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Fruits and Vegetables Disease Prediction using CNN

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Abstract: *When fruit and vegetable diseases are not treated quickly, they dramatically diminish yield. Fruit and vegetable diseases are often brought on by pests, insects, and pathogens. Farmers are losing money as a result of several illnesses. These issues that farmers are facing have a remedy in the suggested system. The suggested system offers a solution to the problems that farmers are experiencing. Pre-processing is used during the first stage. The noisy and fuzzy portions of the segmented image are removed in the second phase using a variety of features, and finally, images are classified into one of the classes using a multi-class algorithm. We examined fruit and vegetable illnesses as a test case. Our findings show that the suggested strategy can significantly aid in the accurate detection and automatic recognition of vegetable and fruit diseases.*

Keywords*:* Attributes, Classification, Convolution Neural Network, Prediction , Image Processing

I. INTRODUCTION

In the modern world, agriculture field provides more than just a food. However, as a result of climatic and other changes over time, crop yields and agricultural output are now more vulnerable to a number of significant problems that are of grave concern. Agriculture will play a significant role in the global economy since demand is expected to outpace supply at an increasingly high rate in the coming years. Currently, production is falling short of rising demand. In general, the size of the cultivation area and the number of crops grown in horticulture are different from those in agriculture. These issues that farmers are facing have a remedy in the suggested system. The suggested system offers a solution to the problems that farmers are experiencing. We list any diseases that may be present in fruits and vegetables along with their symptoms and pesticides so that farmers can take immediate action to prevent them. Fruit and vegetable diseases have a significant negative impact on the productivity and financial losses of the global agricultural industry. An adaptable method for identifying fruit and vegetable diseases is proposed in this study and experimentally validated. Convolutional Neural Network algorithm (CNN) is used.

Why CNN ?:

A Convolutional Neural Network Architecture is suggested for the image-based disease detection of leaves and fruits. When compared to current models, our suggested model provides a 98% accuracy.

Algorithm:

Convolutional Neural Networks with a focus on image and video recognition applications. CNN is primarily utilized for image analysis tasks like segmentation, object detection, and image recognition.

Convolutional Neural Networks have three different kinds of layers:

Convolutional layer: Each input neuron is connected to the following hidden layer in a typical neural network through the convolutional layer. Only a small portion of the input layer neurons in CNN are connected to the hidden layer of neurons.

Pooling Layer: The feature map's dimensionality is decreased using the pooling layer. Inside the CNN's hidden layer, there will be numerous activation and pooling layers.

Fully connected layer: The final few layers of the network are known as Fully Connected Layers. The output from the final pooling or convolutional layer is fed into the fully connected layer, where it is flattened before being applied.

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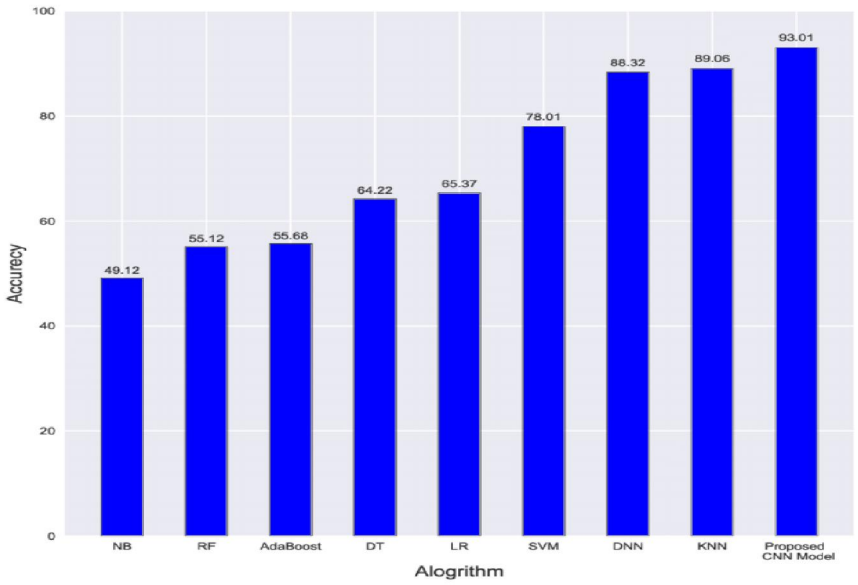

Figure 1 Comparison Between Algorithms

Mathematical Model:

Let S be the Whole system S= {I,P,O}
I-Input
P-procedure
O-output
Input (I),
I= {Image }
Where,
Dataset-> Image
Procedure (P),
P= {I, Using I System perform operations and performs the prediction}
Output(O)-
O= {System detects the diseases in fruits and vegetables}

II. METHODOLOGY

1. Gather and upload a collection of images of fruits and vegetables.
2. Pre-processing: Scale the image, remove blur and distortion, and convert RGB and greyscale to binary.
3. Extract the image's features, including its edges, size, width, and pixel values.
4. Create two distinct groups from the dataset: training (80%) and testing (20%).
5. Classification: Sort the dataset into categories using the CNN algorithm.
6. Create a CNN Training simulation. The CNN model has been used to analyse images.
7. As a result, find the disease in fruits and vegetables.

