PLANT LEAF DISEASES DETECTION USING IMAGE PROCESSING SYSTEM

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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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DHAKA, BANGLADESH

DECEMBER 2019

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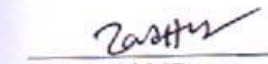

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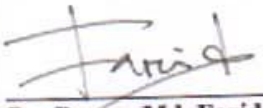

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We hereby declare that, this project has been done by us under the supervision of **Most. Hasna Hena, Senior Lecturer, Department of CSE** Daffodil International University. We also declare that neither this project nor any part of this project has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

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ACKNOWLEDGEMENT

First we express our heartiest thanks and gratefulness to almighty God for His divine blessing makes us possible to complete the final year project/internship successfully.

We really grateful and wish our profound our indebtedness to **Most. Hasna Hena**, **Senior Lecturer**, Department of CSE Daffodil International University, Dhaka. Deep Knowledge & keen interest of our supervisor in the field of "*Data mining*" to carry out this project. His endless patience ,scholarly guidance ,continual encouragement , constant and energetic supervision, constructive criticism , valuable advice ,reading many inferior draft and correcting them at all stage have made it possible to complete this project.

We would like to express our heartiest gratitude to Most. Hasna Hena andHead**,** Department of CSE, for his kind help to finish our project and also to other faculty member and the staff of CSE department of Daffodil International University.

We would like to thank our entire course mate in Daffodil International University, who took part in this discuss while completing the course work.

Finally, we must acknowledge with due respect the constant support and patients of our parents.

ABSTRACT

Bangladesh is country of seasons. Naturally the people of Bangladesh are blessed with various native seasonal fruits to fulfill their needs and appetites. So, hundreds of local fruits are cultivated through the yearlong by the local farmers. But in recent times some obsolete fruits like apple, blueberry, cherry, grape, orange, peach, raspberry, strawberry etc. are getting popularity amongst local consumers of Bangladesh and that is the reason why local farmers are now contemplating towards the commercial cultivation of these obsolete fruits. But there are too many obstacles in that process of commercial cultivation including weather demand, quality of soil, cultivation technology, diseases, insects attack etc. Most of the time diseases of these fruits notice our eyes when fruits are attacked and we cannot help but let the fruits get rotten and suffer the financial loss too. Even though we might not handle every barrier, but we can use deep learning and image processing technology for the detection of diseases of these fruits and help the farmers taking necessary steps on time. To simplify the work, we have taken the images of these obsolete fruits leaves and implemented image processing algorithm and deep learning methods on them. After the completion of this research we have accomplished an accuracy of 92.56%. This research is going to help the farmers to cultivate and promote these obsolete fruits more in a broaden way by reducing the diseases. It is an eco-friendly system which detects diseases without much effort only by clicking attacked images and putting that in the system and the system will give an output of which disease the plant is attacked by.

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CHAPTER 1
Introduction

1.1 Introduction

The people of Bangladesh are fond of fruits. Since Bangladesh is rich in seasons different kind of seasonal fruits are cultivated and found in the market all year round. People here easily accept the unusual but trendy things. Same goes for food culture also. Basically, all the native people of Bangladesh mostly dependent on seasonal fruits. But in recent time some obsolete fruits are gaining popularity in our country. Mostly they are cultivated in different weather and soil and the fruit dealers import and sells those fruits in local market. They are occupying more and more market share of fruit business in our country. Hence the fruit cultivators are leaning towards to cultivate those fruits day by day in order to earn more profit. Although farmers are really interested in commercial cultivation of these obsolete fruits but because of different cultivating weather, soil, lack of knowledge on the insect's attacks on these fruits it became hard to produce them commercially. This research paper tends to work on the leave diseases of these obsolete fruit plants and detect them using CNN algorithm of image processing. This research work is going to detect apple black rot, apple cedar rust, apple scab, cherry powdery mildew, grape black measles, grape black rot, grape leaf blight, orange hunalongbing, peach bacterial spot, strawberry leaf scorch of various obsolete fruits. Therefore, this work may help the farmers to approach something new and motivate them to open new marketplace of these locally cultivating obsolete fruits.

