No reference quality assessment multi labeled classification for distorted images

PROJECT PHASE-2 REPORT
Submitted by

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in partial fulfillment for the award of the degree of
BACHELOR OF ENGINEERING
in
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Under the Guidance of
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B. M. S. COLLEGE OF ENGINEERING
(Autonomous Institution under VTU)
BENGALURU-560019

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

CERTIFICATE

Certified that the project entitled "**No reference quality assessment multi labeled classification for distorted images**" is a bonafide work carried out by Aakashdeep Sil (1BM17CS001), Aditya Kumar (1BM17CS010), Hritik Abhay Shankar (1BM17CS031), Jatin Gandhi (1BM17CS032) in partial fulfillment for the award of Bachelor of Engineering in Computer Science and Engineering of the Visvesvaraya Technological University, Belagavi during the academic year 2020-2021. The project report has been approved as it satisfies the academic requirements in respect of project work prescribed for the said degree.

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ABSTRACT

We humans take millions of photographs a day, photos are transmitted from one place to the other. Many times the images captured are not perfect. The quality of an image depends on a number of aspects and how sharp and clear the overall image looks to the human eye. The camera being used has a major impact on the quality of the image but there are also factors that can affect the quality of the image to degrade which is out of the hand of the user. Distortions in image can be caused by factors like shaky camera, inefficient compression algorithms and more. More photographs are taken by the user and uploaded to clouds resulting in high storage costs. This cost can be reduced if distorted images are prevented from getting automatically uploaded to the cloud.

Most of the algorithms present today either need Full Reference (FR) or reduced reference (RR) to the image whose quality is to be predicted. In full reference (FR) IQA a reference image of the same scene with good quality is needed. This scenario is not always available to us. Most of the distorted images don't have any reference available to them. Moreover the images may be subjected to multiple distortions. Hence the need for a multiply distorted no reference image quality assessment (NR-IQA) algorithm arises.

Here we propose a NR-IQA algorithm which returns the images in different classified folders. The goal is to build a computational model that accurately predicts the quality of digital images with respect to human perception.

DECLARATION

We, hereby declare that the Project Phase-2 work entitled **"No reference quality assessment multi labeled classification for distorted images"** is a bonafide work and has been carried out by us under the guidance of Dr. Kayarvizhy N**,** Associate Professor, Department of Computer Science and Engineering, B.M.S. College of Engineering, Bengaluru**,** in partial fulfillment of the requirements of the degree of Bachelor of Engineering in Computer Science and Engineering of Visvesvaraya Technological University, Belagavi.

I further declare that, to the best of my knowledge and belief, this project has not been submitted either in part or in full to any other university for the award of any degree.

Candidate details:

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Place: Bengaluru

Date: 28-06-2021

Certified that these candidates are students of the Computer Science and Engineering Department of B.M.S. College of Engineering. They have carried out the project work titled **"No reference quality assessment multi labeled classification for distorted images"** as Project Phase-1 work. It is in partial fulfillment for completing the requirement for the award of B.E. degree by VTU. The works are original and duly certify the same.

Guide Name
Dr. Kayarvizhy N

Signature

Date:

ACKNOWLEDGEMENTS

The execution of the first part of our project would not have been possible without the unconditional support of the management of BMSCE, the principal Dr. B V Ravishankar, the head of department of the department of computer science and engineering Dr. Umadevi V, our project guide Dr. Kayarvizhy N. for her patience, expertise and guidance and all the teaching and non-teaching staff of the college and we would like to extend a hearty thank you to them.

We would also like to appreciate those, who through the course of design and development of this project have made time to interact and guide us in numerous ways. We would also acknowledge the fact that there are plenty of mind-boggling breakthroughs that have occurred in the field over the past decade and also the numerous theories that are published and presently in development. We are really grateful to our faculty project guide, who believed in us and bestowed upon us with her time and knowledge to develop this project and bring our vision into reality.

We also express a feeling of appreciation to our friends and family for believing in us and providing moral support in all phases of this project to make it a grand success.

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

1.1 Overview:

Millions of images are generated, processed, and transferred everyday all across the globe. Especially with the advent of smartphones embedded with good quality cameras, it is being used by millions of people to capture images, share them with their friends or post them on social media.

During each of these stages from capturing images to transferring them over the internet, images are subjected to various distortions. It can be caused due to various factors. During the image capturing process, improper focal adjustment of the camera can cause the images to get blurred. This can be due to optical design of the lens, also known as lens distortion. Blurriness can also be caused by a fast moving object in the frame or a shaking camera. Sometimes, noise also gets imparted into the image during image capture. The transfer of images also leads to distortions. Transfer of images requires compression. One common distortion caused by compression is JPEG compression.

All these kinds of distortions affect the quality of an image. Hence, a no reference image quality assessment (NR-IQA) model is proposed to identify these deformations in the images.

1.2 Motivation:

The demand for a new and efficient NRIQA is increasing day by day. We require technology which can predict the quality of any image without making any reference. The present technology handles the case of single distortion very efficiently but the system fails when multiple distortions are introduced in the image. Since millions of images are taken everyday which consume terabytes of storage, an efficient algorithm which can remove pictures of poor quality helps in saving data storage. Google photos recently announced a cap of 15Gb free cloud storage. This algorithm can help users filter out unwanted images thus saving storage space and money. So understanding the current need we came up with an algorithm which can do all the work without the need of intervention by humans. This helps in image quality assessment in real-time where reference image is not available.

1.3 Objective:

The main objective of our project is to build an efficient no-reference image quality assessment (NR-IQA) model which predicts the quality of an image without the help of any reference image. As multiple distortions can arise in an image, we plan to develop a model which can classify and predict the quality based on blur and compression artifacts. Hence, the model is trained on a multiply distorted dataset. When an image is fed as input to this model, the model runs for blur and compression artifacts present in the image. We aim to build a model which can predict image quality with high accuracy.