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Architectural Diagram

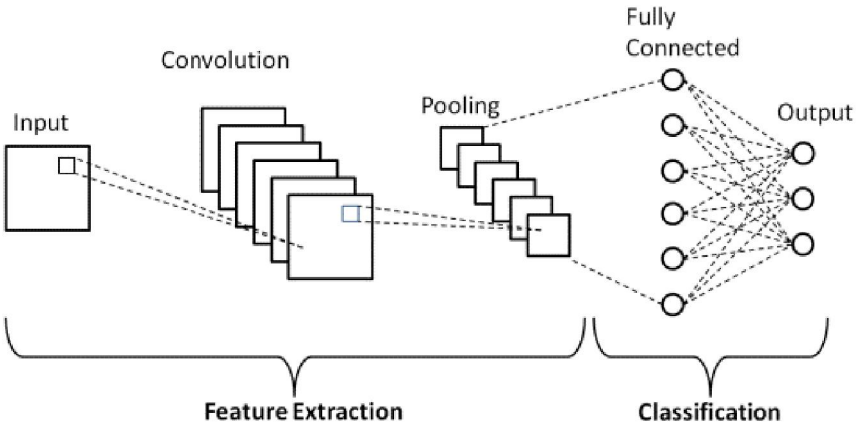

Figure 2 Common Architecture of CNN

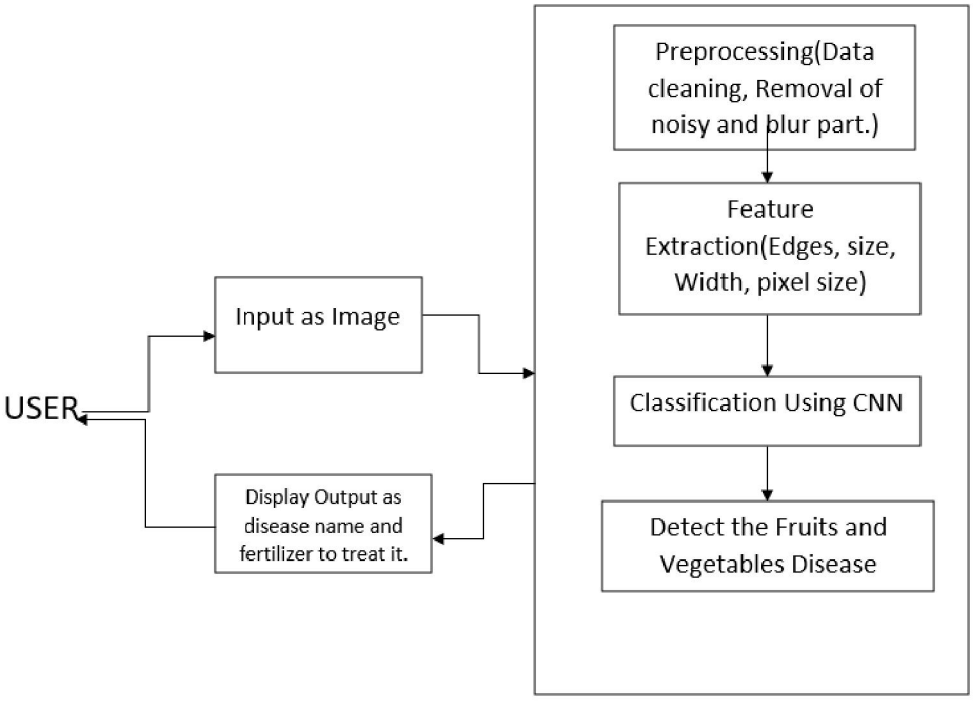

Figure 3 System Architecture

By giving the Convolution Neural Network (CNN) algorithm the proper attributes and clean data, these steps can help it make the most of its capabilities and generate data that is as accurate as possible.

