CARROT DISEASE DETECTION USING IMAGE PROCESSING

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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 titled "**CARROT DISEASE DETECTION USING IMAGE PROCESSING**", submitted by **Shree. Dolax Ray, ID: 172-15-9468, and Mst. khadija tul kubra (Natasha), ID: 173-15-10307** 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 August 2021.

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DECLARATION

We hereby declare that this project has been done by us under the supervision of **Mr. Md. Azizul Hakim, Senior 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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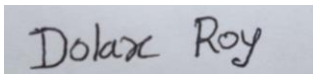

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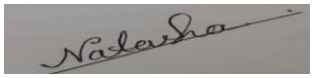

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ABSTRACT

Carrot is a famous nutritional vegetable and developed all through the world. Agriculture remains the most important sector of Bangladesh economy, contributing 19.6 percent to the national GDP and providing employment for 63 percent of the population. Agriculture in Bangladesh is heavily dependent on the weather, and the entire harvest can be wiped out in a matter of hours when cyclones hit the country. According to the World Bank, the total arable land in Bangladesh is 61.2 percent of the total land area (down from 68.3 percent in1980) Yet, Farmers actually developed this vegetable without using applicable logical inventions. This might prompt financial mischances just as lessen the benefit of drovers. As of now, vegetable illness causes loads of financial and natural issues. Be that as it may, beforehand discovery of vegetable illness can drop those mischances and can make drovers beam. Latterly, in our disquisition, we've proposed a Deep Literacy- grounded frame for carrot infection acknowledgment. We've explored different avenues regarding sound carrots and two normal carrot infections, for illustration, Depression spot of carrot, Leaf scar of carrot. We've employed Convolutional Neural Network (CNN) to include birth neural purposes and Fully Convolutional Neural Network model (FCNN) for infection order. Convolutional Network is an extraordinary outfit for picture highlight birth, and it lessens the difficulty of homemade element birth. We've explored different avenues regarding different convolutional models with colorful layers and our proposed Convolutional model gives us a perfection of virtually 99%, which is surely useful for the drovers to distinguish carrot illness and boost their advantage.

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CHAPTER 1
INTRODUCTION

1.1 Introduction

In order to withstand the changing conditions of the Bangladesh economy, the agriculture industry requires a major upgrade. Agriculture provides work for 63 percent of the population in Bangladesh's densely populated country. A complex interplay of soil seed results in the agricultural production system. The taproot of the carrot is the most often consumed component of this root vegetable. Fiber, beta carotene, vitamin K1, antioxidants and potassium are all found in abundance in carrots. Beta-carotene is found in abundance in carrots. It is converted to vitamin A in the human body. Carrots include fiber that can help keep blood sugar levels in check. As crop disease refers to any detrimental departure or variation from the physiological systems' normal functioning. In current agricultural science, there are notable research possibilities and opportunities that are not being adequately developed. Because of rising population and political instability, the agriculture sectors began looking for new ways to enhance food production. In a successful farming system, disease diagnosis in crops is critical. Carrot infections are a serious issue in the agricultural industry. Carrots have a plethora of illnesses. One of the primary issues is cavity spot and leaf blight. As, a farmer detects disease signs in plants by observing them which necessitates constant monitoring. However, in big plantations, this method is more expensive and less precise. Farmers may utilize precision agricultural information technology to gather data and information in order to make informed decisions about how to maximize farm productivity. In this study, an automated method was built to assist farmers in detecting illnesses by collecting images with a camera and then entering the images into a processing system. To identify various carrot illnesses, a Deep learning approach is used. As a result, an accurate value and less expensive Machine Vision System is required to detect diseases from images and recommend the appropriate pesticide as a solution. Typically Bangladeshi growers go to the experts physically to know about the problems or have to stay for veritably long for the experts which can turn the whole crop in a vain. If they have this bandied agro-medical automated system in their hand it can help them gratefully to fete the conditions and therefore make sure about the styles they need to follow for further harvesting.

In this paper, the proposed automated system is developed grounded on the machine vision conception. An image is captured through a mobile device or any type of camera also it's transferred to the system and anatomized for further processing. Features are uprooted using some image processing ways and the uprooted features are given to our proposed model to prognosticate which type of complaint the captured carrot image is having. Our proposed model is grounded on Multiclass SVM which gives a fruitful result of this work that can break the traditional problems of the growers of this country as well as reduce the pitfalls of the unorganized civilization of crops.

1.2 Motivation

Using image technology with deep learning provides a solution to the problem of agricultural production while also ensuring food security. CNN is a pattern detection and image processing method that is highly efficient. Because of its great accuracy, CNNs are employed in picture categorization and recognition. It would provide farmers with a cost-effective and efficient approach to identify diseases.

It discusses the steps of a generic carrot disease detection system as well as a comparison of Deep Learning classification approaches. The development of a system that can recognize and detect illness in crops might be the answer to this enormous challenge. Various carrot illnesses are utilized in study on this issue to make it faster and more precise.

1.3 Rationale of the Study

Every time our country loses a lot of crops due to the attack of root base bacteria and contagions. To help this problem and help our agrarian sector and also help the growers to describe the factual problem of the carrots. We as a whole realize that; our nation is a husbandry- grounded country, a large portion of our people groups calculate upon this specific area. But we could not ameliorate our husbandry system well enough as the other countries did. Currently we also need to use technologies to ameliorate our Farming sector. We believe our work will help the growers to describe the root base problems for the carrots.