1.4 Scope:

The scope for this project is mainly restricted to smartphones. This is because more and more images are being captured using more technologically advanced smartphones. Since the major distortions in such images captured are subjected to blurriness and compression artifacts, we will be concentrating our work on these two distortions. Smartphone users can get to know the quality of the image immediately after capturing. Even the quality of images that are stored, can be accessed. This model can be incorporated into a smartphone application. This model can be used on any type of distorted image.

1.5 Existing System:

Most of the existing applications do not use no reference image quality assessment. Usually, the systems assess the quality of an image using a reference image. This requires the systems to have extra space to store the reference images.

Also, many existing systems do not provide image quality assessment for multiple parameters. Most of the systems provide assessment for only a single parameter.

Even the systems providing image quality assessment are up to good standards. We are implementing a state-of-the-art model for image quality assessment.

1.6 Proposed System:

The proposed system takes various types of distortions into account, in particular, blur and JPEG compression artifacts. The different blur parameters are, initially, run on a given set of images, and the results are fed to a PSO algorithm, which determines the threshold and weights for the given blur parameters. Similar process is adopted for JPEG compression parameters. Using the threshold and weights that we received from the PSO algorithm, we assess the quality of the input image.

Chapter 2

Literature Survey

Background:

Millions of photographs were made, processed, and transmitted daily throughout the world. Especially with the advent of smartphones equipped with state-of-the-art cameras, it is used by millions of people to take pictures, share them with their friends or post them on social media. Images are subject to pressure and distortion which can lead to reduced image quality.

Introduction:

IMAGE (IQA) quality testing is an important topic for scientific research and for the development of digital image processing systems. IQA can serve as a measure of performance and process efficiency for various methods in computer viewing and image processing, such as image / video compression [1], retrieval [2] etc. Traditionally one of the most important ways for IQA is to raise the volume level signal (PSNR). But with the advancement of technology and knowledge, better algorithms can be developed with IQA.

Advanced algorithms can be divided into 3 types:

1. Full Reference (FR-IQA)

2. Reduced reference (RR-IQA)

3. No reference (NR-IQA)

Major work has already been done on the first two types while research and work need to be done on the third type. [5]

From the goal (SD) alone provides accurate predicting the quality of the contradictory images of geographical diversity. SD when used to compare the comparative level of two images is called root-mean-square (rms). The proposed NR-IQA for the opposite twists and turns follows the formation of the Minkowski range. Three elements of the proposed metric are used to distinguish the types of distortion distortions. Two features designed for Minkowski and entropy form the vector of the proposed metric element. Support vector support (SVR) is used to map these three elements to the mean visual schools (MOS). For the purpose of the distortion class distortion, a vector classifier (SVC) is used to assign a label to each image indicating the type of distortion distortion. [6]

Linde-Buzo-Gray (LBG) Algorithm used to design a Codebook with minimal distortions and errors. At the same time the target function representing the distribution of the Haar first element estimates with respect to the NOR is based on genetic algorithms to determine the improved number of entries. Entropy values are divided to determine the FIS's governing basis and the conflicting input features. [7]

Features are calculated and positioned vertically. First, the restriction is estimated because of the difference between the boundaries of the blocks. Second, we measure the function of the image signal. Work is measured using two items. The main difference is the common difference between blocking sample samples The second activity measurement is the zero-crossing (ZC) measurement. This method works best with a computer because there are no complex changes included and algorithms are often used without saving the whole image (or even a list of pixels) in memory, making embedded simplicity easier. [8]

The FMIQA indicator is an image quality test (IQA) metaphor for opposing audio images that is specially supported by frequency map (FM). Riesz feature maps convert an image that will be matched to a well-executed image to calculate the match. [9]

Environmental Statistics (NSS) is used to blindly measure the quality of JPEG2000 (or other wavelet based) images. We mean that natural scenes contain non-linear dependencies that are disrupted by the congestion process, in which these disturbances are measured and associated with human perceptions of quality. The algorithm is trained and evaluated with data from human studies, and demonstrates that complete NSS models can help us make blind, but accurate quality predictions. [10]

The SE-VGG network is developed using flexible transfer learning methods. First a large database of Imagenet was used to pre-train the VGG network to complete the glorification function (VGG-C). After that, the Siamese network is trained to measure the degree of distortion of the image using distorted artificial images. The Siamese network has two VGG networks to detect image distortion (VGG-L) functions. [11]

A new process of image quality analysis of images damaged by many distortions by mixing or combining various image quality measures already in the manipulation of various distortions. The proposed approach could be a multi-method fusion approach and we define it as a random multi-method fusion (RF-MMF) forest integration. [12]

Here we propose a No Reference Image Quality Assessment (NR-IQA) algorithm that can restore the quality rating of any image displayed on it. The goal is to create a computer model that accurately predicts the quality of digital images in relation to human perception. This school can be used to predict image quality.

Chapter 3

Requirement Analysis and Specification

3.1 Functional requirements:

- The user must be able to take tests to assess the quality of the images.
- The user must be able to view all the images taken by him/her.
- The user must be able to compare the results of similar images and thereby keep the best image among them.
- The user must be able to choose whether to remove the lower quality images.
- The given set of images should be properly classified into a set of folders with different quality pictures.

3.2 Non-Functional Requirements:

- Security - The user's images need to be protected at all costs and the data should not be publically available.
- Availability – The software must have minimal downtime so that the user can use the software and check his/her image and upload the same at his/her own convenience.
- Simplicity – The software must be easy to use with a simple and smooth user interface.
- Response Time and Net Processing Time – Must be low. The results of the image quality assessment must be provided to the user in seconds.
- Scalability – The software must be easily scalable and hence must have the capacity to easily accommodate new features.
- Reliability – The software must provide accurate test results.

3.3 Hardware Requirements:

- Memory (RAM): Minimum 8 GB
- GPU required: Recommended Nvidia 1050 4 GB
- Storage: Minimum 100 MB of free space for the storage of images.
- A stable internet connection to upload images.