1.2 Motivation

Bangladesh is an agricultural country. Most of the people of Bangladesh are directly and indirectly connected with agriculture. Farmers of Bangladesh face many kinds of problems. The major problem they can't find out their fruits diseases properly. For this they can't get proper result. To solve this problem we try to build a system that can find out fruits diseases properly. To do something for Bangladeshi farmers we analysis mobile application along with web application about leaf diseases prediction. But most of the application works with some specific diseases. We think do better from that system. After that we discuss with our honorable supervisor about this topic. Ours honorable madam encourage us. From this thinking we starting ours work.

1.3 Research Questions

In our research we wanted to prediction leaf diseases along with proper solution of those diseases. For this reason we study more and more about prediction algorithm. For given solution we need to know about which solution is better for which diseases .Then we need to collect data for this research. To get better result we need to collect huge amount of data .Only more data collection can give better result. Data collection is not so easy, but we try to collect data properly.

The question we have faced:

1. Raw data of collection.
2. Data validity.
3. Best algorithm select for prediction.
4. Find out the expected outcome.
5. Finding the error algorithm.

1.4 Expected outcome

Expected outcome of ours system is below like that:

1. This system can easily find out leaf diseases.
2. Not only leaf diseases prediction this system also gives proper solution of those diseases.
3. The farmer with poorer knowledge can also use the method because the method output system given in Bengali language.
4. Farmers will know about proper way of cultivation fruits.
5. It provides the business with valuable information that in business, that helps to make decision about the future production of the organization.

1.5 Report Layout

Chapter 1: Is all about introduction of our research.
In this chapter Introduction, Motivation, Research Question, Expected Outcome, Report Layout is described.

Chapter 2: Is all about background of the research. In the chapter Related Works, Research Summery, Scope of the Problem and Challenges are described.

Chapter 3: Is all about Research Methodology of the research.
In the chapter Research Subject and Instrumentation, Data Collection Procedure, Statistical Analysis, Implementation Requirements are described.

Chapter 4: Is all about Experimental and Discussion of the research.
In the chapter Experimental results, Descriptive analysis and summary are described.

Chapter 5: In this Chapter Summary, Conclusion, Recommendation and Implication for Future Study and described.

CHAPTER 2
Background

2.1 Introduction

We study more and more about leaf diseases prediction before starting this research. We also study about solution of leaf diseases, necessity of leaf diseases prediction of Bangladesh. Try to analysis existing system, a lot of marketing values. For solve this problem we analysis challenges. For cultivated fresh fruits leaf diseases prediction system is more important. By this system we try to invented proper way to predict leaf diseases. For this reason we need background studies carefully for complete our research.

2.1.1 Ancient method:

Before 2000 most of the farmers can't find out their fruits leaf diseases properly. They use manually method for find out leaf diseases. Most of the time they fall down their fruits leaf and saw those agricultural officer. Then agricultural officer tell them about their fruits leaf diseases. Sometimes agricultural officer give them wrong information.

2.1.2 Modern method:

The system of leaf diseases detection is updated day by day. Now-a-days there are many system already build up which detect leaf diseases properly. Use of data mining is one of the best solutions to detect leaf disease.

2.2 Related Works

In this section detailing of related work is presented. The previous researches about plant diseases detection and their proposed methods are decrypted here. Monishanker Halder, Ananya Sarkar, Habibullah Bahar(2019), "PLANT DISEASE DETECTION BY IMAGE PROCESSING": A LITERATURE REVIEW SDRP Journal of Food