1.4 Objective

Agriculture is extremely important in Bangladesh due to the fast rise of the population and the growing need for food. We describe a system for detecting ails that combine's image processing and deep literacy. Using CNN algorithm which judgments fail on carrot shops. It's doable to produce agrarian profitable growth. This composition includes a system for detecting carrot ails as well as a study of deep literacy bracket approaches for fitting and classifying carrot conditions. It can help in reducing the threat of infection to identify the conditions. To look at characteristics that would be useful for feting carrot illness. This system may be employed to earn plutocrats for the directors. The suggested result is stoner-friendly and adaptable to any system. It has the implication to boost our profitable growth. It can help growers come more apprehensive of how to cultivate crops in a more secure manner. This web- grounded design will run faultlessly. This study aims to discover and examine a strategy that can help different growers in resolving this issue.

1.5 Research Question

It is extreme for us to complete this work. For a reasonable, productive, precise reaction for this issue. The analyzers wish to propose the according inquiries to communicate the sentiments and the results of this issue.

1. Can we gather raw image data for a deep learning research?
2. Is it possible to pre-process the raw image data utilizing a deep learning approach?
3. Is it possible to further develop Carrot diseases identified by utilizing this methodology?
4. Is it possible to train your system to give the expected outcome of this research?

1.6 Expected Outcome

1. Reduce the amount of time spent on disorganized manufacturing.
2. Defective carrots can be discovered using this method.

3. By using this system farmers can make a good profit.
4. This method is also useful to people since it allows them to quickly detect plant illnesses.
5. Using this method, we can easily classify carrot disease

1.7 Report Layout

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

Chapter (1): we have mentioned the introduction, motivation, rationale 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 results. 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.

CHAPTER 2

BACKGROUND STUDIES

2.1 Introduction

Here we have referred to 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 disquisition of our system we've concentrated on some turn of events design and likewise talk about which type of agreement they've been doing. Attempt to decide their limits. Also, what type of rudiments do we need to add?

Then the list of some systems

In paper (1), the author published an exploration paper that an orange fruit complaint bracket by using the convolutional neural network to identify the three conditions of orange. In paper (2), Apple fruit type is performed by some kind of apple, by using Deep literacy for the bracket and discovery of the type of apple. And the author got 100 delicacy. In paper (3), Sponge gourd complaint acknowledgment, for feting the splint and flower conditions by exercising Convolutional Neural Network and image processing strategies. This system will take some images as input and detected conditions will be shown as affair. The reached delicacy is81.52. In paper (4), the Author approached the development control system of expostulation; a recognition grounded on the Convolutional Neural Network is considered. The system is applied to the task of fruits discovery and recognition through Parameter optimization. The result of the test got the delicacy is 94%. In paper (5), the author introduces a dataset of images containing fruits and also presented the result of some numerical trials for training the Neural Network to descry fruits. The test got 98.66 delicacies. In paper (6), they've detected conditions of tomato leaves.

They trained a Deep Convolutional Neural Network for relating five conditions of tomato leaves and the trained model achieved a delicacy of 99.84. In paper (7), The Author presented an overview of different types of factory conditions and colorful bracket ways in machine literacy that are used for relating conditions of different factory leaves and the test got 99.87 delicacies.

In the paper (8), the author approached 2 types of Mango bracket with a Convolutional Neural Network algorithm and a deep literacy fashion. And the trained model achieved 100 of delicacy. In paper (9), a composition considered different types of fruit, anatomized and prognosticate by using Deep Neural Networks. And also, they enforced 3 different styles to prognosticate data. In the paper (10), the author presented a system to classify 4 types of conditions of potato shops grounded on a splint by exercising Deep Learning and using VGG16 and VGG19 Convolutional Neural Network. The model has achieved a delicacy of 91. In paper (11), three authors trained a Deep Convolutional Neural Network to identify 4 types of potato and the achieved delicacy is 99.5.

In paper (12), they classified 4 types of potato splint- grounded conditions. Which indicates the feasibility of the Deep Neural Network approach? In paper (13), the Tomato bracket approach is presented by the Neural Network algorithms and Deep literacy fashion applied for image recognition. In paper (14), the system was precedent for feting the two types of grapefruit pink and white grounded on Deep literacy using python on Colab editor. In paper (15), the author developed to blights of vegetables and fruits. Also, fete conditions by using image processing ways and approaches to descry carrot conditions by using K- means clustering and classified with the Vector machine classifier. Incipiently, all these papers help us a lot to make our design.

2.3 Comparative Analysis and Summary

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

In our carrot diseases project we can predict properly to detect.