3.4 Software Requirements:

- Operating System: Windows , Linux
- Jupyter Notebook
- Tensorflow
- Keras
- OpenCV

3.5 Cost Estimation:

Since this software-based proposed system does not require any additional hardware apart from a PC with the required specification, the cost required for hardware components is almost 0. The software required for this work is free and open source, which sums to an amount of 0. Therefore, the total cost for initial development for the model is almost nil.

Chapter 4

Design

4.1 High level design

4.1.1 System Architecture

The system architecture of the proposed system is shown below. The subsystem comprises 2 parts. First is the blur check while second is the JPEG check. We first train our model for blur images. We have selected 6 parameters for the same :

- Diagonal modified laplacian (DML)
- Singular value decomposition (SVD)
- Laplacian (LAP)
- Energy of laplacian (EOL)
- Total variation (TV)
- Local binary pattern (LBP)

In order to train the model, we first extracted the blur values of a publicly available 350 images dataset. The generated csv file was fed into the PSO algorithm. Using PSO, we obtained the threshold values and the weights for all the selected parameters. We used the similar concept to obtain the JPEG compression value. We manually create a dataset with various levels of compression applied to them. We manually set a threshold for the same. This completes the training process. After training, the testing begins. We select the LIVEMD dataset. It has 225 images with various levels of blur and JPEG compression applied to them. The 6 blur parameters and the JPEG compression value are extracted and fed into the algorithm which decides using the threshold and weights on how to classify the given image.

