Thesis for Bachelor of Science

Age, Gender & Emotion Detection Using CNN For Retail Analytics Customer Profiling.

Supervised By

Mr. Md. Shohel Arman

Assistant Professor

Department of Software Engineering

Submitted By

Name: Rubaiya Razin Bushra

ID: 191-35-2713

Batch: 28th

Department of Software Engineering

APPROVAL

This thesis titled on "**Age, Gender & Emotion Detection Using CNN for Retail Analytics Customer Profiling**", submitted by **Rubaiya Razin Bushra (ID: 191-35-2713)** to the Department of Software Engineering, Daffodil International University has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of Bachelor of Science in Software Engineering and approval as to its style and contents.

BOARD OF EXAMINERS

Chairman

Dr. Imran Mahmud
Head and Associate Professor
Department of Software Engineering
Faculty of Science and Information Technology
Daffodil International University

Internal Examiner 1

Md. Khaled sohel
Assistant Professor
Department of Software Engineering
Faculty of Science and Information Technology
Daffodil International University

Internal Examiner 2

Md. Shohel Arman
Assistant Professor
Department of Software Engineering
Faculty of Science and Information Technology
Daffodil International University

External Examiner

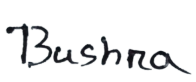
Rimaz Khan
Managing Director
Tecognize Solution Limited

©Daffodil International University

DECLARATION

I hereby declare that this thesis (Age, Gender & Emotion Detection Using CNN For Retail Analytics Customer Profiling.) has been done by me under the supervision of Mr. Md. Shohel Arman, Assistant Professor, Faculty of Science and Information Technology, Department of Software Engineering (SWE), Daffodil International University (DIU). It is additionally declared that neither this thesis nor any component has been submitted elsewhere for the award of any degree. All declarations are fully verified for completeness and the validity of their data element contents.

Done By -



Rubaiya Razin Bushra

ID: 191-35-2713

Batch: 28th

Department of Software Engineering

Faculty of Science & Information Technology

Daffodil International University

Certified By -

Mr. Md. Shohel Arman

Assistant Professor

Department of Software Engineering

Faculty of Science & Information Technology

Daffodil International University

©Daffodil International University

ACKNOWLEDGEMENT

I'm grateful to ALLAH for giving me the ability to complete the final thesis, & I thank my parents, who have always been supportive and who have always believed in me.

Also, I'd like to thank my supervisor, Mr. Md. Shohel Arman sir, Assistant Professor of the Faculty of Science and Information technology, Department of Software Engineering, Daffodil International University, for giving me the opportunity to work on this interesting topic & helping me with his patience, guidance & constructive criticism.

Rubaiya Razin Bushra

 ©Daffodil International University

TABLE OF CONTENTS

TABLE OF CONTENTS

 ©Daffodil International University

TABLE OF CONTENTS

 ©Daffodil International University

LIST OF FIGURES

LIST OF FIGURES

 ©Daffodil International University

ABSTRACT

These days computerized age & gender detection is a completely exciting research topic. For My this studies, when someone enters a retail shop, his or her photo is captured via the security camera. That image will be despatched as input to a machine learning model & by using those ML models age, gender & emotion would be predicted. Then the predicted facts will be stored in a database, for consumer profiling. The intention of this study is to research the usage of image detection for making better customer profiling for retail shops, & to make extra profit. Such as if it's far discovered in a store, most people come between the age group 20-50 & what's the most coming gender, then they can plan a shop offer for those products in which that specific age group or gender's people are interested, however, it will additionally assist to promote marketing, particularly for the age group of human beings. Then again when a purchaser enters a retail store & that person's emotion is diagnosed, then through knowledge of shoppers' sentiments & evaluation of their emotional responses, outlets can keep better customer service & assure first-class service towards each of the customers. A 2D Convolutional Neural Network (CNN) version is constructed to predict people's age, gender & emotion. The version accurately carried out 82.5% for age, 89.5% for gender & 97.3% for emotion.

 ©Daffodil International University

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND

In today's world every day go to many places, and most of the places we go have security cameras. Those cameras capture our presence in that place. Most of the cases that information is saved to a database due to security purposes. But what if, if we use that information for a retail shop's better customer service and get more profit?

In this thesis, I'm trying to work on such an area where we go through most of the day. But now, I'm interested to apply my idea to that part. Now my theme is that when a consumer enters a retail shop, at that time his or her image is captured through the security camera. And when that image is captured, and by the use of the machine learning model, it will be able to predict the consumer's age, gender, and emotion, And when it's possible to predict then that will be an interesting phase for both the consumers and businessmen. Cause when the business person will be able to detect that most people are coming belongs to which age range, & the most coming gender then they can focus on those products on which they are fascinated, on the other hand, they can plan a shop offer based on that information. Also, when they can evaluate the emotion of the consumer when they enter, then they can provide better customer service to each of the consumers. What is really important for enlarging the business, good experience in customer service is really helpful for that.

 ©Daffodil International University

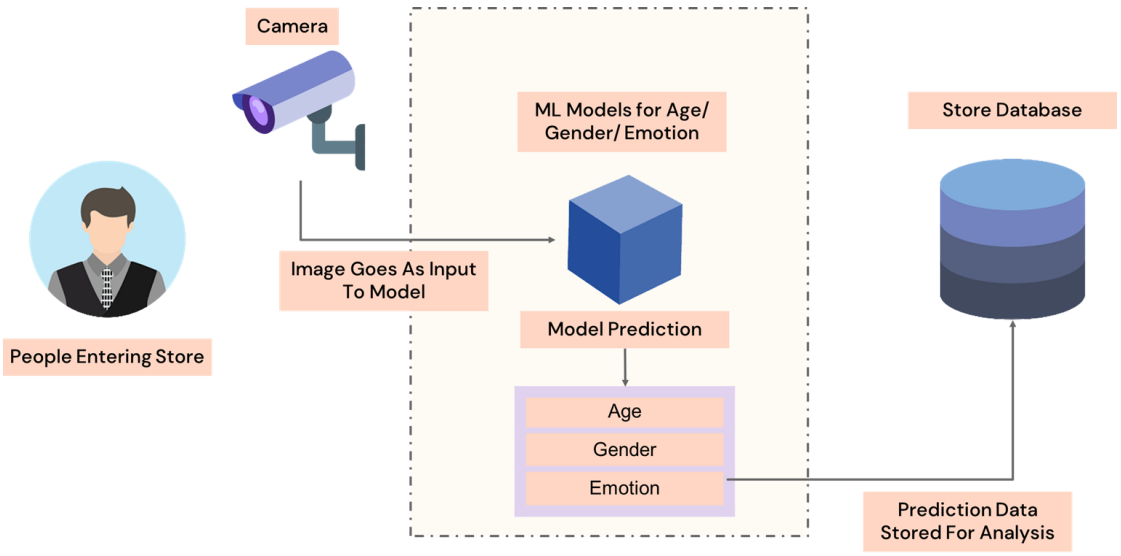


Figure 1: An architectural view of the customer profiling process

Now there can be a question 'why this customer profiling is important?'

This customer profiling is important for a better understanding of the customer's information, which will help to understand the business holder that on which s/he should be focused to enlarge his or her business and gain more profit.

For example, let's think that in a car retail shop if it's analyzed that most of the coming people's age range is 35-55, then based on that information they can think that on which model those age groups people will be more fascinated, also when the most coming gender is also known then they can be more focused on which car model they should invest more. On the other hand, when a consumer enters the shop, then if it is predicted the emotional condition of the consumer that whether s/he is happy, sad, or in a neutral mood, then based on that they can try to provide better customer service.

©Daffodil International University

And that’s necessary also, cause the person who comes to a car retail shop s/he will invest a huge amount of money to buy that product. So if the shop management can make the environment positive by using this, then it will bring a pleasurable feeling to the consumer’s mind, which is really important to earn more profit. If once that consumer is pleasured by the management team's politeness, then s/he will visit again and again to that shop.

1.2 MOTIVATION OF THE RESEARCH

In our country, there is some business holder of retail shops, who don’t understand that exactly on which they should be focused. Who are their target customers and what are their target products. Which is a big issue for making a business platform and enlarging that platform. And because of those lackings in understanding, they fail to survive on that platform. Or they can’t earn the desired profit, what they were wanting. So, I think this research can be helpful for those people. Cause it provides customer profiling, which tells the retail shop’s business holders who could be their target customers and what should be their target product. And this also helps themes to provide better customer service, which makes a good relationship between the business holders and consumers.

So, the motivation of this research is to help the retail shop’s business holder by providing a customer profile, which will help them to figure out their desired target customer, target product, and comfy more the consumers by understanding the emotional condition of the consumers.

 ©Daffodil International University

1.3 PROBLEM STATEMENT

If each and every people should know how to maintain a retail shop business then everyone would earn enough profit. Every retail shop's service holder would be a successful business holder. But it's not true till now. We can see in our surroundings that there are many people who start their own businesses (retail shop's) but somehow they couldn't figure out their target marketplace, they just unknowingly go here and there but lose the actual marketplace, by don't figure out the actual target consumer and actual target product.

So, here I'm trying to solve this issue by detecting the age, gender, and emotion of a person by that person's image, which is captured through the security camera. I think this customer profiling is helpful for those people who are interested to figure out their target marketplace.

1.4 RESEARCH QUESTION

Here the research questions are:

- Is this analysis helpful to figure out the target customer and target product?
- Is this analysis helps to maintain better customer relationship management?

1.5 RESEARCH OBJECTIVES

This research's main objective is to help the retail shop's business holder by making a consumer's profile. This will help them to figure out their target customer, and target product and maintain better customer relationship management.