2.4 Challenges

We know that carrots are a famous nutritious vegetable and it nourishes our body. Agriculture is the most important sector of Bangladesh's economy, contributing 19.6 percent to the national GDP and providing employment to 63 percent of the population. There are six seasons: summer, monsoon, autumn, fall, winter, and spring. Bangladesh is heavily dependent on agro-climatic conditions and the entire crop can be destroyed within hours of a cyclone hitting the country. According to the World Bank, 71.2 percent of the total cultivable land in Bangladesh (less than 6.3 percent in 1970) is still cultivated by farmers without any practical rational innovation. This can lead to financial hardship as well as reduction of driver benefits. So far, vegetable diseases have caused many financial and natural problems. However, early detection of vegetative disease can eliminate those defects and beam the drawer. Carrots are grown in winter in six seasons. As a result, bacterial and fungal diseases are more prevalent in this crop.

The main challenge for this design is collecting data. There isn't important data on the internet. So, it is not easy to collect the data. And because of the epidemic situation, we couldn't go to the field to collect raw data. The other challenge was we need a good GPU backup as deep literacy needs good tackling to work.

CHAPTER 3

METHODOLOGY

3.1 Research Instruction

Getting some information about the subject can be called a disquisition space that has inclined and pored for clearing studies. Because of prosecution as well as for configuration model, gathering information, carrying out or measuring information, and preparing the plan. Any other area is a medium that's invention, a strategy that has been employed. We've employed the windows stage, python language with Google Colab has employed for all the medication, what is further, trying commerce, Google Colab is a free and open- source scattering of the Python and programming language for data wisdom and AI operations.

3.2 Data Collection and Utilized

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

Cavity Spot | Healthy | Leaf Blight

Figure 3.2.0: Images of carrot diseases

3.2.1 Data Preparation

We've collected images from different websites also, we've changed the background of our images and have created synthetic data. In this process, we've made more datasets. Also we've increased our dataset by Data mounting. Also we've put our dataset into four classes are Cavity Spot, Leaf Blight, Healthy, and Fresh Carrot. Also we've divided those datasets into two portions one is train data and the alternate bone is valid data. Also, we've stored these four classes of the dataset into Train data and Confirmation data.

TABLE 3.2.1 DATASET TABLE

No.	Class Name	Train data	Validation
1	Cavity Spot	456	0.99812
2	Healthy	205	0.99812
3	Leaf Blight	264	0.99812
4	Fresh Carrot	648	0.99812
Total: 4 class		1463	~1.00

3.2 Workflow

The system starts with the images of carrots given to the there-processing unit, segmentation unit, point birth unit, training etc.

Step 1-Data collection we've collected images from the different websites also, we've changed the background of our images and have created synthetic data. By this process, we've made more datasets.

Step 2-Data processing in this unit, we've increased our dataset by Data Augmentation. We've expanded the most important in 5 image processing tasks these tasks given below:

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

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

Step 4- Training data creators to train and validate our data for better delicacy we've named some models. There are numerous convolutional neural networks. To get better delicacy with our machine configuration. We've enforced many models and incipiently, one model has been named for the final training and testing process.

Step 5- Performances Evaluation In this part, every one of the issues has been considered with graphs. Posterior to training and testing those commerce has given us a many rigor graph with training and confirmation delicacy & training and confirmation loss. Also, we've calculated the confusion matrix and a table for showing the perfection, recall, and f1 score.

