FRESH AND ROTTEN FRUITS CLASSIFICATION USING VGG16 AND RESNET50 ALGORITHM

BY
Saidur Rahman Saeed

ID: 171-15-8892

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

Supervised By

Nusrat Jahan
Senior Lecturer
Department of CSE
Daffodil International University

Co-Supervised By

Ms. Zerin Nasrin Tumpa
Lecturer
Department of CSE
Daffodil International University

DAFFODIL INTERNATIONAL UNIVERSITY
DHAKA, BANGLADESH

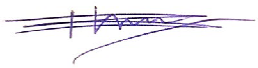
SEPTEMBER 2021

APPROVAL

This Project/internship titled "**FRESH AND ROTTEN FRUITS CLASSIFICATION USING VGG16 AND RESNET50 ALGORITHM**", submitted by **Saidur Rahman Saeed**, ID No: 171-15-8892, 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 September-09, 2021.

BOARD OF EXAMINERS

Chairman

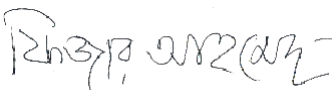


Dr. Touhid Bhuiyan
Professor and Head
Department of Computer Science and EngineeringFaculty of Science & Information Technology Daffodil International University

Internal Examiner

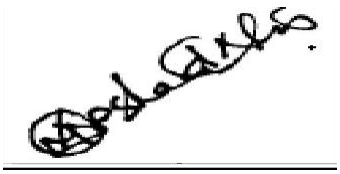
Nazmun Nessa Moon
Assistant Professor
Department of Computer Science and EngineeringFaculty of Science & Information Technology Daffodil International University

Internal Examiner



Dr. Fizar Ahmed
Assistant Professor
Department of Computer Science and EngineeringFaculty of Science & Information Technology Daffodil International University

External Examiner

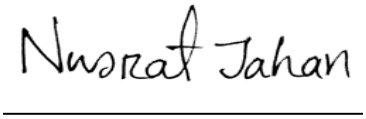


Dr. Md Arshad Ali
Associate Professor
Department of Computer Science and Engineering
Hajee Mohammad Danesh Science and Technology University

DECLARATION

We hereby declare that this thesis has been done by us under the supervision of Nusrat Jahan, Senior Lecturer, Department of CSE, and co-supervision of Ms. Zerin Nasrin Tumpa, Lecturer, and **Department of CSE** Daffodil International University. We also declare that neither this thesis nor any part of this thesis has been submitted elsewhere for the award of any degree or diploma.

Supervised by:

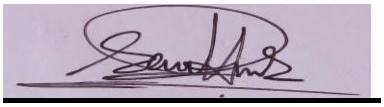


Senior Lecturer
Department of CSE
Daffodil International University

Co-Supervised by:

Lecturer
Department of CSE
Daffodil International University

Submitted by:



ID: 171-15-8892
Department of CSE
Daffodil International University

ACKNOWLEDGEMENT

First of all, we want to render our gratitude to the Almighty Allah for the enormous blessing that makes us able to complete the final thesis successfully.

We are really grateful and express our earnest indebtedness to **Nusrat Jahan**, Assistant Professor, Department of CSE Daffodil International University, Dhaka, Bangladesh. Profound Knowledge & intense interest of our supervisor in the field of "Machine Learning & Deep Learning" make our way very smooth to carry out this thesis. His remarkable patience and dedication, scholarly guidance, continual encouragement, vigorous motivation, direct and fair supervision, constructive criticism, valuable advice, great endurance during reading many inferior drafts and correcting the work to make it unique paves the way of work very smooth and ended with a great result.

We would like to express our gratitude wholeheartedly to **Prof. Dr. Touhid Bhuiyan**, Professor, and Head, Department of CSE, for his kind help to finish our thesis and also to other faculty members and the staff of CSE department of Daffodil International University.

We would like to express thankfulness to the fellow student of Daffodil International University, who took part in this discussion during the completion of this work.

We would like to express our immense thanks to the people who provided us with the required raw data to make our work possible.

Finally, we must acknowledge with due respect the constant support and passion of our parents and family member

ABSTRACT

In Bangladesh fruit production was a traditional aspect of farming. Fruit cultivation has undergone a revolution. We acquire nourishment from fruits. Lt is a vitamin and mineral supplier. Fruits are also rotting towards the end of the packaging in the consumer. So we came up with this study effort to prevent these rotting fruit. Our method is to see if a fruit is fresh or rotting in the latest developments in computer vision and profound learning. Now the entire lot is clever and relies on generation. We can observe everywhere the use of Al and gadgets. After that, a gadget was built right here. An intelligent, quick gadget that can perceive clean and rotten fruit. We utilize the CNN architecture of the red fruit and clean fruit right here to vgg16 and resnet50. The utilization of photographic data enable this gadget to sense the proportion of red and fresh fruit. With a large farm and savory factory to perceive rotten fruit this gadget may make our artwork easier. In much less time, we want our artwork to be furthermore accurate. The vgg16 architecture produced best accuracy about 99.55%. So for implementation we used vgg16 model in our work.

TABLE OF CONTENTS

CONTENTS	PAGE NO.
Approval Page	ii
Declaration	iii
Acknowledgements	iv
Abstract	v
List of Tables	ix
List of Figures	x
CHAPTER	
Chapter 1: Introduction	**1-3**
1.1 Introduction	1
1.2 Motivation	1
1.3 Rationale of the Study	2
1.4 Research Questions	2
1.5 Expected Output	2
1.6 Project Management and Finance	3
1.7 Report Layout	3
Chapter 2: Background	**4-7**
2.1 Terminologies	4
2.2 Related Work	4
2.3 Comparative Analysis and Summary	6
2.4 Scope of the Problem	7
2.5 Challenges	7

Chapter 3: Research Methodology **9-15**

3.1 Research Subject and Instrumentation 9

3.2 Data collection Procedure 9

3.3 Statistical Analysis 12

3.6 Apply Mechanism 13

3.7 Implementation Requirements 15

Chapter 4: Experimental Results and Discussion **16-20**

4.1 Experimental Setup 15

4.2 Experimental Result 16

4.3 Discussion 20

Chapter 5: Summary, Conclusion, Recommendation and Implication for Future Research **21-21**

5.1 Summary of the Research 21

5.2 Conclusion 21

5.4 Implication for Future Study 21

REFERENCES 22

APPENDIX 24

PLAGIARISM REPORT 25

LIST OF TABLE

Table	PAGE NO.
Table 3.1 Training data size	12
Table 3.2 Testing data size	12
Table 4.1 Algorithms implementation	16

LIST OF FIGURES

FIGURES	PAGE NO.
Figure 3.1: Methodology diagram	9
Figure 3.2: Data augmentation process	10
Figure 3.3: Dataset representations by piechart	11
Figure 3.4: Dataset representations	11
Figure 3.5: Basic ResNet50 architecture.	13
Figure 3.6: VGG16 architecture.	13
Figure 3.7: Model design of VGG16	14
Figure 4.3: Training vs validation accuracy of vgg16	17
Figure 4.4: Training vs validation loss of vgg16	18
Figure 4.5: Training vs validation accuracy of ResNet 50	19
Figure 4.6: Training vs validation loss of ResNet 50	19
Figure 4.7 Two models comparison	20