 ©Daffodil International University

So, the objectives of this research are:

- Collect dataset
- Use algorithm and method
- Age range prediction
- Gender prediction
- Emotion prediction
- Making a consumer's profile to maintain a good customer relationship with consumers and earn more profit.

1.6 RESEARCH SCOPE

Scope of this research is:

- Information from this research will help to make the planning of shop offer on the product.
- Information from this research will help to maintain better relationships with the customers.
- Information from this research will help to advertise more specifically.

1.7 THESIS ORGANIZATION

In the first chapter I have said the background of this thesis, what's the motivation of this, why it's attractive to do, what is creating an issue and how that issue can have a solution. What is the research question of this paper and what are the objectives of this research?

 ©Daffodil International University

After that in the second chapter I'm going to talk about some literature review, that has been done till now on this age, gender, and emotion detection area. How the previous researcher thought and did their work, what was their lackings area and how I'm going to work on those lacking areas etc.

After that in the third chapter, I'm going to discuss how I collected data, how I preprocessed them, which algorithms I used, which methodology I have used, and how well they work.

In the fourth chapter I'm going to talk about the result of my thesis, and how is it performed, by showing the accuracy and loss function value I will discuss the result of my work

In the last chapter, in chapter 5 I'll mention the conclusion that what I want to remind my readers to recall, what I've done throughout the journey, the expected output ect. and the limitations of my work. Also, in future what I'm wanting to do on this area.

©Daffodil International University

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

Till this time convolutional neural network (CNN) model has been used in many areas in different expects. Sometimes it has gained the desired accuracy and sometimes it doesn't. In the field of image detection, deep learning and machine learning has used so many models and algorithm for time being to get more accuracy, and more satisfactory output.

2.2 PREVIOUS WORK

In 2018 R. Chauhan, K. K. Ghanshala, and R. C. Joshi [1] uses the MNIST algorithm, with the CIFAT-10 dataset, using the real-time augmented dataset for image detection. Where their algorithm MNIST work with their desired 99.6% accuracy, but the CIFAR-10 don't get the desired output, which they should work to improve.

On the year of 2021, Singh, Arjun, and Rai, Nishant and Sharma, Prateek and Nagrath, Preeti and Jain, Rachna [2] tried to predict age, gender, also emotion recognition. Where they use wide resnet architecture for age and gender detection. And CNN architecture for emotion recognization. There they got good accuracy for age and gender prediction but got low accuracy for emotion recognization.

 ©Daffodil International University

Ito, K., Kawai, H., Okano, T., & Aoki, T. (2018) [3] tried to predict age and gender form face image. Where they proposed a method for age and gender detection by using CNN architecture. There they also use wide resnet, regression/classification and DMTL/STL functions, where age was predicted by regression and gender was predicted by classification. But their data cleaning method was not that much powerful, also they should try to improve their accuracy for the proposed method by trying to modify the DMTL approach.

CNN model has been used for various points of view. It has used for facial point detection [4] , also in the year 2022 Nikolina Ljepava [5] proposed an AI base decision making marketing solution, where it was tried to use five steps of marketing process to be identify what they want to detect and by the use of machine learning they try to discover the insights from database and improve existing process. But lacking of that research was specified search item and mostly based on study design.

Wu Liu and Tao Mei. 2022 [6] tried to give a survey based result for monocular human pose for both 3D and 2D visualization. Here they used multi task learning model, regression model and bottom-up, top-down approach. But they have to focus on progress in algorithm, data and senarios of application.

Angulu, R., Tapamo, J. R., & Adewumi, A. O. (2018) [8] used cumulative score and mean absolute error to evaluate. But this paper wasn't investigate fully due to lack of data set by teh african, american an cauasian.

 ©Daffodil International University

Anjani Suputri Devi D, & Satyanarayana Ch. (2021) [7] proposed deep neural network-regression activation classifier, which has six phases. But this deep learning centered facial emotion recognition takes higher time for training.

Bulat, A., Tzimiropoulos, G. (2016) [9] also proposed an CNN cascade architecture for the prediction of human pose. Key feature of this paper was teh joint regression of part detection using heat maps. This CNN architecture was also proposed for facial parsing [11], recongnizing the speech [10].

Karim, N. T., Jain, S., Moonrinta, J., Dailey, M. N., & Ekpanyapong, M. (2018) [12] presented an automated approach by the use of image processing and deep learning, where they classify emotions. But due to the limitations of space they failed to provide all details. Also, their age module need more improvement.

Yi, D., Lei, Z., & Li, S. Z. (2015) [13] also proposed an CNN based model and multiscale convolutaional network analysis and logical alignment is place where they contributed. But they should focus on designing more reasonable multi task architecture for age prediction.

2D gabor transform image analysis by neural netwrok uses three steps for filtering and modification [22]. A paper also work on face tracking by the use of CNN model for age prediction [15]. For that prediction system they tried to use original CNN architecture,rather than modifying, that's why their accuracy was not as good as

 ©Daffodil International University

bio-inspired feture thesis [18]In biometrics face recognition has huge demand, science using face for recognition is a natural way [14].

By the use of machine learning in computer vision, emotion has been classified into sad or happy to see the use of artificial intelligence in medicine [19]. In th einital stage face use to recognized from an image, then it learns to predict the facial component and finally it upgraded and can predict the emotion from an facial image [21]. Deep learning method and traditional method has splited for facial expression recognition [17]. Predicting the emotional state of a person is not that much easy, not only for robots, but it's also difficult for human also to predict that accurately [20].

Satisfaction of consumer's are really important for retail stores. Here a paper try to use this information by the use of image processing, which will detect face, track them and also identify the customer who has come before. For that they use deep learning , convolutional network and gender classification [25].

In the year of 2018, a peper proposed that an approch will be able to detect the depressive and stressful content by detecting the sentence. Where a bi directional long short term memory, recurrent neural network and convulutional neural network model will work. But for some features it's accuracy was 69%. Which is really poor. So they should work on this fact to improve their accuracy [26].

 ©Daffodil International University

2.3 CONCLUSION

Till now their have been done different kind of research on image detection. Many has uses different kind of algorithm and modes to get desired result and a good accuracy. Now I'm going to use convolutional neural network model, haar cascader algorithm and other functions to get my desired output for age, gender and emotion prediction.

©Daffodil International University

CHAPTER 3

RESEARCH METHODOLOGY

3.1 RESEARCH METHODOLOGY

Here, I've used My own dataset. I've used image resizing, image gray scaling for data preprocessing, Haar cascade algorithm & 2D Convolutional Neural Network Model.

3.2 DATA COLLECTION

There are already many available data sets on Kaggle Such as CK+ Facial expression detection, UTK Faces, Facial age, etc. But here I've used my own dataset from Dhaka city of Bangladesh, where I collect about 1000 data. & trained them by using the makesense.ai tool & download the trained file as a CSV file. Then I used those trained datasets in my model.

Here are some sample images of my dataset:

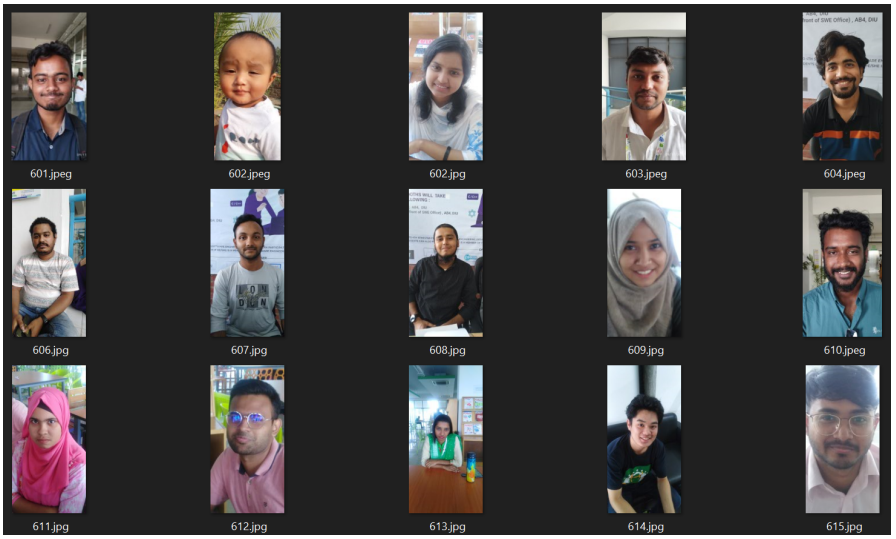


Figure 2: Different age, gender & emotion's sample picture

©Daffodil International University

In my data set, there are different ages people, of different genders people, also people with different emotions.

3.3 DATA PREPROCESSING

Data preprocessing plays a very important role in the use of machine learning. It's a process of preparing knowledge & making it suitable for machine learning models.For that, it is necessary to clean the data set & make it a formatted data set for Machine learning model usage. It takes the steps to format the image before they are going to used by model training. Here I've split the dataset into 75% for training & 25% for testing.