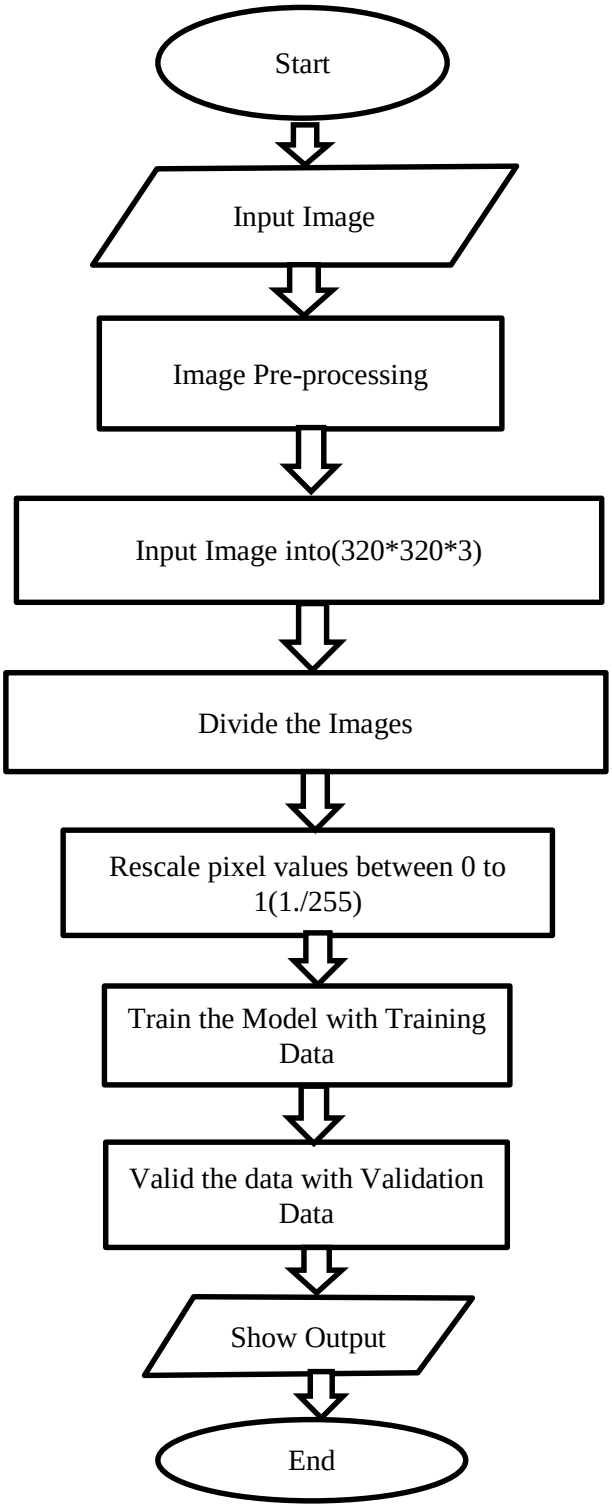

Figure 3.3.1: Workflow of our approach

3.3 Proposed Methodology/Applied Mechanism

We have proposed a Convolutional Neural Network, which have 4 convolutional layers and 2*2 max pooling layers and 2*2 dense layers.

The first convolutional layer contains 32-3 x 3 filters and the activation function is “Relu”.

Max pooling (2x2)

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

Max pooling (2x2)

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

Max pooling (2x2)

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

Max pooling (2x2)

Dropout (0.5)

First Dense units: 128 and activation function is “Relu”.

Dropout (0.25)

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

```
cnn_model = keras.models.Sequential([
                                    keras.layers.Conv2D(filters=32, kernel_size=3, input_shape=[320, 320, 3]),
                                    keras.layers.MaxPooling2D(pool_size=(2,2)), # max pooling reduce the overfitting
                                    keras.layers.Conv2D(filters=64, kernel_size=3),
                                    keras.layers.MaxPooling2D(pool_size=(2,2)),
                                    keras.layers.Conv2D(filters=128, kernel_size=3),
                                    keras.layers.MaxPooling2D(pool_size=(2,2)),
                                    keras.layers.Conv2D(filters=256, kernel_size=3),
                                    keras.layers.MaxPooling2D(pool_size=(2,2)),

                                    keras.layers.Dropout(0.5),
                                    keras.layers.Flatten(), # neural network beulding
                                    keras.layers.Dense(units=128, activation='relu'), # input layers relu(rectified linear unit) remove -values and replace with zero
                                    keras.layers.Dropout(0.1),
                                    keras.layers.Dense(units=256, activation='relu'),
                                    keras.layers.Dropout(0.25),
                                    keras.layers.Dense(units=4, activation='softmax') # output layer
])
```

Figure 3.3.2: Our model implement

```
cnn_model.summary()
```

```
Model: "sequential"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv2d (Conv2D)              (None, 318, 318, 32)      896
_________________________________________________________________
max_pooling2d (MaxPooling2D) (None, 159, 159, 32)      0
_________________________________________________________________
conv2d_1 (Conv2D)            (None, 157, 157, 64)      18496
_________________________________________________________________
max_pooling2d_1 (MaxPooling2 (None, 78, 78, 64)        0
_________________________________________________________________
conv2d_2 (Conv2D)            (None, 76, 76, 128)       73856
_________________________________________________________________
max_pooling2d_2 (MaxPooling2 (None, 38, 38, 128)       0
_________________________________________________________________
conv2d_3 (Conv2D)            (None, 36, 36, 256)       295168
_________________________________________________________________
max_pooling2d_3 (MaxPooling2 (None, 18, 18, 256)       0
_________________________________________________________________
dropout (Dropout)            (None, 18, 18, 256)       0
_________________________________________________________________
flatten (Flatten)            (None, 82944)             0
_________________________________________________________________
dense (Dense)                (None, 128)               10616960
_________________________________________________________________
dropout_1 (Dropout)          (None, 128)               0
_________________________________________________________________
dense_1 (Dense)              (None, 256)               33024
_________________________________________________________________
dropout_2 (Dropout)          (None, 256)               0
_________________________________________________________________
dense_2 (Dense)              (None, 4)                 1028
=================================================================
Total params: 11,039,428
Trainable params: 11,039,428
Non-trainable params: 0
_________________________________________________________________
```

Figure 3.4.0: Model Summary

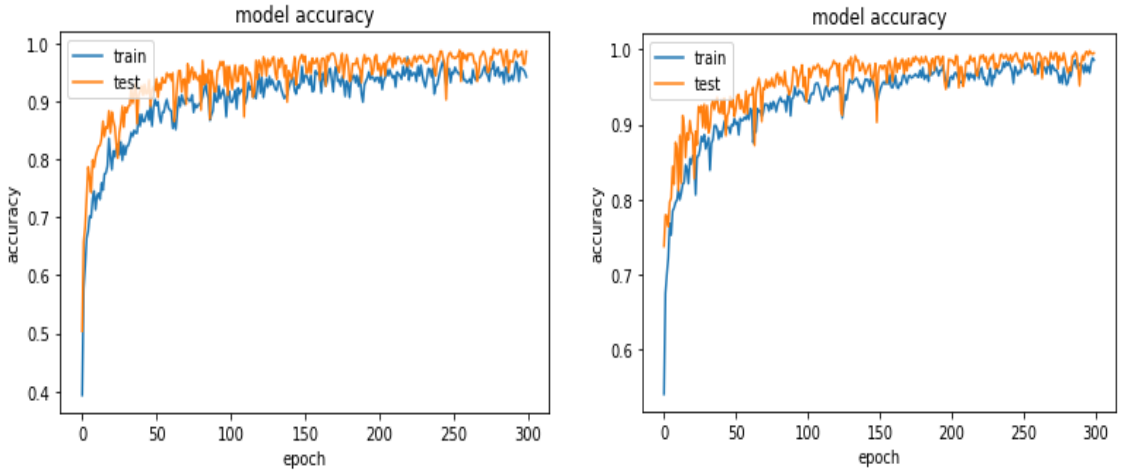

Figure 3.4.1: Validation accuracy left (2 max pooling and 1 dense) and right (4 max pooling and 2 dense)