Chapter 1
Introduction

1.1 Introduction

Picture Classifier is a major test for the study of human reasoning and deep learning. It is perhaps the most often used progress and exam topic to address our day-to-day concerns and reality. In our own lives, we face many sorts of problems that may be dealt with and resolved efficiently via the use of human brain capacity and classification. A problem such as the realization of which natural product is appropriate or the spoiling of which food is helpful for your health or even dreadful may help us to find which disease impacted or should consume the organic product or plant. I have taken a tough time in tackling this problem, namely the acceptable organic and the spoilt organic goods. I will use human thinking and calculations to find out which organic product is novel and which is spoilt by vgg16 and resnet50 architecture. Natural items are not new at the super shop, but we receive this because of the illumination. By using my framework, everyone is aware that filtering soil items is an appeal to them to pay out and buy the new organic product in shopping malls.

1.2 Motivation

Many individuals now buy wholesale or supermarket fruits. They cannot tell if the fruit is fresh or rotting due to lack of time. Due to the fact that fruit is time consuming one by one, they never control fruits before purchasing. A lot of fruit is therefore deliberately or unwittingly rotting. These rotting fruits are hazardous and waste a lot of money for our health. We will develop an automated method to identify whether the fruit is fresh or rotting to decrease this expense and in order to address health problems. We can develop these solutions from the very start using the current advances in AI and image processing techniques. In this study work, then, this difficulty is minimized and a system created that will allow users to scan quickly and receive the results.

1.3 Rationale of the Study

Recently, in so many areas, AI has been a revolution. We can address many issues with the aid of AI. Vgg16 and resnet50 also known as image classifier can used in many types of fields to solve various problems like - find cancer cell or can detect disease in leaf. so, we find it useful to solve our problem also. We also note that the latest state-of-the-art tensorflow library improves the way vgg16 and resnet50 is used. AI is now ubiquitous and the issue can even be shown via the categorization of fresh produce. We thus opt to use AI to recognize fresh fruit and rotten fruit. We can use the latest AI and image processing breakthroughs to build these solutions from the very start. This problem is minimized and a system is built to allow users to rapidly scan and obtain the findings. In this study work.

To prevent this problem, we tried to developed an intelligence system based on deep learning technology. Our system can detect rotten and fresh fruit based on fruit condition. And it can detect disease 99.55% accurately.

1.4 Research Questions

- How will the data set be built and manufactured?
- Can the behavior of the rotten and fresh fruits be properly characterized?
- How to categorize the rotten and fresh fruits?
- How can people be helped by this work?

1.5 Expected Outcome

In order to create these solutions from the start we may make advantage of the latest AI and image processing advances. This difficulty is minimized and a method is created to enable users to scan quickly and get the results.

In order to prevent this dilemma, we have sought to establish a deep learning technological intelligence system. Our technique may detect fresh and rotten fruits based on fruit condition. 99.55% of the disease can be identified appropriately.

1.6 Project Management and Finance

For algorithm tuning in Google Collaborate I used their premium version to extend 12 hours limit to 24hours. And the cost is 10 dollar only.

1.7 Report Layout

The contents of our report will have appeared as regards:

Chapter 1 Give an overview of this study. The first analysis is a key step in this first part. We also describe what prompted us to undertake this research in this chapter. The problem description is the most essential aspect of this chapter. The challenge comprises this section of the research survey.

Chapter 2 It comprises a context analysis and provides a brief summary of the work concerned. A significant effort on deep learning, mostly predictive work is described here.

Chapter 3 Provides a short technique or procedure definition. How this section of the investigation was conducted

Chapter 4 The assessment of the findings is included. The findings of the analysis are shown in the graph.

Chapter 5 The conclusion is shown inside the study. The model efficiency is shown in this section. The comparison is also shown in this section. This section also comprises the component of the model and performance web implementation. A debate on the bounds of the work concludes in this chapter. The following job is also encoded.

Chapter 2

Background Study

2.1 Terminologies

Various investigations on the prevention and detection of various herbal illnesses have been carried out. Prediction is one of the most widely used apps for master learning and profound learning. A significant number of research have been carried out which forecast or detect different plant diseases. The research focuses on questions and uses various methods of machine learning to address the problem. This section gives an overview of the important work done by certain professionals in the subject described above.

2.2 Related Works

We shall discuss in this part the works we have already done. Then in Section II, we present the outcomes or summaries of our research on the associated work and then analyze the advantages and problems that this project will encounter.

For the identification of fruit skin flaws in the study a machine vision system was developed by Azizah et. Al. [1]. Color is the most important function utilized for categorization, with the support vector machine (SVM) employed as a method for machine learning. A sufficient number of data sets are supported by the vector machine (SVM). The exactness of the classification process is based mostly on the features developed and the characteristics used for the transfer to the machine study method. Through deep learning models, we can increase performance. These models assist classify big data sets of pictures.

The grade of defects and non-default fruits can also contributes to image processing introduced by VenkataRamiReddy et. Al. [2]. It may be used to detect flaws on mango fruit surface. First, the fruits are picked manually and are evaluated as fine and defective by the

Researchers themselves. Pre-processing is then performed on the pictures and delivered for classification to a CNN model. The precision of this model was 97.5%. The Laser Backscattering Imagery and CNN Theory approach presents a concept and theoretical framework for efficient, non-destructive and online fruit quality detection.

In their work, the authors [3] utilized a visioning machine to identify flaws in fruit skin. A machine learning technique, known as a vector machine (SVM), is utilized to classify the principal color characteristic and support. Suitable outcomes for a limited number of data sets for support Vector machines (SVMs). The exactness of the categorization using machine learning is mostly reliant on the drawn characteristics and the characteristics chosen for the machine learning method. By employing deep learning models, we can enhance performance. These models may be used to group pictures into huge databases.

A new technique is introduced by Nyarko et .al.[4] to fruit recognition is suggested in RGB-D pictures based on convex surface detection and classification. The RGB-D picture is divided by a rising area in first place on convex surfaces. A suitable descriptor will then describe each convex surface and classify it using the linked description. A novel descriptor is suggested, called the CTI (Convex temple instance) descriptor, of roughly convex surfaces. It is based on surfaces approximated by convex polyhedrons with quantified face lines, where each side of the polyhedron represents a single descriptor. The descriptor calculation is straightforward and can be done extremely efficiently. A descriptor is a standard descriptor for 3D point clouds, comparable with the SHOT descriptor. A variation that utilizes color and a variant that does not, is tested for two variant of the both CTI and SHOT descriptors. A k-neighbor classification classification is used to divide the surfaces observed into two classes: fruit and other. Compared to existing fruit recognition methods, the major benefit of the suggested expert system is its calculation efficiency, which is important for its purpose - autonomous fruit picker.