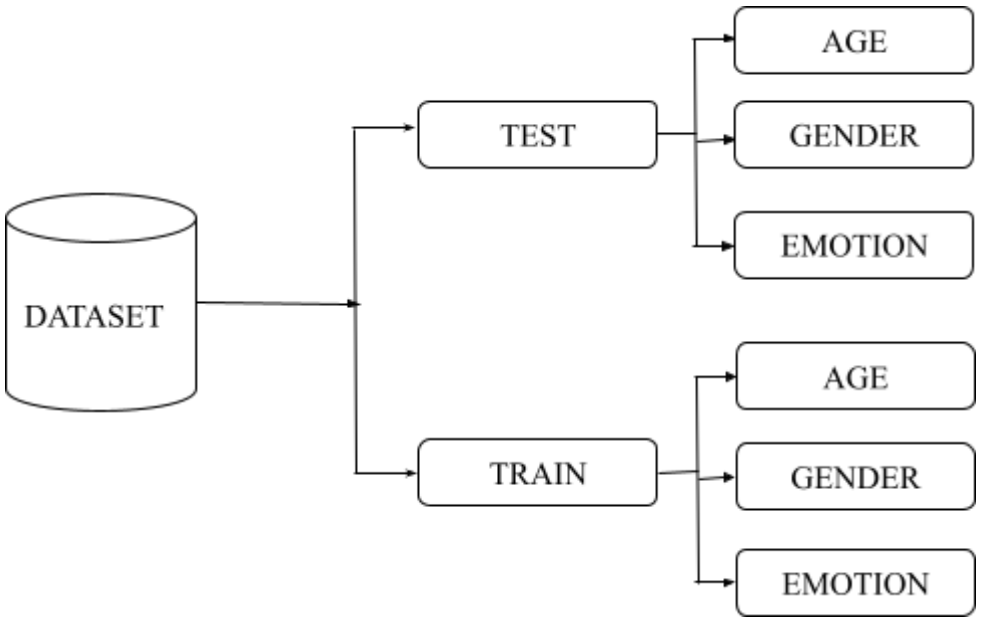


Figure 3: Dataset Labeling

 ©Daffodil International University

3.3.1 IMAGE RESIZING

Image resizing is an important phase in computer vision. Because the deep learning model trains faster when the image is small, on the other hand, if an image is twice larger then it requires the network to learn four times as many pixels. Which increases the training period for that architecture. That's why here I resized my sample images to [200, 200] shape.

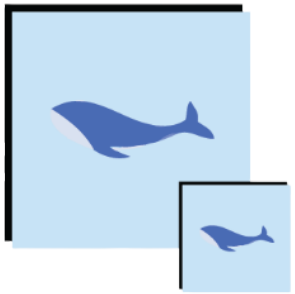


Figure 4: Image resizing

3.3.2 IMAGE GRAY SCALING

Image Gray scaling is a process by which we can convert the RGB, CMYK, HSV, etc. images to sheds of gray. It helps to simplify algorithms, and also eliminates the complexity related to computational requirements. This grayscale compressor an image to its minimum pixel.

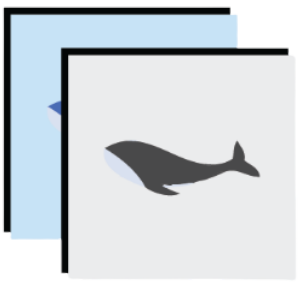


Figure 5: Image gray scaling

©Daffodil International University

3.4 HAAR CASCADE ALGORITHM

Haar cascade is an algorithm that can detect objects from images. This algorithm is easier & less complex to use. Also, this can run in real-time. We can train a haar cascade detector to detect various things. Like face detection, fruits, car, etc. This object detection algorithm is used to detect faces from an image or run-time video. This algorithm was first proposed by Viola and Jones in their research paper " Rapid Object Detection using a Boosted Cascade of Simple Features " which was published in 2001. This algorithm classifies its data point as positive data point & negative data point.

Positive data points → are those, which are part of our detected object. Which we want our classifier to identify.

Negative data points → are those, which don't contain our object that we may want to identify.

This is a machine learning-based approach, where we use a lot of positive and negative images to train the classifier. Haar Cascade is not that much accurate as modern object detection techniques we have. But it's much easier to use and can work in real-time.

 ©Daffodil International University

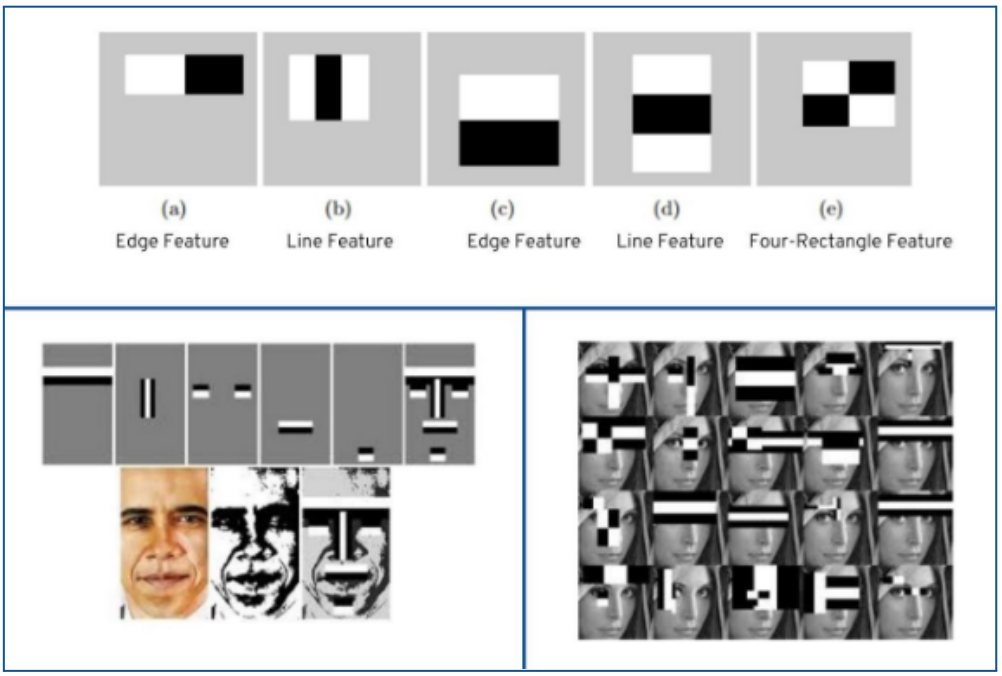


Figure 6: Terminologies used in Face Detection with Haar Cascade

3.5 CONVOLUTIONAL NEURAL NETWORK (CNN)

In image detection and obligations related to the processing of pixels, convolutional neural networks (CNNs) are used. Deep learning algorithms consisting of convolutional neural networks are capable of taking pictures as input and destination learnable weights and biases for diverse objects in the image. Comparatively different class algorithms, CNN no longer requires tons of preprocessing. while it has sufficient training then CNN has the potential to analyze the filters & characteristics.

©Daffodil International University

3.5.1 LAYERS OF CONVOLUTIONAL NEURAL NETWORK

The deep learning CNN consists of 3 layers. One is a convolutional layer, the second one is the pooling layer and the other one is the fully connected layer (FC).

From this convolutional layer to the Fully connected layer, the complexity of CNN increases. And it is the increasing complexity that allows the CNN to successively identify larger portions and more complex features of an image until it finally identifies the objects in their entirety.

Convolutional layer: An CNN's core building block is the convolutional layer, which performs most of the computations. Following the initial convolutional layer, a second convolutional layer can be applied to check whether the feature is in the image.

In multiple iterations, the kernel sweeps over the entire image. A dot product is calculated between the input pixels and the filter after each iteration. Feature maps or convolved features are the final results of the series of dots. As a result, this layer transforms the image into numerical values that are interpreted and analyzed by CNN.

Pooling layer: The pooling layer sweeps a kernel or filter across the input image similarly to the convolutional layer. The pooling layer, however, reduces the number of parameters in the input and also causes some information loss compared to the convolutional layer. Nevertheless, this layer enables the CNN to be more efficient and reduces complexity.

 ©Daffodil International University

Fully connected layer: In the fully connected layer ultimately the image classification happens, here in this layer all the previous layers are connected. In a convolutional neural network, all the layers are not always connected to each other because it will make the model more complex, that's why there is one dense layer.

In a CNN, there are multiple layers, & after passing each layer complexity of the feature increases. By passing each step it learns to identify partially. & when all of the steps are done then it learns to finally identify the desired object. Here in CNN kernel layer & max pooling or average pooling also there, where by max pooling or average pooling we minimize the number of layers. & finally, we got the dense layer, which can identify the object.

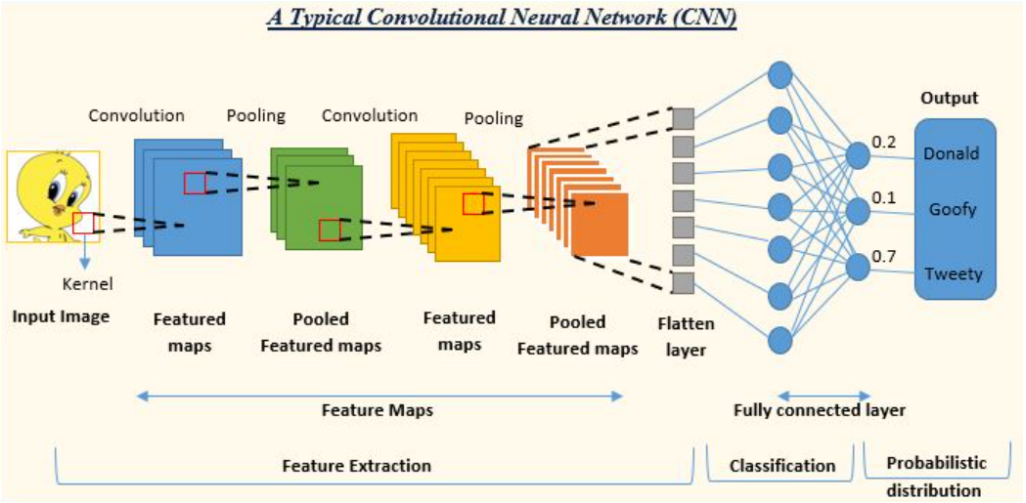


Figure 7: Basic CNN architecture

©Daffodil International University

3.6 2D CONVOLUTIONAL NEURAL NETWORK

2 Dimensional CNN model is generally used for image detection because in that model kernel can slide from 2 sides in the dataset. Like the given picture.

