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Leaf Disease Discerning and Pesticides Recommendation using Neural Network

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Abstract: ***Crop production problems are common in India which severely effect rural farmers, agriculture sector and the country's economy as a whole. Food production is to be compromised by various problems; one among them is leaf disease. In Crops, leaf plays a significant job as it gives data about the amount and nature of yield ahead of time contingent on the state of leaf. In this paper we propose the framework which takes a shot at pre-processing, feature extraction of leaf pictures from plant dataset pursued by convolution neural system for disease classification and suggesting Pesticides utilizing Tensorflow innovation.***

Keywords: Convolution Neural Network (CNN), Tensorflow and Pesticides

I. INTRODUCTION

Agrarian efficiency is something on which economy profoundly depends. This is the one of the reasons that disease recognition in plants assumes a significant job in agribusiness field, as having disease in plants are very characteristic. In the event that appropriate consideration isn't taken here, at that point it causes genuine impacts on plants and because of which individual item quality, amount or efficiency is influenced. Recognition of plant sickness through some auto-programmed strategy is useful as it diminishes a huge work of observing in huge ranches of crops, and at beginning period itself it identifies the side effects of sicknesses for example at the point when they show up on plant leaves.

Innovation helps individuals in expanding the generation of food. Anyway the generation of food can be influenced by number of factor, for example, climatic change, infections, soil fruitfulness and so forth. Out of these, disease plays major job to influence the generation of food. Agriculture plays an significant job in Indian economy. Leaf spot infections debilitate trees and bushes by intruding on photosynthesis, the procedure by which plants make vitality that supports development and guard frameworks and impacts survival [1].

Over 58% smallholder rancher relies upon horticulture as their head methods for occupation. In the creating scene, more than 80 percent of the agrarian creation is produced by smallholder ranchers, and reports of yield loss of more than half because of vermin and illnesses are common[2]. The creation is diminishing step by step with different variables and one of them is sicknesses on plants which are not identified early arrange.

Different endeavours have been created to avoid crop misfortune due to maladies. Chronicled methodologies of broad application of pesticides have in the previous decade progressively been enhanced by coordinated irritation the board (IPM) approaches [7]. Autonomous of the methodology, distinguishing an illness effectively at the point when it initially shows up is a vital advance for proficient illness the board. Verifiably, ailment recognizable proof has been upheld by farming augmentation associations or other organizations, for example, neighbourhood plant facilities. In later occasions, such endeavours have also been upheld by giving data for sickness finding web based, utilizing the expanding web infiltration around the world. Considerably more as of late, devices in view of cell phones have multiplied, exploiting of the generally unrivalled fast take-up of cell phone innovation in all pieces of the world [8].

There is different work is done in earlier years. Bacterial sickness lessens plants development fastly so to distinguish this kind of infections , Identifying the ailment at an beginning time and proposing the arrangement so greatest mischief can be maintained a strategic distance from to expand the harvest yield [4] have utilized ANN and K-intends to group the ailment and grade the ailment for. There is a need to structure the programmed framework to identify the leaf ailment and suggest the correct pesticide.

So as to create exact picture classifiers for the reasons of plant disease determination, we required an enormous, confirmed dataset of pictures of unhealthy and solid plants. Until as of late, such a dataset didn't exist, and significantly littler datasets were not unreservedly accessible. To address this issue, the Plant Village venture has started gathering a huge number of pictures of solid and ailing yield plants [9], and has made them straightforwardly and uninhibitedly accessible.

A. Problem Statement

Crop illnesses are a significant danger to food security; however their fast recognizable proof stays troublesome in numerous pieces of the world due to the absence of the fundamental foundation. This problem is overcome by blend of expanding worldwide computer infiltration and ongoing advances in neural science made conceivable by profound learning has made ready for system helped disease finding and suggesting required pesticide.

B. Objectives

In Crops leaf plays an significant job as it gives data about the amount and nature of yield ahead of time contingent on the state of leaf. We propose the framework which should accomplish the following objectives:

1) To process the data of the leaf picture from plant dataset.
2) To extract the feature from pre-processed data.
3) To accurately classify the leaf disease.
4) To suggest the pesticide based on disease classification using tenor stream innovation technique.
5) To evaluate performance analysis.

