# AN INTELLIGENT SYSTEM FOR FRESH BITTER GOURD DETECTION USING CNN

**BY**

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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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**DAFFODIL INTERNATIONAL UNIVERSITY**

**DHAKA, BANGLADESH**

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## APPROVAL

This Project/internship titled **"AN INTELLIGENT SYSTEM FOR FRESH BITTER GOURD DETECTION USING CNN"** submitted by **Zarin Tasnim**, ID No: **131-15-2400** 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 **9 September,2021**.

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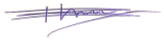

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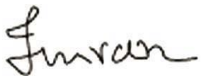

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# DECLARATION

I hereby declare that, this project has been done by me under the supervision of **Ms. Nazmun Nessa Moon, Assistant Professor, Department of CSE** Daffodil International University. I 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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Finally, I must acknowledge with due respect the constant support and patients of my parents.

# ABSTRACT

Agriculture development is not only a normal development sector but also a vital sector all over the world. Convolution Neural Network is one of the most advanced algorithms in Machine Learning. In my study, I have built up a strong relationship between agriculture and Image processing system, bitter gourd freshness detection and automation system using multi-layer automation process. I have used 5*3 training layers for the dataset and relevant output process. In this study, I show 4 types of output like Fresh, Moderate, Wrong and rotten bitter gourd. After analyzing data and method implementation I get 91.56% model accuracy which is better than the other image processing algorithm. In the modern era agriculture development is the highly contribute field of food security. This study will allow farmers to choose the proper crop in the right market condition, which will play a key role in strengthening the economy of the country. Technology on the other hand is a huge blessing in people's lives. In today's world, the introduction of information technology in agriculture has led to great improvements in this field.

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# CHAPTER 1
# INTRODUCTION

## 1.1 Introduction

This era is full of innovative ideas which are developed our life more comfortably. Food and Food related all components are more important for human life. So, food development and food security are very essential for us. In my study, I am working with food quality measurements and their proper distribution. Hereby I am working with a Bitter gourd freshness detection system using CNN. This algorithm is more dynamic than the other image processing algorithm. Bitter gourd is a very useful vegetable for us because of its food quality and nutrition. This vegetable is used for medicine too.

## 1.2 Motivation

In this thesis, I am trying to look at the market balance, food security, ICT develop. These are given below:

- Market Prices balance about fresh and rotten vegetable
- Automated vegetable detection system
- Customer shopping support
- A collaboration between Agricultural and ICT
- Unsocial and greedy vegetables sellers or businessman verification

## 1.3 Rationale of the Study

In my study, I am focusing on the image dataset which is processing by me for the image accuracy find out. This data set helps me to find out fresh and rotten bitter gourd detection. I have used different types of algorithms for better accuracy. After all types of data analysis, I deceased the main major factor and decision about freshness.

## 1.4 Expected Output

The main contribution of the research which is summarize as the following:

- As I have studied about image processing method to find out fresh Bitter gourd. I identify it using a deep learning algorithm and data mining.
- In this research, I am working with the Process Image and object detection algorithm. This system is implemented with Machine learning and Image processing.
- The proposed hybrid methodology, to identify vegetable freshness which is the most significant for this study. CNN, python coding, algorithm, Heat map are the major function in this study which are create an accuracy.
- In this research, I am describing the combination of the Agriculture sector and Machine learning. I am focusing on the automation detection which is very vital to our upcoming world and society.

## 1.5 Report Layout

**Chapter 1** In this section I have written about the inspiration of my research, final expected outcome.

**Chapter 2** Here I have presented about the foundation of our work and examine about others related works, similar investigations, the extent of the issues and difficulties in this section.

**Chapter 3** In this section I talked about the research subject and instrument used, data storing process, analysis of certain statistics and the execution.

**Chapter 4** Here, final result, descriptive analysis and summery of the research are given.

**Chapter 5** This chapter explains about summary of prediction, conclusion and what the future work could be.

# CHAPTER 2
# BACKGROUND

## 2.1 Introduction

In this technological world agriculture development is very necessary due to food security. So many scholars are working with technological and agriculture combinations as well. Machine learning and deep learning are the most vital algorithm to develop our computer vision section. This computer vision section is most impactful if we apply it in agriculture. We can turn into smart agriculture which can be productive for agriculture. For agriculture development, many researchers work with ICT, Computer vision, Data Science, Machine learning as well as Agri research.