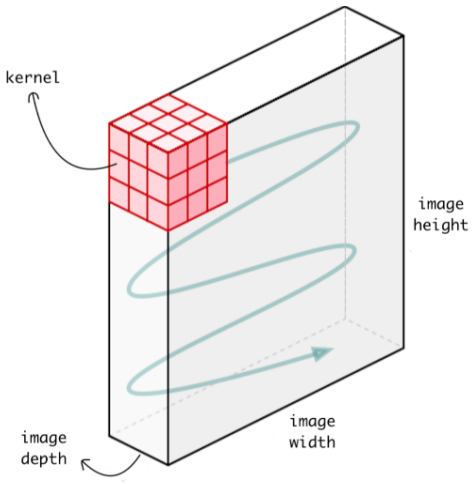


Figure 8: Kernel's sliding in 2D CNN

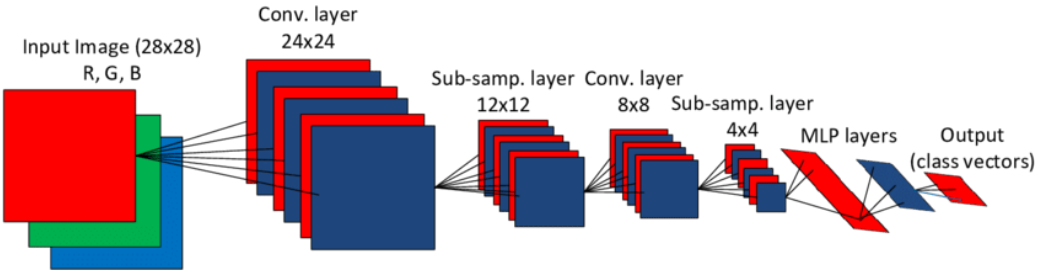


Figure 9: A basic architecture Of 2D CNN model

©Daffodil International University

Now, I'm going to explain for this thesis how I educated my version using 2d CNN.

3.6.1 For the age prediction version :

After defining my training of age range, I used 60 epochs on my CNN architecture, where in the beginning as an input I pass a Conv2D layer(32 filters) that are paired with an average Pooling2d layer, then I bypass 3 pairs of Conv2D (64, 128, 246 filters) and average Pooling 2d layers, then a global average Polling 2d layer I exceeded, then one dense layer with 132 nodes, after that it comes out as an output dense layer with 7 nodes.

Loss & Accuray of my model is given below:

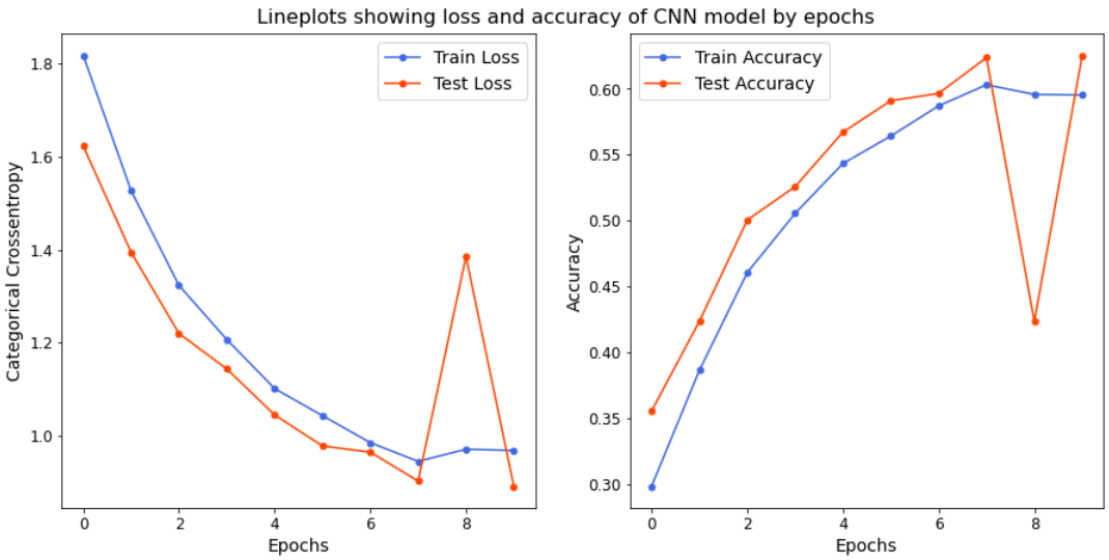


Figure 10: Loss and Accuracy of my model for age prediction

©Daffodil International University

3.6.2 For the gender detection version:

After converting all of the pics RGB to Grayscalling, I run 30 epochs to my version architecture, where at the start as an input Conv2D layer(32 filters) paired with a Maxpooling 2d layer changed into exceeded, then 3 pairs of Conv2D (64, 128 and 256 filters) and Max Pooling 2d layers had been run, then 1 Dense layer with 128 nodes and eventually as a dense output layer turned into a pop out with 3 nodes.

Loss & Accuray of my model is given below:

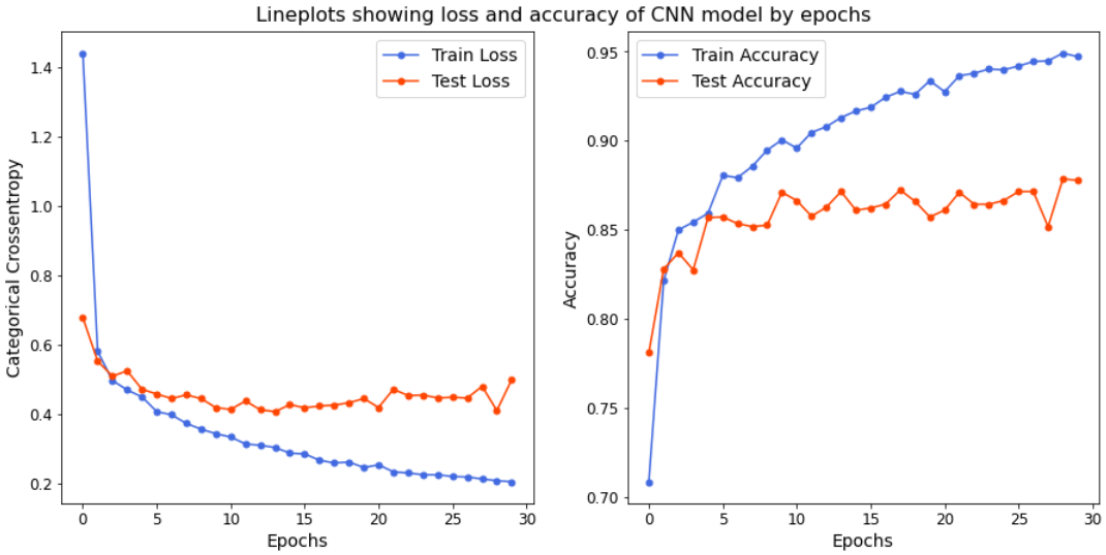


Figure 11: Loss and Accuracy of my model for gender prediction

©Daffodil International University

3.6.3 For the emotion detection model:

After defining the emotion labels, I run 50 epochs to my model architecture, where at the start as an input Conv2D layer(32 filters) paired with a Maxpooling 2d layer changed into exceeded, then 3 pairs of Conv2D (64, 128 and 256 filters) and Max Pooling 2d layers had been run, then 1 Dense layer with 128 nodes and eventually as a dense output layer turned into a pop out with 3 nodes.

Loss & Accuray of my model has given below:

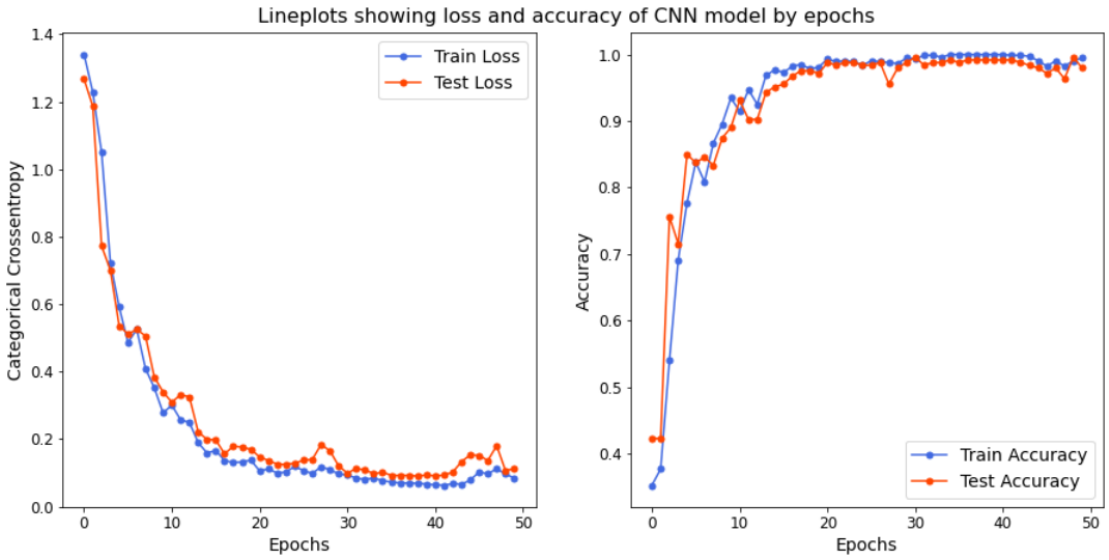


Figure 12: Loss and Accuracy of my model for emotion prediction

©Daffodil International University

3.7 EVALUATION METRICS

For the evaluation I have plotted confusion matrix for age model. And plotted line chart to see the both of training and testing accuracy and loss for age, gender and emotin model.