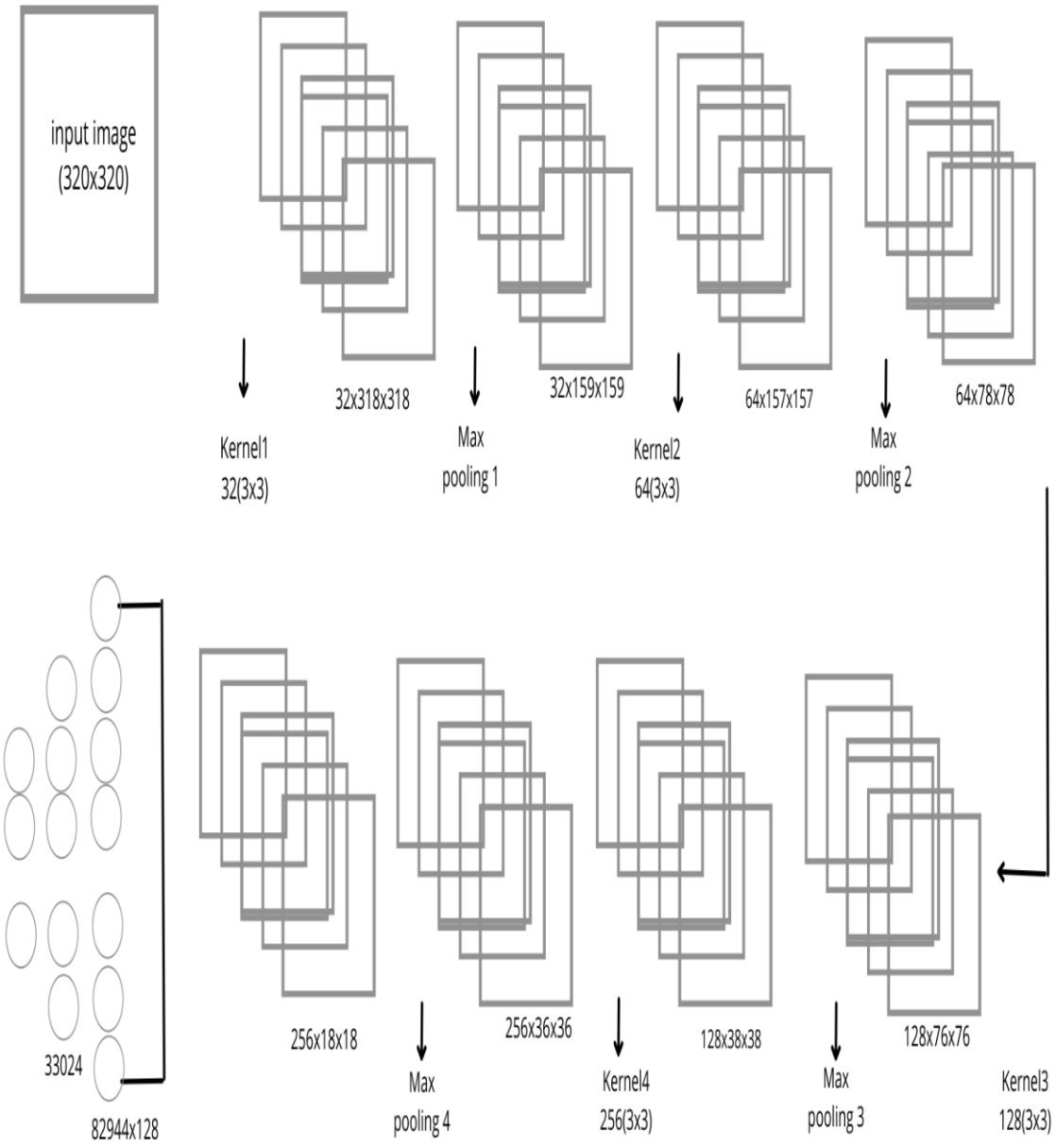

Figure 3.4.2: Proposed CNN layer

Convolutional Layer

A convolutional neural network is a deep literacy algorithm that can take in an input image, assign significance to colorful objects in the image. And to be suitable to separate one from the other there-processing needed in a cloister is much lower as compared to other groups. CNN is faster than another machine learning algorithm. The novelty of the proposed approach is exercising a low- cost, high delicacy system that defines a deep literacy system. CNN has wide operations in the film land and videotape protestation, recommender structures also, ordinary conversational taking care of. Convolutional neural networks. Sounds like an exceptional mix of wisdom and calculation with a little CS sprinkled in, yet these systems have been a couple of the preeminent influential marches inside the field of PC vision. 2012 was the essential time that neural nets were created to obviousness as Alex Krizhevsky used them to win that time's ImageNet contest (principally, the monthly Olympics of PC vision), dropping the order botch record from 26 to 15, a stunning advance at that point. When a pc sees film land (snaps a print as information), it will see a bunch of pixels. Contingent upon the assurance and hand of the image, it will see.