## 2.2 Related Works

K. Goyal et al in their research about the food adulteration system based on deep learning and machine learning algorithm. Most of the study they use analyze based research procedures. They found out the main adulation for some fruits and vegetables and they also comparison many datasets for the better accuracy [1]. I. Salehin et al in their research about image processing base agricultural crop detection system. They use Scale-Invariant Feature Transform (SIFT) algorithm and also compare other object detection methods. After the detection process, they try to solve the problem-solution in their studies. It's a very important procedure for an object detection system [2]. D. G. Chandra and D. B. Malaya describe their research article about rural agriculture development using ICT. They focused on e-agriculture and communication systems development for the proper food and agriculture development. They work with 28 States and 7 Union Territories 626 District 6, 38,596 villages and 70% of the Indian population dataset [3]. S.H. Abed et al in their research paper about deep learning framework in robot vision for automated bean leaves diseases detection. This an automatic process about the detection system. They use some classification stage, most valuable five diverse deep learning models are (e.g., Densenet121, ResNet34, ResNet50, VGG-16, and VGG-19) is assessed accurately to identify the healthiness of bean leaves [4]. S. Jana et al in their research paper about Rotten

Fruits and Vegetable detection using Deep Learning. They use experimentation is done on a dataset, which contains 13,599 images of fresh and rotten fruits. CNN architecture is built from scratch to perform the task of classification between fresh and rotten fruits and vegetables. This very advanced technique about the detection system [5].

## 2.3 Research Summary

I have proposed hybrid methodology; algorithm strength identification freshness is the most significant for this study. Image processing classifier, python coding, Machine algorithm, and CNN are the major function in this study which creates an accuracy [6]. I am describing the combination of the Agriculture sector and machine learning. Technological device use in agriculture is very important for social and economic development.

## 2.4 Challenges

My research will have some challenges:

- Collecting a lot amount of Image data.
- After collecting and process the all dataset.
- Image Data error rate removing.
- Benchmark and outstanding detection process buildup.

# CHAPTER 3
# RESEARCH METHODOLOGY

## 3.1 Introduction

This chapter presents the methodology that was used in the study of the detection of Bitter Gourd freshness. It begins with Research Subject and Instrumentation, Data Collection Procedure, Statistical Analysis, and Implementation Requirements.

## 3.2 Research Subject and Instrumentation

Research instruments were used and played a key role in guiding the researcher into choosing a combination of qualitative and quantitative research methods. The questionnaire is a critical stage in the survey research process, the questionnaire must be relevant and accurate in trying to capture the essence of the research objective. To achieve these ends, a research will be required to make several decisions:

- Which data should be collected?
- How should each question be phrased?
- In what sequence should the questions be arranged?
- How to ensure that the collected data are okay?
- Does the questionnaire need to be revised?

## 3.3 Data Collection Procedure

Data is the core of each research and analysis [7]. Data collection always allows us to gather the information needed for any kind of analysis. Depending on the type of research data, document review data, Observation data, Raw Image data, testing data or a combination of different methods data. To collect my data, I use online data bank, Field data.

- **Questionnaire**

Data collection based on questionnaires is a way that consists of a series of questions and participants provide feedback based on these questions.

**Steps required to design Questionnaire**

1) Defined the objectives of the study
2) Define the target audience, methods and ways to reach them
3) Question Design
4) Question Testing
5) Questionnaire Administration
6) Results Interpretation

## 3.3.1 Data Preprocessing & Organizing

Data pre-processing refers to the pre-phase of processing the dataset. Generally, raw data sets are not able to perform operations and generate the expected outcomes. As a result, data Pre-Processing is required and it is considered to be one of the most important parts of research.


Figure 3.1: Raw Image Ratio

The questionnaire contained four independent pieces of information to be analyzed through machine learning. I have some Image data in my dataset. For the image processing and detection system, I use two types of datasets, Figure 3.1.

1) Train data= 740

2) Test data=300

After analysis and better accuracy, I also use a cross-check 100 amount image data set.

## 3.4 Model Analysis

I have used Convolution neural network system for detection and calculate the accuracy for my model. Figure 3.2, shows the basic idea that how the algorithm works smoothly. For the first step, I need the dataset. It will select the best feature for segmentation using the Attribute Selection Measures.

