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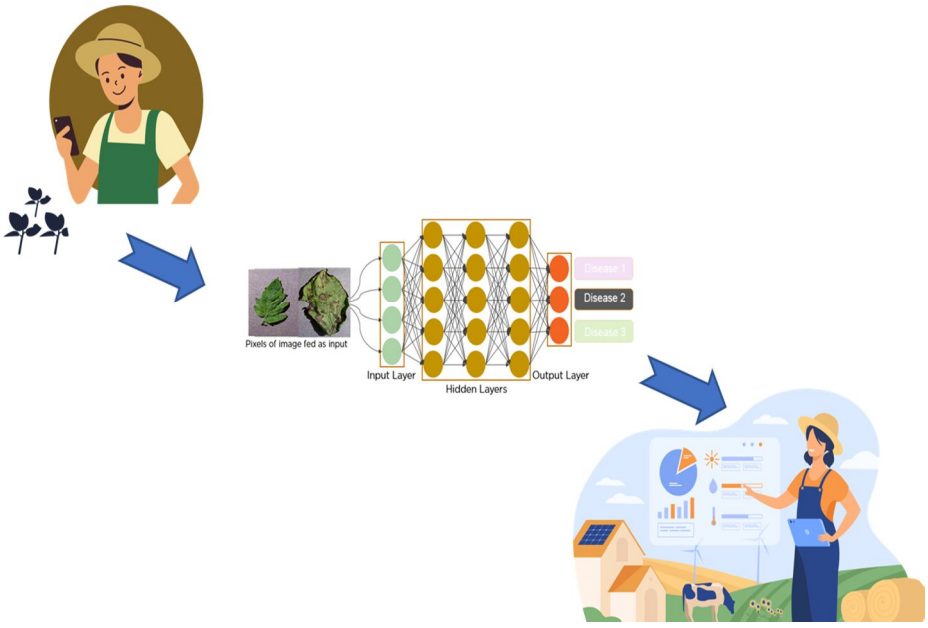
Leaf Disease Detection and Prevention Application

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Abstract: ***Agriculture is the backbone of an economy. Farmers play a vital role in strengthening the economy of any country. Due to the diseases a crop undergoes due to various reasons, Food security is compromised and affects the crop production. A crop disease not only affects a single crop but tends to spread to the neighboring crops as well. Detection and cure of such diseases becomes very difficult for a farmer. This problem can be fixed by using an application that uses a Machine Learning system, which takes leaf image as an input and detects the disease suffered by any particular crop and shows the possible cure. Also considering the farmer's location, Crops that are suitable to grow in the particular location can be displayed.***
Keywords: Machine Learning, Agriculture, ML in Agriculture.

I. INTRODUCTION

Agriculture is the major source of livelihood for around 58% of India's population. India ranks second in the world in terms of farm outputs. Agriculture plays a significant role in the overall socio-economic growth of India. According to a study, crops worth Rs 50,000 crore are lost due to attacks of pests and diseases every year. The reason for this is the lack of knowledge related to disease identification and low pesticide consumption. Diseases can hinder the vital functions of the crops. Identification and diagnosis of the plant disease are essential at the early stage so that the wastage of that particular crop can be minimized or avoided. Since identification through naked eye observation requires continuous monitoring of the crop along with expertise in disease detection, there must be a system that can detect and identify a particular disease. This problem can be solved with the help of Machine Learning. With the help of a dataset consisting of images of various crop diseases along with healthy crops, a model can be prepared which can detect a particular disease. It will take fewer efforts, less time, and be highly efficient. Based on the texture of the leaf, the disease can be detected.



Thus we are presenting a web application that will make use of the Machine Learning Model which can detect and identify the disease suffered by a particular crop. A farmer has the option to click a picture or upload an existing picture of the infected leaf. Along with the identification, a possible cure will be provided as per the identified disease. Also, the buy link for a specific chemical or fertilizer will be provided. Furthermore, a list of crops will be displayed according to the districts. For the convenience of the farmers, we have added regional languages (viz. Hindi and Marathi). A customer service option is also available for any complaints.