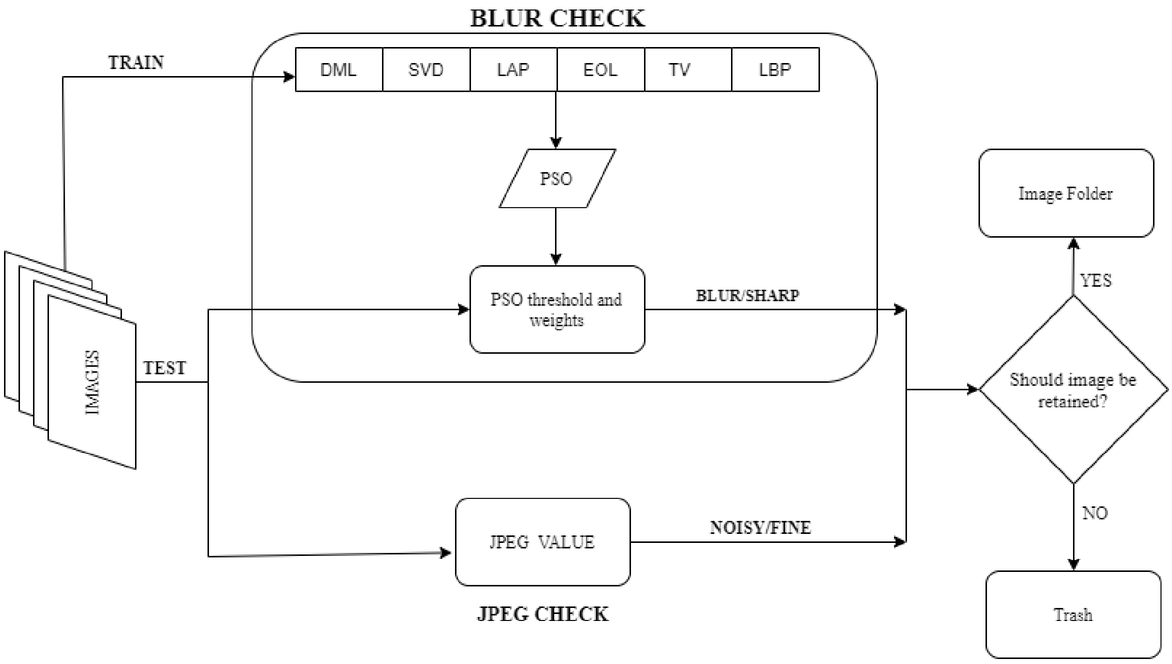

Fig 4.1 - High Level Design

4.1.2 Use-Case Diagram

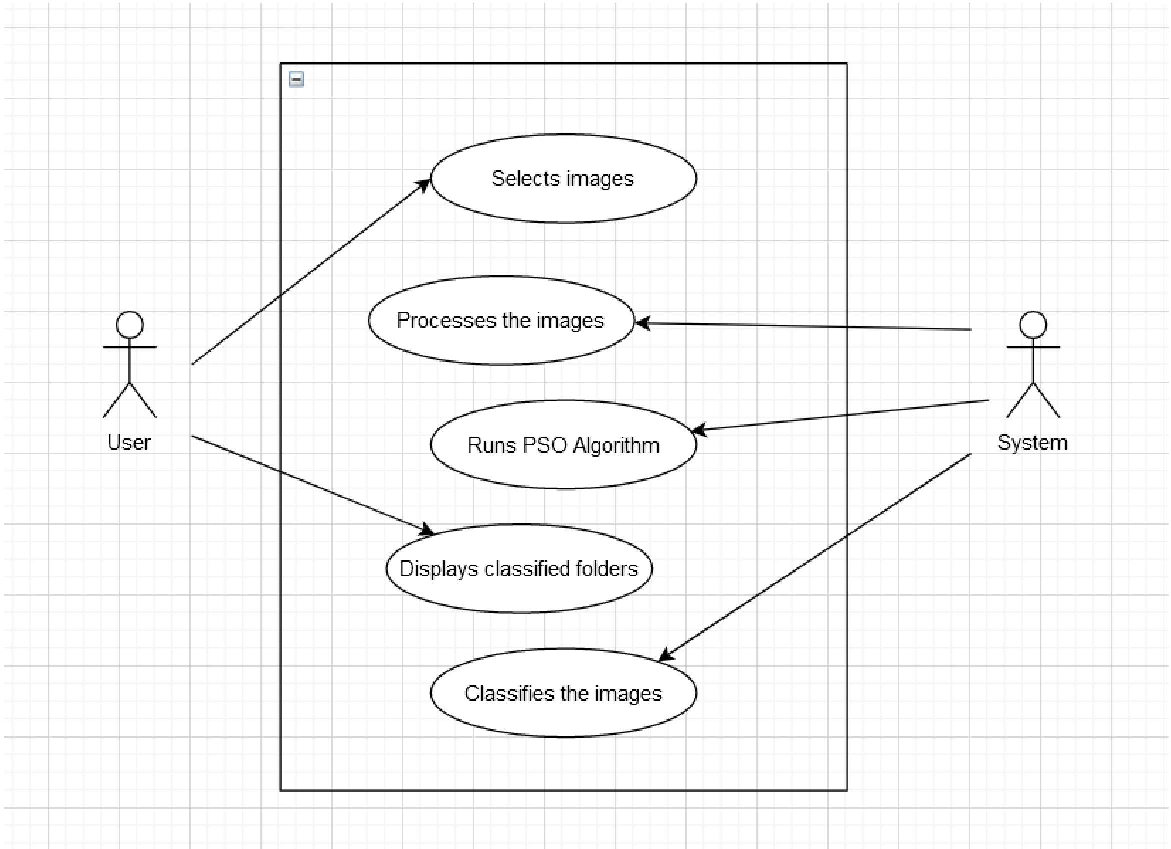

Fig 4.2 - Use Case Diagram for High Level Design

4.2 Detailed Design

4.2.1 System Architecture

Blur parameters:

Blur in images is considered as an undesirable effect because it leads to the loss of the necessary details required for the scene interpretation. It can be caused due to various reasons:-

- Any sort of defect in lens,
- Shaking of camera,
- Fast movement of objects in front of the camera, etc.

Based on the papers we read, 6 parameters have been selected. Each parameter measures the level of blurriness associated with the pixels or regions of the image and realizes discrimination between sharp and blurred pixels

a. Singular value decomposition : It is based on the eigenvalues which are computed for each pixel in the image by placing that pixel in the center of a small image neighborhood window. As the blur in an image increases the output value increases
b. Total variation : It is the sum of the absolute differences for neighboring pixel-values in the input images.This measures how much noise is in the images.This can be used as a loss-function during optimization so as to suppress noise in images.As the blur in an image increases the output value decreases.
c. Local binary pattern : It is an effective texture pattern descriptor to describe the local texture patterns of an image. It works in a block size of 3 x 3. The center pixel is used as a threshold for the neighboring pixel. As the blur in an image increases the output value increases.
d. Laplacian : It is used for edge detection in images by comparing the current pixel's value from neighboring pixels. It sses only a row and column kernel matrix for horizontal and vertical edge detection. As the Value decreases as image blurriness increases
e. Modern Diagonal laplacian : It is similar to above, but also takes into account neighboring diagonal pixels. It makes use of three kernel matrices.

f. Energy of laplacian : It uses a single 3x3 kernel matrix for image edge detection. As the value decreases as image blurriness increases.

PSO algorithm:

It is a computational method that optimizes a problem by iteratively trying to improve a candidate solution with regard to a given measure of quality. We first find a threshold for each of the 6 parameters. We use this threshold to calculate the accuracy. We then use PSO to find weights of each of the parameters needed to better result. The general working of this algorithm is shown below :

- Particles are like pigeons. They have location and velocity.
- Particles are given random location and velocity first.
- With each iteration a new position and velocity is being found out.
- The process is iterated 1000 times in order to find the best fit.
- The final weights achieved helps in boosting the accuracy.

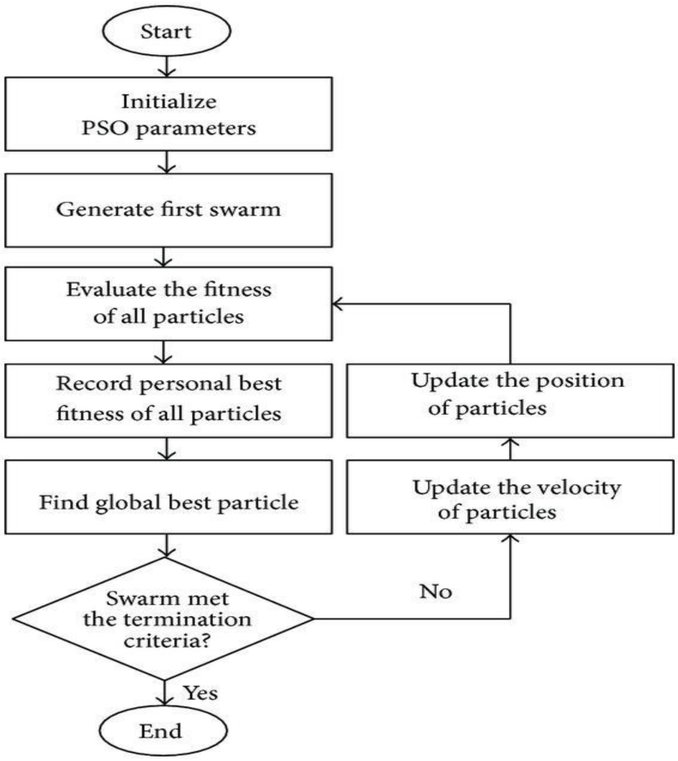

Fig 4.3 - Flow Diagram

JPEG compression:

Images go through a lot of JPEG compression when getting transferred or saved. Sometimes the compression results in loss of data. The main factors that determine jpeg compression are :

- Blockiness
- Luminance change

Higher value of blockiness means less image quality while high level of lumiance results in high quality of image. Higher value results in higher compression.