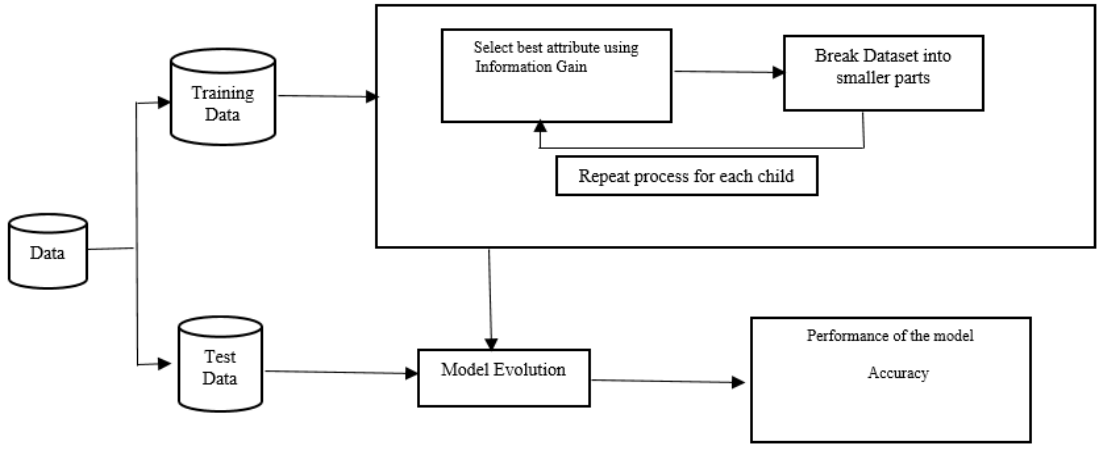


Figure 3.2: Working Process of the Model

Then it will make that feature, the decision node. The next step is to break down the data set and divide it into 2 subsets, one is the training dataset and the other one is the test dataset. Now the tree-building process will start. This process will continue until one of the conditions will match. The next step is to test the data with the pre-training dataset with the evaluated model. At last, the model will give the accuracy of the entire work.

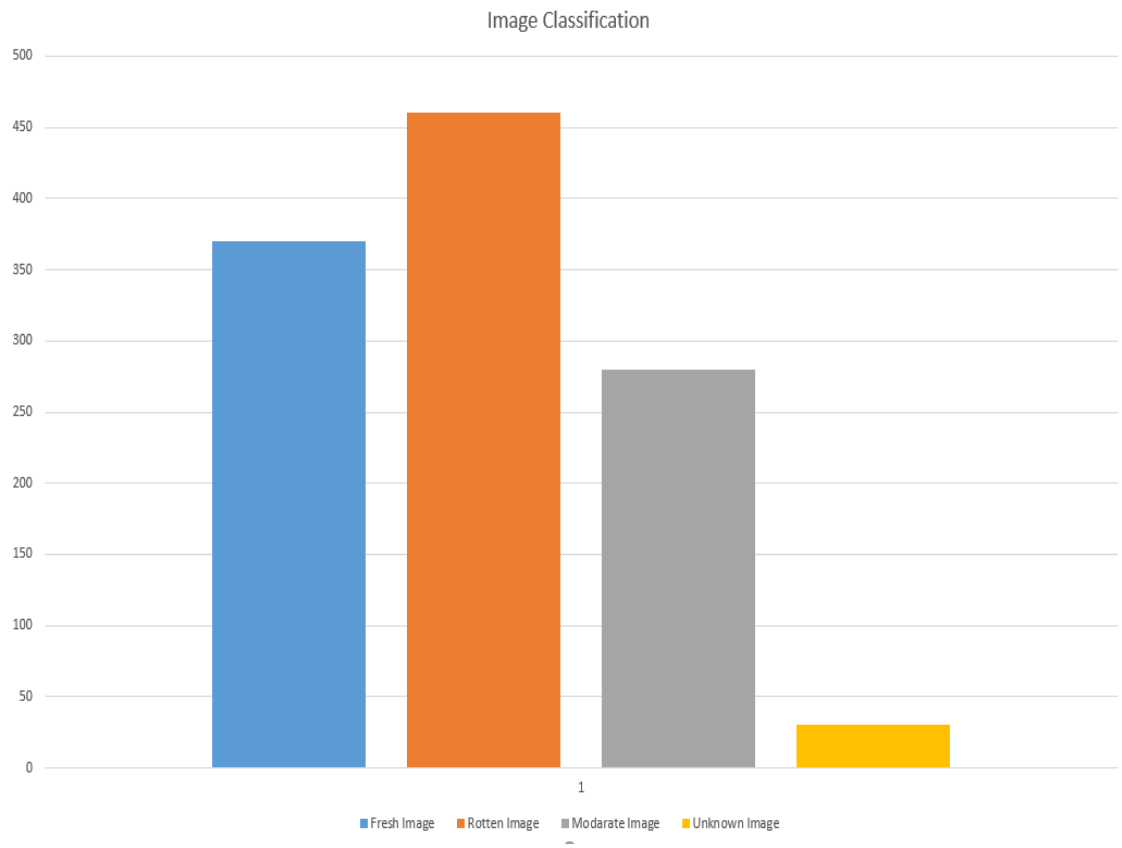


Figure 3.3: Image Classification Data Ratio

## 3.5 Data Category Analysis and Data Criteria section

In this study, Image processing is the main procedure so that I am using different classification datasets. Bitter gourd different angle data set I process for the image classification and freshness detection. There are four types of data classification like a fresh image set, rotten image, moderate and some unknown image classifier.

For better detection, I am using this rotten dataset. I collect this data from the farm, google, Kaggle data bank. After collecting this image, process all data and remove all noises and ready for analysis.

## 3.6 Statistical Analysis

For the statistical analysis i have used Statistical Package for the Social Sciences SPSS () and google colab for data entry and analysis. Pearson's correlation technique tool also used to establish the relationships among the variables.