Science & Technology 3(6) had reviewed the work of some previous researchers who had used K-means clustering algorithm along with SVM, ANN, GLCM, SURF, FUZZY Classification of image processing method for detecting plant diseases[1]. Sujatha R, Y Sravan Kumar and Garine Uma Akhil(2017),"Leaf disease detection using image processing". Journal of Chemical and Pharmaceutical Sciences. ISSN: 0974-2115 have showed how to solve the problem of identification of plant diseases in MATLAB following up the process like loading the image, contrast enhancement, converting images from RGB to HSI, extracting of features and SVM[2]. Sowmya GM, Chandan V, Sampath Kini(2017), "Disease Detection in Pomegranate Leaf Using Image Processing Technique". International Journal of Science, Engineering and Technology Research (IJSETR) Volume 6, Issue 3, ISSN: 2278 -7798. Where they have detected the leaf disease of Pomegranate by using RGB color method and Gray Level Co-occurrence Matrix with the help of MAT LAB and GUI (graphical user interface)[3].Zalak R. Barot, Narendrasinh Limbad. An Approach for Detection and Classification of Fruit Disease. International Journal of Science and Research (IJSR) ISSN (Online): 2319-7064. Represents the survey of various approaches for segmentation method along with feature extraction and classifiers for detection of diseases in fruit and leaf in India[4].Santosh Adhikari, Bikesh Shrestha, Bibek Baiju and Er. Saban Kumar K.C.(2018): "tomato plant diseases detection system using image processing". KECConference has used CNN and achieved an overall 89% accuracy on the plant village dataset[5].In this research we are using CNN (Convolution Neural Network). CNN is a newly invented technology of artificial intelligence which is much easier and more convenient than the other existing methods. The world is getting more acceptable with CNN since it ensures high accuracy rate amongst researches. In this research only by inputting diseased images the pre-trained machine gives the name of the disease as an output with highest accuracy of 92.56% along with a to do list of for preventing the disease is making the model more trustable and unique than previous researches.The world is getting more acceptable with CNN since it ensures high accuracy rate amongst researches.But there are too many obstacles in that process of commercial cultivation including weather demand, quality of soil, cultivation technology, diseases, insects attack etc. Most of the time diseases of these fruits notice our eyes when fruits are attacked and we cannot help but let the fruits get rotten and suffer the financial loss too.

2.3 Research Summary

By study a lot of research papers, we get much valuable information to find out the fruits leaf diseases detection of modern agricultural system. Analysis exiting system for get information. Most of the research paper only research one or two fruits leaf disease. But in our research we try to work with multiple fruits and multiple diseases. We also gave proper solution with this system. This type of work in Bangladesh is very difficult. For this reason we select this topic. Algorithm selection is more important part to successfully complete any research. After analysis various algorithm then select the better of them (CNN) for complete our research.

2.4 Challenges

We face many challenges while we working on this research which was too difficult to solve but we try our best to solve most challenge. We can't get our proper result without solve those challenge. To solve challenge we solve carefully.

There are some major challenges we face:

1. Collection of data as more as possible.
2. Select proper data.
3. Divided data into many part.
4. Study about leaf diseases.
5. Analysis of various algorithms.
6. Select proper algorithm.
7. Making user friendly system.
8. Making the output system in Bengali language.

CHAPTER 3
Research Methodology

3.1 Introduction

To help the commercial farmer who wants to cultivate obsolete fruits, Whole idea of detecting the leaf diseases is going to present them. For make more profit main barrier are insects and diseases .To store those problem also experienced source is needed to be paid. It wastes time as well as money. Most of the farmer of Bangladesh can't bear cost of the hiring agricultural officer. They sometimes waste their time to hiring experienced agricultural officer. Using the latest technology especially image processing system can properly solve those problems. Only by clicking leaf diseases picture and input it into the system we have created an informational output with the name of the diseases will the shown to the farmer. Use of CNN has made easier to this procedure.

3.2 Research Subject and Instruction:

This research used data mining technique to complete total work. We worked CNN (convolution neural network) as data mining tools. In this research we use RGB (Red, Green, and Blue) color model. We used multiple Conv2D layer and ReLu activation function. Also use batch normalization for activation of the every layer. Last output layer used 17 units with activation softmax. To decreasing the learning rate we used adam algorithm whereas the value used 0.001.