The detection was carried out of rotting or fresh apple based on the faults of the fruit skin introduced by Roy et.al.[5] the rotting section in the apple's RGB picture is seminically divided into deep learning architecture. For segmentation that produces promising results, UNet and the updated version of it are the Enhanced Unet (En-UNet). With a training and

validation accuracy of 97.46 percent and 97.54 percent respectively, UNet as a basic architecture achieved an accuracy of 95.36 percent were the suggested En-UNet model generating improved results than UNet. The best average IoU score of 0.95% achieved by En-UNet is 0.866% and the UNet score of 0.66%.

Ni et. al. [6] analyzed the blueberry fruit characteristics including compactness of the cluster, fruit ripeness and quantity of berries, a deep study segmentation was implemented in order to help the blueberry breeders. For blueberry identification at maturity, a masked R-CNN model has been developed and evaluated. The model has averaged validation and test data accuracy of 78.3 percent and 71.6 percent, with 0.5 above the union threshold being considered.

Brahimi et al.[7] used a big dataset compared to state-of-the-art technology. In this dataset there are 14828 tomato leaves suffering from nine diseases. The CNN was introduced as a learning approach, which employs images directly and prohibits handcrafted functions for training your classification. To detect the symptoms and follow the locations of the disease in the leaf we have used methods of visualization to evaluate the given deep model. The acquired findings are encouraging, achieve a precision of 99.18%, produce drastically shallow models and may be used as useful instruments in protecting farmers from tomatoes.

2.3 Comparative Analysis and Summary

I opted to go to VGG16 because,

- It works well with agricultural, nature and other classification following the investigation of some research papers and projects. It works best with what we all require for our purposes.
- CNN is best accurately trained, with an accuracy of 99.55% or higher, among other image classification algorithms.
- It is straightforward to use and many resources may be deployed for further development.

- Comparison of pictures such as fresh fruit and red fruit is also the most effective way. Face, not face and so forth.
- By utilizing CNN layers correctly and with adequate training, I may achieve good outcomes and accuracy.

2.4 Scope of the Problem

The key to our effort is to build a system that can quickly identify rotting or excellent fruit. Through our study, we have found that the Convolutional Neural Network does such a great job. At the future, in several locations including large industrial mega stores, we will be able to employ such technologies.

We shall open our work to anyone and make it easy for everybody. Magistrates may simply fulfill their responsibilities using our technology in many sections of the wholesale marketplaces of this nation, where red fruit is sold.

2.5 Challenges

The main difficulty throughout our job is the preparation of data sets for future management. For properly determining our data set or future modification, we have used strong ML and image processing technologies. In Bangladesh, there is another issue that we cannot find enough resources or jobs.

Data Collection:

Good data collection for deep learning is highly crucial. Since Deep Learning needs a large number of data from various marketplaces and from wholesale locations, we could not collect so many data. Because the fruit sellers allowed us to only sell their fruits to them. This has meant that we have chosen another way to get our data. This is why we have obtained our data from the Kaggle website of a third party. Even if we try to incorporate in our data set part of the data obtained in the field.

Model Selection:

There are numerous models for deep learning. It is a very essential duty for them to select the correct model. Actually, it is much easier to select good data and the correct model. Many sorts of models are found for picture categorization. We examined the performance of our model using the models vgg16 and resnet50 architecture. For the implementation of our model, we use a googles tensorflow library.

Chapter 3

Research Methodology

3.1 Research Subject and Instrumentation

We shall discuss in this part the methods and techniques for research. In addition, instruments will be discussed for the research project, data collecting, study subject, pre processing, statistical analysis and its application. Figure 3.1 demonstrates the suggested technique:

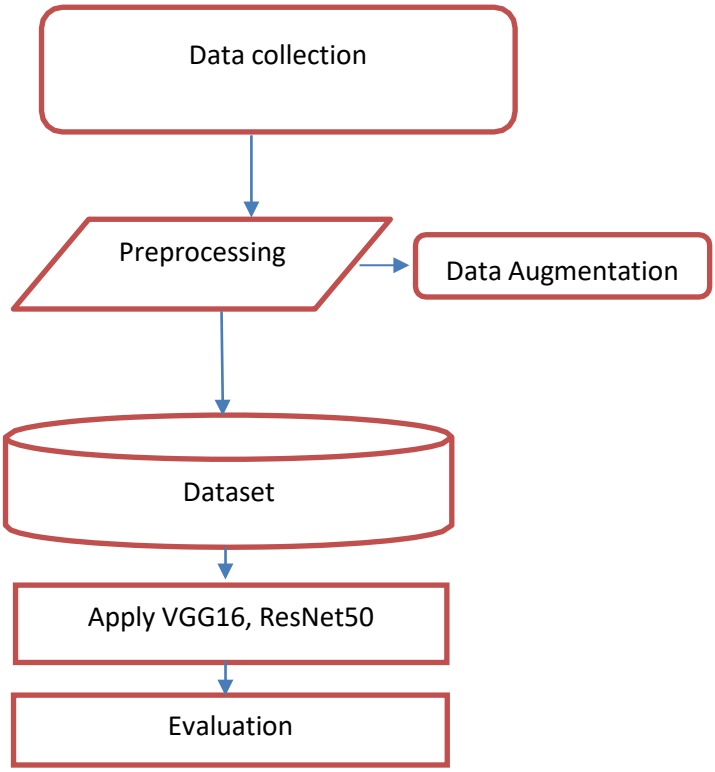


Figure 3.1: Methodology diagram

3.2 Data Collection Procedure

Good data collection for deep learning is highly crucial. Since Deep Learning needs plenty of data from multiple marketplaces and wholesale locations we could not collect that much.

Since we were not allowed to touch the fruit vendors other than selling their produce. As a consequence, we have chosen another way to collect our data. That is why we have gathered our data from the Kaggle website of a third party. Even if we were trying to place in our data collection some all data obtained from the field.

Data Pre-Processing:

Before we use the algorithm following data collection, we processed the data two ways. Enhanced data. More data. In most cases, the categorizing mistake may, according to writers, be minimized by preprocessing [10].

