CARROT DISEASE PREDICTION USING CONVOLUTIONAL NEURAL NETWORK

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This Report Presented in Partial Fulfillment of the Requirements for the Degree of Bachelor of Science in Computer Science and Engineering.

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APPROVAL

This Project/internship titled "Carrot disease detection using Deep Learning approach", submitted by Aminul Islam Shohug, Mst.Sarmin Akter and Sumaiya Nasrin to the Department of Computer Science and Engineering, Daffodil International University has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of B.Sc. in Computer Science and Engineering and approved as to its style and contents. The presentation has been held on 09 September.

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DECLARATION

We hereby declare that, this project has been done by us under the supervision of **Warda Ruheen Bristi, Lecturer, Department of CSE,** Daffodil International University. We also declare that neither this project nor any part of this project has been submitted elsewhere for award of any degree or diploma

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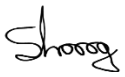

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ABSTRACT

Carrot is a popular nutritious vegetable and cultivated throughout the world. But Farmers still cultivating this vegetable without utilizing proper scientific technology. This may lead to financial losses as well as reduce the profit of farmers. At present, vegetable disease causes lots of financial and environmental problem. But, Early detection of vegetable disease can reduce those losses and can make farmers smile. Hence, in our research we have proposed a Deep Learning-based system for carrot disease recognition. we have experimented with healthy carrot and three common carrot disease such as: Black rot, Sclerotinia rot and Root knot. We have used Convolutional Neural Network (CNN) for feature extraction purposes and fully connected neural network (FCNN) for disease classification. Convolutional Neural Network is a great tool for image feature extraction, and it reduces the hardship of manual feature extraction. We have experimented with different convolutional model with different layer and our proposed Convolutional model gives us accuracy of almost 94%, which is certainly helpful for the farmers to identify carrot disease and maximize their benefit.

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CHAPTER 1
INTRODUCTION

1.1 Introduction

Carrot is a popular and nutritious vegetable that belongs to the Daucus genus and the umbellifers family. Carrot land is on the ascent in New England, as more producers target extending, all year advertises. Carrots can be influenced by numerous microscopic organisms, parasites and nematodes in the field and away. Foliar diseases might cause lower yields because of loss of photosynthetic region, trouble in reap if the tops are debilitated, and lower attractiveness if the carrots can't be sold in bundles. Root diseases can bring down yields of crisp eating carrots and can spread away, radically lessening yields brought to later business sectors. Root diseases are brought about by soil abiding organic entities and accordingly their occurrence might shift impressively from one ranch to another. Appropriate sickness distinguishing proof will assist farmers with forestalling future flare-ups by changing harvest pivots likewise, and keep moving pervaded soil from one field to another. A portion of the significant carrot infection indications are portrayed underneath. In case farmers are seeing foliar or root side effects like those depicted, send an example to the state analytic lab to affirm, and find ways to secure current and future harvests.

1.2 Motivation

Farmers struggle a lot because they don’t have a scientific process to detect crops. So, if they apply modern technology in the detection of crops it would be very helpful for them. By doing so, farmers can save their crops from mass damage.

1.3 Rational of the Study

Every year our country losses a lot of harvest due to the attack of root basis bacteria and viruses. To prevent this problem and help our agricultural sector and also help the farmers to detect the actual problem of the carrots. We as a whole realize that; our nation is an agriculture-based country,

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a large portion of our people groups rely upon this specific area. But we couldn't improve our farming method well enough as the other countries did. Nowadays we also need to use technologies to improve our Farming sector. We believe our work will help the farmers to detect the root basis problems for the carrots.

1.4 Expected Outcome

1. To help the farmers to improve their harvest and make the process easier detect the carrot diseases.
2. To make the Agricultural database richer.
3. It will decrease our losses of harvest for the farmers.

1.5 Project Executive and Finance

For this pandemic situation, we have need to manage this project resources from the internet. We have collected our Data set image from the internet, and to run the system we have used Collab. So, we have not expensed any cost for this project.

1.6 Report Layout

In our project report, we have manufactured our contents in chapters such as:

Chapter (1): we have mentioned the introduction, motivation, rational in the study, research question.

Chapter (2): we have mentioned Background, task-related similar work, limitations.

Chapter (3): Research methodology in this part we have discussed our assignment business measure demonstrating, need collection of data and assessment, use case, showing and portrayal, reasonable data set, and plan essentials.

Chapter (4): It provides the experimental results, performance evaluation, and discussion of result.