4.2.2 Use-Case Diagram

Fig 4.4 - Use Case Diagram for Low Level Design

4.2.3 Class Diagram

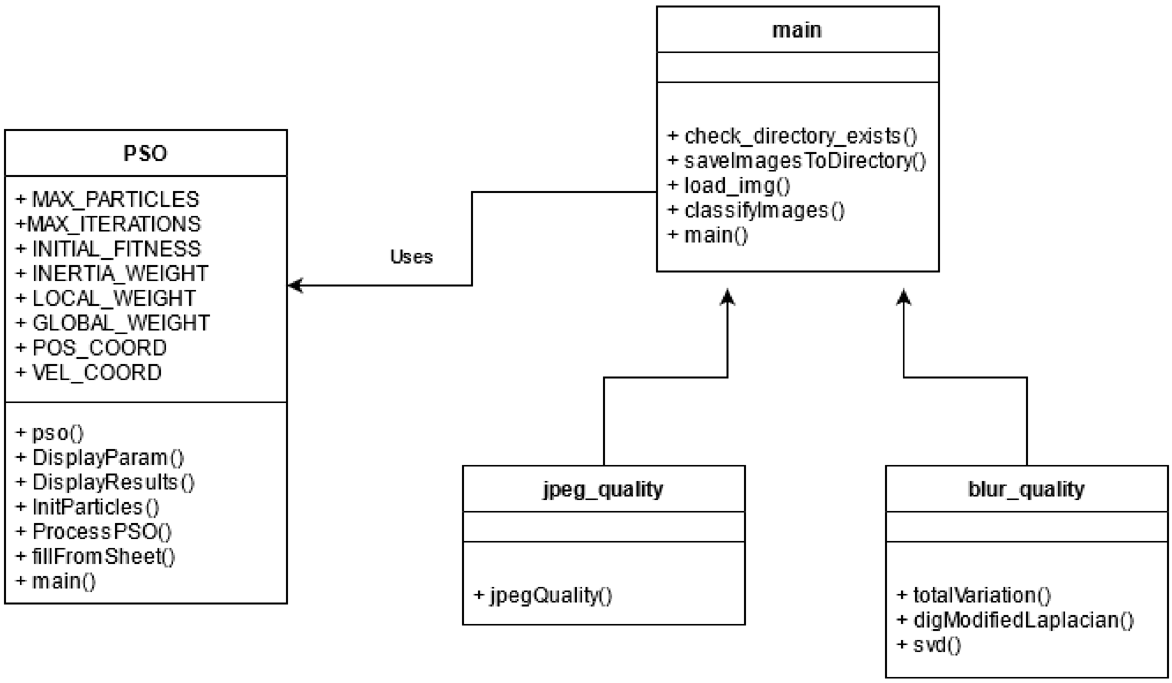

Fig 4.5 - Class Diagram

4.2.4 Sequence Diagram

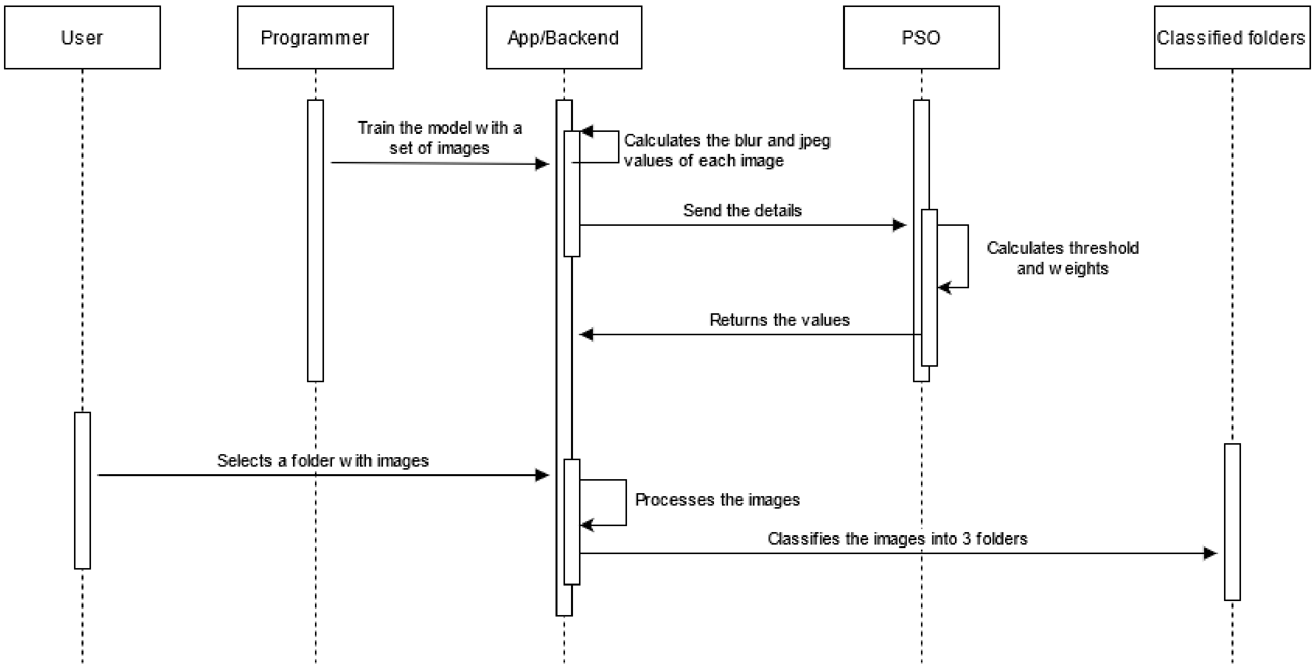

Fig 4.6 - Sequence Diagram

Chapter 5

Implementation

5.1 Overview of Technologies Used

i) Image Processing :

Image processing is used to perform operations on the image and extract valuable information from the same. In our project we have used various parameters to extract values and use it for calculation purposes.

ii) Python 3 :

Python was used as the main language for the project. Python is an interpreted language.

iii) Tensorflow :

Tensorflow is an open source library to help you develop and train ML models. We used tensorflow to calculate values of parameters.

iv) C++ :

C++ was used to develop PSO code. PSO was used to find thresholds and weights of the various parameters used.

v) Git :

Git is software for tracking changes in any set of files, usually used for coordinating work among programmers collaboratively developing source code during software development.