C. Methodology

The fundamental point is to structure a framework which is proficient and which give disease name and pesticides name as quick as conceivable. For that reason we utilize two stage: first is training stage and second is testing stage. In first stage: Image procurement, Image Pre-preparing and CNN based preparing. In second stage Image procurement, Image Pre-preparing, classification and disease distinguishing proof and pesticides identification. For experimentation reason we have utilized PlantVillage datasets.

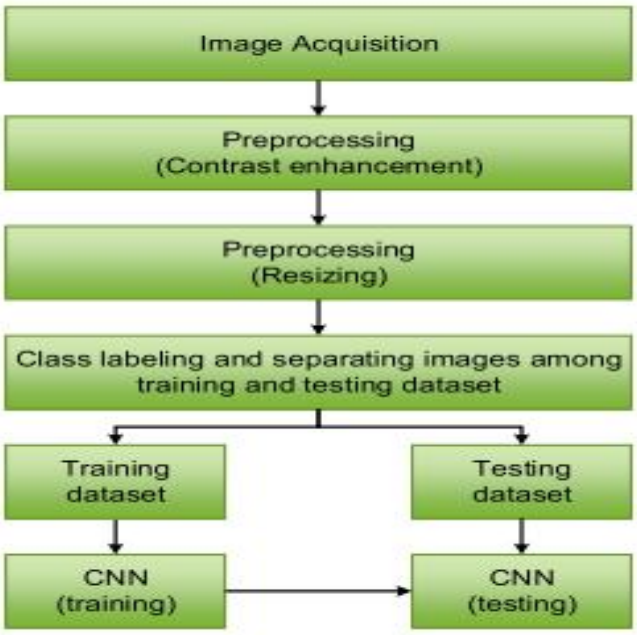

Fig. 1 Block Diagram of Proposed System

II. LITERATURE SURVEY

In 2017, Monzurul Islam, Anh Dinh, Khan Wahid ,Pankaj Bhowmik present an approach that coordinates picture preparing and AI to permit diagnosing ailments from leaf pictures. This computerized technique groups sicknesses (or nonappearance thereof) on potato plants from an openly accessible plant picture database called 'Plant Town'. Our division approach and usage of help vector machine show sickness grouping more than 300 pictures with a precision of 95%.

In 2017, Vijai Singh A.K. Misra exhibits a calculation for picture division method which is utilized for programmed identification and order of plant leaf illnesses. It moreover spreads overview on various infections characterization strategies that can be utilized for plant leaf illness identification. Picture division, which is a significant angle for sickness discovery in plant leaf illness, is finished by utilizing hereditary calculation.

In 2016, Sharada Prasanna Mohanty,David Hughes and Marcel Salathe Utilizing an open dataset of 54,306 pictures of ailing and sound plant leaves gathered under controlled conditions, they train a profound convolutional neural system to distinguish 14 harvest species and 26 ailments (or nonattendance thereof). The prepared model accomplishes an exactness of 99.35% on a held-out test set, exhibiting the practicality of this methodology.

In 2016, Davoud Ashourloo, Hossein Aghighi, Ali Akbar Matkan, Mohammad
Reza Mobasheri, and Amir Moeini Rad uses the spectra of the contaminated and non tainted leaves in various infection manifestations were estimated utilizing a non imaging spectroradiometer in the electromagnetic district of 350 to 2500 nm. So as to deliver a ground truth dataset, we utilized photographs of an advanced camera to figure the infection seriousness and ailment manifestations portions. At that point, extraordinary test sizes of gathered datasets were used to prepare each technique.

In 2016, Noa Schor, Avital Bechar,Timea Ignat present an automated location framework for joined recognition of two significant dangers of nursery ringer peppers: Powdery buildup (PM) and Tomato spotted wither infection (TSWV). The framework depends on a controller which encourages arriving at different location presents. A few identification calculations are created dependent on head part investigation (PCA) and the coefficient of variety (CV). Tests find out the framework can effectively identify the plant and arrive at the identification posture required for PM, yet it experiences issues in arriving at the TSWV discovery present.