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Chapter (5): It provides the influence on Society, environment and sustainability of the project.

Chapter (6): In this chapter we have talked about the summary of the project, future work and conclusion.

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CHAPTER 2

BACKGROUND STUDIES

2.1 Introduction

Here we have referred the project works that identified with our project idea. We have attempted to discover their restrictions and examine them. We have discovered the distinction between them and us. We have also explained why our system is the best one. At last, it has to clarify the difficulties of our project.

2.2 Related Works

To decide the possible investigation of our system we have concentrated on some turn of events project and furthermore talk about which type of agreement they have been doing. Attempt to decide their limits. Also, what type of elements does we need to add.

Here is the list of some projects:

Ruplai Saha published a research paper that an orange fruit disease classification by using the Convolutional neural network to identify the three diseases of orange [1]. Mohammed O. Al-Shawwa disclosed Apple fruit type is performed by some kind of apple, by using Deep learning for the classification and detection of the type of apple. And the author got 100% accuracy [2]. Tahmina Tashrif observed that Sponge gourd disease acknowledgment, for recognizing the leaf and flower diseases by utilizing Convolutional Neural Network and image processing strategies. This system will take some images as input and detected diseases will be shown as output. The reached accuracy is 81.52% [3]. Zaw Min Khaing approached to the development control system of objection, a recognition based on the Convolutional Neural Network is considered. The method

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is applied to the task of fruits detection and recognition through Parameter optimization. The result of the test got the accuracy is 94% [4]. Horea Muresan introduces a dataset of images containing fruits and also presented the result of some numerical experiment for training the Neural Network to detected fruits. The test got 98.66% accuracy [5]. Belal A. M. Ashqar and Samy S. Abu-Naser have detected diseases of tomato leaves. They trained a Deep Convolutional Neural Network for identifying five diseases of tomato leaves and the trained model achieved and accuracy of 99.84% [6]. L. Sherly Puspha Annabel presented an overview of different types of plant diseases and various classification techniques in machine learning that is used for identifying diseases of different plant leaves and the test got 99.87% accuracy [7]. Alaa Soliman Abu Mettleq approached with 2 types of Mango classification with Convolutional Neural Network algorithm and a deep learning technique. And the trained model achieved 100% of accuracy [8]. Tamoor Khan considered different types of fruit, analyzed and predicted by using Deep Neural Networks. And also, they implemented 3 different methods to predict data [9]. Divyansh Tiwari presented a system to classify 4 types of diseases of potato plants based on leaf by utilizing Deep Learning and using VGG16 and VGG19 Convolutional Neural Network. The model has achieved an accuracy of 91% [10]. Abeer A. Elsharif has trained a Deep Convolutional Neural Network to identify 4 types of potato and the achieved accuracy is 99.5% [11]. Rizqi Amaliatus Sholihati classified 4 types of potato leaf-based diseases. Which indicates the feasibility of Deep Neural Network approached [12]. Mahmoud A. Alajrami published Tomato classification approached is presented by the Neural Network algorithms and Deep learning technique applied for image recognition [13]. Mohammed M. Abu-Saqer observed that the system was precedented for recognizing the two types of grapefruit pink and white based on Deep learning using python on colab editor [14]. Ahmed F. Al-daour describes the proposed solution as a selected convolutional network (ConvNet) architecture and discusses design decisions and implementation details and the model has achieved an accuracy of 100% [15].

Lastly, all these papers help us a lot to make our project.

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2.3 Comparative Analysis and Summary

We have concentrated, such countless activities work and attempting to find out about them. We have concentrated so numerous things and have discovered numerous things like accuracy, limitation, graph, algorithms, different features, and so on Presently we have separated our project from another project

In our carrot diseases project can predict properly to detect.

2.4 Challenges

The main challenge for this project is collecting data. There is no much data on the internet. So, it has not easy to collect the data. And for the pandemic situation, we could not go the field for collecting raw data.

The other challenge was we need a good GPU backup as deep learning needs good hardware to work.

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CHAPTER 3

METHODOLOGY

3.1 Research Instruction

Get some information about the subject can be called as investigation space that has minded and perused for clearing thoughts. Because of execution as well as for configuration model, gathering information, carry out or measure information, and preparing the plan. Any other area is a mechanism which is innovation, strategy that have utilized. We have utilized windows stage, python language with Google Colab has utilized for all the preparation what's more, trying interaction, Google Colab is free and open-source scattering of the Python and programming language for data science and AI applications.