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II. METHODOLOGY

In this study, we will make use of different machine learning models to process the dataset and identification.

CNN Model

A Convolutional Neural Network (CNN) is a Deep Learning algorithm that can take an image as an input, assign importance to various aspects in the particular image and be able to differentiate one image from the other.

1) The picture of the infected leaf can be captured using the phone's camera.
2) The captured picture is scaled at the resolution of 224 x 22 4 pixels. The input is compared with the obtained patterns from the CNN model.
3) The picture transformation is done using CV2, Keras, Tensorflow, and Sklearn.
4) After carrying out the comparison with the CNN model, the model outputs the result which is displayed on the front end.
5) After displaying the result, there are certain functions created to display the disease name, possible cure, and the purchase link for any chemical for that particular cure.
6) Furthermore, Functions are created for the crop location.
7) Each district has a different written function that has the list of crops that can be grown in that district. The list has been divided into various sections like Field crops, fruits, etc. The list of crops have been listed after proper research about their growth.
8) The crops that can be grown in a particular district are displayed on the front end (Only districts from Maharashtra are supported at the moment).
9) Option of multiple Regional Languages is provided that can be changed using the displayed option. This project currently supports three languages which are English, Marathi, and Hindi.

Customer Help displays the email address where one can send the desired query and get their query answered by us.

III. MODELING AND ANALYSIS

In the past few decades, Deep Learning has proved to be a very powerful tool because of its ability to handle large amounts of data. The interest to use hidden layers has surpassed traditional techniques, especially in pattern recognition. One of the most popular deep neural networks is Convolutional Neural Networks. In deep learning, a convolutional neural network **(**CNN/ConvNet**)** is a class of deep neural networks, most commonly applied to analyze visual imagery. Now when we think of a neural network we think about matrix multiplications but that is not the case with ConvNet. It uses a special technique called Convolution. Now in mathematics convolution is a mathematical operation on two functions that produces a third function that expresses how the shape of one is modified by the other. Because of this reason the choice of selecting CNN for identifying the disease pattern on leaves of the crops became obvious. After transformation and scaling of image, the image is inserted as an input in CNN model and it recognizes pattern and gives the appropriate result. The dataset on which the model was trained contained the following number of files:

Name of the Disease	Image Data File
Pepper bell Bacterial spot	997
Pepper bell healthy	1478
Potato Early blight	1000
Potato healthy	152
Potato Late blight	1000
Tomato Target Spot	1404
Tomato mosaic virus	373
Tomato Yellow Leaf Curl Virus	3209
Tomato Bacterial spot	2127
Tomato Early blight	1000
Tomato healthy	1591
Tomato Late blight	1909
Tomato Leaf Mold	952
Tomato Septoria leaf spot	1771
Tomato Spider mites Two spotted spider mite	1676
Total Files	20639

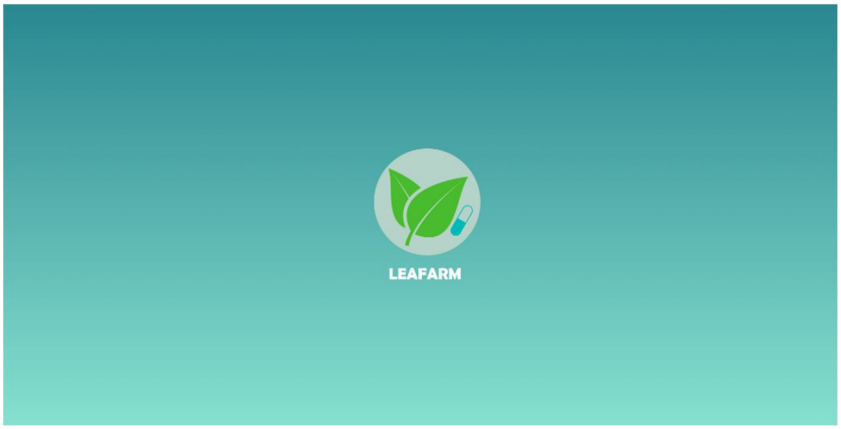
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Around 40 Epochs (An epoch is a term used in machine learning and indicates the number of passes of the entire training dataset the machine learning algorithm has completed) were ran to make model more efficient. The accuracy of the model came to 90.08 percent. Around 10% of the time model shows wrong identification. Model is able to detect the patterns of leaves more correctly. Web app is used using JavaScript, HTML and CSS, convolutional neural network model was implemented using Python (2.7.9) and other particular libraries. The functions embedded in the web app have no bugs (at the time of testing) and can be updated. The web app is hosted and can be use on any device (For example: Android, Windows, Ubuntu, IOS etc). As for the future scope, the model can be made more accurate with more data files or by trying and testing other new models which are not tested, more disease recognition can be added, more native languages can be added and more awareness can be done about the app among the farmers.