## 3.7 Implementation Requirements

- **Algorithm**

This section discusses the rapid structure and development of its algorithm. The analysis process will start with a single frame and multi-frame. Using OpenCV and CNN, this model trains its intelligent system through training datasets.According to I have proposed model and methodology, I have divided the image matching and expression identification into some major parts. Using CNN method to identify the single image freshness is one of them [9]. When I get images from the real-time video, I have used a face detection algorithm and also train by this image with a dataset. So that i get the best output and accuracy from a single image processing system. In the Convolution approach, I see the shift-invariant artificial neural networks due to the shared-weights architecture for different types of characteristics [10]. It also contains some hidden layers in image matching with mathematical calculations.

Here, j is the output node, data point is represented as n, d is called the target vale in here, and y is the value produced by the perceptron.

$$e_j(n) = d_j(n) - y_j(n) \quad (1)$$

And, another side I can write minimize the error in the entire output:

$$\varepsilon(n) = \frac{1}{2}\sum_j^n e^2\,(n) \quad (2)$$

It is more difficult to analyze the hidden node (layer) for the weight change, but I have shown the relevant formula:

$$-\frac{\partial \varepsilon(n)}{\partial v_j(n)} = \emptyset(v_j(n)) \sum_k^n -\frac{\partial \varepsilon(n)}{\partial v_k(n)} w_{kj}(n) \quad (3)$$

Derivative of the activation function is ∅ and local field Vj, Wk is weight. Starting from inputs, this model has three main stages, including convolution and max-pulling layer, a flat layer, fully connected two layers, and a softmax layer for the output shown in figure 3.4.

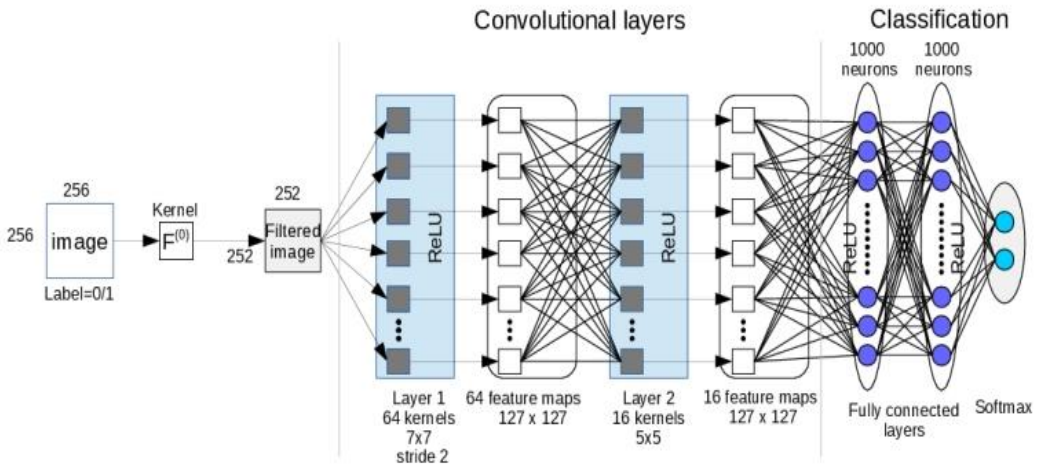


Figure 3.4: Convolution three major stages.

- **Hardware and Software**
  - **Python 3.7:-** Python 3.7 is a Python version. It is a high-level programming language. Most of the researchers use it to do their research.
  - **Google Colab: -** Google Collab is a free to use open-source distributor of Python programming language.
  - **Operating System: -** Windows (7, 8.1 or 10).
  - **Browser: -** Google Chrome.
  - **RAM & ROM:-** Hard Disk (Minimum 4 GB), ROM(Minimum 4 GB)

# CHAPTER 4
# EXPERIMENTAL RESULT AND DISCUSSIONS

## 4.1 Introduction

In this section I discussed about the results and data analysis. The result and data analysis is based on the research objectives. In order to show the output results and data analysis report, tables and graphs are used.

## 4.2 Experimental Results

There are some necessary has taken for the final result generator in Figure 4.1. First, I train my image dataset with several algorithms. After train the images I get some feedback that the rotten and fresh information as well.