3.2 Data Collection and Utilized

In this research, we have used a dataset for image processing. We have collected our images from different websites. We have collected 50 raw images for per disease and have increased the dataset by image processing like Rotate, Shear, Width-shift, Height-shift, Horizontal-flip.

Black-Root

Root-knot

White-Mold

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Healthy

Figure 3.2.1: Images of carrot diseases

3.2 .1 Data Preparation

We have collected images from different website then, we have changed the background of our images and have created synthetic data. In this process, we have made more dataset. Then we have increased our dataset by Data mounting. Then we have put our dataset into four classes are Black Rot, Healthy, Root Knot, Sclerotinia Rot. Then we have divided those datasets into two portion one is train data and the second one is valid data. Also, we have stored these four classes of the dataset into Train data and Validation data.

TABLE 3.2.1 DATASET TABLE

No	Class Name	Train data	Validation
1	Black Rot	354	49
2	Healthy	356	50
3	Root knot	356	44
4	Sclerotinia Rot	356	49
Total : 4 class		1422	192

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3.3 Work Flow

The system starts with the images of carrots has given to the pre-processing unit, segmentation unit, feature extraction unit, training etc.

Step 1- Data collection: We have collected images from different website then, we have changed background of our images and have created synthetic data. By this process we have made more dataset.

Step 2- Data processing: In this unit we have increased our dataset by Data Augmentation. We have expanded the most important in 5 image processing task these tasks given bellow:

1. Rotate
2. Shear
3. Width-shift
4. Height-shift
5. Horizontal-flip

Step 3- Data resize: The Images we have collected they were in different sizes. And we have to bring them in a single size so we have to resize them all.

Step 4- Training data generator: For train and validate our data for better accuracy we have selected some model. There are many convolutional neural networks. To get better accuracy with our machine configuration. We have implemented few models and lastly, one model has selected for final training and testing process.

Step 5- Performances Evaluation: In this part, every one of the outcomes have considered with graphs. Subsequent to training and testing those interaction has given us few precisions graph with training and validation accuracy & training and validation loss. Also, we have calculated the confusion matrix and a table for showing the precision, recall and f1 score.

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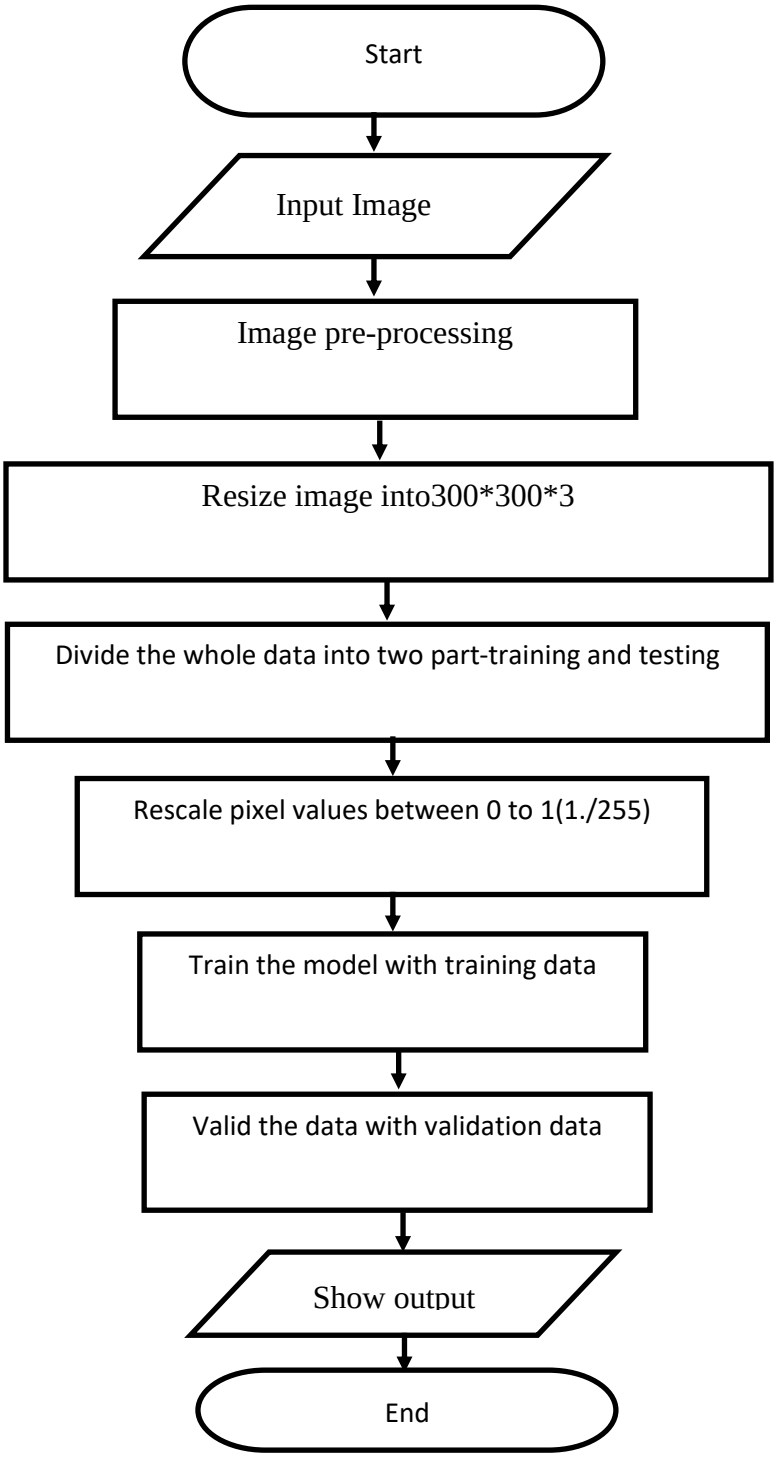