Data augmentation:

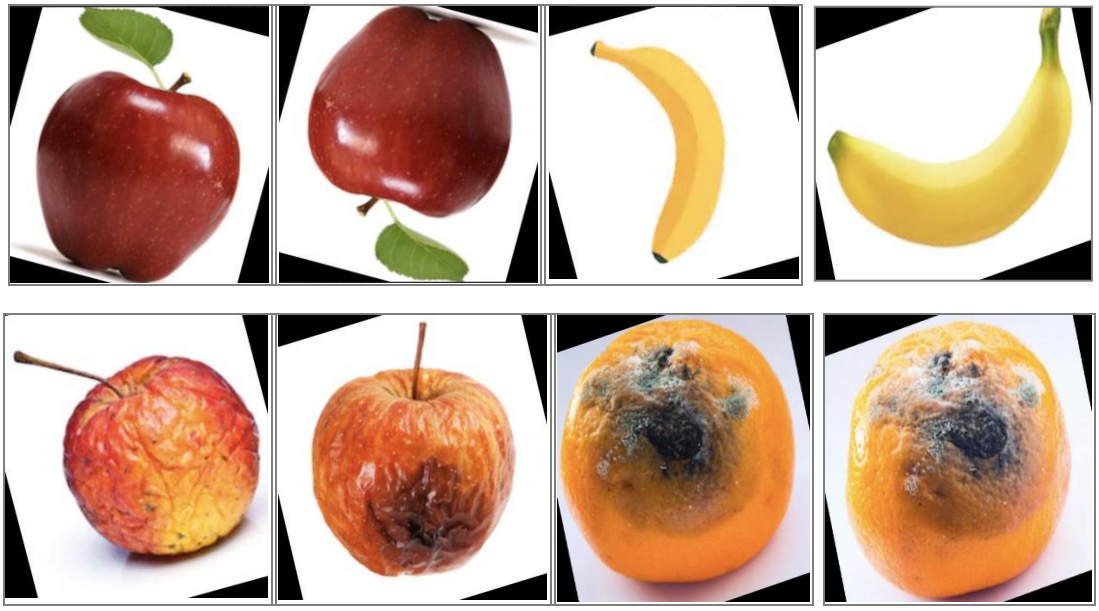


Figure 3.2: Data augmentation and background removal

The data increase procedure augmentation method are shown in Figure 3.2. We utilized zoom, shree, rotation, horizontal flip, vertical flip etc for data increase.

Dataset:

After image augmentation our total dataset was 10901 images. These image dataset contains preprocessed, augmented and background removed images. Some of raw data also included in this dataset. The graphical representation of our dataset is given bellow:

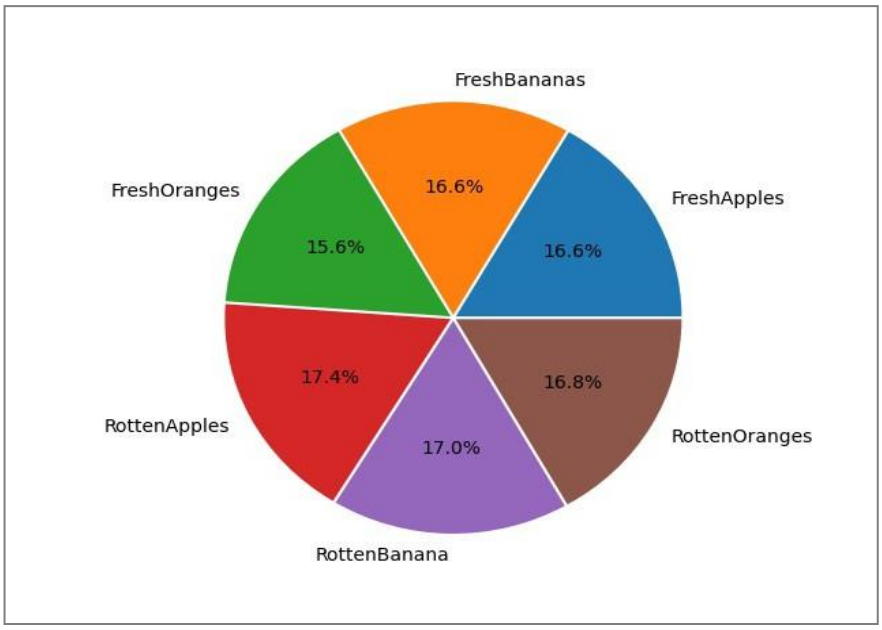
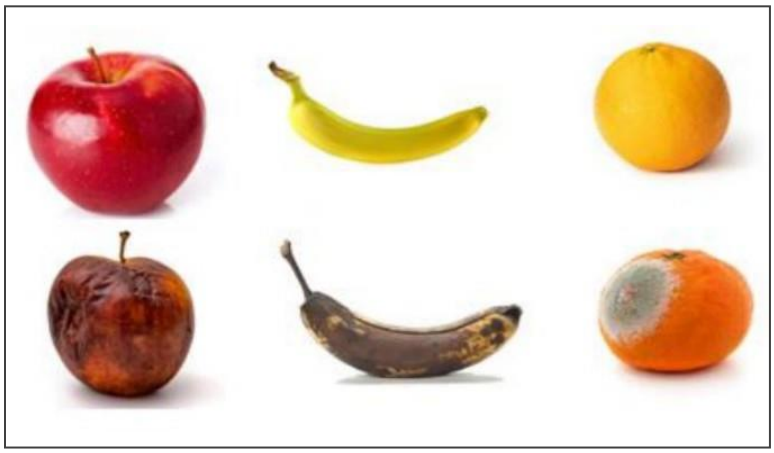


Figure 3.3: Dataset representations

We classified our total 10901 images into 6 classes. FreshApples contains 15.5% Fresh Bananas contains 16.6% FreshOranges contains 15.6% RottenApples contains 17.4% RottenBanana contains 17.0% and RottenOranges contains 16.8% of 10901 images data. We tried to divided



total images into same quantity for each classes. Figure 3.3 represents dataset representations graph.

Figure 3.4: Dataset representations

Figure 3.4 represents sample of dataset. In this figure we can see all rotten and fresh fruits among all six classes.

Fruits Name	**Amount**
Fresh Apples	1817
Fresh Bananas	1816
Fresh Oranges	1700
Rotten Apples	1900
Rotten Banana	1850
Rotten Oranges	1830

3.3 Statistical Analysis

Table 3.1 Represents the training image number of each classes.

Table 3.1 Training data size

Table 3.2 Testing data size

Table 3.2 Represents the testing images number of each classes.

3.4 Applied Mechanism

In our work we used most usable CNN architecture VGG16 and ResNet50. The basic structure of these two architecture is given bellow:

ResNet50 architecture:

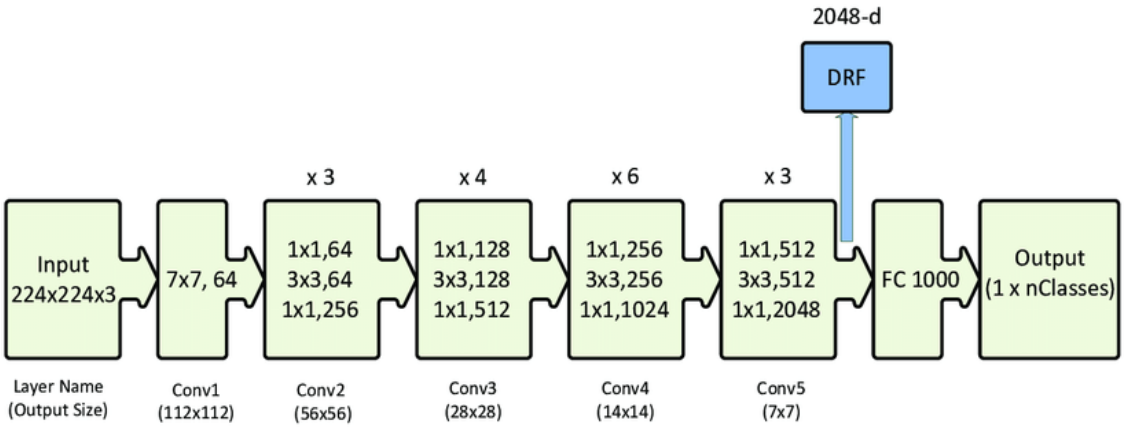


Figure 3.5: Basic ResNet50 architecture.