IV. RESULTS AND DISCUSSION

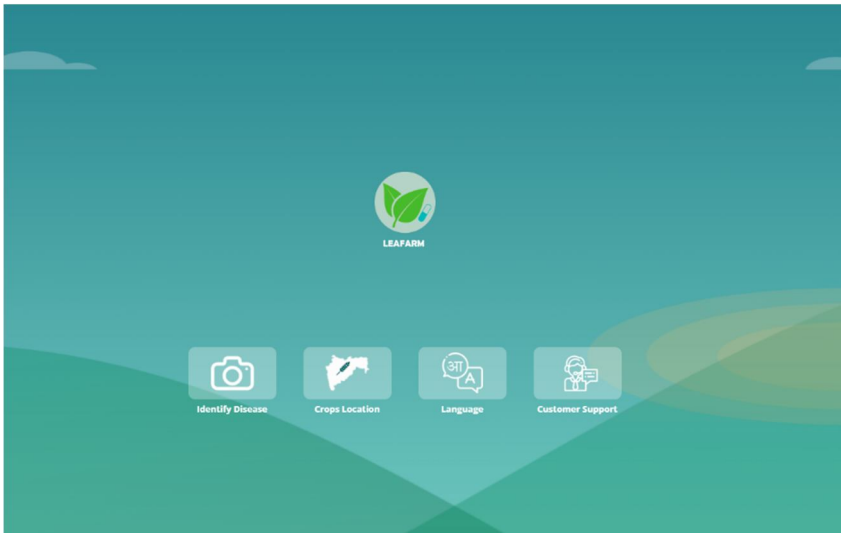
A. Welcome Page

Welcome page displays the logo of our web application ‘Leafarm’.



B. Homepage

Different options are displayed on the homepage.