Figure 3.3.1: Workflow of our approach

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3.4 Proposed Methodology/Applied Mechanism

We have proposed a Convolutional Neural Network, which have 13 convolutional layers and 6 max pooling layers and 3 dense layers.

The first convolutional layer contains 64-3 x 3 filters and activation function is “Relu”.

The second layer has 32-3 x 3 filters and activation function is “Relu”.

The third layer has 32-3 x 3 filters and activation function is “Relu”.

Max pooling (2x2)

The fourth layer has 64-3 x 3 filters and activation function is “Relu”.

The fifth layer has 64-3 x 3 filters and activation function is “Relu”.

Max pooling (2x2)

The sixth layer has 128-3 x 3 filters and activation function is “Relu”.

The seventh layer has 128-3 x 3 filters and activation function is “Relu”.

Max pooling (2x2)

The eighth layer has 256-3 x 3 filters and activation function is “Relu”.

The ninth layer has 256-3 x 3 filters and activation function is “Relu”.

Max pooling (2x2)

The tenth layer has 512-3 x 3 filters and activation function is “Relu”.

The eleventh layer has 512-3 x 3 filters and activation function is “Relu”.

Max pooling (2x2)

The twelfth layer has 512-3 x 3 filters and activation function is “Relu”.

The thirtieth layer has 512-3 x 3 filters and activation function is “Relu”.

Max pooling (2x2)

First Dense units: 512 and activation function is “Relu”.

Second Dense units: 256 and activation function is “Relu”.

Third Dense units: 4 and activation function is “softmax”.