3.7.1 CONFUSION MATRIX

Confusion matrix is a summurized table to visualize the performance of a classification model.

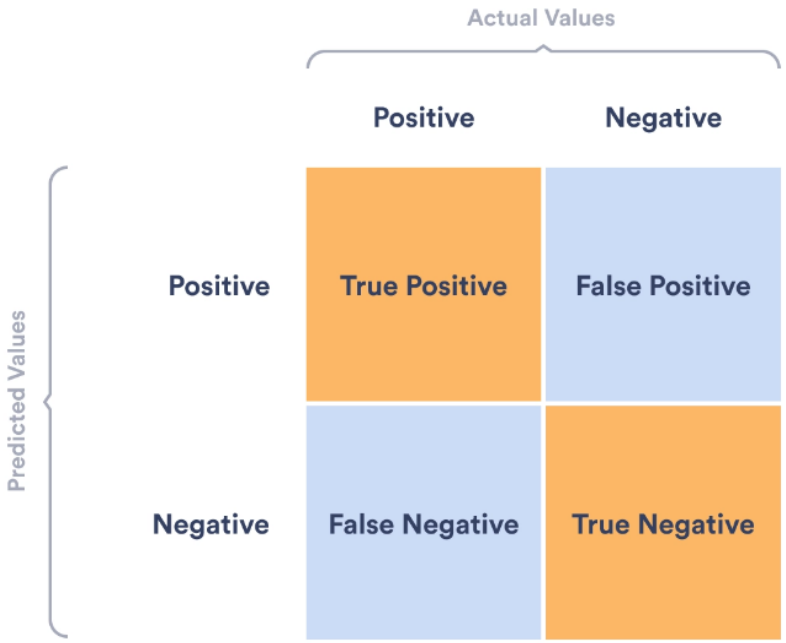


Figure 13: Confusion matrix

Here there is true positive, true negative, false positive and false negative in a confusion matrix. This informations helps to calculate that whether a model is useful or not. Or how much useful this model is.

©Daffodil International University

3.7.2 ACCURACY

Accuracy is an evaluation metrics that says that how much your model's prediction is right. Whether it is good or not. We can say that accuracy is the fraction which is accurate prediction in our model.

3.7.3 LOSS FUNCTION

It's the training which makes neural network able to learn something and after that by testing it can be evaluated that whether the training is good enough for the model to do something or not. And this loss function compares between the target and predicted output that how well the data was trained. And by completing each epochs a model try to decrease the loss quantity of the train and test data.

©Daffodil International University

CHAPTER 4

RESULT AND DISCUSSION

Now i'm going to visualize the result of my model and talk on that. For my this work I used 2D CNN model to train and test data. Now i'm going to show the accuracy and loss of train and test data for all of the three model for age, gender, and emotion prediction. Also, confusion matrix output for age prediction model.

This is the output of confusion matrix for my age prediction model:

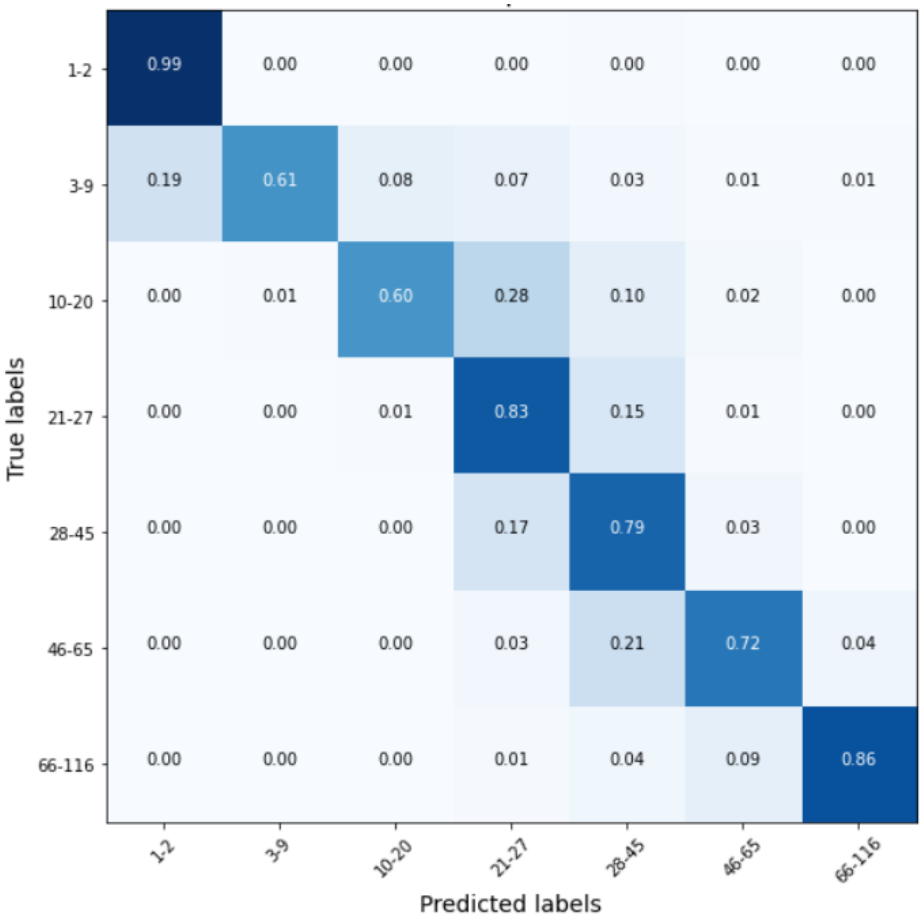


Figure 14: Confusion matrix of my age prediction CNN model

©Daffodil International University

Here from this confusion matrix we can say that, accuracy is quite good in between the agerange 1-2. After that accuracy in between 21-27 and 66-116 agerange is good, and accuracy of the agerange 28-45 and 46-65 is not bad. But the accuracy of agerange 3-9 and 10-20 is not that much good. It's not as expected.

Here, line plots showing the loss of the test and train data for age prediction model:

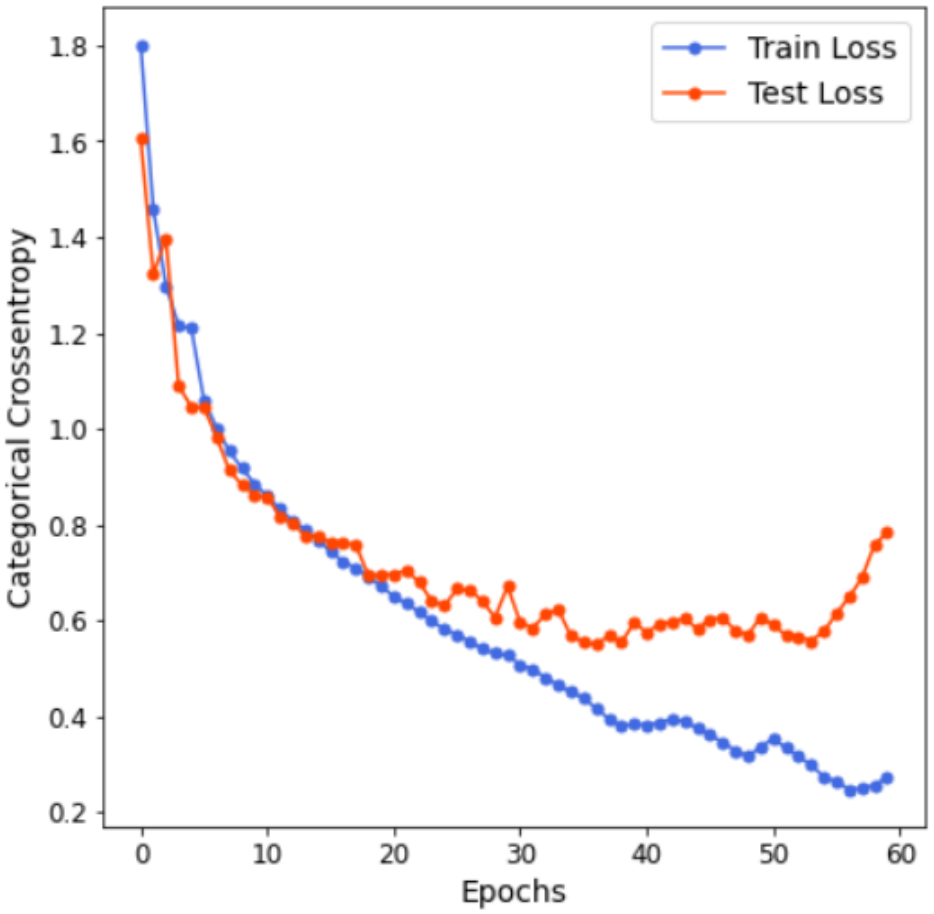


Figure 15: Loss of the test and train data for age prediction model

Here, we can see that after completing every epoch the loss function is decreasing. Which is good, as we know loss function is the quantity what's decreasing is wanted.