5.2 Implementation details of modules

There are three modules for our project - Jpeg_Quality, Blur_Quality and Main.

i) Jpeg_Quality :

This module computes the jpeg quality of an image. It considers different parameters that affect the jpeg quality and returns a value. The value represents the jpeg compression in an image. Higher the value, more jpeg compressed image.

```python
def jpegQuality(image):
    m,n = image.shape
    f1 = np.array([[1,-1]])
    f2 = f1.transpose()
    h = abs(convolve2d(image,f1,'valid'))
    v = abs(convolve2d(image,f1.transpose(),'valid'))
    m1 = m//8
    n1 = n//8
    map1=[]
    map2=[]
    len=4
    for i in range(1,m1-1):
        for j in range(1,n1-1):

            value = sum(h[i*8:i*8+8,j*8-len-1:j*8+8+len])/8
            L_h = sum(value[len+1:len+8])/7
            P_h = sum(value[0:len]+value[len+1:len+1+len]+value[8:len+8]+value[len+9:len+9+len])/4/len
            B_h = value[len]+value[8+len]

            value = np.sum(v[i*8-len-1:i*8+8+len,j*8:j*8+8],axis=1)/8
            L_v = sum(value[len+1:len+8])/7
            P_v = sum(value[0:len]+value[len+1:len+1+len]+value[8:len+8]+value[len+9:len+9+len])/4/len
            B_v = value[len]+value[8+len]
```

Fig 5.1 - Jpeg_Quality Code Snippet

ii) Blur_Quality:

This module consists of three different parameters - Total Variance, Diagonal Modified Laplacian, Singular Value Decomposition. These different parameters are used combinedly to find the blurriness in an image.

- Total Variance : The sum of the absolute differences for neighboring pixel-values in the input images. This measures how much noise is in the images.
- Diagonal Modified Laplacian : It makes use of three kernel matrices. The value of function decreases as image blurriness increases.
- Singular Value Decomposition: It is based on the eigenvalues which are computed for each pixel in the image by placing that pixel in the center of a small image neighborhood window. It is used to restore a corrupted image by separating significant information from the noise in the image data set. As the blur in an image increases the output value increases.

```python
#Total Variation
def totalVariation(content_image):
    image = tf.Variable(content_image)
    total_variation = tf.image.total_variation(image).numpy()
    return total_variation[0]

# Diagonal Modified Laplacian
def digModifiedLaplacian(img):
    M1 = np.array([[-1, 2, -1]])
    M2 = np.array([[0, 0, -1], [0, 2, 0], [-1, 0, 0]])/np.sqrt(2)
    M3 = np.array([[-1, 0, 0], [0, 2, 0], [0, 0, -1]])/np.sqrt(2)
    F1 = np.abs(cv2.filter2D(img, -1, M1))
    F2 = np.abs(cv2.filter2D(img, -1, M2))
    F3 = np.abs(cv2.filter2D(img, -1, M3))
    F4 = np.abs(cv2.filter2D(img, -1, M1.T))
    FM = np.abs(F1) + np.abs(F2) + np.abs(F3) + np.abs(F4)
    return(np.mean(FM))
```

Fig 5.2 - Blur_Quality Code Snippet

iii) Main : This module combines the result of both jpeg quality and blur quality and classifies the image into one of the three categories.

```python
def main():
    # YOU NEED TO CHANGE THESE PATHS ACCORDING TO YOUR SYSTEM
    GOOD_IMAGES_PATH = r'E:\Images\Results\goodImages'
    BAD_IMAGES_PATH = r'E:\Images\Results\badImages'
    IMAGE_SUGGESTED_FOR_DELETION_PATH = r'E:\Images\Results\imageSuggestedForDeletion'
    imageDirectory =r'E:\Images\imagesToClassify\*'

    goodImages, badImages, imageSuggestedForDelettion = classifyImages(imageDirectory)

    check_directory_exists(GOOD_IMAGES_PATH)
    check_directory_exists(BAD_IMAGES_PATH)
    check_directory_exists(IMAGE_SUGGESTED_FOR_DELETION_PATH)

    os.mkdir(GOOD_IMAGES_PATH)
    os.mkdir(BAD_IMAGES_PATH)
    os.mkdir(IMAGE_SUGGESTED_FOR_DELETION_PATH)

    saveImagesToDirectory(imageDirectory,GOOD_IMAGES_PATH,goodImages)
    saveImagesToDirectory(imageDirectory,BAD_IMAGES_PATH,badImages)
    saveImagesToDirectory(imageDirectory,IMAGE_SUGGESTED_FOR_DELETION_PATH,imageSuggestedForDelettion)
```

Fig 5.3 - Main file Code Snippet

5.3 Difficulties encountered and Strategies used to tackle

Initially, we selected 6 parameters to find the blurriness in an image. This was taking a lot of time and computer memory. We reduced the 6 parameters to 3 without any reduction in accuracy. This is done by using the PSO algorithm. PSO is a computational method that optimizes a problem by iteratively trying to improve a candidate solution with regard to a given measure of quality. PSO helped in feature reduction (considering only 3 parameters to obtain the same result but with increased performance).

Chapter 6

Testing and Results

6.1 Unit Testing

Testing was done on the various parameters to see the trend each parameter's value had on the degree of blurriness applied on a picture. The table below shows the relation of values obtained as the blurriness of each image increased.