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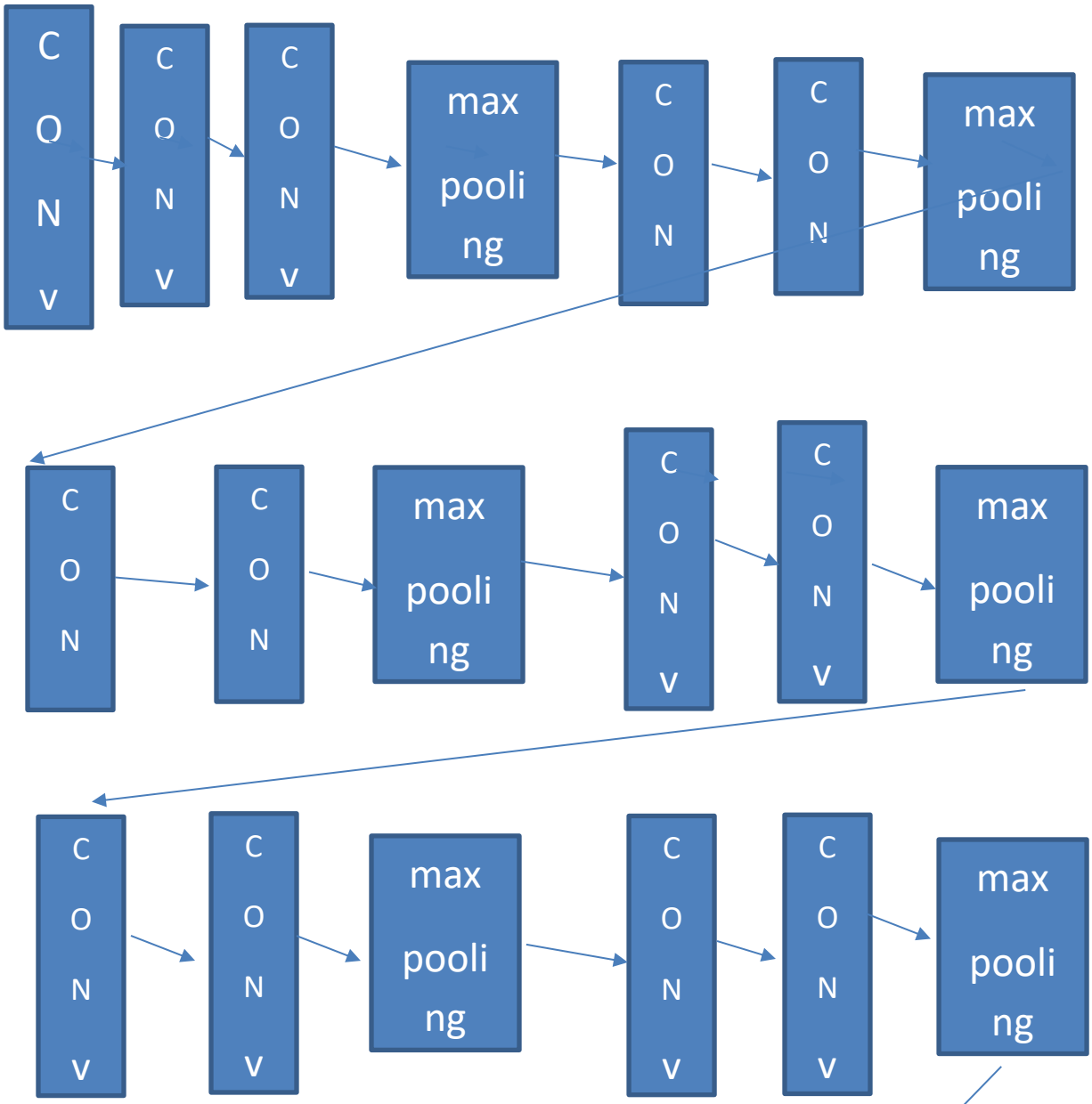

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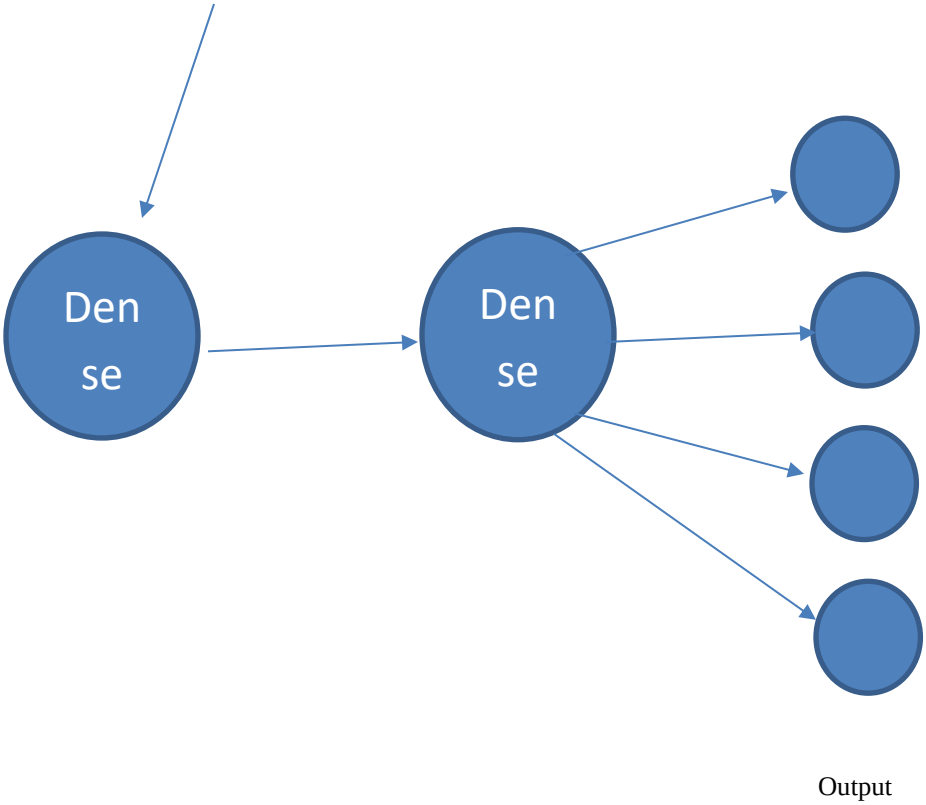