 ©Daffodil International University

Here, line plots showing the accuracy of the test and train data for age prediction model:

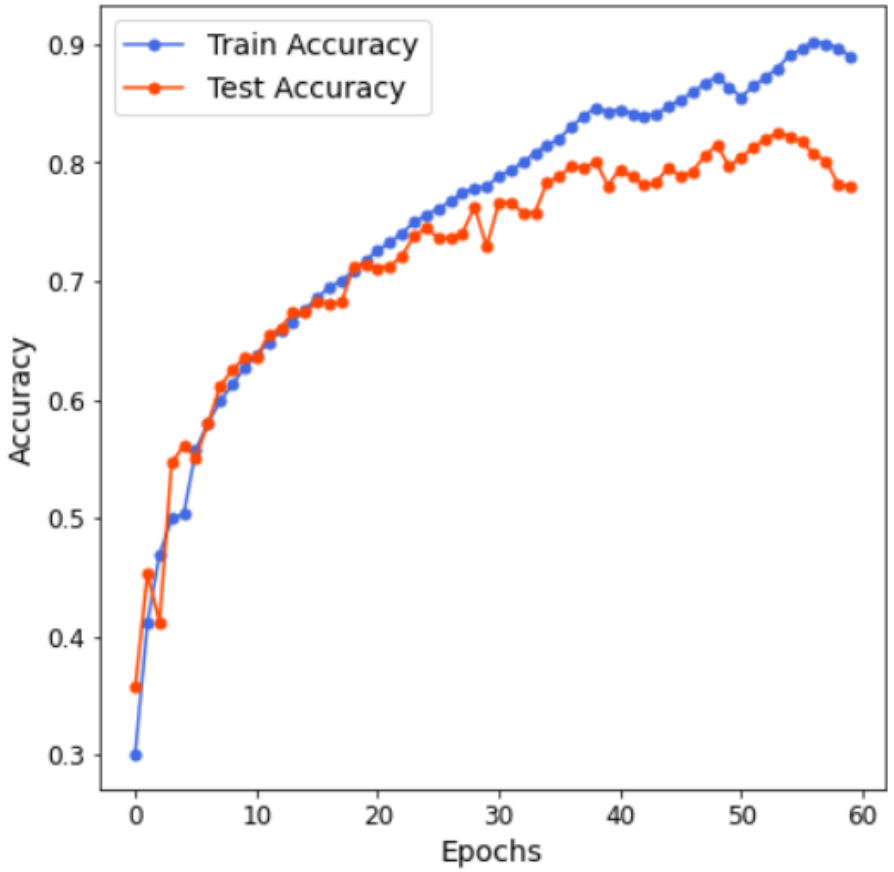


Figure 16: Accuracy of the test and train data for age prediction model

Here, we can see that after completing every epoch the accuracy function is increasing. And it's good, cause this upside graph means that the train and test accuracy is getting good by completing each epoch. And when it's the last epoch, then the accuracy is highest. What is quite satisfying.

©Daffodil International University

Here, line plots showing the loss of the test and train data for gender prediction model:

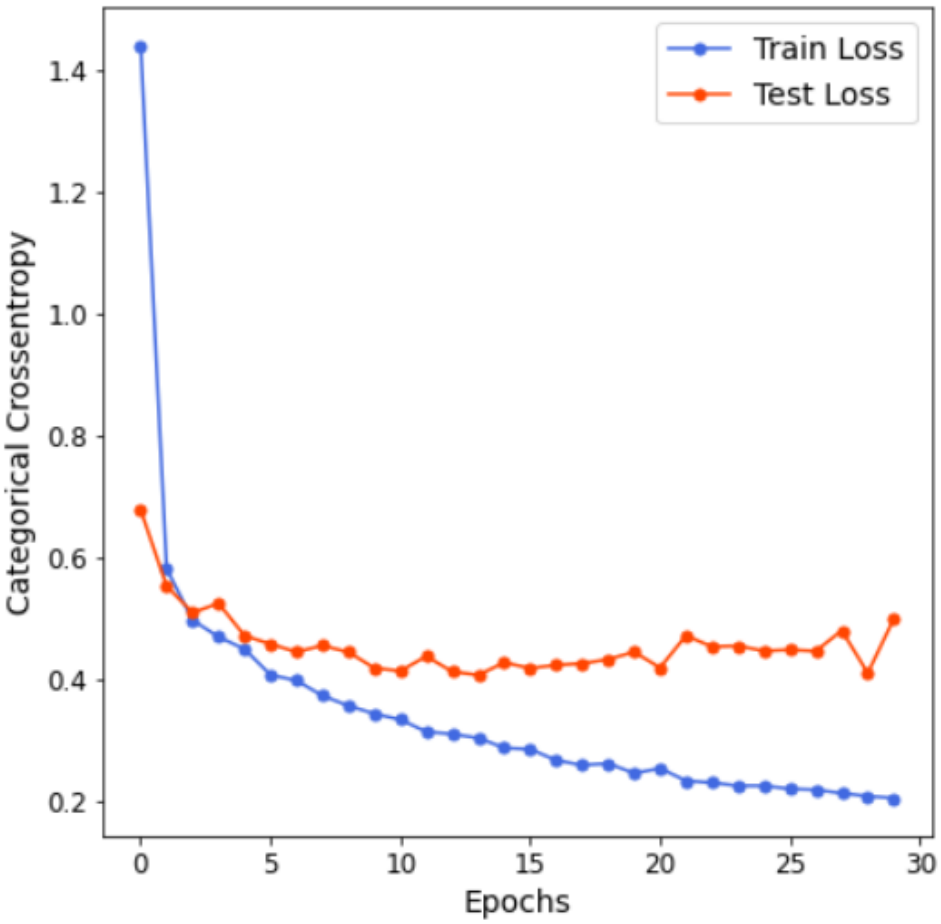


Figure 17: Loss of the test and train data for gender prediction model

Here, by this line plots we can visualize that with completing each epoch the loss function value is decreasing for the gender prediction 2D CNN model. And it's a good sign for the model evaluation.

©Daffodil International University

Here, line plots showing the accuracy of the test and train data for gender prediction model:

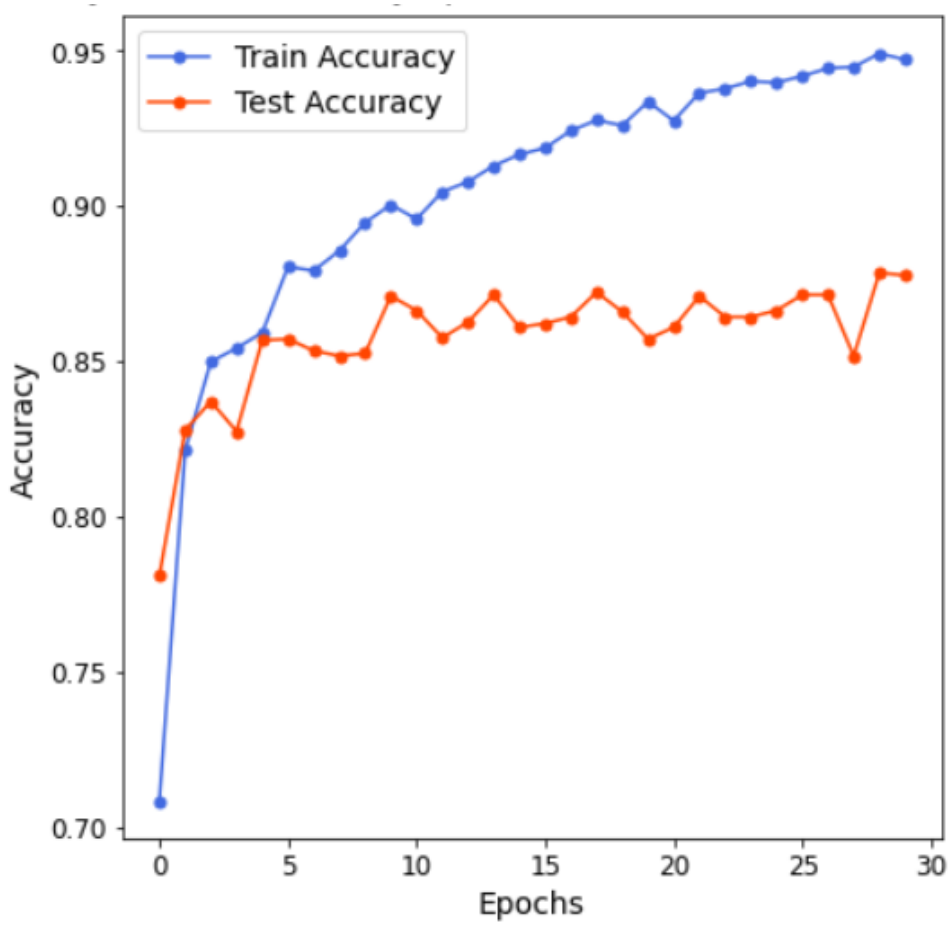


Figure 18: Accuracy of the test and train data for gender prediction model

Here, in this line plost of gender predection accuracy we can visualize that by completing every epoch the accuracy is getting higher. But at the same time we can visualize that the test accuracy is lower than the train accuracy.