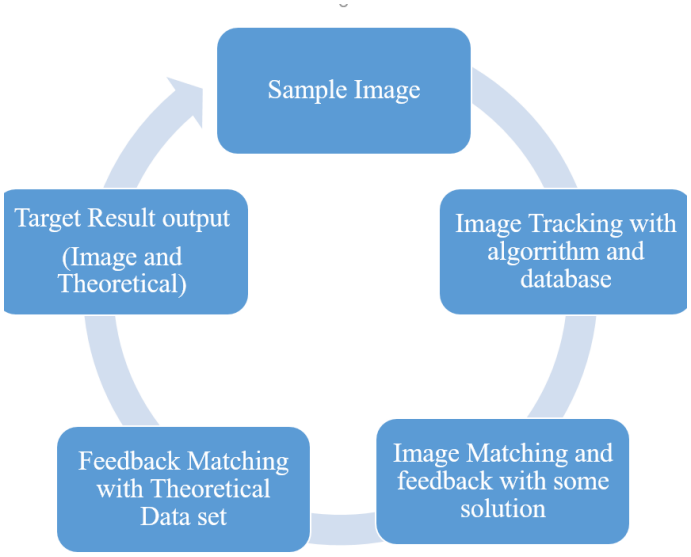


Figure 4.1: Result Analysis Full Life Cycle

Then I get my final output and accuracy about the model train and matching rate.

### 4.2.1 Fresh Image Dataset Train

Figure 4.2, implies that the fresh image dataset sample. This type of 700 images I train with python programming. I select some learn base train-up models. This model is creating some convolution layer for intelligence system development. I use a 5*3 image detection layer for the data detection system.

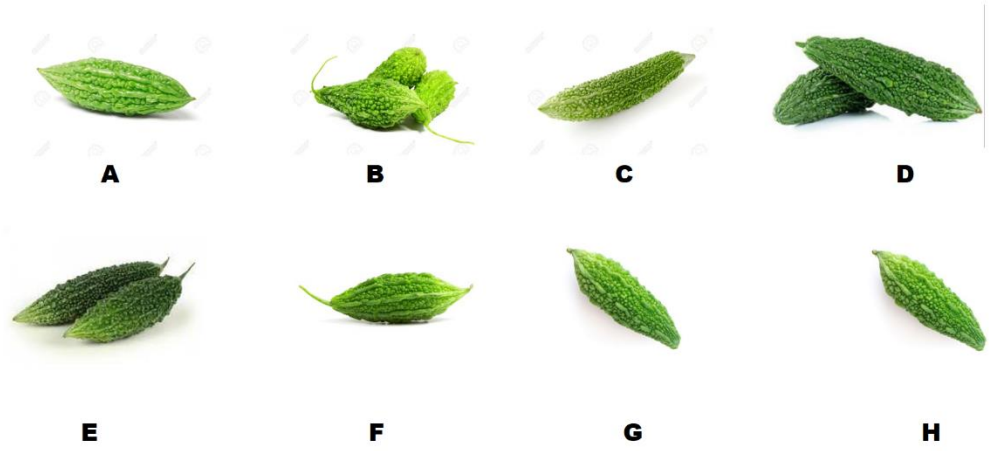


Figure 4.2: Fresh Image Bitter Gourd Data sample

### 4.2.2 Rotten Image Dataset Train

Figure 4.3, implies that the rotten image dataset sample. This type of 300 images I train with python programming. For the different types of data variants and accurate analysis, I use my rotten dataset. Due to the data variant, I different them and perfectly detect the fresh vegetables as well.

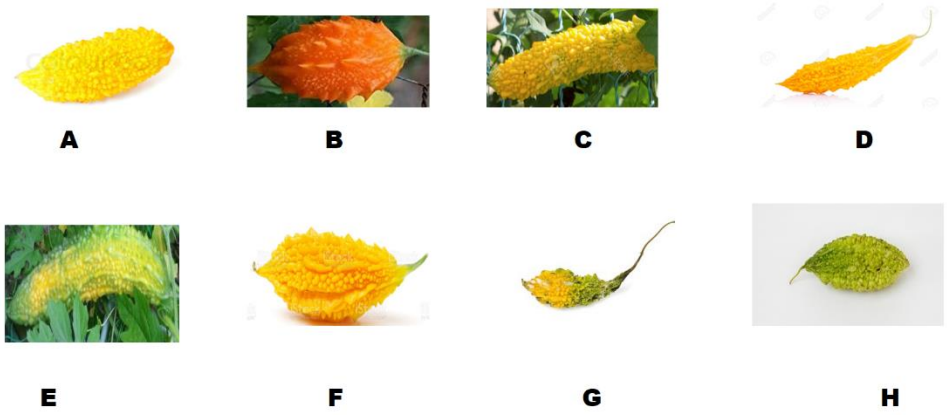


Figure 4.3: Rotten Image Bitter Gourd Data sample

### 4.2.3 Image Error Rate Analysis

For the image accurate position processing, I have fixed all image sizes and shapes. All image sizes are properly for image processing. Wrong and Blur image remove. After that, I have set up a well arrange data set.