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

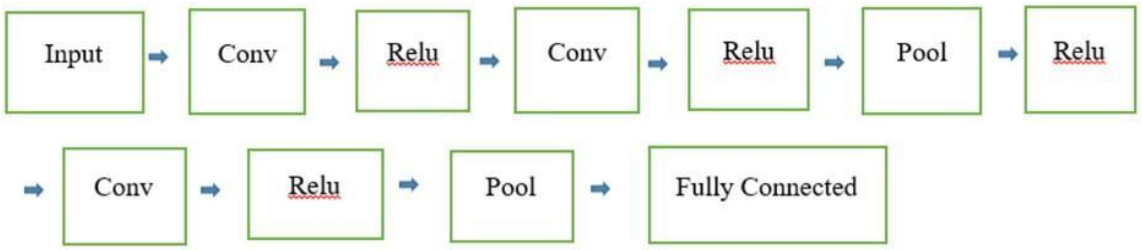

Figure 3.4.2: A classic CNN architecture

Feature Extraction

Convolution is relatively conceivably the most structured bit of CNN. The term complication intimates the logical mix of two capacities to convey the third work. It unites two arrangements of information. Inside the case of CNN, the complication is performed on the input information data with the application of a channel or part to at that point produce a highlight figure. We've executed a complication by sliding the channel over the input. At every space, an association duplication is performed and summarizes the outgrowth onto point layout.

Max-Pooling

Max Pooling could be a down testing fashion in Convolutional Neural Systems. The thing is to down- illustrate a data representation dwindling its conditionality and allowing for reservations to be made around features contained inside the sub-areas binned. It's principally used to reduce the proportion of the image since the lesser number of pixels added to further boundaries which can incorporate immense lumps of data. In this way, we bear smaller boundaries with the end thing that a CNN can in any case fefe the image. Max pooling is arranged for 75 of the authorizations and controlling over-fitting.

Padding

Padding is a term applicable to convolutional neural networks as it suggests the proportion of pixels added to an image when it's being taken care of by the bit of a CNN. For case, assuming the padding in a CNN is set to nothing, every pixel regard that's added will be worth zero. Assuming, still, the zero paddings are 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 to have the occasion to install this data into a neural arrangement a while later on. Completely affiliated layers do not have a close-by limitation like convolutional layers (which as it was watching a couple of close-by corridors of an image by using convolutional channels). This implies it can join all the discovered area features of the once convolutional layers. Each point illustration channel inside the yield of a CNN sub caste could be a" fixed"2D group made by including the issues of colorful 2D corridors (one for each channel inside the information sub caste).

Dense Layer

A thick sub caste is reasonable another title of the total associated sub caste. Similar conditioning take put in the thick subcaste where every neuron is related to one another. It's also called thick since it addresses a thick relationship of thick neurons. A thick sub caste has loads linked with every neuron consolidated and with exceptional rates. Colorful kinds of work like soft maximum authorization work, SVM, and colorful others are used then for inarguable position enterprise inside the neural orchestrate. Still, in our illustration, we follow habituated soft maximums for arrangement.

After a couple of complications and pooling layers, we get a couple of significant position features as information. These information picture features are used as a grouping to probe colorful classes.

Still, when we consolidate the complicated sub caste's features and look over the sub caste features it gives way more effects of arrangements. In Fully Associated layers totality of yield, chances are One Convolutional sub caste shares loads with other Convolutional layers. It's outstandingly problematic to get all centers together with a soft maximum sub caste.

SoftMax

Allow us to consider a characterization model to a group with n classes. This model takes input datasets and a computation and produces a score of each class. The SoftMax actuation work changes over from a score to the probability between 0 and 1. The totality of all chances has 1. We've used this work to a definitive sub caste of the convolutional neural network to characterize the classes. This work is conveyed through colorful exercises from a word exhibition.

3.4 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

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 five models with different dataset. One dataset has 506 images and another dataset has 1063 images.

In the first model we have used Five max-pooling layers and three dense layers. The accuracy we have gotten is 0.99407%.

In the second model, we have used three max-pooling layers and one dense layer. The accuracy we have gotten is 0.99605%.
Then we used Four max-pooling layers and one dense layer. Third accuracy is 0.9740%.

We have used Two max-pooling layers and one dense layer. Fourth accuracy is 0.99012%, After tarin, our system has Four max-pooling layers and two dense layers has given the best accuracy. In Fifth model we try to optimize our CNN model and increase data, finally get the best accuracy is 0.99812%. Here is the table of all layer accuracy:

TABLE: 4.2.1: Models and validation accuracy

Model Number	Max-pooling Layer	Dense Layer	Validation accuracy
First model	5	3	0.98407% out of 1%
Second model	3	1	0.99605% out of 1%
Third model	4	1	0.9740% out of 1%
Fourth model	2	1	0.99012% out of 1%
Fifth model	4	2	0.99812% out of 1%

Final model we try to optimize our CNN model and increase data, finally get the best accuracy is 0.99812%.