In 2016, Lucas G. Nachtigall and Ricardo M. Araujo ponders the utilization of Convolutional Neural Systems to naturally distinguish and characterize sicknesses, wholesome insufficiencies and harm by herbicides on apple trees from pictures of their leaves. This errand is basic to ensure a high nature of the subsequent yields and is at present to a great extent performed by specialists in the field, which can seriously constrain scale and include to costs.

In 2016, Davoud Ashourloo, Ali Akbar Matkan planned for building up an unearthly malady file that can distinguish the phases of wheat leaf rust malady at different DS levels. To meet the point of the investigation, the reflectance spectra (350–2500 nm) of tainted leaves with various side effect parts and DS levels were estimated with a spectroradiometer.

In 2015, Aakansha Rastogi,Ritika Arora,Shanu Sharma proposed the framework which takes a shot at preprocessing, highlight extraction of leaf pictures from plant town dataset pursued by convolution neural system for grouping of ailment and suggesting Pesticides utilizing Tensor stream innovation.

The principle two procedures that they use in our framework is android application with Java Web Services and Deep Learning. They have use Convolution Neural Network with various layers five, four and three to prepare our model and android application as a UI with JWS for association between these frameworks.

In 2015, Xingchun Chen and Ron made survey which examines science, worldwide dissemination and plant harm and yield misfortunes in soyabean brought about by creepy crawly bugs, plant infections, nematodes and weeds. The connections among bugs, weeds and illnesses are point by point. A soyabean incorporated irritation the executives (IPM) bundle of works on, covering the yield from pre-planting to collect, is delineated. The impact of atmosphere changes on arthropod bugs, plant illnesses and weeds are talked about.

In 2015, Rajleen Kaur,Dr. Sandeep Singh Kang proposed programmed location of ailments and ailing part present in the leaf pictures of plants and even in the horticulture Crop creation. It is finished with headway of PC innovation which encourages in cultivating to build the creation. Basically there is issue of recognition exactness and in neural system approach support vector machine (SVM) is most recent classifier of that approach.

In 2014, Ms. Kiran R. Gavhale,Prof. Ujwalla Gawande,Mr. Kamal O.Hajari present about the picture handling methods utilized in performing early recognition of plant illnesses through leaf highlights assessment. The goal of this work is to actualize picture examination and characterization methods for extraction and characterization of leaf maladies. Leaf picture is caught and after that handled to decide the status of each plant.

In 2010, Dheeb Al Bashish, Malik Braik, and Sulieman Bani-Ahmad We propose and assess a structure for identification of plant leaf/stem sicknesses. Studies show that depending on unadulterated unaided eye perception of specialists to identify such ailments can be restrictively costly, particularly in creating nations. Giving quick, programmed, modest and exact image processing based answers for that undertaking can be of extraordinary sensible essentialness.

In 2008, Santanu Phadik ar and Jaya Sil depicts a product model framework for rice sickness recognition dependent on the tainted pictures of different rice plants. Pictures of the tainted rice plants are caught by advanced camera and prepared utilizing picture developing, picture division procedures to recognize contaminated pieces of the plants. At that point the tainted piece of the leaf has been utilized for the arrangement reason utilizing neural system.

III.SYSTEM DESIGN

System design thought as the application of theory of the systems for the development of the project. System design defines the architecture, data flow, use case, class, sequence and activity diagrams of the project development.

A. System Architecture

The below architecture diagram in figure 2 illustrates how the system is built and is the basic construction of the software7method. Creations of such structures and documentation of these structures is the main responsible of software architecture.