DML	↓
Laplacian	↓
SVD	↑
EOL	↓
TV	↓
LBP	↑

Fig 6.1

	DIAGONAL MODIFIE	LAPLACIAN	SINGULAR VALUE D	ENERGY OF LAPLA	TOTAL VARIATION	LOCAL BINARY PA
blur 0.00.JPG	28.47670702	15.96601741	0.207004475	40.38492552	87287.73438	7.26E-05
blur 0.03.jpg	3.036491243	1.447665908	0.290553239	4.719779147	37823.85938	0.005783539
blur 0.05.jpg	1.897737821	0.985063235	0.344383668	2.278878848	31605.48438	0.012781461
blur 0.08.jpg	1.565240098	0.818778617	0.377243844	1.67780556	18406.56445	0.024186556
blur 0.10.jpg	1.517786662	0.813205083	0.406123795	1.645215034	21478.96094	0.020347595
blur 0.30.jpg	0.862053871	0.414900462	0.662064135	0.716129621	5609.595703	0.043095907
blur 0.40.jpg	0.49362723	0.217669487	0.822015116	0.35410881	2509.572998	0.043837229
blur 0.50.jpg	0.862905184	0.421893438	0.668968677	0.734004974	5460.75293	0.035372416
blur 0.70.jpg	0.891777462	0.414634281	0.700347816	0.705175188	3750.274902	0.04302258
blur 0.85.jpg	0.708701422	0.312143358	0.798837875	0.507224058	2659.636475	0.079165236
blur 1.00.jpg	0.585378391	0.275816664	0.766339258	0.464357615	2335.904785	0.041044242

Fig 6.2

Using these values and a threshold testing was done to check the accuracy of the parameters on a dataset. Similarly various no of iterations were taken to improve the results received from PSO algorithm. It also helped in feature reduction.

6.2 Results

Test dataset was used to see and compare the results. Kaggle dataset was used to calculate the accuracy of the model. 350 blur images were used to calculate the overall accuracy. It was calculated using the following formula:

Overall Accuracy =(No of correct pred)/(Total predictions) x 100

The below graph shows the accuracy level of each of the parameters.

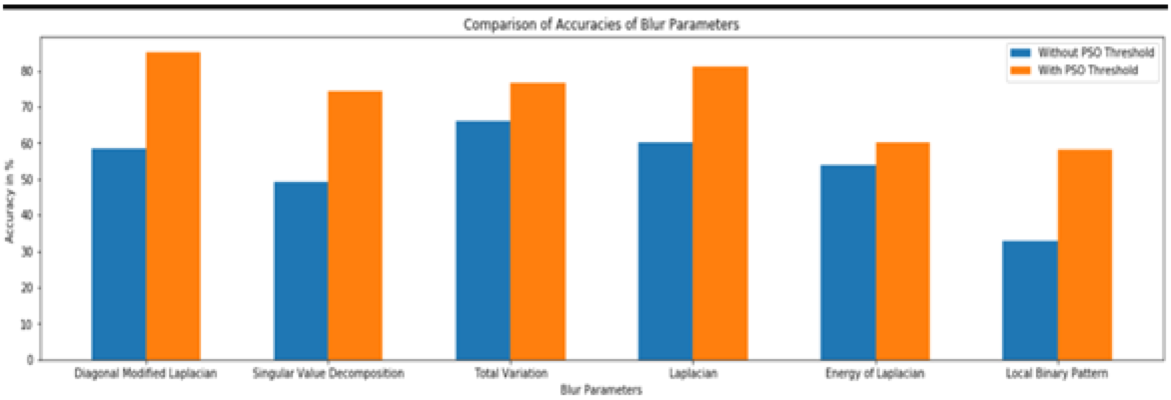

Fig 6.1

The performance can be boosted after using the PSO algorithm. After using PSO the accuracy changes from 81% to 82.5714%.

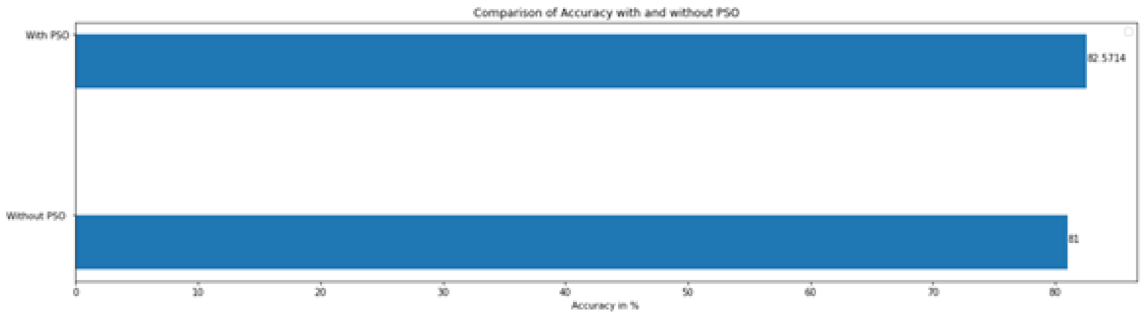

Fig 6.2

Chapter 7

Conclusion and Future Enhancements

7.1 Conclusion:

IQA for distorted images is an important problem in the field of image processing analysis. The goal of image quality assessment (IQA) is to build a computational model that can accurately predict the quality of digital images with respect to human perception or other measures of interest. In practice, images are usually corrupted with various kinds of distortion types simultaneously. This project is devoted to the problem of quality assessment for multiple distorted images. Our team intends to build an effective NR-IQA multi-labelled model to assess image quality on various quality metrics.

7.2 Future Enhancements:

- The software can be further improved by increasing the strength of the image assessment techniques, training the model better to give more accurate and faster results.
- The user interface of the software can also be improved hence encouraging more users to use the application.
- The software should be improved in such a way as to enable the user to assess images containing even more distortions.