A residual neural network (ResNet) is a form of artificial neural system (ANN), built on

Fruits Name	**Amount**
Fresh Apples	395
Fresh Bananas	381
Fresh Oranges	388
Rotten Apples	601
Rotten Banana	503
Rotten Oranges	403

structures in the cerebral cortex known from pyramidal cells. This is done by residual

neural networks employing skip connections or shortcuts to hop over specific levels. The ResNet-50 consists of five stages and consists of an identification block. There are three different layers of each block of convolution and three levels of each bloc of identity.[12]

VGG16 architecture:

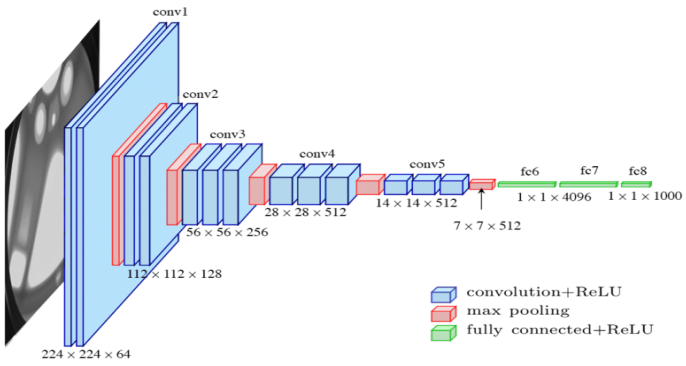


Figure 3.6: VGG16 architecture.

VGG16 is a CNN architecture for neural Networks that was used in the 2014 ILSVR(Imagenet) competition (CNN). It had previously been considered one of the greatest models of architecture. The most distinguishing characteristic of VGG16 is that they focused on 3x3 step 1 filter layers and always used 2x2-step maxpool and padding filters rather than having a large number of hyper parameters. This mix of convolution and maximum pool layers is consistent throughout the full architecture. Finally, there are two FCs and an output softmax. The layers are fully connected. The weight of the 16th layer of VGG16 is 16.In our dataset VGG16 generates highest accuracy about 99.55%. The basic model implementation of vgg16 is given bellow. Figure 3.6 is basic architecture of vgg16.

Layer (type)	Output Shape	Param #
input_3 (InputLayer)	[(None, 224, 224, 3)]	0
block1_conv1 (Conv2D)	(None, 224, 224, 64)	1792
block1_conv2 (Conv2D)	(None, 224, 224, 64)	36928
block1_pool (MaxPooling2D)	(None, 112, 112, 64)	0
block2_conv1 (Conv2D)	(None, 112, 112, 128)	73856
block2_conv2 (Conv2D)	(None, 112, 112, 128)	147584
block2_pool (MaxPooling2D)	(None, 56, 56, 128)	0
block3_conv1 (Conv2D)	(None, 56, 56, 256)	295168
block3_conv2 (Conv2D)	(None, 56, 56, 256)	590080
block3_conv3 (Conv2D)	(None, 56, 56, 256)	590080
block3_pool (MaxPooling2D)	(None, 28, 28, 256)	0
block4_conv1 (Conv2D)	(None, 28, 28, 512)	1180160
block4_conv2 (Conv2D)	(None, 28, 28, 512)	2359808
block4_conv3 (Conv2D)	(None, 28, 28, 512)	2359808
block4_pool (MaxPooling2D)	(None, 14, 14, 512)	0
block5_conv1 (Conv2D)	(None, 14, 14, 512)	2359808
block5_conv2 (Conv2D)	(None, 14, 14, 512)	2359808
block5_conv3 (Conv2D)	(None, 14, 14, 512)	2359808
block5_pool (MaxPooling2D)	(None, 7, 7, 512)	0
flatten_2 (Flatten)	(None, 25088)	0
dense_2 (Dense)	(None, 1)	25089

Figure 3.7: Model design of VGG16.

Figure 3.7 represents the total structure of vgg16.

3.5 Implementation Requirements

For project implementation we used different machine learning library all of the version is given bellow.

Python:

It is version of Python 3.8. It is a language of high standard programming. Most research uses it to carry out its research. It is highly suggested for AI-based work programming languages and is very popular with the programmer of the new generation since it is easy to learn.

Google CoLab:

Google CoLab may utilize the Python programming language open source distribution free of charge. We may work here online, like with Jupiter Notebook, but it provides us with free online virtual GPU access. Here is the major benefit of this Google CoLab.

Hardware/Software Requirements:

1. Operating System (Windows 10 preferable)
2. A Web Browser
3. Hard Disk (minimum 4 GB)
4. Ram(more than 4 GB)

Chapter 4

Experimental Results and Discussion

4.1 Experimental Setup

The main focus of this chapter is on empirical evidence and descriptive study. When we evaluate it, we think first about what the findings are? The Implications section should be designed such that the findings are communicated without being aware or examined. The section on research papers includes suggestions. The findings and the test will be documented in this chapter.

4.2 Experimental Result and Analysis

As is common, an experiment consists of the systematic manipulation and effect of one or more independent variables on specific dependent variables[11]. A machine learning experiment therefore takes a lot of work than just one training course under diverse settings.

Table 4.1 Algorithms implementation

CNN structure	Image size	Epochs	Parameter usages	Highest Accuracy
VGG16	224*224	15	activation = 'softmax' loss ='categorical_crossentropy'	99.55%
ResNet50	224*224	15	activation = 'softmax' loss ='categorical_crossentropy'	78.39%

VGG16

VGG16 has been used in 2014 as CNN architecture to win the ILSVR (Imagenet) competition. It's considered to be one of the greatest vision model architectures ever. In addition to its huge numbers of hyperparameters and always having the same 2x2-string two-filter padding layer, VGG16 is different with an emphasis on 3x3 filter convolution layers with Step 1. This combination of convolution and Max Pool Layers follows the whole design continuously.