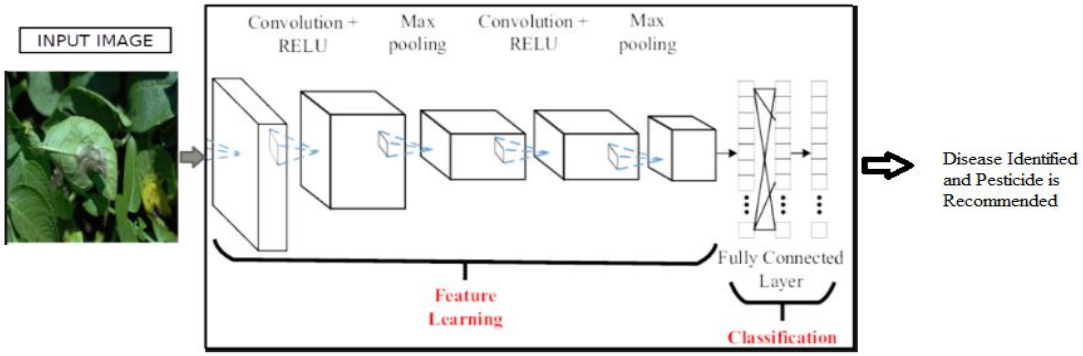

Fig. 2 Architecture Diagram

Main Steps to build a architecture if proposed system are:

1) *Convolution:* Is the first layer to extract features from the input image and it learns the relationship between features using kernel or filters with input images.
2) *ReLU Layer:* ReLU stands for the Rectified Linear Unit for a non-linear operation. The output is $f(x) = \max(0, x)$. We use this because to introduce the non-linearity to CNN.
3) *Pooling Layer:* it is used to reduce the number of parameters by down sampling and retain only the valuable information to process further.
4) *Flattening:* We flatten our entire matrix into a vector like a vertical one. so, that it will be passed to the input layer.
5) *Fully Connected Layer:* we pass our flatten vector into input Layer .we combined these features to create a model. Finally, we have an activation function such as softmax or sigmoid to classify the outputs.

B. Dataflow Diagram

Data flow diagram also referred as bubble graph. This diagram is useful for representing the system for all degree of constructions. The figure is differentiated into parts which show maximizing data path & practical aspect. The below figure 3 shows the dataflow of the proposed system.