3.3 Materials and Methods

To determine the output of neural network like yes or no, activation is used. In this research we use ReLu as activation function. Right now ReLu (Rectified Linear Unit) is the most activation function. The range of ReLu is [0 to infinite). Equation of ReLu [6] is below.

$$Relu(X) = MAX(0, X) \qquad (1)$$

SoftMax [7] and Sigmoid activation is used last output layer which has 17 units.

$$\sigma(Z) = \frac{e^{zj}}{\sum_{k=1}^{k} e^{zk}} forj \ = \ 1, \ldots\ldots k \qquad (2)$$

$$\varphi(z) \ = \frac{1}{1+e^{-z}} \qquad (3)$$

The architecture of this proposed methodology is shown in fig.3.1

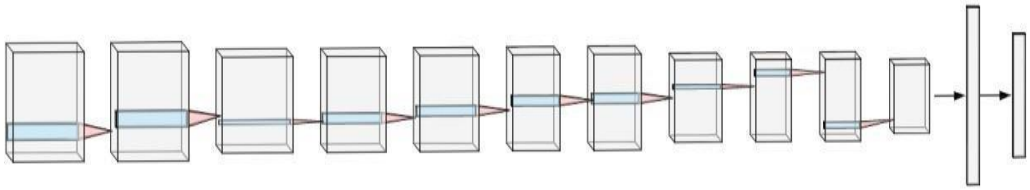

Figure 3.1: Proposed architecture model

3.4 Data collection procedure

We collect our all dataset from ourselves and google. All dataset are to be .jpg type and we convert all of dataset in (256 × 256) pixel for finding the better accuracy. We collected almost 5,000 image which are diseases and healthy.

Flowchart of data processing shown in Fig. 3.2

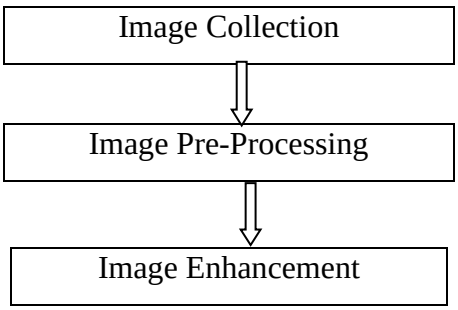

Figure 3.2: Flowchart of this proposed methodology.

3.4.1 Image Collection

Data collection must need to work any research. Real life data collection is most important to get proper result. We think that as more as data collection as more as we get better result. For this reason we try our best to collect huge amount of data. After hard work we were able to collect 5000 image. We work on eight different obsolete fruits with nine type of diseases also with healthy class. Our image formats are .jpg .gif .bmp. To ten types of image is below

- apple black rot
- apple cedar rust
- apple scab
- cherry powdery mildew
- grape black measles
- grape black rot
- grape leaf blight
- orange hunalongbing
- peach bacterial spot
- strawberry leaf scorch and healthy

The sample dataset of this research is shown in Fig.3.3.

Figure 3.3: The collected data set.

3.4.2 Image Pre-Processing

This dataset has been split up into two sections declared as test and train where both have 20% and 80% images of the dataset. All images were processed and resized into (256*256) pixels by not compromising their qualities to pre-train them according to the proposed method.

3.4.3 Image Enhancement

Image enhancement is a method that artificially inflates the dataset. This research used image enhancement as given below:

▪To reduce complexity exhibition of an image.

▪To create a bigger dataset by giving different types of shape and angle.

▪To guarantee the best accuracy our proposed model uses image rotation: 40, in range: 40, 0.2 width shift in range, 0.2 height shift in the range, 1. /155 as rescale, 0.2 shear in the range, 0.2 zoom in the range. Horizontal flip has been augmented as True and fill mode nearest for ensuring the highest accuracy shown in Fig.3.4.

