5] Andreas Kamilaris, Francesc X. Prenafeta-Boldú, "Deep learning in agriculture: A survey", Computers and Electronics in Agriculture, Vol. 147, 2018.

[6] Mohammed Brahimia,b, Kamel Boukhalfaa, Abdelouahab Moussaouic, "Deep learning for Tomato Diseases: Classification and Symptoms Visualization", Applied Artificial Intelligence, April 6, 2017

[7] Nivedita.R.Kakade1,Dnyaneswar.D.Ahire, "real time grape leaf disease detection", IJARIIE, Vol. 1, Issue 4, 2015.

[8] Prakash M. Mainkar, Shreekant Ghorpade, Mayur Adawadkar, " Plant Leaf Disease Detection and Classification Using Image Processing Techniques", International Journal of Innovative and Emerging Research in Engineering, Vol. 2, Issue 4, 2015.