REFERENCES

APPENDIX A: Details of publications

1. S. Wang, A. Rehman, Z. Wang, S. Ma, and W. Gao, “SSIM-motivated rate distortion optimization for video coding,” IEEE Trans. Circuits Syst. Video Technol., vol. 22, no. 4, pp. 516–529, Apr. 2012.
2. A. Rehman and Z. Wang, “Reduced-reference image quality assessment by structural similarity estimation,” IEEE Trans. Image Process., vol. 21, no. 8, pp. 3378–3389, Aug. 2012
3. Hybrid No-Reference Quality Metric for Singly and Multiply Distorted Images Ke Gu, Guangtao Zhai, Xiaokang Yang, Senior Member, IEEE, and Wenjun Zhang, Fellow, IEEE [2014]
4. Efficient No-Reference Quality Assessment and Classification Model for Contrast Distorted Images Hossein Ziaei Nafchi and Mohamed Cheriet, Senior Member, IEEE 2018
5. Wavelet entropy based No-Reference Quality Prediction of distorted/Decompressed Images Indrajit De,Jaya Sil 2010
6. No-Reference Perceptual Quality Assessment Of JPEG Compressed Images Zhou Wang, Hamid R. Sheikh and Alan C. Bovik
7. No-Reference Quality Assessment of Noise-Distorted Images Based on Frequency Mapping GUANGYI YANG , YUE LIAO, QINGYI ZHANG, DESHI LI, AND WEN YANG 2017
8. No-Reference Quality Assessment Using Natural Scene Statistics: JPEG2000
9. Hamid Rahim Sheikh, Member, IEEE, Alan Conrad Bovik, Fellow, IEEE, and Lawrence Cormack 2005
10. Deep feature importance awareness based no-reference image quality Prediction Xiaohan Yanga, Fan Li a, Hantao Liub 2020
11. No-reference image quality measure for images with multiple distortions using multi-method fusion kanjar deb and masilamani v 2018

APPENDIX B: POs and PSOs Mapped

B.M.S. College of Engineering.
Department of Computer Science and Engineering.
Attainment of POs and PSOs

Batch no: 16 Date: 22-12-2020

Project Title: No reference quality assessment multi labeled classification for distorted images

PROGRAM OUTCOMES

PO	Level (3/2/1) 3-High 2-Medium 1-Low	Justification if addressed
PO1	3	Engineering knowledge: Applied complex techniques like machine learning, deep neural networks and image processing to try and come up with a solution to assess image quality without reference.
PO2	3	Problem Analysis: Identified a major problem in the image quality assessment. Conducted a very detailed literature survey on the current image quality detection measures that exist in the market for the same purpose along with their cost and drawbacks.
PO3	2	Designed a solution to create a no reference image quality assessment model.
PO4	1	Collected information on models that exist in the market that address the same problem as our model. Interpreted the data from the models to understand their advantages and disadvantages.
PO5	2	Used modern tools and techniques to perform research on the subject and create designs for the project.
PO6	3	Applied reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice
PO7	1	Understood the impact of the professional engineering solutions in societal context and demonstrated the knowledge of, and need for sustainable development.

PO8	3	Applied all the ethical principles to perform our duties in the sincerest way possible. Every step of the process was carefully scrutinized by a machine learning professional.
PO9	3	Worked Effectively as an individual, a team member, a team leader in a multidisciplinary setting.
PO10	3	Communicated effectively on complex engineering activities with the society such as, being able to write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	2	Demonstrated knowledge and understanding of the engineering and management principles and applied these to our work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	3	Recognized the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES

PSO	**Level (3/2/1)** **3-High** **2-Medium** **1-Low**	**Justification if addressed**
PSO1	3	Broke down the entire process into a series of steps such as Requirement, Analysis and Design according to the software engineering principles.
PSO2	2	Designed an effective algorithm to address the problem at hand.
PSO3	2	Develop an effective code.

APPENDIX C: Plagiarism Report

ORIGINALITY REPORT

20%	10%	16%	7%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	"Image Analysis and Recognition", Springer Science and Business Media LLC, 2019 Publication	4%
2	www.mdpi.com Internet Source	3%
3	www.tensorflow.org Internet Source	2%
4	Ke Gu, Guangtao Zhai, Xiaokang Yang, Wenjun Zhang. "Hybrid No-Reference Quality Metric for Singly and Multiply Distorted Images", IEEE Transactions on Broadcasting, 2014 Publication	1%
5	makerhacker.github.io Internet Source	1%
6	Y. Yalman, F. Akar, C. Bayilmis. "A web-based digital analysis interface for image quality assessment", The Imaging Science Journal, 2013 Publication	1%

7	www.jgrcs.info Internet Source	1%
8	dep.fie.umich.mx Internet Source	1%
9	en.wikipedia.org Internet Source	1%
10	N.J. Sairamya, L. Susmitha, S. Thomas George, M.S.P. Subathra. "Hybrid Approach for Classification of Electroencephalographic Signals Using Time–Frequency Images With Wavelets and Texture Features", Elsevier BV, 2019 Publication	1%
11	researchnetwork.net Internet Source	1%
12	Min Liu, Ke Gu, Guangtao Zhai, Patrick Le Callet, Wenjun Zhang. "Perceptual Reduced-Reference Visual Quality Assessment for Contrast Alteration", IEEE Transactions on Broadcasting, 2017 Publication	1%
13	Xiaohan Yang, Fan Li, Hantao Liu. "Deep feature importance awareness based no-reference image quality prediction", Neurocomputing, 2020 Publication	<1%

14	etd.ohiolink.edu Internet Source	<1 %
15	Submitted to essex Student Paper	<1 %
16	Submitted to Queen's University of Belfast Student Paper	<1 %
17	Shahrukh Athar, Zhou Wang. "A Comprehensive Performance Evaluation of Image Quality Assessment Algorithms", IEEE Access, 2019 Publication	<1 %
18	Submitted to University of Luton Student Paper	<1 %
19	Submitted to City University of Hong Kong Student Paper	<1 %
20	Nikunj Parikh, Santosh Chapaneri, Gautam Shah. "No-reference image quality assessment using extreme learning machines", 2016 International Conference on Inventive Computation Technologies (ICICT), 2016 Publication	<1 %
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22	Internet Source	<1 %
23	"ECR 2019: Book of Abstracts", Insights into Imaging, 2019 Publication	<1 %
24	Zhigang Gao. "Quality Constrained Compression Using DWT-Based Image Quality Metric", IEEE Transactions on Circuits and Systems for Video Technology, 07/2008 Publication	<1 %

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