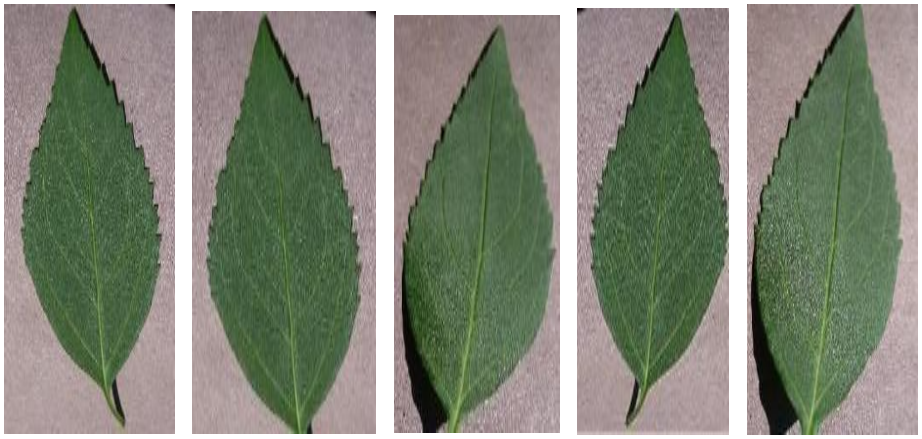

Figure 3.4: Image enhancement.

3.4.4 Data mining

In this part we analyze our collected data. We divide this collected dataset with their disease wise. And all classification data keep into two folder in test and train folder. We divide this dataset into 80% and 20% for train and test. Then the dataset opening and training set and testing the dataset into machine learning.

Table 3.1 our proposed model.

Layer (type)	Output Shape	Param #
conv2d_23 (Conv2D)	(None, 256, 256, 64)	12352
conv2d_24 (Conv2D)	(None, 256, 256, 64)	262208
max_pooling2d_10 (MaxPooling)	(None, 128, 128, 64)	0
conv2d_25 (Conv2D)	(None, 128, 128, 32)	51232
conv2d_26 (Conv2D)	(None, 128, 128, 32)	25632
batch_normalization_7 (Batch)	(None, 128, 128, 32)	128
conv2d_27 (Conv2D)	(None, 128, 128, 16)	12816
conv2d_28 (Conv2D)	(None, 128, 128, 16)	6416
max_pooling2d_11 (MaxPooling)	(None, 64, 64, 16)	0
conv2d_29 (Conv2D)	(None, 64, 64, 8)	1160
conv2d_30 (Conv2D)	(None, 64, 64, 8)	584
max_pooling2d_12 (MaxPooling)	(None, 32, 32, 8)	0
batch_normalization_8 (Batch	(None, 32, 32, 8)	32
flatten_4 (Flatten)	(None, 8192)	0
dense_7 (Dense)	(None, 512)	4194816

This table represent of our proposed methodology. Whereas used multiple layer of CNN. We used various library of CNN like batch_normalization, max_pool etc.

3.5 Statistical Analysis

After the first successful epoch, this model has achieved accuracy for training as 42.35% and an accuracy of validation as 36.10%. After two successful epoch an accuracy for training as 52.68% and an accuracy of validation as 48.08% and reduce the learning rate 0.0002. After the ten successful epoch an accuracy for training as 72.69% and an accuracy of validation as 75.34% and reduce the learning rate le-04. After final epoch this model achieve 92.28% accuracy for train and an accuracy of validation as 92.56% reduce learning rate 0.0001.

3.6 Implementation Requirement

Now-a-days super computer used to control the data for predicting application which need huge amount of power. For the huge number of collection of data caught up in problems higher than explain. It is most needed to simpler the data set before scheduled with other analysis. Data mining system are proper for it. CNN model is the best use to detect any image diseases. For this we see CNN model. We are planned to use smooth as data with standard error bands. We use bootstrap technique to complete achievement for show the nonparametric.

CHAPTER 4

Experimental Result and Discussion

4.1 Introduction

In this chapter we wanted to presented and discussed with proper reference to the aim of study which was determine the leaf disease detection. In our research we work with CNN (Convolution Neural Network) as data mining tools. We use various algorithms for get proper result. After that we got our expected outcome which we want to get in our system. In this chapter we try to show the result with proper figures and tables. To get better our system in future we will some update in our system.