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Activity Diagram :

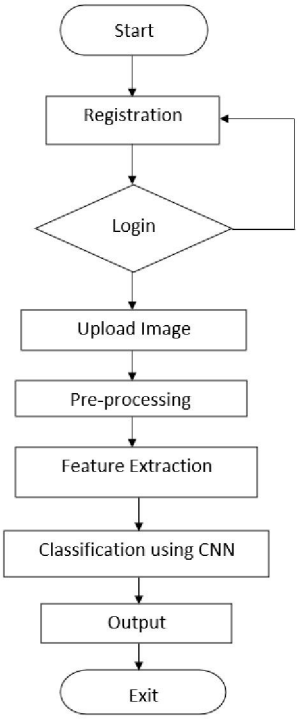

Figure 4 Activity Diagram

Tools/Technologies used in system :

Python :

Python is a general-purpose, high-level programming language. Its design philosophy prioritizes code readability through extensive indentation in accordance with the off-side rule.Python is garbage-collected and dynamically typed. It supports various programming paradigms, including structured (especially procedural), object-oriented, and functional programming. Because of its enormous standard libraries, it is frequently refereed to as a "batteries included" language.

Python Libraries used *:*

Tkinter - Tkinter is Python's standard GUI library. When hooked with Tkinter, Python provides an immediate and simple approach to constructing graphical user interface (GUI) applications. Tkinter serves as an object-oriented interface that utilises the Tk GUI toolkit.

Cv2 - OpenCV is a Python package designed for image processing and computer vision applications. It offers multiple features, especially object detection, facial recognition, and tracking.

Numpy - NumPy is a Python library that incorporates support for huge, multi-dimensional arrays and matrices, as well as a vast number of high-level mathematical functions to work on these arrays. Numeric, NumPy's precursor, was designed by Jim Hugunin with help from numerous other people.

Sqlite3 - SQLite is an open-source database engine built in C. It is not a separate programme, but rather a library that software developers include in their applications. As such, it is a member of the embedded database family.

Keras - Keras is a Python interface for artificial neural networks that is open-source software. Keras serves as a front end for the TensorFlow library.

Matplotlib - Matplotlib is a Python visualisation toolkit, as well as its numerical mathematics extension NumPy. It provides an object-oriented API for introducing plots into programs that use general-purpose GUI toolkits such as Tkinter, wxPython, Qt, or GTK.

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Spyder *:*

Spyder is an open-source cross-platform integrated development environment (IDE) for scientific programming in the Python language. Spyder integrates with a number of prominent packages in the scientific Python stack, including NumPy, SciPy, Matplotlib, pandas, IPython, SymPy and Cython, as well as other open-source software. It is released under the MIT license.

DB Browser for SQLite:

DB Browser for SQLite (DB4S) is a high quality, visual, open-source tool to create, design, and edit database files compatible with SQLite.DB4S is for users and developers who want to create, search, and edit databases. DB4S uses a familiar spreadsheet-like interface, and complicated SQL commands do not have to be learned.

Working:

The suggested system for Fruits and Vegetables Disease Prediction Using CNN would include data pre-processing, feature engineering, and machine learning techniques such as CNN. The system would be able to identify and anticipate illnesses, as well as provide drugs to avert them. Following are the basic steps :-

Data Pre-processing: The first stage would be to pre-process the data by eliminating any unnecessary or duplicate information, dealing with missing numbers, and normalising the data. This ensures that the data is consistent and appropriate for analysis.

Feature Engineering: The following stage would be to determine the important traits that would aid in disease detection in fruits and vegetables.

Using CNN (ML Algorithm): Following feature engineering, the system would detect fraudulent activity using CNN machine learning methods. Convolution Layer, Pooling Layer, and Fully Connected Layer are some of the algorithms that might be employed.

Cvtcolor is an inbuilt function of cv2 library which we used to convert RGB images into grey images. These Grey images generated where then resized as per requirement. We took the help of Threshold function to convert grey scale image into binary values. Many layers of Keras libraries were used such as Sequential layer to pass or process data in a proper sequence. Then we used Max Pooling layer which will get all active pixel and features and will create 2D matrix. Then we used Flatten layer to convert 2D matrix into 1D matrix and they elements created by them are called as Dense or nodes. Dropout were used to drop irrelevant or unfamiliar or mismatched features. The features which were dropout by model were passed again and again to ensure that its matching with categorized function or not. We have used activation functions lie Relu and SoftMax. While training data we had rescaled the image, given a particular range, zoomed that images as per requirements and that flipped it horizontally to obtain features more accurately. Once the model is trained, we used testing data set to check if the given output is valid or not. When the model was trained, we also calculated its accuracy with the help of Matplotlib library which is shared in Result section.