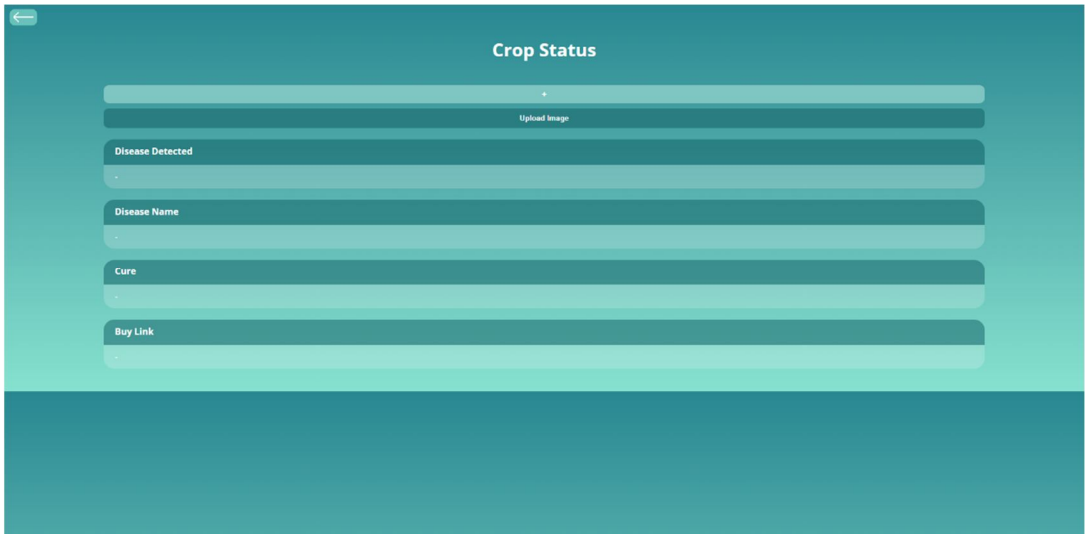


C. Identify Disease

On this page, the infected leaf’s picture needs to be uploaded as input. Users have to make use of ‘+’ to either capture leaf’s picture using the phone’s camera or select an existing image.

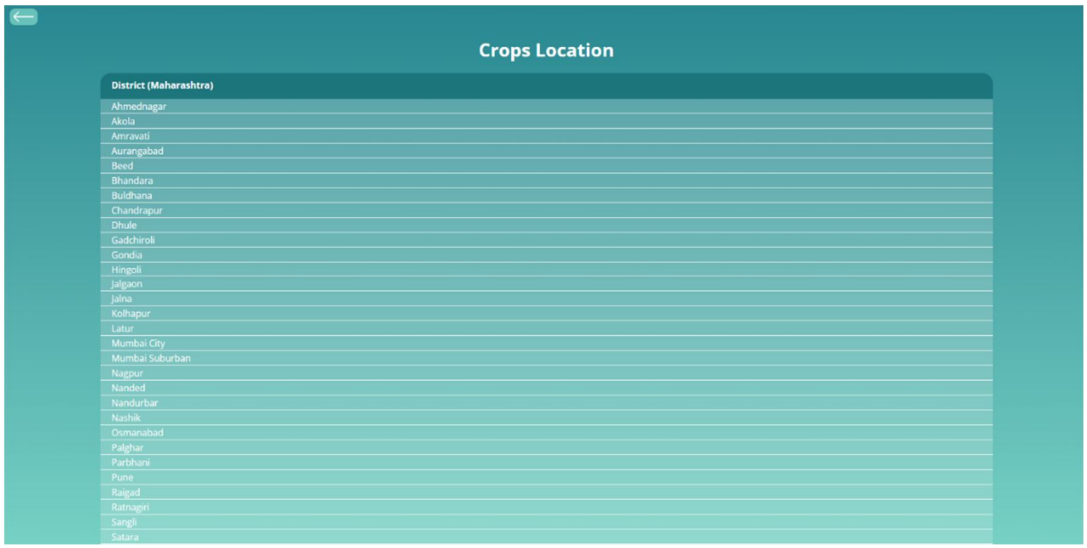
After clicking or selecting an existing image, clicking ‘Upload Image’ will send the leaf’s image to the model for processing. Once the input is compared with the model, the output is displayed.

The name of the disease is displayed in ‘Disease Name’ along with Cure and Buy Link for the particular displayed cure.