4.2 Accuracy Graph

Accuracy graph used for justifies the experimental result. By the model graph an out is checked of the numeric values. In this graph very first training and validation graph has under fitting issue. Next graph is showing after the final epoch there has no issues of over fitting or under fitting. The accuracy graph of the proposed model is shown below in Fig.4.1.

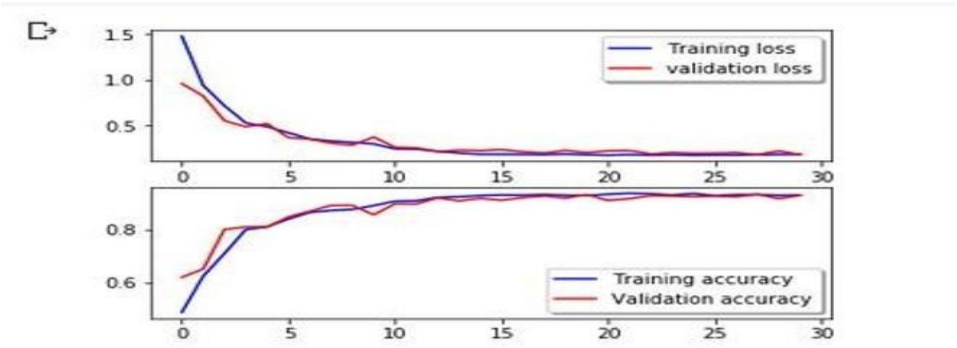

Figure 4.1: Accuracy graph

4.3 Confusion Matrix

Confusion matrix shows how accurate a proposed model works. Precision, Recall can be easily found out by judging a confusion matrix of any research. The proposed model of this research is working smoothly as all the diagonal values of (17 × 17) matrix is larger than other values.

Confusion matrix shown in fig.4.2.