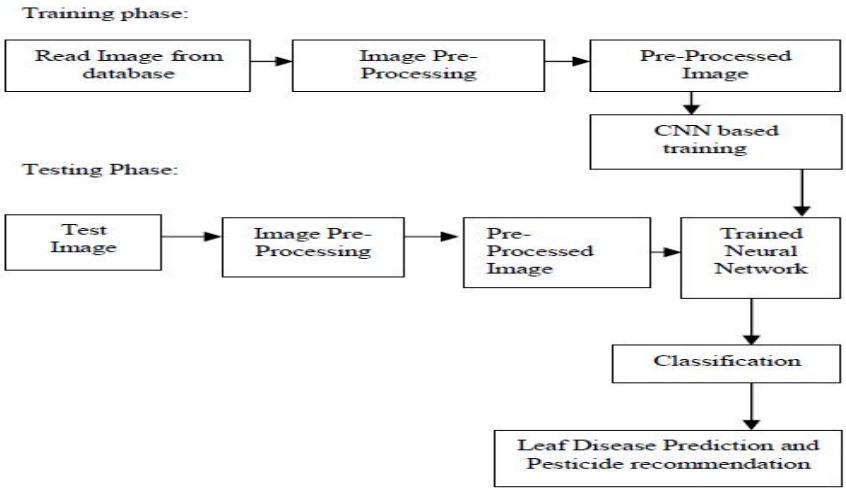

Fig. 3 Dataflow Diagram

C. Flowchart

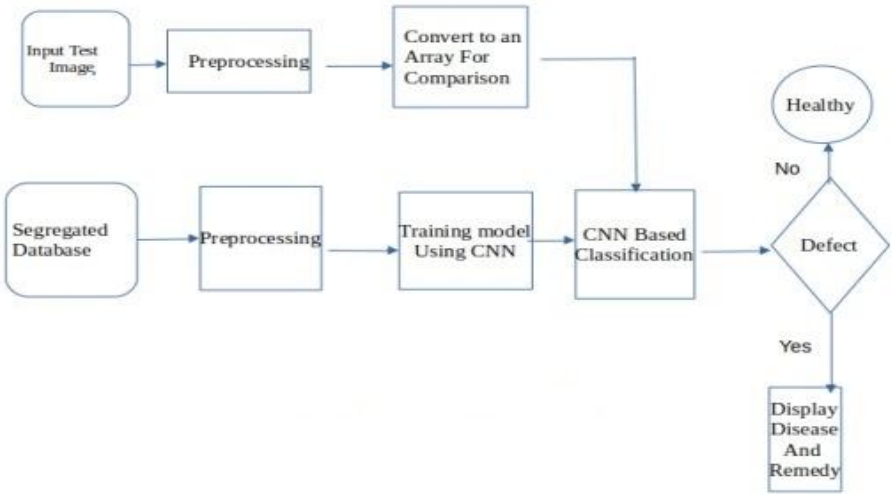

Fig. 4 Flowchart

D. General Explanation of Flowchart

1) The input test image is acquired and pre-processed in the next stage and then it is converted into array form for comparison.
2) The selected database is properly segregated and pre-processed and then renamed into proper folders.
3) The model is properly trained using CNN and then classification takes place.
4) The comparison of the test image and the trained model take place followed by the display of the result.
5) If there is a defect or disease in the plant the software displays the disease along with the remedy

IV. IMPLEMENTATION

Pre-processing and Training the model (CNN): The database is Pre-processed such as Image reshaping, resizing and conversion to an array form. Similar processing is also done on the test image. A database consisting of different plant species is obtained, out of which any image can be used as a test image for the software. The train database is used to train the model (CNN) so that it can identify the test image and the disease it has .CNN has different layers that are Dense, Dropout, Activation, Flatten, Convolution2D, and MaxPooling2D. After the model is trained successfully, the software can identify the disease if the plant species is contained in the database. After successful training and pre-processing, comparison of the test image and trained model takes place to predict the disease.

A. Image Acquisition

For training, Image is taken from database. And for testing, you can take image from camera at real time but in this work, we made a particular folder on mobile from that image will be fetched by android application 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.

B. Image Pre-Processing

Image should be processed before sending to the algorithm for testing and training purpose. For that purpose, in this work image is scaled or resize into 150 x 150 dimensions. 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.

C. Convolutional Neural Network (CNN)

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 android application 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.

CNN image classifications takes an input image, process it and classify it under certain categories Computers sees an input image as array of pixels and it depends on the image resolution. Based on the image resolution, it will see h x w x d(h = Height, w = Width, d = Dimension). Eg., An image of 6 x 6 x 3 array of matrix of RGB (3 refers to RGB values) and an image of 4 x 4 x 1 array of matrix of grayscale image.

Technically, deep learning CNN models to train and test, each input image will pass it through a series of convolution layers with filters (Kernels), Pooling, fully connected layers (FC) and apply Softmax function to classify an object with probabilistic values between 0 and 1

1) *Convolution Layer:* Convolution is the first layer to extract features from an input image. Convolution preserves the relationship between pixels by learning image features using small squares of input data. It is a mathematical operation that takes two inputs such as image matrix and a filter or kernel.

- An image matrix (volume) of dimension **(h x w x d)**
- A filter **(f_h x f_w x d)**
- Outputs a volume dimension **(h - f_h + 1) x (w - f_w + 1) x 1**

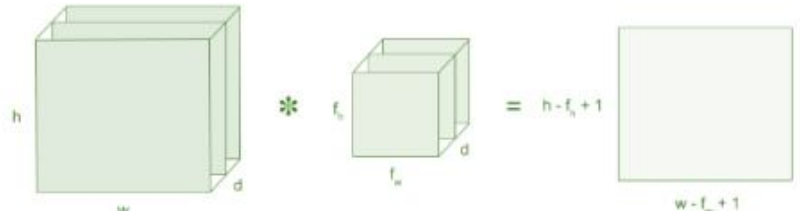

Fig. 5 Image matrix multiplies kernel or filter matrix.

2) *Pooling Layer:* Pooling layers section would reduce the number of parameters when the images are too large. Spatial pooling also called subsampling or downsampling which reduces the dimensionality of each map but retains important information.
3) *Fully Connected Layer:* The layer we call as FC layer, we flattened our matrix into vector and feed it into a fully connected layer like a neural network.