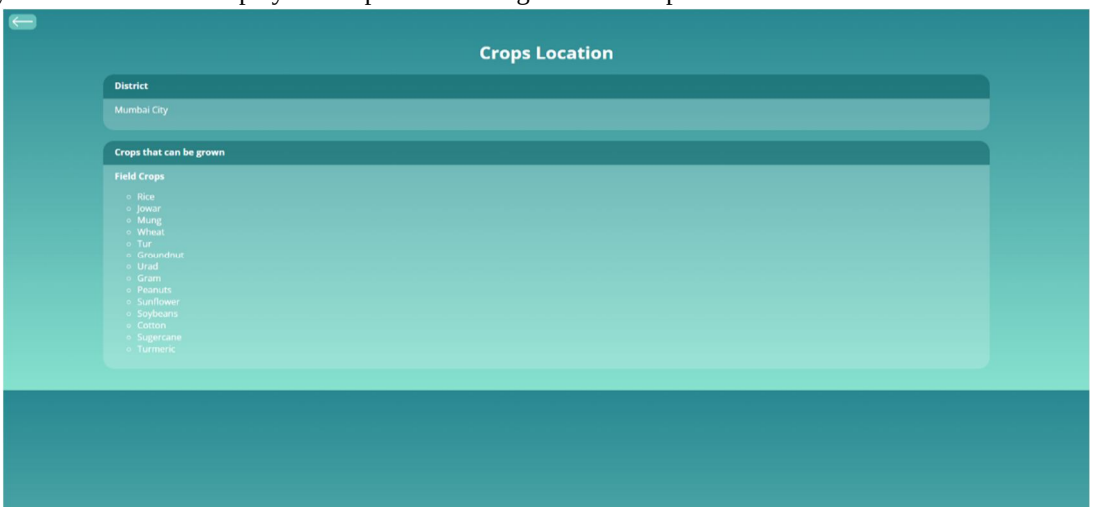


D. Crops Location

This page will display the various district names of the state of Maharashtra.

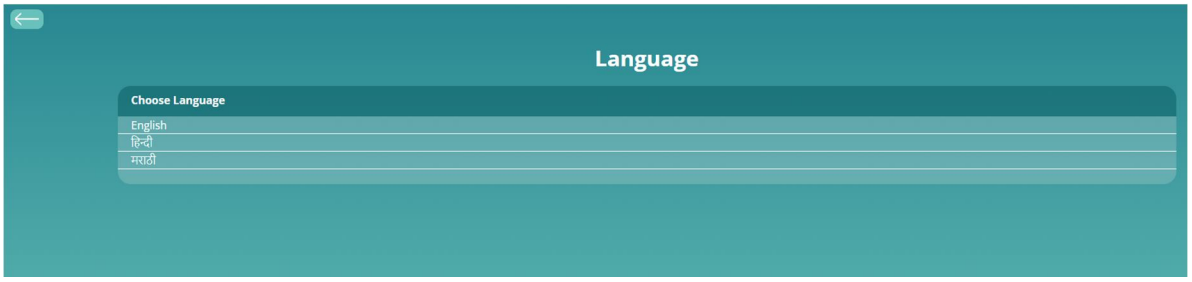


Clicking on any district name will display the crops that can be grown in that particular district.

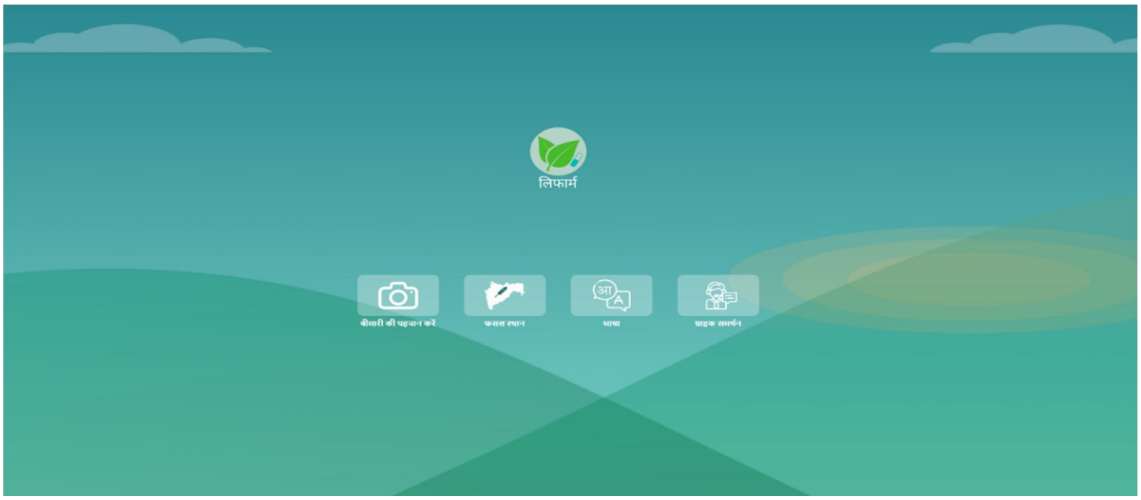


E. Language

This page displays the Language options. Clicking on any language will change the entire language of our web application.