Finally, the exit softmax includes 2 FC (fully connected layers). The weight of the 16 in VGG16 is 16 layers. [9]

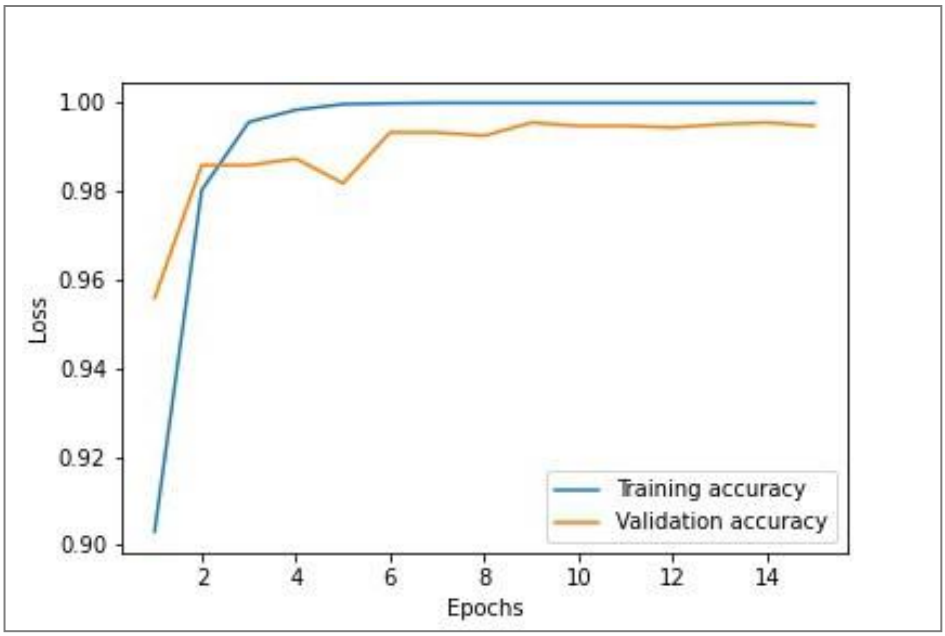


Figure 4.1: Training vs validation accuracy of vgg16

In Figure 4.1 you can see the precise training versus validation of the first algorithms. Green line shows training accuracy, whereas the red line displays validation accuracy. We have built our vgg16 across 15 epochs. For this model when periods gradually increase the accuracy of training and validation. Training as well as validation are extremely smooth. And between two lines there is far less difference. This incidence shows our dataset's good learning rate. The maximum training accuracy of this model and validation accuracy of our three architectures is 99.55 percent, which is the best accuracy.

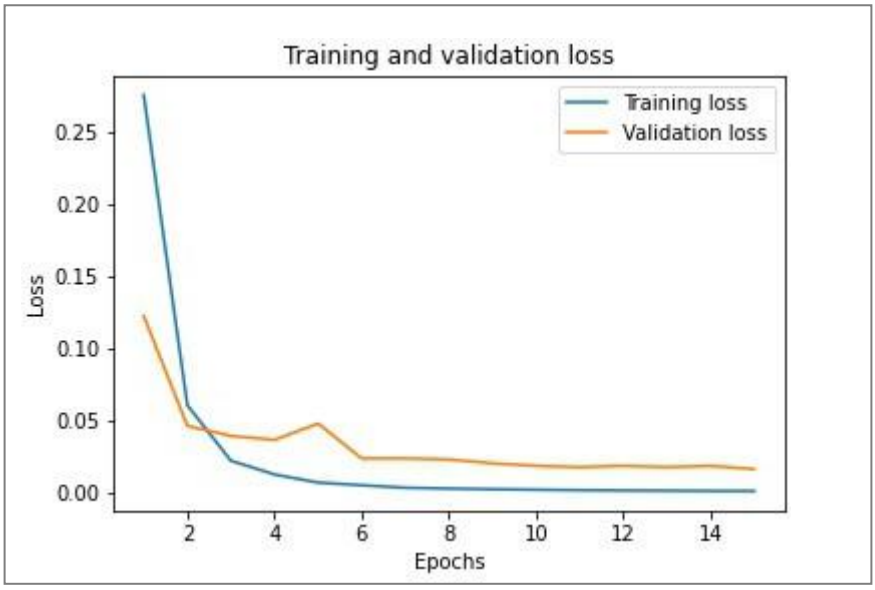


Figure 4.2: Training vs validation loss of vgg16

One of the most often used measurement combinations is a training loss against validation loss over time. The training loss demonstrates that the model matches the training data well, but the validation loss shows how well the model fits new data. Figure 4.2 shows the loss of vgg16 training versus validation. For both training loss and loss of validation, vgg16 generated very smooth lines. And when epochs are growing validation loss and training loss reducing progressively. This instance demonstrates extremely good learning rate and no overfitting of vgg16 model.

ResNet50

ResNet-50 is a 50-layer deep neural network. In more than one millions of photos from the ImageNet database, you can load an advanced version of the network. The network can group pictures into 1000 types of objects, such as keys, mouse, pencils and numerous animals.[10]

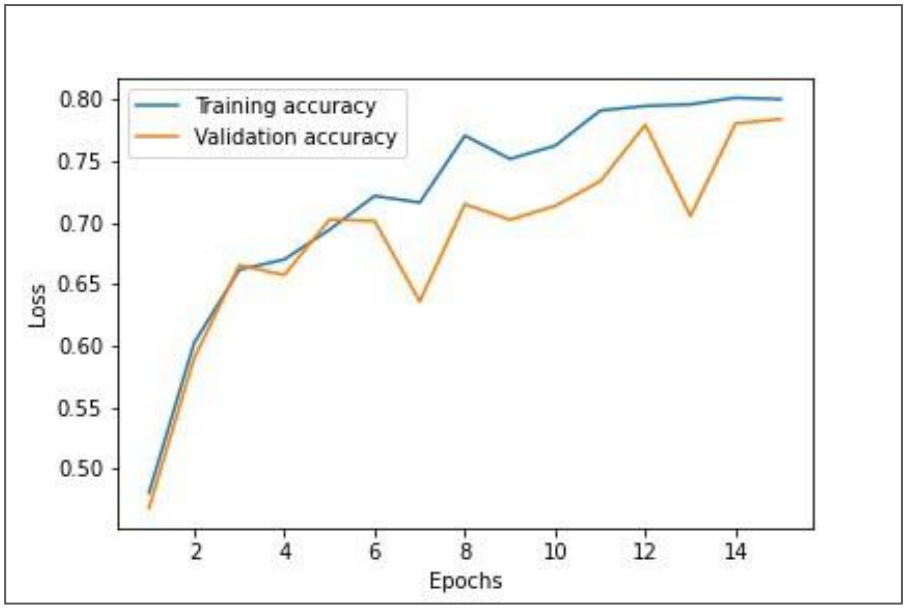


Figure 4.3: Training vs validation accuracy of ResNet 50

Figure 4.3 shows training versus resnet50 architecture validation accuracy. For this model, the accuracy of the training increases at times, but it created zigzag lines for validation accuracy. This implies that this model doesn't match our dataset. The resnet50 is around 78.39 percent highest in accuracy. That's lower than two other models.