In below we have create our best model for final result:

Building cnn model

```
cnn_model = keras.models.Sequential([
                                    keras.layers.Conv2D(filters=32, kernel_size=3, input_shape=[320, 320, 3]),
                                    keras.layers.MaxPooling2D(pool_size=(2,2)), # max pooling reduce the overfitting
                                    keras.layers.Conv2D(filters=64, kernel_size=3),
                                    keras.layers.MaxPooling2D(pool_size=(2,2)),
                                    keras.layers.Conv2D(filters=128, kernel_size=3),
                                    keras.layers.MaxPooling2D(pool_size=(2,2)),
                                    keras.layers.Conv2D(filters=256, kernel_size=3),
                                    keras.layers.MaxPooling2D(pool_size=(2,2)),

                                    keras.layers.Dropout(0.5),
                                    keras.layers.Flatten(), # neural network beulding
                                    keras.layers.Dense(units=128, activation='relu'), # input layers relu(rectified linear unit)
                                    keras.layers.Dropout(0.1),
                                    keras.layers.Dense(units=256, activation='relu'),
                                    keras.layers.Dropout(0.25),
                                    keras.layers.Dense(units=4, activation='softmax') # output layer
])
```

Figure 4.2.1: Our Final CNN Model

Here we have showed our model summary for best CNN model.

```
cnn_model.summary()
```

```
Model: "sequential"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv2d (Conv2D)              (None, 318, 318, 32)      896
_________________________________________________________________
max_pooling2d (MaxPooling2D) (None, 159, 159, 32)      0
_________________________________________________________________
conv2d_1 (Conv2D)            (None, 157, 157, 64)      18496
_________________________________________________________________
max_pooling2d_1 (MaxPooling2 (None, 78, 78, 64)        0
_________________________________________________________________
conv2d_2 (Conv2D)            (None, 76, 76, 128)       73856
_________________________________________________________________
max_pooling2d_2 (MaxPooling2 (None, 38, 38, 128)       0
_________________________________________________________________
conv2d_3 (Conv2D)            (None, 36, 36, 256)       295168
_________________________________________________________________
max_pooling2d_3 (MaxPooling2 (None, 18, 18, 256)       0
_________________________________________________________________
dropout (Dropout)            (None, 18, 18, 256)       0
_________________________________________________________________
flatten (Flatten)            (None, 82944)             0
_________________________________________________________________
dense (Dense)                (None, 128)               10616960
_________________________________________________________________
dropout_1 (Dropout)          (None, 128)               0
_________________________________________________________________
dense_1 (Dense)              (None, 256)               33024
_________________________________________________________________
dropout_2 (Dropout)          (None, 256)               0
_________________________________________________________________
dense_2 (Dense)              (None, 4)                 1028
=================================================================
Total params: 11,039,428
Trainable params: 11,039,428
Non-trainable params: 0
```

Figure 4.2.2: Our Final CNN Model Summary

4.3 Result Discussion

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

TABLE: 4.3.1: Validation Accuracy Discussion

Diseases Name	precision	recall	f1 score
Cavity Spot	0.90%	0.94%	0.92%
Leaf Blight	0.92	0.90	0.95%
Healthy Carrot	0.98%	0.96%	0.97%
Fresh Leaf	0.95%	0.96%	0.98%
Fresh Carrot	0.94%	0.97%	0.97%

We have achieved our final accuracy of 0.99812%.

CHAPTER 5

EFFECT ON SOCIETY, ENVIRONMENT AND SUSTAINABILITY

5.1 Effect on Society

We believe this work will be positive for society. As we've said before our country loses a big quantum of crop every time for the root cause of conditions and for that we've lost a massive quantum of plutocrats too. Our work will help to reduce the loss of crops and save some plutocrats for the growers too. Which will have a good impact on our husbandry. And we can also keep the data of conditions for further study for our design.

5.2 Effect on Environment

Human beings need a healthy terrain 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 a husbandry officer or a planter can describe the root conditions before also they can take the necessary way to save the crop. What will help the terrain to be free from dangerous contagions? We believe in healthy food and healthy life. So, our design will surely impact the terrain appreciatively.

5.3 Ethical Aspects

Most of the developed countries have used stylish technologies to ameliorate their husbandry. In tilling the hardest part is detecting the exact conditions for the crop and crops or differently there’s a chance to lose the crop. In that part, we've made it easier for them. With this exploration base design, they can fluently describe the problem for the carrot crop. What will make them more profitable and also help the frugality to rise.

5.4 Sustainability Plan

We'd like to give a field test on this design. And if we've gotten enough response also we'd like to work on it more and ameliorate the features and add further. Also, we will collect further data and make the system easier to use. Day by day we will ameliorate our database. And we will go global for it.

CHAPTER 6

CONCLUSION AND FUTURE WORK

6.1 Summary of the Study

At first, we collected our data also we've increased our data by using image accession (Internet replicas) and Image pre-processing. Also we've trained our dataset by using CNN. Also we've tested our model by using a training dataset. We've gotten the stylish training and confirmation delicacy graph of our design. Eventually, we've plant our anticipated result which is that the delicacy is stylish and it's 0.99812%.