## 4.3 Implementation of Interactions

In this part I will discuss how I evaluate my freshness detection model. For detection, I use machine learning algorithm with the Google Colab IDE. Whole process is given below:

- **Importing Required Library functions**

For the first step, I imported my required library functions Figure 4.4 to complete this study.

```
# import the libraries as shown below

from tensorflow.keras.layers import Input, Lambda, Dense, Flatten
from tensorflow.keras.models import Model
from tensorflow.keras.applications.inception_v3 import InceptionV3
#from keras.applications.vgg16 import VGG16
from tensorflow.keras.applications.inception_v3 import preprocess_input
from tensorflow.keras.preprocessing import image
from tensorflow.keras.preprocessing.image import ImageDataGenerator,load_img
from tensorflow.keras.models import Sequential
import numpy as np
from glob import glob
#import matplotlib.pyplot as plt
```

Figure 4.4: Importing All Required Library Functions

- **Divide the data into train and test**

I have divided my data into train and test split using the sklearn train_test_split function Figure 4.5. It is divide the data set at 80% of the training data and 20% of the test data. Test data will be selected randomly for better detection.

```
# re-size all the images to this
IMAGE_SIZE = [224, 224]

train_path = 'Datasets/train'
valid_path = 'Datasets/test'
```

Figure 4.5: Train and Test Split of Data

## 4.4 Test Implementation

Finally, I have used machine-learning and CNN algorithm for find out the final accuracy of my model. I have used three machine learning algorithm to complete my work which is shown in Figure 4.6, 4.7, 4.8.

- **Convolutional Layer**

```
prediction = Dense(len(folders), activation='softmax')(x)

# create a model object
model = Model(inputs=inception.input, outputs=prediction)
```

```
# view the structure of the model
model.summary()
```

```
Model: "model"
_________________________________________________________________________________________________
Layer (type)                 Output Shape              Param #     Connected to
=================================================================================================
input_1 (InputLayer)         [(None, 224, 224, 3) 0
_________________________________________________________________________________________________
conv2d (Conv2D)              (None, 111, 111, 32) 864         input_1[0][0]
_________________________________________________________________________________________________
batch_normalization (BatchNorma (None, 111, 111, 32) 96          conv2d[0][0]
_________________________________________________________________________________________________
activation (Activation)      (None, 111, 111, 32) 0           batch_normalization[0][0]
_________________________________________________________________________________________________
conv2d_1 (Conv2D)            (None, 109, 109, 32) 9216        activation[0][0]
_________________________________________________________________________________________________
batch_normalization_1 (BatchNor (None, 109, 109, 32) 96          conv2d_1[0][0]
_________________________________________________________________________________________________
activation_1 (Activation)    (None, 109, 109, 32) 0           batch_normalization_1[0][0]
_________________________________________________________________________________________________
conv2d_2 (Conv2D)            (None, 109, 109, 64) 18432       activation_1[0][0]
_________________________________________________________________________________________________
batch_normalization_2 (BatchNor (None, 109, 109, 64) 192         conv2d_2[0][0]
_________________________________________________________________________________________________
activation_2 (Activation)    (None, 109, 109, 64) 0           batch_normalization_2[0][0]
_________________________________________________________________________________________________
max_pooling2d (MaxPooling2D) (None, 54, 54, 64)   0           activation_2[0][0]
_________________________________________________________________________________________________
conv2d_3 (Conv2D)            (None, 54, 54, 80)   5120        max_pooling2d[0][0]
```

Figure 4.6: Convolutional Layer for CNN modeling

- **Support Vector Machine Algorithm (SVM):**

```
from sklearn.svm import SVC
svc = SVC()
s= svc.fit(x_train, y_train)
print("SVC Model Score" , ":" , s.score(x_train, y_train) , "," ,
      "Cross Validation Score" ,":" , s.score(x_test, y_test))
```

Figure 4.7: SVM Algorithm

- **CNN Train Model Matrix Load:**

```
In [23]: import numpy as np
         y_pred = np.argmax(y_pred, axis=1)

In [24]: y_pred

Out[24]: array([0, 1, 0, 2, 1, 1, 3, 3, 2, 3, 3, 0, 1, 2, 2, 3, 2, 1], dtype=int64)

In [ ]:

In [1]: from tensorflow.keras.models import load_model
        from tensorflow.keras.preprocessing import image

In [2]: model=load_model('model_resnet50.h5')

In [39]: img_data

Out[39]: array([[[[ 6.7060997e+01,  5.4221001e+01,  4.7320000e+01],
                  [ 6.9060997e+01,  5.6221001e+01,  4.9320000e+01],
                  [ 7.3060997e+01,  6.0221001e+01,  5.3320000e+01],
                  ...,
                  [ 7.4060997e+01,  5.6221001e+01,  4.6320000e+01],
                  [ 5.5060997e+01,  3.7221001e+01,  2.7320000e+01],
                  [ 4.1060997e+01,  2.3221001e+01,  1.3320000e+01]],

                 [[ 7.5060997e+01,  6.2221001e+01,  5.5320000e+01],
                  [ 7.8060997e+01,  6.5221001e+01,  5.8320000e+01],
                  [ 8.1060997e+01,  6.8221001e+01,  6.1320000e+01],
                  ...,
                  [ 9.7060997e+01,  7.9221001e+01,  6.9320000e+01],
                  [ 7.3060997e+01,  5.5221001e+01,  4.5320000e+01],
                  [ 4.9060997e+01,  3.1221001e+01,  2.1320000e+01]],
```