Figure 3.4.1 Proposed CNN layer

Convolutional Layer

A convolutional neural network is a deep learning algorithm that can take in an input image, assign importance to various objects in the image. And be able to differentiate one from the other the pre-processing required in a convnet is much lower as compared to other classifications. The CNN is faster than another machine learning algorithm. The novelty of the proposed approach is utilizing a low cost, high accuracy system that defines a deep learning method.

CNN have wide applications in the pictures and video affirmation, recommender structures also, ordinary vernacular taking care of. Convolutional neural networks. Sounds like an exceptional blend of science and math with a little CS sprinkled in, yet these systems have been a couple of the preeminent influential headways inside the field of PC vision. 2012 was the essential year that neural nets created to obviousness as Alex Krizhevsky used them to win that year's ImageNet rivalry (basically, the yearly Olympics of PC vision), dropping the order botch record from 26% to 15%, a stunning headway at that point. When a pc sees pictures (snaps a photo as information), it'll see a bunch of pixels esteems. Contingent upon the assurance and gauge of the image, it'll see

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a 32 x 32 x 3 group of numbers (The 3 implies RGB esteems). In a regular convolutional neural networks plan, there other layers are mixed between these conv layers. I'd decidedly empower those intrigued.

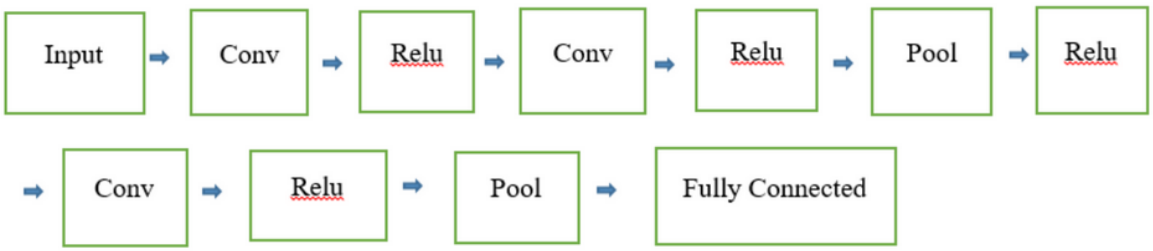

Figure 3.4.2: A classic CNN architecture

Feature Extraction

Convolution is quite possibly the most structure bits of CNN. The term convolution intimates the logical blend of two abilities to convey a third work. It unites two arrangements of information. Inside the case of CNN, the convolution is performed on the input information data with to utilize of a channel or part to at that point create a highlight outline. We have executed a convolution by sliding the channel over the input. At every space, an organization duplication is performed and aggregates the outcome onto feature layout.

Max-Pooling

Max Pooling could be a down testing technique in Convolutional Neural Systems. The goal is to down-example a data representation decreasing its conditionality and allowing for suspicions to be made around features contained inside the sub-areas binned. It is basically, used to reduce the proportion of the image since the greater number of pixels add to more boundaries which can incorporate immense lumps of data. In this way we require less boundaries with the end goal that

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a CNN can in any case recognize the image. Max pooling is arranged of 75% of the authorizations and controlling over-fitting**.**

Padding

Padding is a term appropriate to convolutional neural networks as it suggests the proportion of pixels added to an image when it is being taken care of by the bit of a CNN. For instance, assuming the padding in a CNN is set to nothing, every pixel esteem that is added will be worth zero. Assuming, however, the zero paddings is set to one, there will be a one-pixel line added to the picture with a pixel worth of nothing.

Flatten Layer

The reason to use this can be too had the opportunity to install this data into a neural arrange a while later on. Totally related layers don't have a close-by limitation like convolutional layers (which as it was watching a couple of close by parts of an image by using convolutional channels). This implies it can join all the discovered area features of the past convolutional layers. Each feature diagram channel inside the yield of a CNN layer could be a "fixed" 2D group made by including the outcomes of various 2D parts (one for each channel inside the information layer).