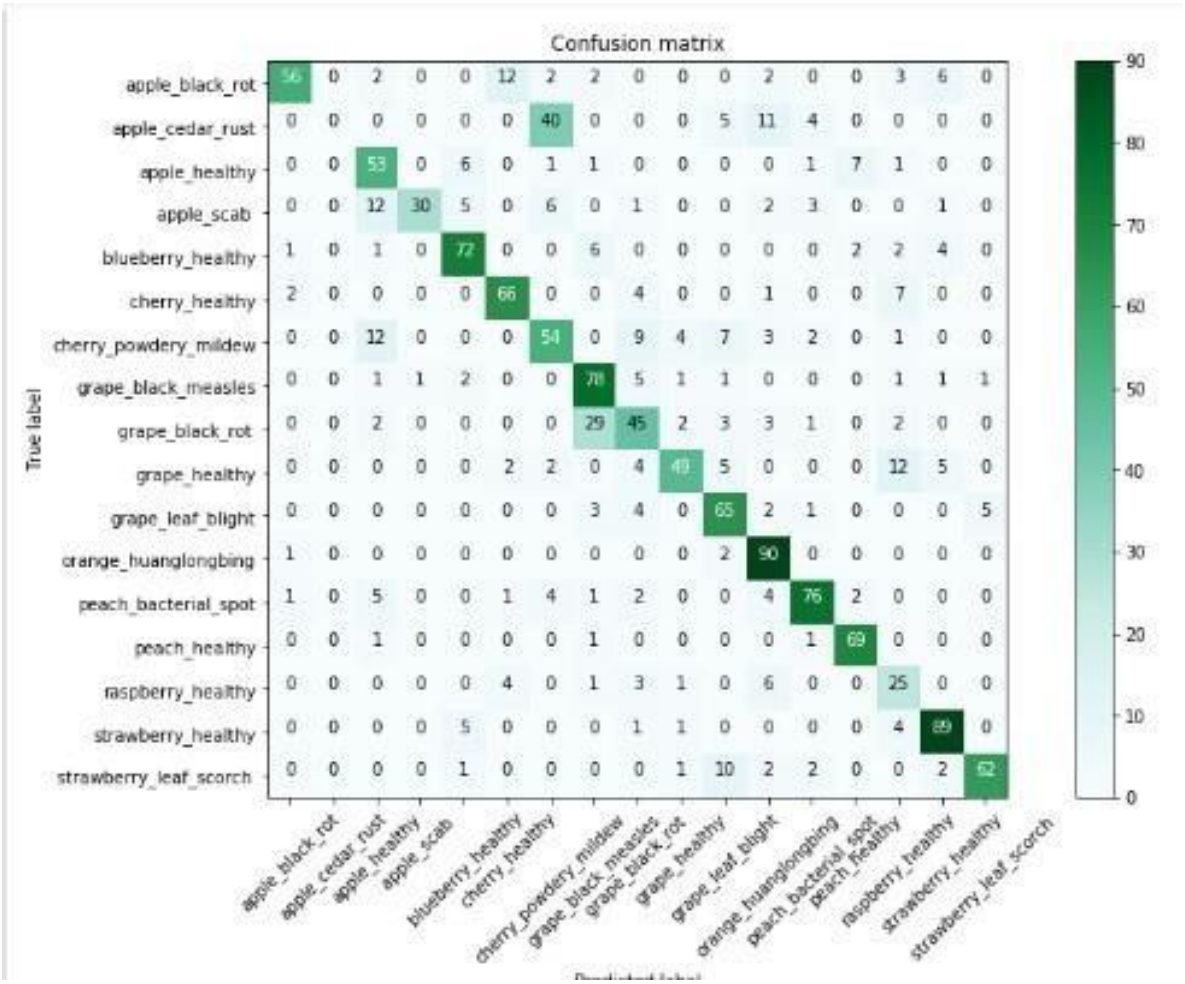

Figure 4.2: Confusion matrix.

Table 4.1: classification report.

Name	Precision	recall	F1score	Support
apple_black_rot	0.92	0.66	0.77	85
apple_cedar_rust	0.00	0.00	0.00	60
apple_healthy	0.60	0.76	0.67	70
apple_scab	0.79	0.50	0.66	60
blueberry_healthy	0.78	0.82	0.80	88
cherry_healthy	0.50	0.82	0.80	88
cherry_powdery_mildew	0.64	0.69	0.54	92
grape_black_measles	0.58	0.88	0.73	92
grape_black_rot	0.83	0.53	0.55	87
grape_healthy	0.66	0.62	0.71	79
grape_leaf_blight	0.71	0.81	0.73	80
orange_huanglongbing	0.84	0.97	0.82	93
peach_bacterial_spot	0.86	0.79	0.81	96
peach_healthy	0.43	0.96	0.91	72
raspberry_healthy	0.82	0.61	0.67	40
strawberry_healthy	0.91	0.89	0.86	100
strawberry_leaf_scorch	0.70	0.89	0.84	80
macro avg	0.97	0.70	0.69	1354
weighted avg	0.71	0.72	0.79	1354

The classification report table represent how much good working of this proposed model for this dataset. The precision, recall, F1score is calculated by below equation

$$precision = \frac{TP}{TP + FP} \qquad (1)$$

$$recall = \frac{TP}{TP + FN} \qquad (2)$$

$$F1score = 2 \times \frac{precision \times recall}{precision + recall} \qquad (3)$$

Whereas TP means true positive and FP means false positive.

4.4 Repercussion

As input of our model we randomly select an image then the system compare the input image with pre trained data to find the matched diseases given an output. Along with the diseases name out system also provided a list according to the diseases shown in fig.4.3