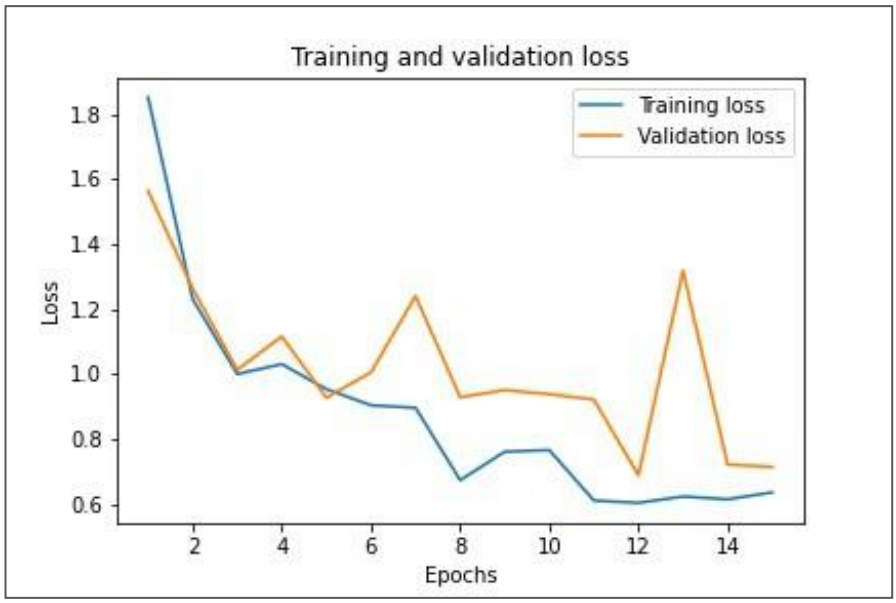


Figure 4.4: Training vs validation loss of ResNet 50

Figure 4.4 shows the ResNet50 architecture training against validation loss. Instead of two models, Resnet50 does pretty badly. The loss comparison of resnet50 training losses progressively decreases while the epochs increase but vey zigzag line is created for validation loss, that indicates a very high loss for certain epochs and a very low loss for certain epochs.

4.3 Discussion

In this section we will graphically compare our used three architectures in terms of accuracy to find which architecture produced best accuracy.

The comparison of three based on accuracy is presented in Figure 4.5. Green color stands for resnet50 precision. Red is the accuracy of vgg16. With this chart, we can observe that 2 architectures have been given the most precision by vgg16. In other two designs, the rate of precision is highly steady. And 99.55 percent is the greatest precision of vgg16.

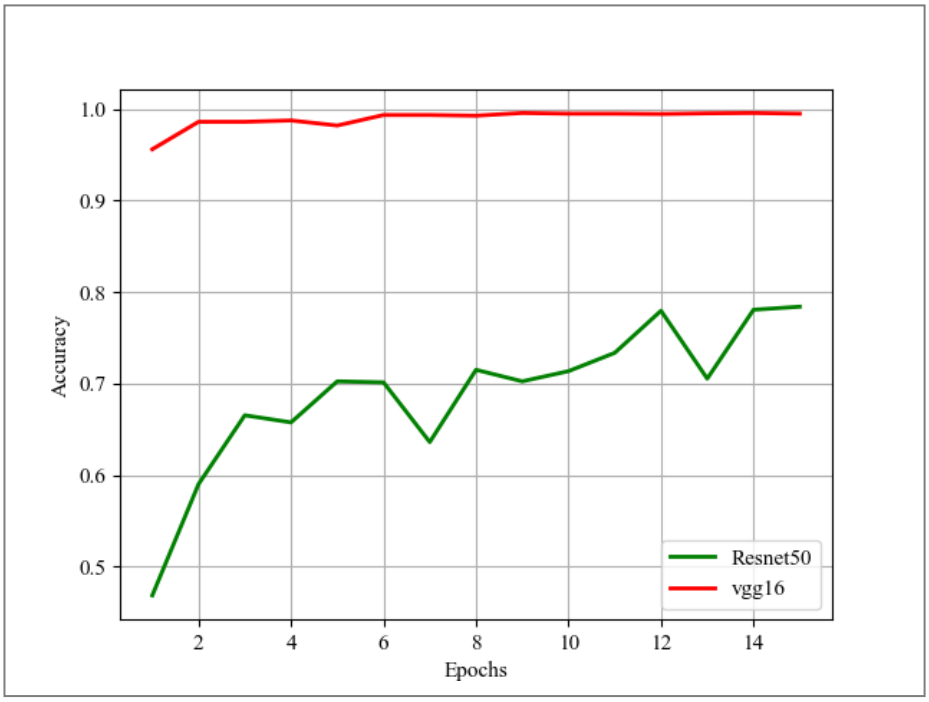


Figure 4.5 Two models comparison

Chapter 5

Summary, Conclusion, Recommendation and Implication for Future Research

5.1 Summary of the Study

The primary objective of our research is to discover the difference from a given picture between fresh and rotting fruit. In our case, we saw CNN extremely precisely classifying pictures. We initially gathered data from several locations for our investigation. We then preprocess and then divide the training and testing into our work. We have our want outcomes later on.

5.2 Conclusion

In agriculture it is necessary to classify fresh and rotting fruits. In our study, a CNN-based vgg16 model was introduced which focuses on fresh and reddish fruits categorization. In this study are questioned the impacts of the different hyper-parameters - such as batch size, number of epochs, optimizer and learning rate. The findings showed that fresh and rotting fruit can be classified with greater precision and firmness by the suggested VGG16 model. The suggested VGG16 model may therefore automate the human brains process with the assistance of the proposed neural network model in identifying fresh and rotten fruits and reducing human error in the triage of fresh and red fruits. For the suggested vgg16 model, 99.55% accuracy was attained.

5.3 Implication for Future Study

The instructions for the further production of the work are given below:

- Since a huge quantity of data is required by CNN, I will add more data to increase the efficiency of this model.
- more classes will be used with greater precision
- In future we will produce a web app & android

REFERENCE

[1] Azizah, L.M.R., Umayah, S.F., Riyadi, S., Damarjati, C., Utama, N.A. (2017). Deep learning implementation using convolutional neural network in mangosteen surface defect detection. In 2017 7th IEEE International Conference on Control System, Computing and Engineering (ICCSCE), pp. 242-246. https://doi.org/10.1109/iccsce.2017.8284412

[2] VenkataRamiReddy, C., Kishore, K.K., Bhattacharyya, D., Kim, T.H. (2014). Multi-feature fusion based facial expression classification using DLBP and DCT. International Journal of Software Engineering and Its Applications, 8(9): 55-68. https://doi.org/10.14257/ijseia.2014.8.9.05

[3] Wang, L., Li, A., Tian, X. (2013). Detection of fruit skin defects using machine vision system. In 2013 Sixth International Conference on Business Intelligence and Financial Engineering, pp. 44-48. https://doi.org/10.1109/bife.2013.11

[4] Emmanuel Karlo Nyarko, Ivan Vidović, Kristijan Radočaj, Robert Cupec, A nearest neighbor approach for fruit recognition in RGB-D images based on detection of convex surfaces, Expert Systems with Applications, Volume 114, 2018, Pages 454-466, ISSN 0957-4174, https://doi.org/10.1016/j.eswa.2018.07.048.