Example *:*

Apple disease:

Apples come in many different varieties, including Aceymac, Adanac, Akane, and Akero. The diseases that affect apples vary depending on the variety and climatic conditions in which they are growing, and they are categorized as black rot, rust, crown rot, scab, fire blight, and numerous other diseases. The disease that has the worst impact on apple growth out of the ones mentioned is apple scab. Apple scab is one of the most pervasive diseases of apples in the world and is brought on by a fungus called Venturia Inequalis. It is a fungal disease that affects both leaves and fruits. On the surface of tree bark, leaves, buds, and fruits, the disease manifests as pale black or gray-brown lesions. Occasionally, lesions will develop on the tree's woody tissues. The disease's lifecycle begins with the arrival of spring and develops over the course of about 15 days. The secondary infection may also develop as a result of the rising leaf moisture content and high temperature.

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The relationship between temperature and wetness can be used to predict the progression of a disease. Around the fruit's calyx, the lesions mostly take the shape of a cluster. Lesions are smaller and can have a diameter of up to 1 cm.
So, We have got dataset from Kaggle website which is a supervised data means which is inbuilt categorized according to diseases. We select an image from training dataset and process using CNN and then predict the diseases with their corresponding treatment pesticides or fertilizers.

III. IMPLEMENTATION

Landing Page

Registration Page

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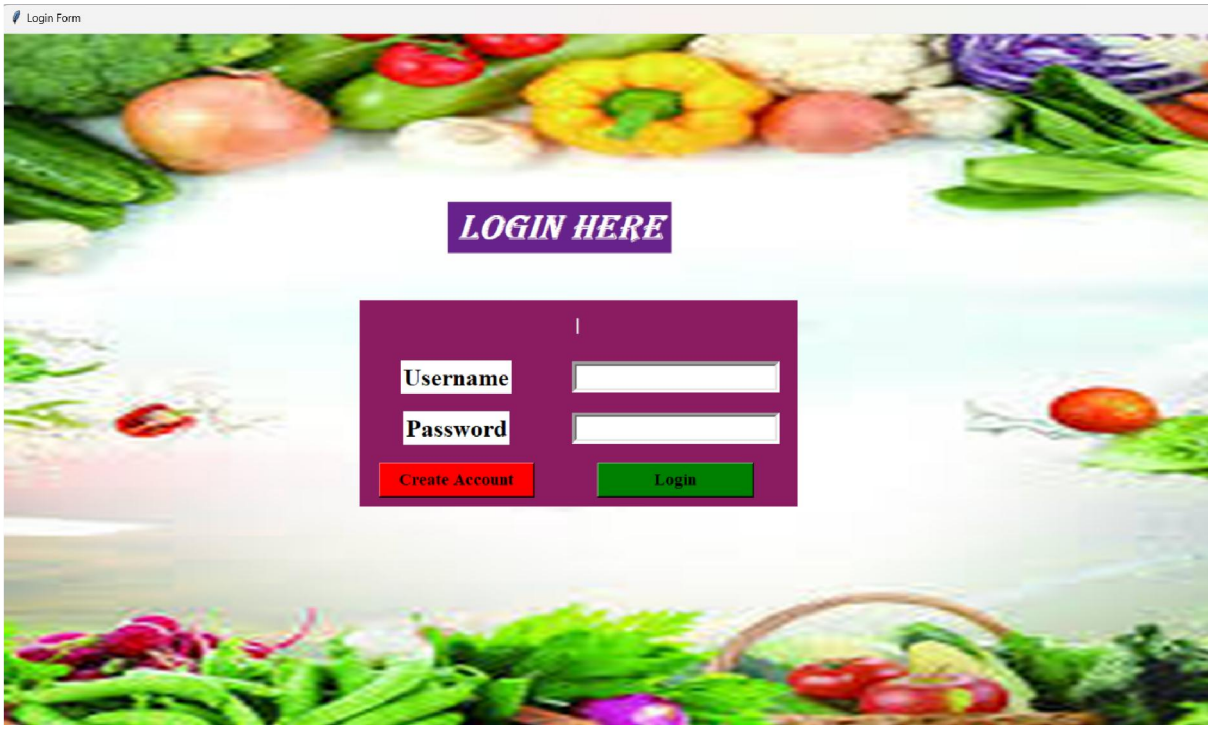
Login Page