Figure 4.8: Train Model Matrix

## 4.5 Test Result Analysis

Image processing and its key point matching are some of the most key techniques for feature transform algorithms. In this work, I have used multiple algorithms to get more accuracy and image-matching feature. Using the CNN (Convolutional Neural Network) model I get 91.56% accuracy. From scale-invariant feature transform (SIFT) and Histogram of Oriented Gradients (HOG) algorithms, I get 82.25% and 84.25% accuracy. Using the CNN algorithm, I get my best accuracy shown in Table 4.1.

Table 4.1: Model Accuracy

| Algorithm | Accuracy |
|---|---|
| CNN | 91.56% |
| SIFT | 82.25% |
| HOG | 84.25% |

## 4.6 Summery

In this study, I have mainly observed some input and output with layers. My algorithm and agriculture development help to find out proper accuracy. The first time, I input the data and it going through the train layer. After the pass through the data it matching the image and show the main output results in Figure 4.9. In the train layer, I train four types Fresh, Rotten, Wrong, Moderate data and find out the accurate results as well as system.

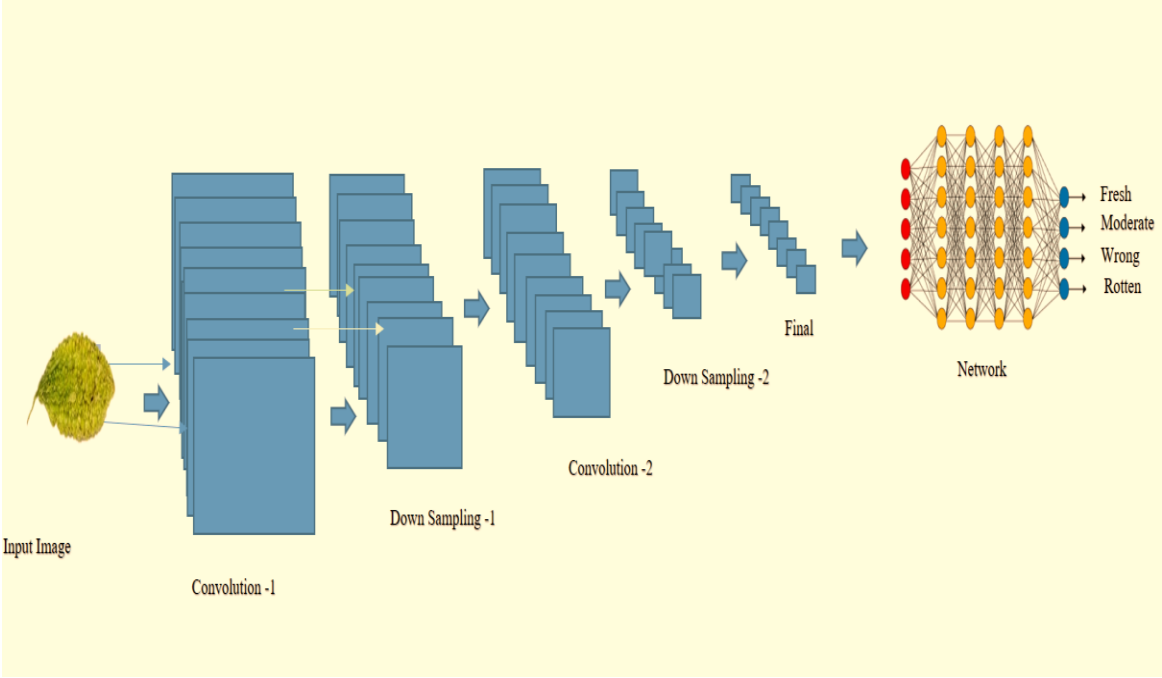


Figure 4.9: Image Processing Layer with Input and Output

# CHAPTER 5

# SUMMARY, CONCLUSION, RECOMMENDATION AND FUTURE STUDY

## 5.1 Summery of the Study

From my research, I can see that I have developed a model that can easily identify its fresh or rotten feel from a bitter gourd. Here I have used special algorithms for image processing. Many layers have been used to perform this identification processing. I have even used some more algorithms to find out the functionality of this model. Later I used the best of them in my research.