[5] Roy, K., Chaudhuri, S.S. & Pramanik, S. Deep learning based real-time Industrial framework for rotten and fresh fruit detection using semantic segmentation. Microsyst Technol 27, 3365–3375 (2021). https://doi.org/10.1007/s00542-020-05123-x

[6] Ni X, Li C, Jiang H (2020) Blueberry harvest ability trait extraction from 2D images and 3D point clouds based on deep learning and photogrammetric reconstruction. In 2020 ASABE Annual International Virtual Meeting (p. 1). American Society of Agricultural and Biological Engineers.

[7] Brahimi, M., Boukhalfa, K. & Moussaoui Deep learning for tomato disease: classifcation and symptoms visualization. Appl. Artif. Intell. 31, 299–315 (2017).

[8] M. Mehedi Hasan, M. Omar Faruk, B. Biswas Biki, M. Riajuliislam, K. Alam and S. Farjana Shetu, "Prediction of Pneumonia Disease of Newborn Baby Based on Statistical Analysis of Maternal Condition Using Machine Learning Approach," 2021 11th International Conference on Cloud Computing, Data Science & Engineering (Confluence), 2021, pp. 919-924, doi: 10.1109/Confluence51648.2021.9377169.

[9] H. Qassim, A. Verma and D. Feinzimer, "Compressed residual-VGG16 CNN model for big data places image recognition," 2018 IEEE 8th Annual Computing and Communication Workshop and Conference (CCWC), 2018, pp. 169-175, doi: 10.1109/CCWC.2018.8301729.

[10] E. Rezende, G. Ruppert, T. Carvalho, F. Ramos and P. de Geus, "Malicious Software Classification Using Transfer Learning of ResNet-50 Deep Neural Network," 2017 16th IEEE International Conference on Machine Learning and Applications (ICMLA), 2017, pp. 1011-1014, doi: 10.1109/ICMLA.2017.00-19.

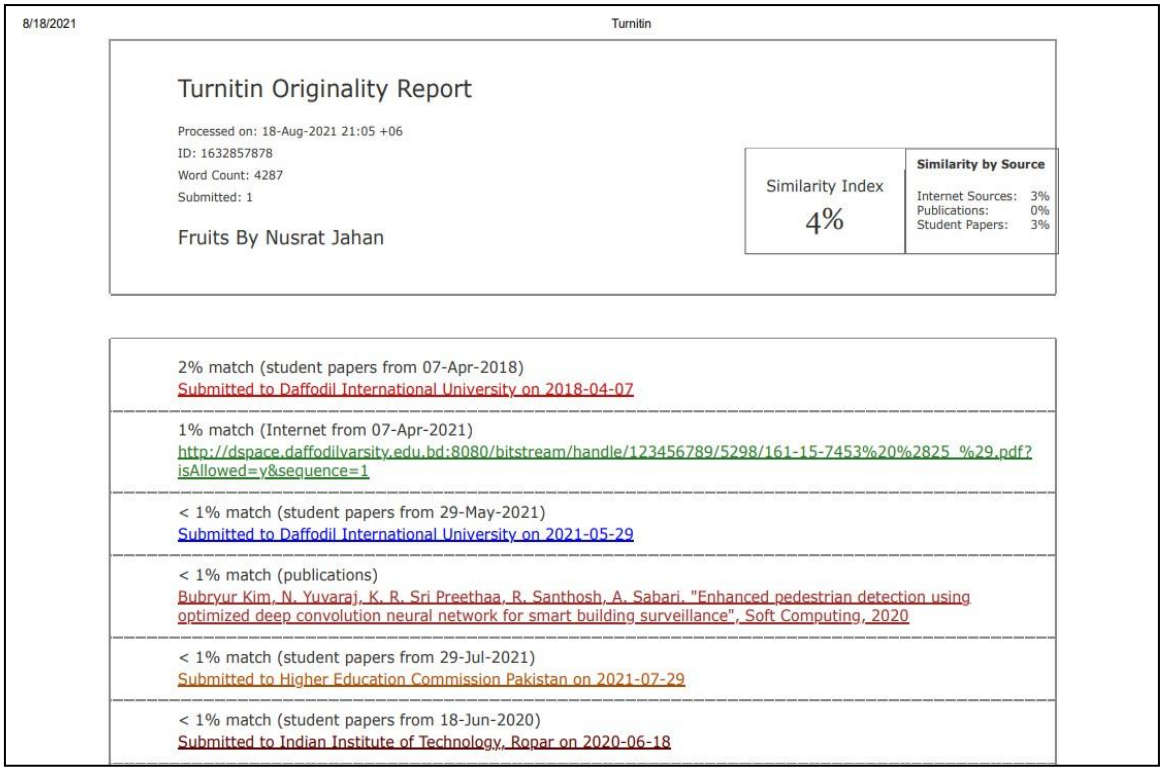
[11] Mithu M.A., Momo S.I., Hasan M.M., Rahman K.M., Sattar A. (2022) Pumpkin Leaf Disease Detection: Convenience of CNN Over Traditional Machine Learning in Terms of Image Classification. In: Somani A.K., Mundra A., Doss R., Bhattacharya S. (eds) Smart Systems: Innovations in Computing. Smart Innovation, Systems and Technologies, vol 235. Springer, Singapore. https://doi.org/10.1007/978-981-16-2877-1_32

[12] Theckedath, D., Sedamkar, R.R. Detecting Affect States Using VGG16, ResNet50 and SE-ResNet50 Networks. SN COMPUT. SCI. 1, 79 (2020). https://doi.org/10.1007/s42979-020-0114-9

APPENDIX

One was to describe the analytical methods we encountered with too many difficulties in our study. Furthermore, there was scarcely nothing in this area prior. Our supervisor has given us a lot of assistance. The data gathering was another problem, which was an enormous effort for us. We began gathering information manually. In contrast, there is another issue in the categories of different postings. After a long period of hard work we could achieve this.

PLAGIARISM REPORT



8/18/2021 Turnitin

Turnitin Originality Report

Processed on: 18-Aug-2021 21:05 +06
ID: 1632857878
Word Count: 4287
Submitted: 1

Fruits By Nusrat Jahan

Similarity Index	Similarity by Source
4%	Internet Sources: 3% Publications: 0% Student Papers: 3%

2% match (student papers from 07-Apr-2018)
Submitted to Daffodil International University on 2018-04-07

1% match (Internet from 07-Apr-2021)
http://dspace.daffodilvarsity.edu.bd:8080/bitstream/handle/123456789/5298/161-15-7453%20%2825_%29.pdf?isAllowed=y&sequence=1

< 1% match (student papers from 29-May-2021)
Submitted to Daffodil International University on 2021-05-29

< 1% match (publications)
Bubryur Kim, N. Yuvaraj, K. R. Sri Preethaa, R. Santhosh, A. Sabari. "Enhanced pedestrian detection using optimized deep convolution neural network for smart building surveillance", Soft Computing, 2020

< 1% match (student papers from 29-Jul-2021)
Submitted to Higher Education Commission Pakistan on 2021-07-29

< 1% match (student papers from 18-Jun-2020)
Submitted to Indian Institute of Technology, Ropar on 2020-06-18