©Daffodil International University

Here, line plots showing the loss of the test and train data for emotion prediction model:

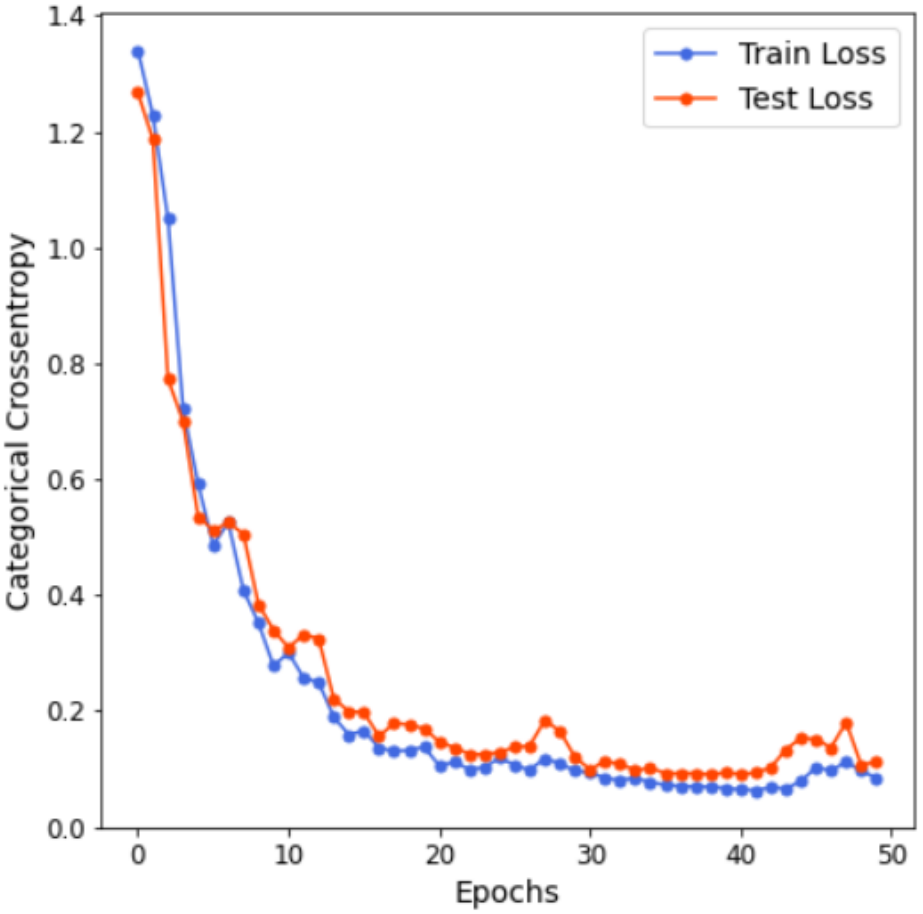


Figure 19: Loss of the test and train data for emotion prediction model

Here, by visualizing the line plots of loss function of emotion prediction model, we can see that the loss quantity value is decreasing with time and completing each epoch. And the train loss and tess loss is almost closest to each other.

©Daffodil International University

Here, line plots showing the accuracy of the test and train data for emotion prediction model:

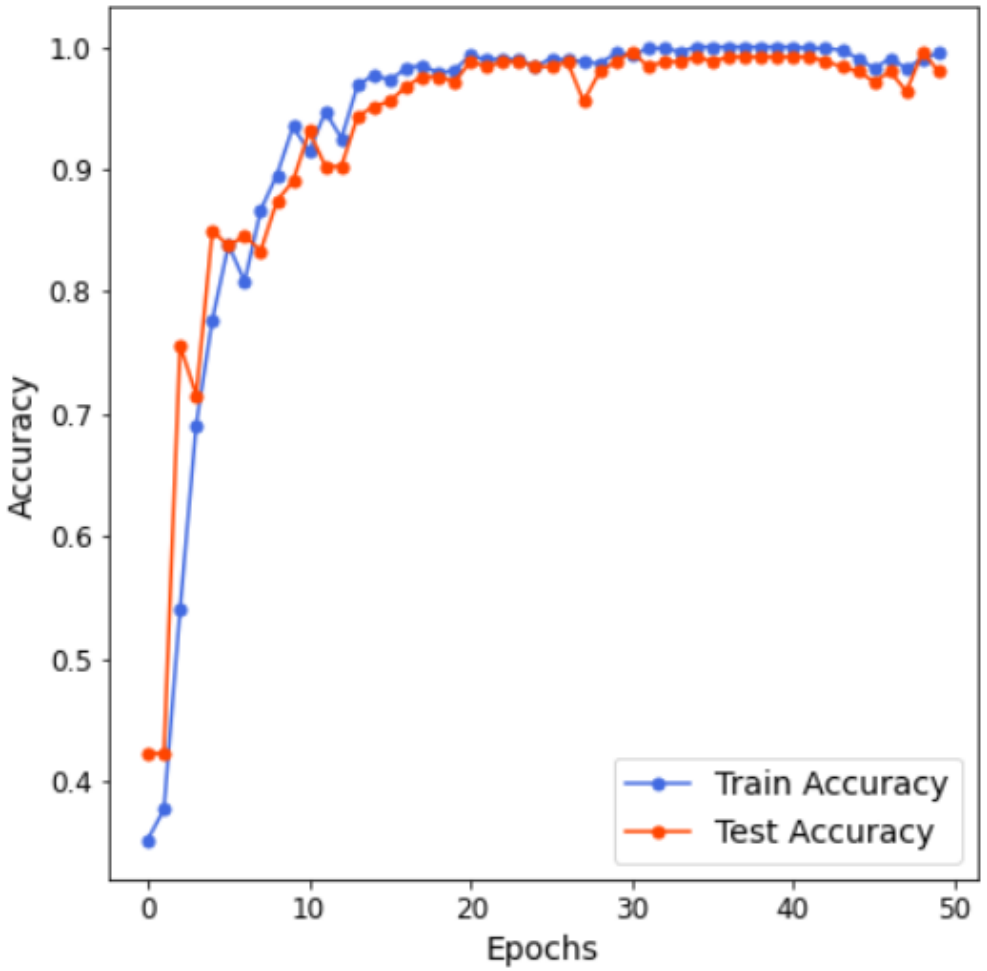


Figure 20: Accuracy of the test and train data for emotion prediction model

From visualizing the line plots for accuracy of emotion prediction model we can say that train and test accuracy is getting better with the time by completing each epoch. And the train and test accuracy is closest to each other which is good.

©Daffodil International University

CHAPTER 5

CONCLUSION AND LIMITATIONS

5.1 CONCLUSION

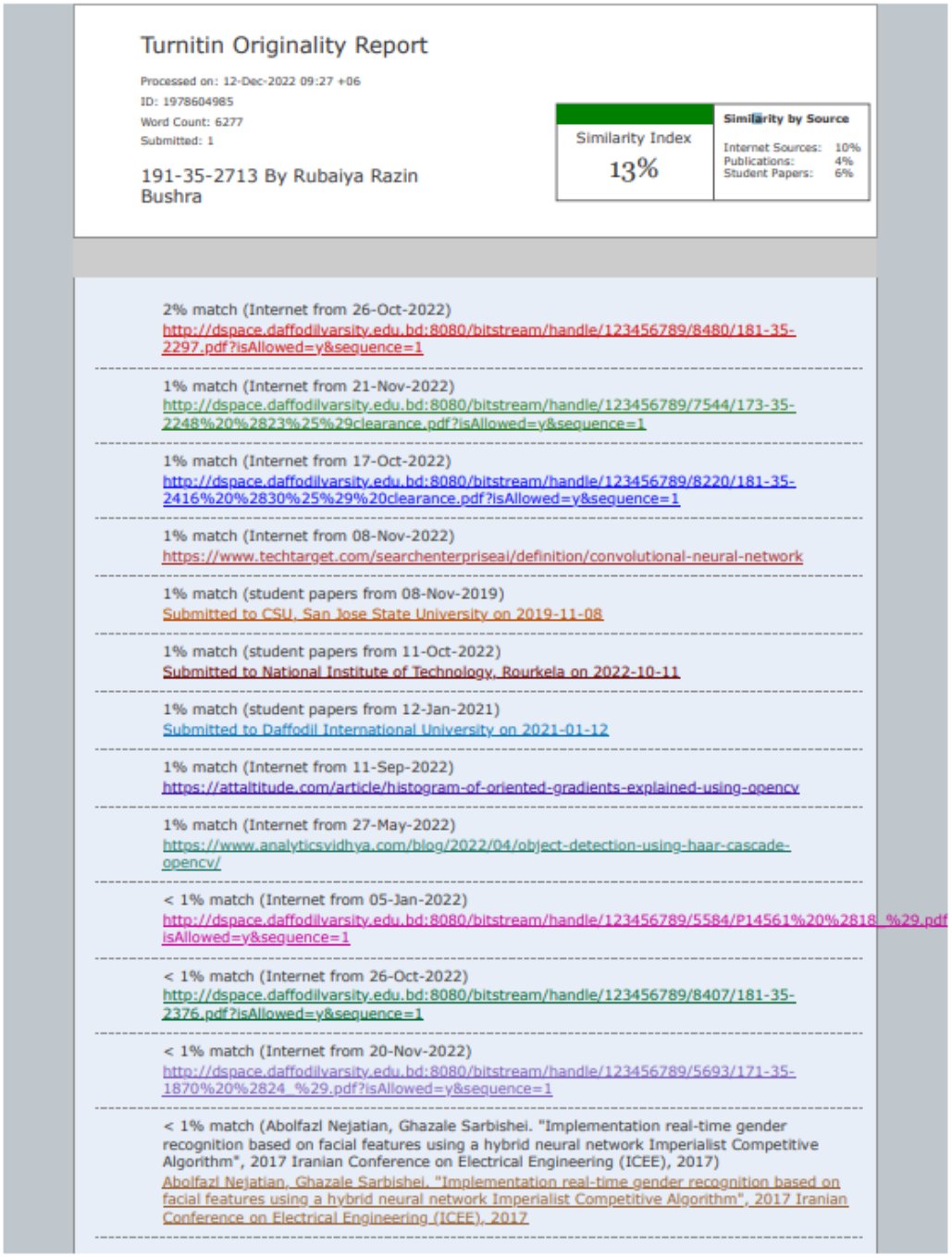
In this paper I try to find out an efficient process of age, gender, and emotion prediction by image detection. For that I used 2D CNN model what bring a good result, where it carried out 82.5% for age, 89.5% for gender & 97.3% for emotion prediction. And I hope that this will help the retail shop analytics to make consumer profiling and to figure out the actual target customer, aslo target product. What will help them to maintain a good customer relationship and planing shop offer and advertising more specifically.

5.2 LIMITATIONS:

Limitation of this paper is that, here the age prediction among the age range of 3-9 and 10-20 doesn't provide that much exact accuracy, though the average accuracy is good. So, in future I'd like to work for improving the accuracy of that agerange.