## 5.2 Conclusion

This research confirms that one of the detection systems for bitter gourd freshness. Here mainly use four types of different results as well as a hybrid system. The development of the ICT sector is looking for new horizons for us and Agriculture development is very essential for the upcoming world. In the modern era agriculture development is the highly contribute field of food security. Data Science is one of the top analysis experimental methods for forecasting and mapping synchronize and detection systems. In this study, I have used a very advanced image processing method for the detection approach. This study will allow farmers to choose the proper crop in the right environmental condition, which will play a key role in strengthening the economy of the country.

## 5.3 Recommendations

- ✓ A frame work should be made to evaluate the main cause of this research.
- ✓ Specific attributes should be taken through detailed studies.
- ✓ Step by step process can clarify and makes the work easier.
- ✓ Dedication in dataset preparing is needed.

## 5.4 Future Study

Since man has no control over nature, he has to work in agriculture in harmony with nature. Improvements in this agriculture field can be achieved only if changes in crop production can be brought about in conjunction with natural climate change.All types of crops don't grow well in all environments, so it is impossible to get good yields every time. In the future, we can apply this technique in many different sectors like as:

1.Fresh Fruits detections

2.Different vegetable identification

3.Crop pest detection system

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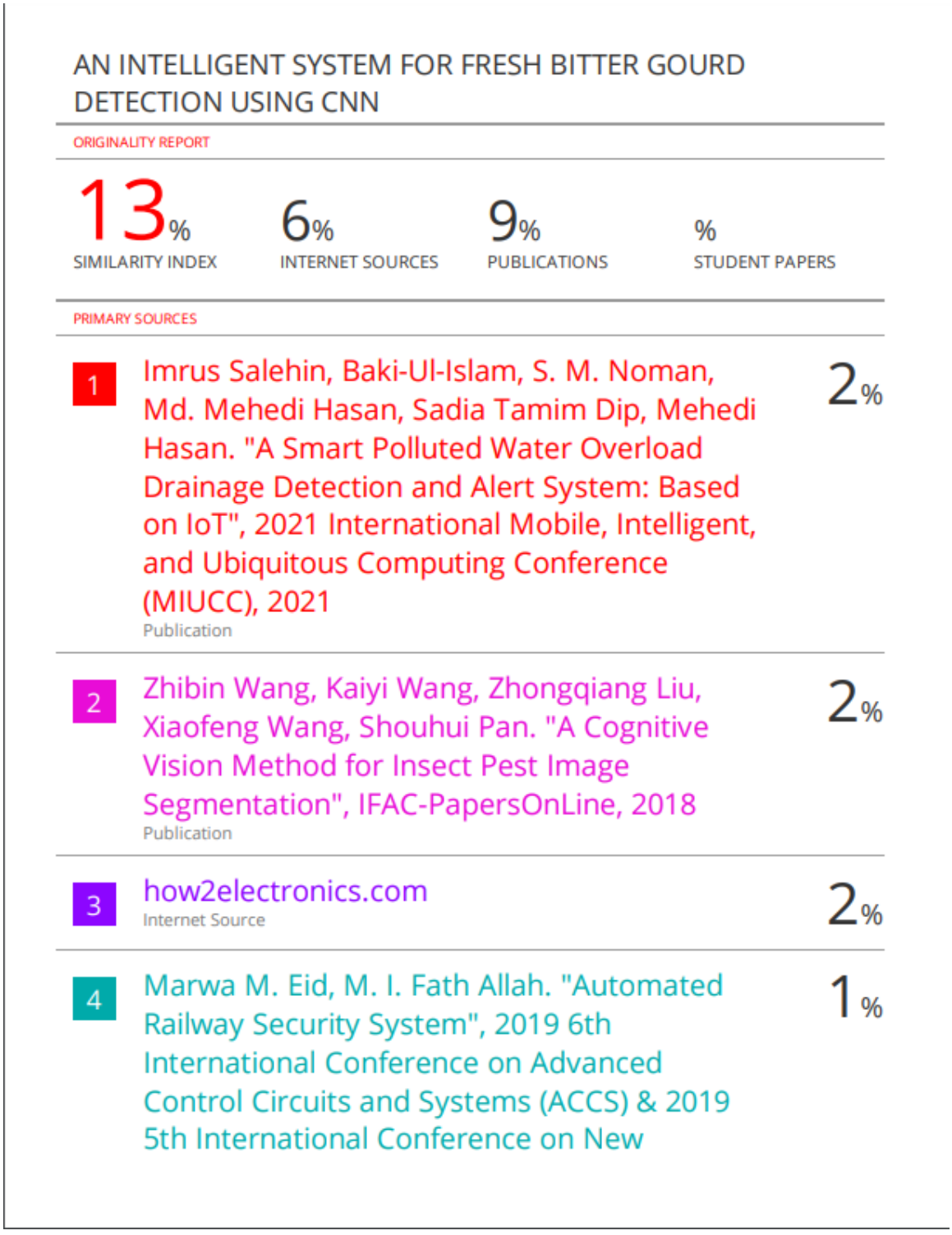

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