6.2 Conclusion

The proposed system is used to identify unhealthy carrots which will help the growers and agrarian sector to cultivate healthy carrots. The main part of our exploration is to help those growers so that they can fluently get their awaiting crop details through our model and can take the necessary way. In the future, the number of conditions the system identifies could be better. And complaint inflexibility can also be linked.

6.3 Future Work

In the future, we'd like to develop an app and also, we will add further features and algorithms to get the stylish outgrowth. And we will train our system with further conditions. We'll make the system easier for the growers and others.

Figure 6.2.1: Our Application Layout

APPENDIX

In our design, we've trained our system with four types of carrot conditions. If someone wants to describe other conditions that we haven't trained in our system that wouldn't be possible to describe. To finish the design, we've defied such colorful issues, in the first place, one was to choose the methodological methodology for our bid. It wasn't traditional work it was a request about the grounded bid, in addition, there was veritably little work done at some point as of late on this reach. So, we presumably will not get that many offers of help from wherever. Another issue was the multifariousness of data, it was relatively delicate for us.

Then some further snap image of our carrot complaint dataset

Figure 6.2.2: Some image of our dataset

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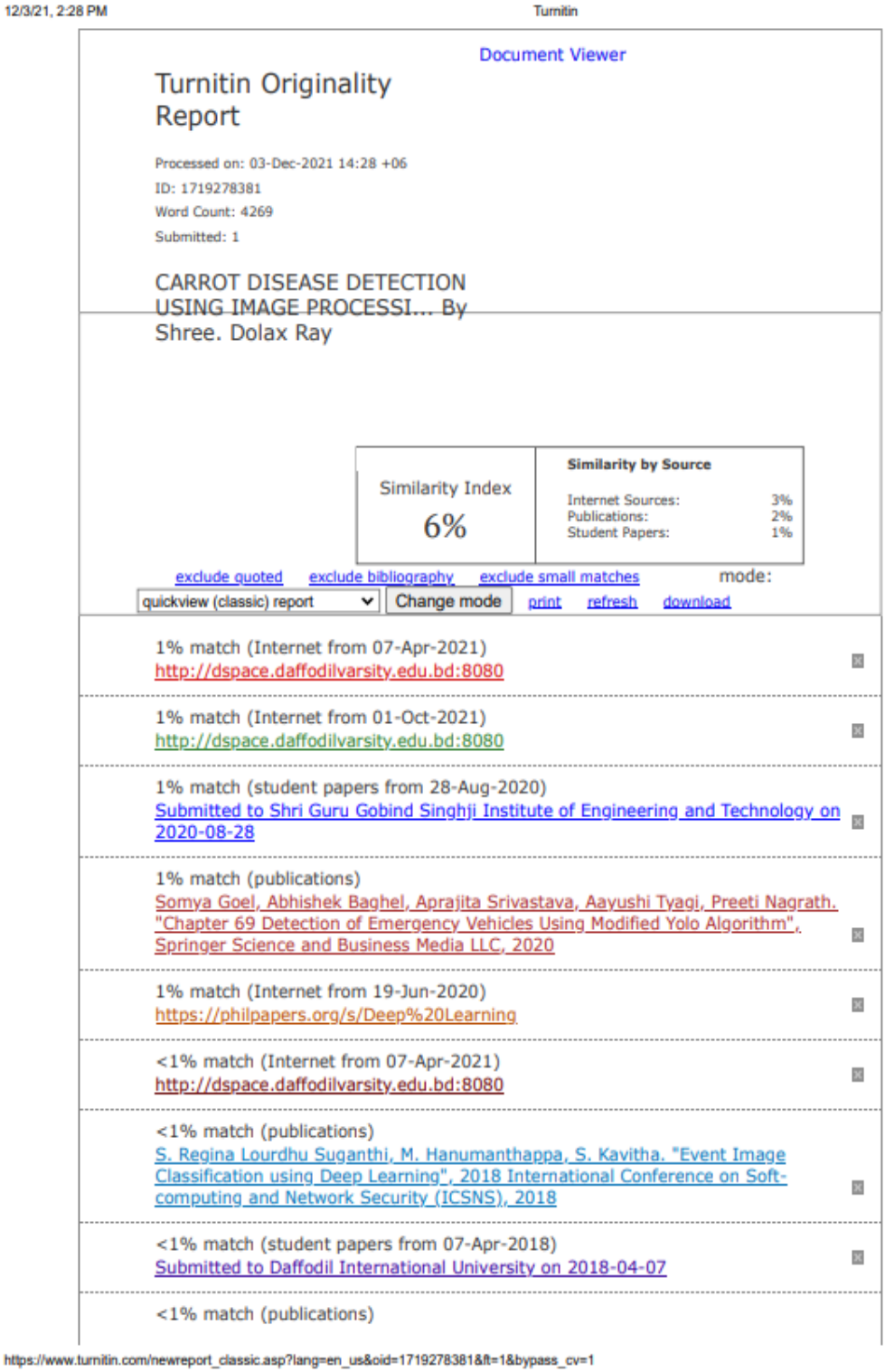

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