©Daffodil International University

PLAGIARISM REPORT



Turnitin Originality Report

Processed on: 12-Dec-2022 09:27 +06
ID: 1978604985
Word Count: 6277
Submitted: 1

191-35-2713 By Rubaiya Razin Bushra

Similarity Index 13%

Similarity by Source
Internet Sources: 10%
Publications: 4%
Student Papers: 6%

2% match (Internet from 26-Oct-2022)
http://dspace.daffodilvarsity.edu.bd:8080/bitstream/handle/123456789/8480/181-35-2297.pdf?isAllowed=y&sequence=1

1% match (Internet from 21-Nov-2022)
http://dspace.daffodilvarsity.edu.bd:8080/bitstream/handle/123456789/7544/173-35-2248%20%2823%25%29clearance.pdf?isAllowed=y&sequence=1

1% match (Internet from 17-Oct-2022)
http://dspace.daffodilvarsity.edu.bd:8080/bitstream/handle/123456789/8220/181-35-2416%20%2830%25%29%20clearance.pdf?isAllowed=y&sequence=1

1% match (Internet from 08-Nov-2022)
https://www.techtarget.com/searchenterpriseai/definition/convolutional-neural-network

1% match (student papers from 08-Nov-2019)
Submitted to CSU, San Jose State University on 2019-11-08

1% match (student papers from 11-Oct-2022)
Submitted to National Institute of Technology, Rourkela on 2022-10-11

1% match (student papers from 12-Jan-2021)
Submitted to Daffodil International University on 2021-01-12

1% match (Internet from 11-Sep-2022)
https://attaltitude.com/article/histogram-of-oriented-gradients-explained-using-opencv

1% match (Internet from 27-May-2022)
https://www.analyticsvidhya.com/blog/2022/04/object-detection-using-haar-cascade-opencv/

< 1% match (Internet from 05-Jan-2022)
http://dspace.daffodilvarsity.edu.bd:8080/bitstream/handle/123456789/5584/P14561%20%2818_%29.pdf?isAllowed=y&sequence=1

< 1% match (Internet from 26-Oct-2022)
http://dspace.daffodilvarsity.edu.bd:8080/bitstream/handle/123456789/8407/181-35-2376.pdf?isAllowed=y&sequence=1

< 1% match (Internet from 20-Nov-2022)
http://dspace.daffodilvarsity.edu.bd:8080/bitstream/handle/123456789/5693/171-35-1870%20%2824_%29.pdf?isAllowed=y&sequence=1

< 1% match (Abolfazl Nejatian, Ghazale Sarbishei. "Implementation real-time gender recognition based on facial features using a hybrid neural network Imperialist Competitive Algorithm", 2017 Iranian Conference on Electrical Engineering (ICEE), 2017)
Abolfazl Nejatian, Ghazale Sarbishei. "Implementation real-time gender recognition based on facial features using a hybrid neural network Imperialist Competitive Algorithm", 2017 Iranian Conference on Electrical Engineering (ICEE), 2017

 ©Daffodil International University

REFERENCES

1. R. Chauhan, K. K. Ghanshala and R. C. Joshi, "Convolutional Neural Network (CNN) for Image Detection and Recognition," 2018 First International Conference on Secure Cyber Computing and Communication (ICSCCC), 2018, pp. 278-282, doi: 10.1109/ICSCCC.2018.8703316.
2. Singh, Arjun and Rai, Nishant and Sharma, Prateek and Nagrath, Preeti and Jain, Rachna, Age, Gender Prediction and Emotion recognition using Convolutional Neural Network (April 25, 2021). Proceedings of the International Conference on Innovative Computing & Communication (ICICC) 2021, Available at SSRN: https://ssrn.com/abstract=3833759 or http://dx.doi.org/10.2139/ssrn.3833759
3. Ito, K., Kawai, H., Okano, T., & Aoki, T. (2018). Age and Gender Prediction from Face Images Using Convolutional Neural Network. 2018 Asia-Pacific Signal and Information Processing Association Annual Summit and Conference (APSIPA ASC), 7-11.
4. Y. Sun, X. Wang, and X. Tang. Deep convolutional network cascade for facial point detection. In Proc. Conf. Comput. Vision Pattern Recognition, pages 3476–3483. IEEE, 2013.
5. AI-Enabled Marketing Solutions in Marketing Decision Making: AI Application in Different Stages of Marketing Process. TEM Journal. Volume 11, Issue 3, Pages 1308-1315, ISSN 2217-8309, DOI: 10.18421/TEM113-40, August 2022.

 ©Daffodil International University

6. Wu Liu and Tao Mei. 2022. Recent Advances of Monocular 2D and 3D Human Pose Estimation: A Deep Learning Perspective. ACM Comput. Surv. Just Accepted (March 2022). https://doi.org/10.1145/3524497
7. Anjani Suputri Devi D, & Satyanarayana Ch. (2021). An efficient facial emotion recognition system using novel deep learning neural network-regression activation classifier. Multimedia Tools and Applications, 80(12), 17543–17568. doi:10.1007/s11042-021-10547-2
8. Angulu, R., Tapamo, J. R., & Adewumi, A. O. (2018). Age estimation via face images: a survey. EURASIP Journal on Image and Video Processing, 2018(1). doi:10.1186/s13640-018-0278-6
9. Bulat, A., Tzimiropoulos, G. (2016). Human Pose Estimation via Convolutional Part Heatmap Regression. In: Leibe, B., Matas, J., Sebe, N., Welling, M. (eds) Computer Vision – ECCV 2016. ECCV 2016. Lecture Notes in Computer Science(), vol 9911. Springer, Cham. https://doi.org/10.1007/978-3-319-46478-7_44
10. A. Graves, A.-R. Mohamed, and G. Hinton. Speech recognition with deep recurrent neural networks. In Acoustics, Speech and Signal Processing (ICASSP), 2013 IEEE International Conference on, pages 6645–6649. IEEE, 2013
11. P. Luo, X. Wang, and X. Tang. Hierarchical face parsing via deep learning. In Proc. Conf. Comput. Vision Pattern Recognition, pages 2480–2487. IEEE, 2012

 ©Daffodil International University

12. Karim, N. T., Jain, S., Moonrinta, J., Dailey, M. N., & Ekpanyapong, M. (2018). Customer and target individual face analysis for retail analytics. 2018 International Workshop on Advanced Image Technology (IWAIT). doi:10.1109/iwait.2018.8369732
13. Yi, D., Lei, Z., & Li, S. Z. (2015). Age Estimation by Multi-scale Convolutional Network. Lecture Notes in Computer Science, 144–158. doi:10.1007/978-3-319-16811-1_10
14. S.Z. Li and A.K. Jain, Handbook of Face Recognition, Springer, 2011
15. Yang, M., Zhu, S., Lv, F., Yu, K.: Correspondence driven adaptation for human profile recognition. In: CVPR. (2011) 505–512
16. DeeperCut: A Deeper, Stronger, and Faster Multi-Person Pose Estimation Model. https://doi.org/10.48550/arXiv.1605.03170
17. Chen J, Lv Y, Xu R, Xu C (2019) Automatic social signal analysis: facial expression recognition using difference convolution neural network. Journal of Parallel and Distributed Computing
18. Guo, G., Mu, G., Fu, Y., Huang, T.S.: Human age estimation using bio-inspired features. In: CVPR. (2009) 112–119
19. Kalantarian, H., Jedoui, K., Washington, P., Tariq, Q., Dunlap, K., Schwartz, J., & Wall, D. P. (2019). Labeling images with facial emotion and the potential for pediatric healthcare. Artificial Intelligence in Medicine, 98, 77–86

 ©Daffodil International University

20. Yanli Ji, Yuhan Hu, Yang, YangFuminShen, Heng TaoShen (March 2019) Cross-domain facial expression recognition via an intra-category common feature and inter-category Distinction feature fusion network. https://doi.org/10.1016/j.neucom.2018.12.037
21. Yingsheng Ye, Xingming Zhang, Yubei Lin, and Haoxiang Wang. 2019. Facial expression recognition via region-based convolutional fusion network. J. Vis. Comun. Image Represent. 62, C (Jul 2019), 1–11. https://doi.org/10.1016/j.jvcir.2019.04.009
22. J. G. Daugman, “Complete Discrete 2D Gabor Transforms by Neural Networks for Image-Analysis and Compression,” IEEE Transactions on Acoustic Speech Signal Process, Vol. 36, No. 7, 1988, pp. 1169-1179. doi:10.1109/29.1644
23. Jifeng Dai, Yi Li, Kaiming He, Jian Sun (May 2016). Object Detection via Region-based Fully Convolutional Networks.
24. Y. Fu, G. Guo and T. S. Huang, "Age Synthesis and Estimation via Faces: A Survey," in IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. 32, no. 11, pp. 1955-1976, Nov. 2010, doi: 10.1109/TPAMI.2010.36.

 ©Daffodil International University

25. Karim, Nabil Tahmidul; Jain, Sanjana; Moonrinta, Jednipat; Dailey, Matthew N.; Ekpanyapong, Mongkol (2018). [IEEE 2018 International Workshop on Advanced Image Technology (IWAIT) - Chiang Mai, Thailand (2018.1.7-2018.1.9)] 2018 International Workshop on Advanced Image Technology (IWAIT) - Customer and target individual face analysis for retail analytics. , (), 1–4. doi:10.1109/IWAIT.2018.8369732
26. Lopes Rosa, R., M. Schwartz, G., Vicente Ruggiero, W., & Zegarra Rodriguez, D. (2018). A Knowledge-Based Recommendation System that includes Sentiment Analysis and Deep Learning. IEEE Transactions on Industrial Informatics, 1–1. doi:10.1109/tii.2018.2867174

 ©Daffodil International University