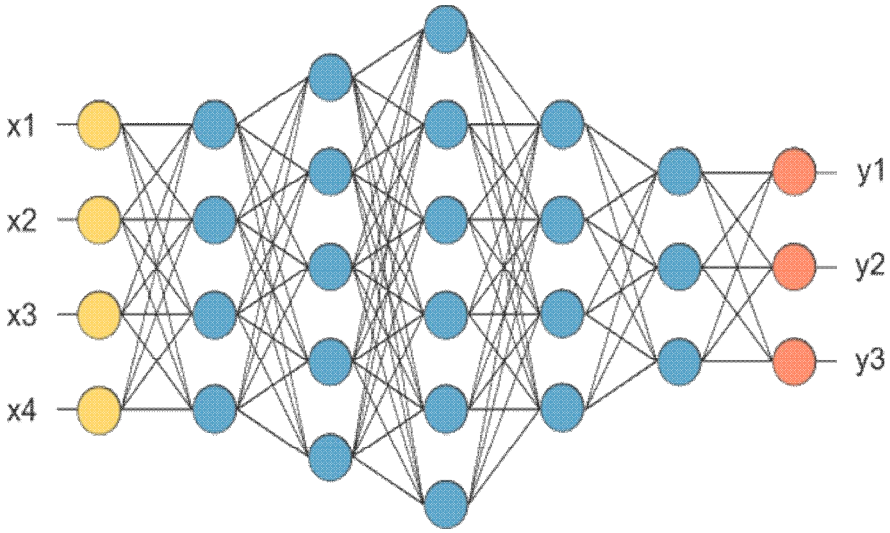

Fig. 6 After pooling layer, flattened as FC layer

In the above figure 6, the feature map matrix will be converted as vector (x1, x2, x3, …). With the fully connected layers, we combined these features together to create a model. Finally, we have an activation function such as softmax to classify the outputs.

V. RESULTS

Fig. 7 Model training and validation accuracy

From the plot of accuracy in figure 7, we can see that the model could probably be trained a little more as the trend for accuracy on both datasets is still rising for the last few epochs. We can also see that the model has not yet over-learned the training dataset, showing comparable skill on both datasets.

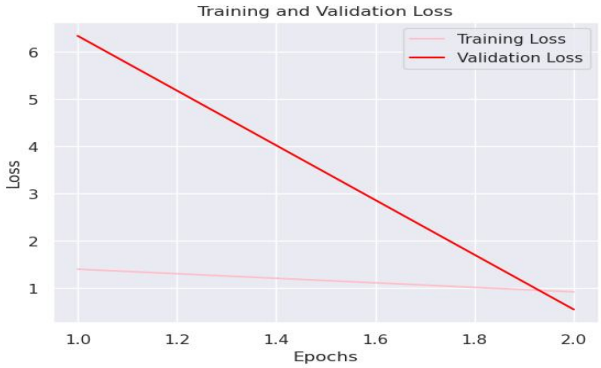

Fig. 8 Model training and validation loss

From the plot of loss in figure 8, we can see that the model has comparable performance on both train and validation datasets (labelled test). If these parallel plots start to depart consistently, it might be a sign to stop training at an earlier epoch.

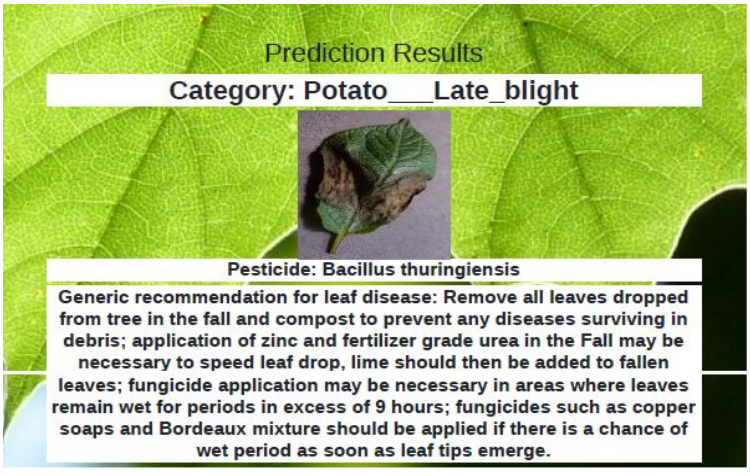

Fig. 9 Predicted result of test image

Figure 9 shows the results of test image predicted. Results contain the details of disease identified and also prefer the pesticide for the identified disease along with the description of the usage of pesticide.