Dense Layer

A dense layer is reasonable another title of the total associated layer. Comparable activities take put in the thick layer where every neuron is related to one another. It is moreover called dense since it addresses a thick relationship of thick neurons. A thick layer has loads identified with every neuron consolidate and with exceptional qualities. Various kinds of work like soft max authorization work, SVM, and various others are used here for undeniable level speculation inside the neural orchestrate. However, in our illustrate, we follow used soft max for arrangement.
After a couple of convolutions and pooling layers, we get a couple of significant level features as information. This information picture features are used as a grouping to research various classes.

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However, when we consolidate the convolution layer's features and looking over the layer features it gives the way better aftereffects of arrangements. In Completely Associated layers summation of yield probabilities is One Convolutional layer shares loads with other Convolutional layers. It is outstandingly problematic to get all centers together with a soft max layer.

Softmax

Allow us to consider a characterization model to a group with n classes. This model takes input datasets and a calculation and produces a score of each class. The Soft Max actuation work changes over from a score to the probability between 0 and 1. The summation of all probabilities has 1. We have used this work to a definitive layer of the convolutional neural network to characterize the classes. This work is conveyed various exercises from an info exhibit.

3.5 Utilization Requirements

After the appropriate examination of all important measurable or theoretical ideas and methods, a list of necessities has been created that should be needed for such a work of Classification. The reasonable fundamental things are:

Hardware and Software requirements:

1. Operating system (Windows 7 or above)
2. 4GB RAM
3. Minimum 100 GB Hard-disk

Developing tool:

1. Python Environment
2. Google Colab

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CHAPTER 4

RESULTS AND DISCUSSION

4.1 Primary Setup

1. We have set up the Graphical Processing Unit (GPU) into the computer and installed it's in the drive.
2. Next, we have mounted the Google Colab with Google drive.
3. Also, we have kept the dataset in Google drive and we labeled them all.

4.2 Results and Analysis

In this project, we have trained the dataset among seven models. In the first model we have used three convolutional layer and one max-pooling the accuracy we have gotten 0.88%.
In the second model, we have used five convolutional layers and two max-pooling accuracy we have gotten 0.88%. Then we have used seven convolutional layers and three max-pooling Third accuracy is 0.89%. we have used nine convolutional layers and four max-pooling Fourth accuracy is 0.91%, we have used eleven convolutional layers and five max-pooling Fifth accuracy is 0.85%, we have used thirteen convolutional layers and six max-pooling sixth accuracy is 0.93% and we have used fifteen convolutional layers and six max-pooling we have gotten the accuracy is 0.86%. After tarin, our system thirteen convolution layers and six max-pooling has given the best accuracy. Here is the table of all layer accuracy:

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TABLE:4.2.1 EXPERIMENT WITH CNN LAYERS

Layers	Accuracy
3 layer	0.88%
5 layer	0.88%
7 layer	0.89%
9 layer	0.91%
11 layer	0.85%
13 layer	0.93%(best)
15 layer	0.86%

Now here we have showed the best training and validation graph, also Training and validation loss graph. And final accuracy result:

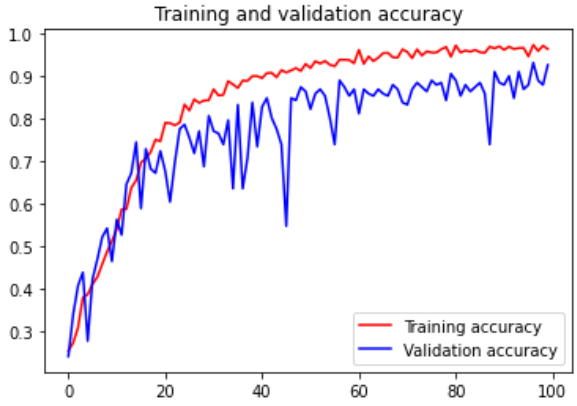

Figure 4.2.1: Training and validation accuracy

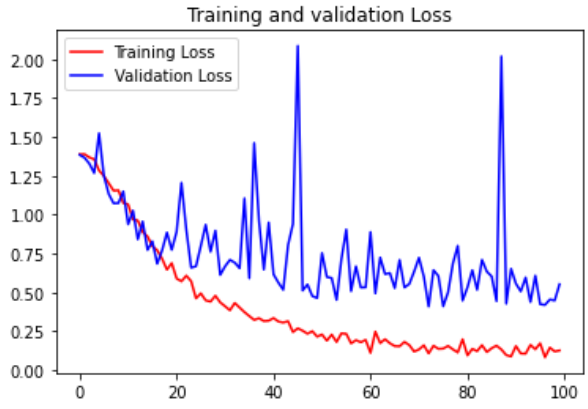

Figure 4.2.2: Training and validation loss

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```
Confusion Matrix
['Black_Rot', 'Healty', 'Root_knot', 'Scal_Rot']
[[46  0  0  3]
 [ 2 48  0  0]
 [ 2  0 42  0]
 [ 1  1  4 43]]
Classification Report
              precision    recall  f1-score   support

   Black_Rot       0.90      0.94      0.92        49
      Healty       0.98      0.96      0.97        50
   Root_knot       0.91      0.95      0.93        44
    Scal_Rot       0.93      0.88      0.91        49

    accuracy                           0.93       192
   macro avg       0.93      0.93      0.93       192
weighted avg       0.93      0.93      0.93       192
```

Figure 4.2.3: Accuracy Details

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4.3 Result Discussion

Here the best Accuracy, Recall, Precision and F1 score result of our system:

TABLE: 4.3.1: RESULT DISCUSSION

Diseases Name	precision	recall	f1 score
Black Root	0.90%	0.94%	0.92%
Healthy	0.98%	0.96%	0.97%
Root Knot	0.91%	0.95%	0.93%
Scalitonia	0.93%	0.88%	0.91%

We have achieved our final accuracy is 0.93%.

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CHAPTER 5

EFFECT ON SOCIETY, ENVIRONMENT AND SUSTAINABILITY

5.1 Effect on Society

We believe, this work will have a positive for society. As we have said before our country loss a big amount of harvest every year for the root cause of diseases and for that we have lost a massive amount of money too. Our work will help to reduce the loss of harvest and save some money for the farmers too. Which will have a good impact on our agriculture. And we can also keep the data of diseases for further study for our project.

5.2 Effect on Environment

The human being needs a healthy environment and healthy food to live a good life. For a good life, we need healthy food. Our work can help to produce healthy vegetables for us. If an agriculture officer or a farmer can detect the root diseases earlier then they can take the necessary steps to save the harvest. What will help the environment to be free from harmful virus? We believe in healthy food and healthy life. So, our project will definitely impact the environment positively.

5.3 Ethical Aspects

Most of the developed countries have used the best technologies to improve their farming. In farming the hardest part is detecting the exact diseases for the harvest and crops or else there's a chance to lose the harvest. In that part, we have made it easier for them. With this research base project, they can easily detect the problem for the carrot harvest. What will make them more profitable and also help the economy to rise.

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5.4 Sustainability Plan

We would like to give a field test on this project. And if we have gotten enough response then we would like to work on it more and improve the features and add more. Also, we will collect more data and make the system easier to use. Day by day we will improve our database. And we will go global for it.

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CHAPTER 6

CONCLUSION AND FUTURE WORK

6.1 Summary of the Study

At first, we have collected our data then we have increased our data by using image acquisition (Internet + synthetics) and Image pre-processing. Then we have trained our dataset by using CNN. Then we have tested our model by using training dataset. We have gotten the best training and validation accuracy graph of our project. Finally, we have found our expected result which accuracy is best and it is 0.93%.

6.2 Conclusion

The proposed system is used to identify unhealthy carrots which will help the farmers and agricultural sector to cultivate healthy carrots. The main part of our research is to help those farmers so that they can easily get their expecting harvest details through our model and can take necessary steps. In the future, the number of diseases the system identifies could be improved. And disease severity can also be identified.

6.3 Future Work

In future, we would like to develop an app and also, we will add more features and algorithms to get the best outcome. And we will train our system with more diseases. We will make the system easier for the farmers and others.

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APPENDIX

In our project, we have trained our system with four types of carrot diseases. If someone wants to detect other diseases that we have not trained our system that could not be possible to detect. To finish the project, we have defied so various issues, in the first place, one was to choose the methodological methodology for our endeavor. It was not traditional work it was a request about the based endeavor, in addition, there was very little work done at some point as of late on this reach. So, we probably won't get that a lot of offer help from wherever. Another issue was that assortment of data, it was quite difficult for us.

Here is the some more snap image of our carrot disease dataset:

Knot-root

Black-root

Scalitonia

Healthy

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