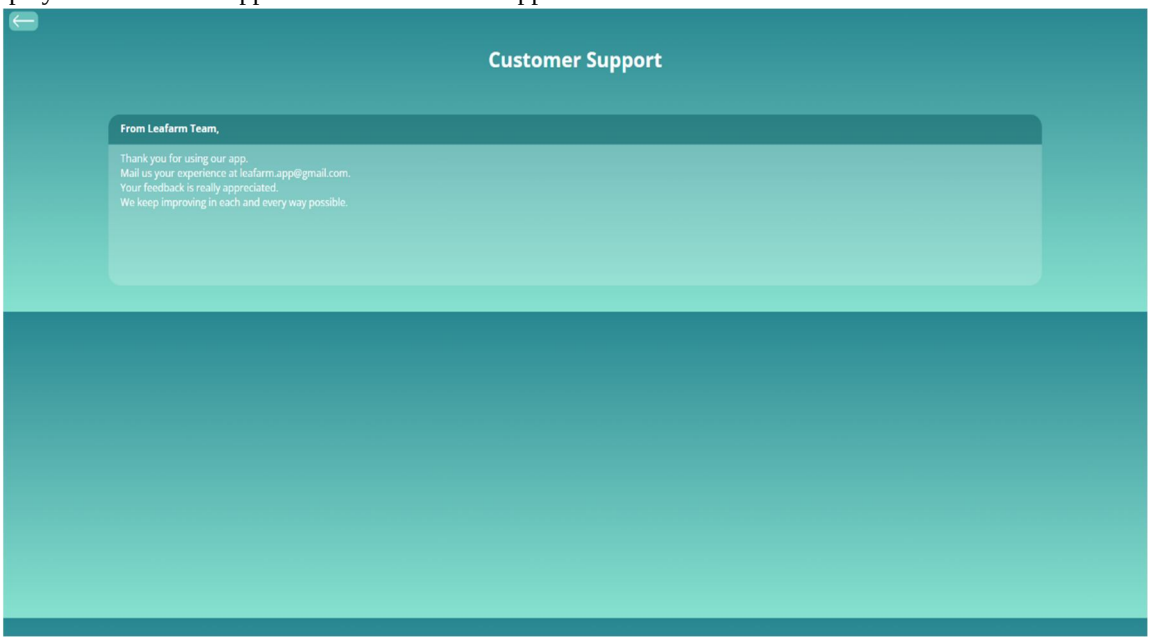


For instance, the below picture is the Hindi version of our web application.



F. Customer Support

This page displays the customer support section of our web application which consists of our contact information.



We have also added a back button for ease of navigation on each page which takes us back to the homepage.

Below is the Android/iOS interface of the mobile application which works same as the web application. Pictures can be captured using the phone's camera.