Main Page

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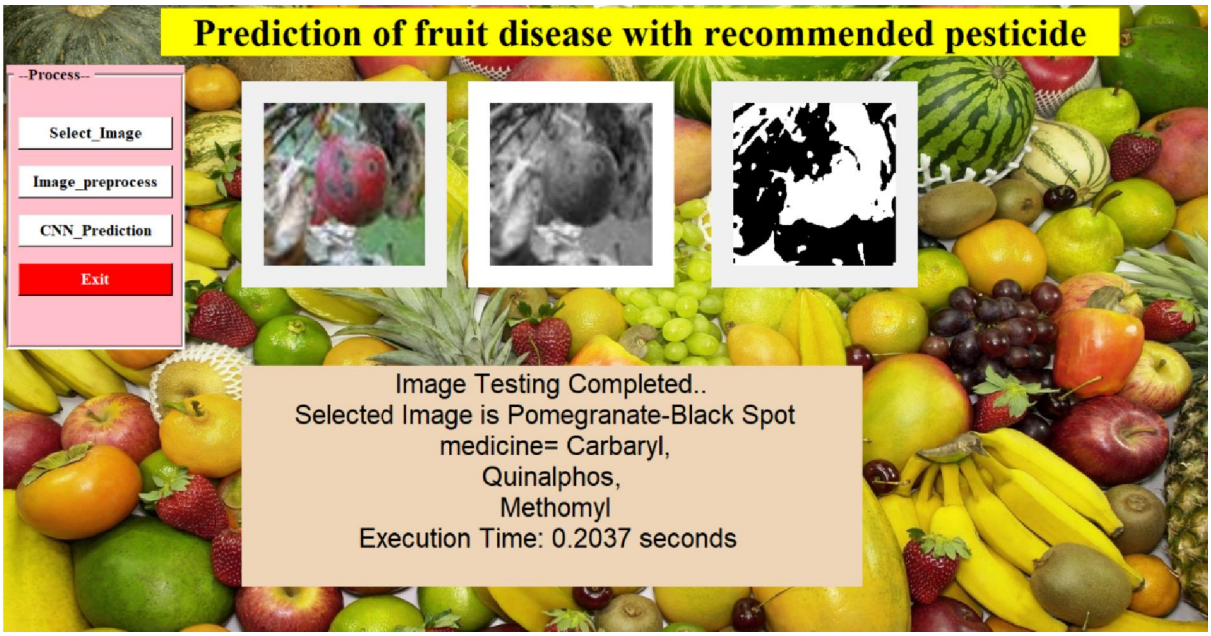
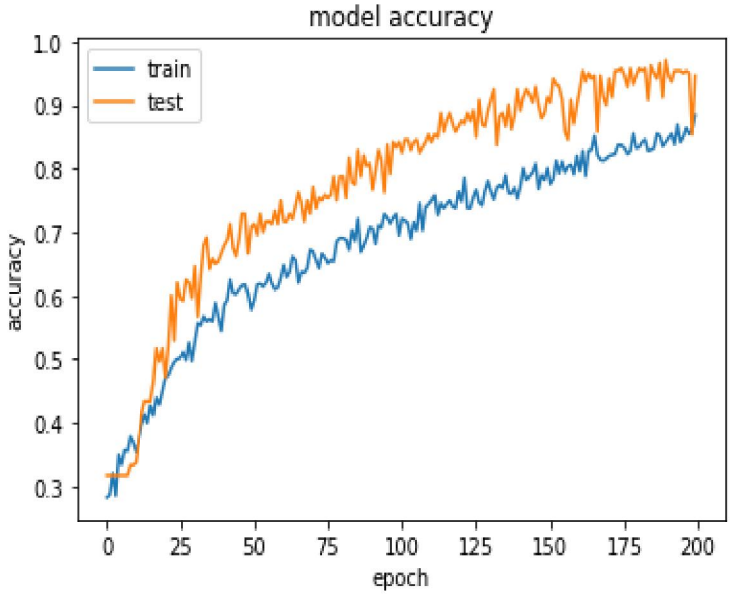
Result :



Firstly Select Images was identified as Pomegranate with disease named as Pomegranate Black-spot and a medication was suggested i.e. pesticide named Carbaryl Quinalphos Methomyl and an Execution time of these process were showed below i.e. 0.2037s.



We have successfully trained model with 10K+ images of fruits and vegetables to detect diseases in them and obtained 98% accuracy. We were detect several types of fruits such as Apple, Pomegranate, Papaya, Banana, Mango and in Vegetables Tomato and Cauliflower.

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