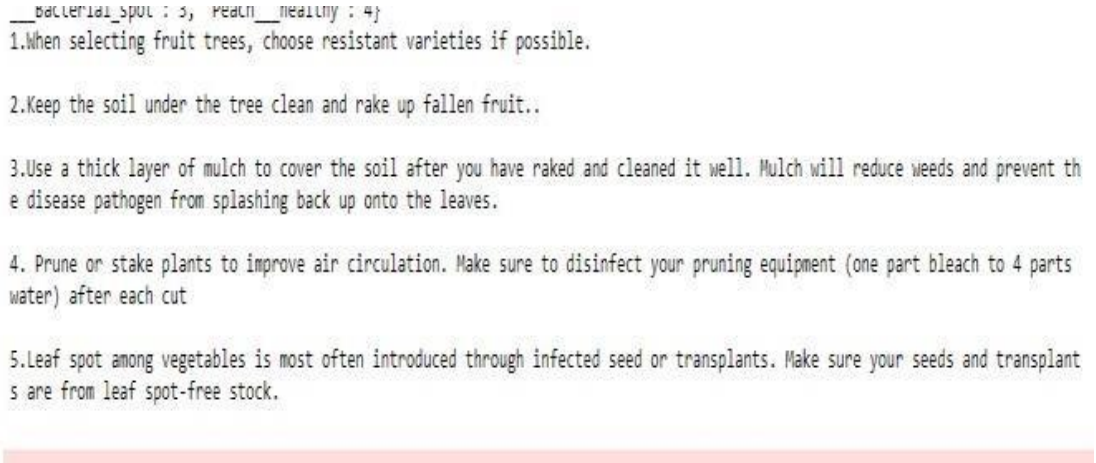

Figure 4.3: Repercussion.

4.5 Summary

Before 2000 agricultural officer is trying for leaf diseases detection manually. But most of time they face many problem. Leaf diseases detection one of them. We work upon like diseases and it solution which can change at any time. For this reason our result may not work as the leaf disease act on. But we they our best to overcome those entire problem and develop is successfully. Most of the time in Bangladesh this type of research is not fully developed. We also face some limitation. Such as the leaf diseases and solution data is not available. We know that always machine work basic on algorithms along with predefined set of instructions. Most of the time machine doesn't know which is wrong or right. It gives output on basic from the previous input. In future is our system fall any problem then we will updated our system.

CHAPTER 5

Summary, Conclusion, Recommendation and Implication for Future Research

5.1 Summary of the study

Most of the time any prediction system can’tgiven proper result. Every time it faces some limitation. We try our best to reduce limitation and get the proper result from the research. In our system algorithm are used to detect which leaf is or not. To use of data mining to solve the problem for reduce error rate. CNN (convolution neural network) as tools of data mining used for predict. We study Relu, Softmax, and batch normalization.

5.2 Conclusion

To promote and upgrade our food industry locally and globally, this research aimed to help the local farmers solving the biggest problem in cultivation. CNN and image processing algorithms are gaining popularity in advanced countries and helping the farmers from lengthy diseases detection processes. The model which has been proposed in this research has shown its ability ensuring the most accurate detection of the diseases from images and farmers can have complete trust on our newly proposed system also in Bangladesh. Following this path, we are hoping to see these obsolete fruits having their own corner in the fruit market beside our local seasonal fruits and the temporary solution provided with the output might help the growers in a better way and maybe in near future they will be exported in the outer world. We now working on developing an android based application for detecting the diseases so that rural people having only android phones can receive this convenience soon.

5.3 Recommendation

In our best research we use real life data. But leaf diseases and it solution change day by day. For this reason most of the time the result not so much accurate. To solve this kind of problem, we used some important component which is given better result. In future is needed we will update our system.

5.4 Implication for Further study

Any prediction is not easy work. But leaf diseases detection is most hard work. Because many leaf diseases detection given same Symptom. Basic on our output we will make a system for leaf diseases and it solution. It depends on only software. By using only data mining tools is not given proper result. In future we will try to build up a system with hardware and software to detection better result**.**

APPENDIX

6.1 Appendix A: Project Reflection

To implementation our leaf diseases prediction, we started our work from spring 2019. We try our best level for make user-friendly system. One of the most important part to build up our system to collect previous data set to predict properly. Web and Mobile apps help to build our system easily. For implement our system we used CNN as data mining tools. We also use more algorithms to develop our system. After more hard and long journey finally we able to build up our system properly.

Appendix B: Related Issues

We read lots of paper and journal for implement our system. Leaf diseases is a complex and challenging task which are related observing and processing lots number of data set. We use Adam to reduce learning errors rate. In future we will build up a mobile and web app to use our system easily.

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