VI. CONCLUSION

The proposed work was developed taking in mind the benefits of the farmers and agricultural sector .The developed system can detect disease in plant and also provide the remedy that can be taken against the disease. By proper knowledge of the disease and the remedy can be taken for improving the health of the plant .The proposed work is based on python and gives an accuracy of around 78%.The accuracy and the speed can be increased by use of Googles GPU for processing.

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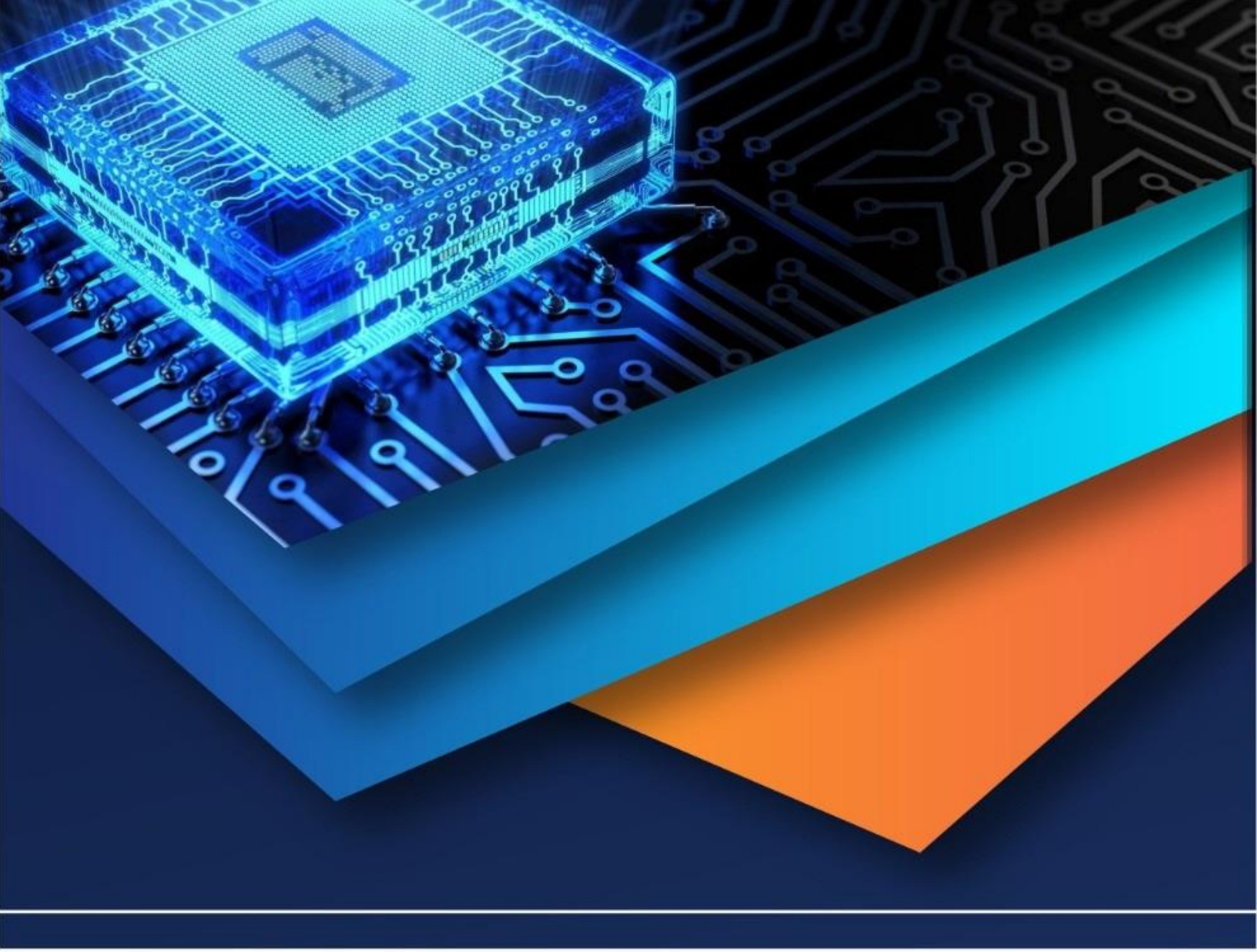

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