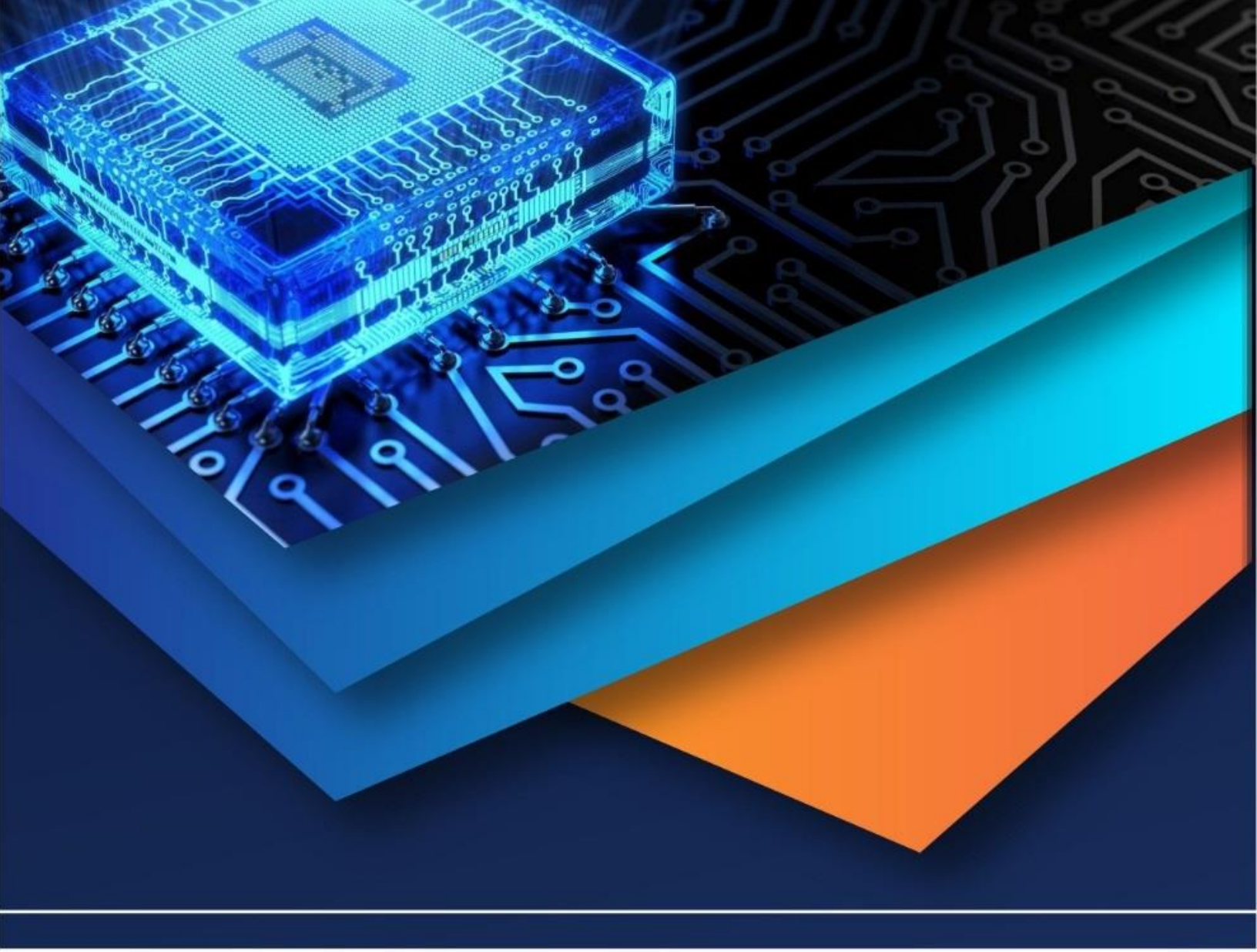


V. CONCLUSION

In this research we studied the use of Machine Learning which includes Deep Learning which provides a dependable method to detect a particular crop disease and provide a possible cure for a disease. ML is the key to overcome the agricultural challenges. The real-time feature to click or upload an image of an infected crop is a boon. A farmer can efficiently click a picture of the infected crop using a phone's camera. The Machine Learning Model which detects the particular disease as well as suggests a possible cure which can be a specific pesticide or chemical will help to reduce the wastage of crops caused by various diseases. Also, the spread of diseases among crops can be controlled. The food security which takes a hit due to the wastage of infected crops can be improved with the help of this system. Also, financial loss faced by farmers by virtue of damaged crops can be reduced with the help of this system. Addition of various features by considering the location can have a positive impact. This system can be installed in a Farmer's smartphone to detect a crop disease and display a possible cure. This system will improve the food security and reduce the wastage of crops on large scale.

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