CONTENT ACCESS USING FACE BIOMETRICS

A DISSERTATION

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS

FOR THE AWARD OF THE DEGREE

OF

MASTER OF TECHNOLOGY

IN

SIGNAL PROCESSING & DIGITAL DESIGN

Submitted by:

Prashant Bhatt

2K16/SPD/12

Under the supervision of

Dr. Dinesh Kumar Vishwakarma

(Associate Professor)

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

DELHI TECHNOLOGICAL UNIVERSITY

(Formerly Delhi College of Engineering)

Bawana Road, Delhi-110042

DECLARATION

I, (Prashant Bhatt), 2K16/SPD/12 of M.Tech (Signal Processing & Digital Design), hereby declare that the project dissertation titled "**CONTENT ACCESS USING FACE BIOMETRICS**" has been completed and presented in accordance with the academic rules and ethical conduct. This report is my own, unaided work. The citation of all the referred material and results have been done that are not original to this work. It is being submitted for the degree of Master of Technology in Engineering at the Delhi Technological University. It has not been submitted before for any degree or examination in any other university.

Place: Delhi Prashant Bhatt

Date: (2K16/SPD/12)

CERTIFICATE

This is to certify that the work which is being presented in the dissertation entitled "**CONTENT ACCESS USING FACE BIOMETRICS**" is the authentic work of Prashant Bhatt (Registration No. 2K16/SPD/12) under my guidance and supervision in the partial fulfilment of requirement towards the degree of Master of Technology in Signal Processing and Digital Design Engineering (Department of Electronics and Communication) in Delhi Technological University during the 2016-18. As per the candidate declaration, this work has not been submitted elsewhere for the award of any other degree.

Place: Delhi

Date:

Dr. Dinesh Kumar Vishwakarma

(SUPERVISOR)

Associate Professor

(Department of IT)

ABSTRACT

In recent years, privacy and security have become a major challenge to all of us. Each type of data is easily available and accessible to all. This raises a concern that is everyone should have access to every kind of data? Unlike for adults, the access to the data contents for children should be limited and access to adult content like pornography etc. should be controlled and kept out of reach of the children until they become certain years of age. Therefore, we aim to design an approach that allows the access of data contents stored in a system based on the face biometrics of the person trying to access the data. We have thus created a system with data mainly videos that are segregated in two categories mainly adult videos and child videos. Our approach works in real time and allows access to the data to a particular age group only. It works for the prediction of the age group to allow access to the data contents. So, first, the age group of a person is predicted by using the Voila-Jones algorithm to detect the faces or face limitations. After detecting the face, features are extracted using HOG approach to get the feature vector, and then to train the system we have used KNN classifier. A publically available dataset is used for training purposes. We have thus implemented an approach that works in real time and gives efficient results.

Acknowledgment

I owe my gratitude to all the people who have helped me in this dissertation work & who have made my postgraduate college experience one of the most special periods of my life.

I express my sincere gratitude to my project supervisor **Dr. Dinesh Kumar Vishwakarma**, Associate Professor (Department of IT) for his invaluable support, guidance, motivation & encouragement throughout the period during which this work was carried out. I have benefited greatly from her wealth of knowledge. I am deeply grateful to **Dr. S.Indu**, H.O.D. (Department. of ECE) for their support & encouragement in carrying out this project.

My gratitude extends to my colleagues and friends who have not been personally mentioned here in making this project a success.

Lastly, I would like to thank my parents, for instilling a good spirit, and as a result, I am able to do my work after graduation from this esteemed institution. Also, I would also like to thank my friends for believing in my abilities and always giving me their invaluable support and constant encouragement.

PRASHANT BHATT

(2K16/SPD/12)

Table of Contents

List of Figures

List of Abbreviations

1. KNN: k-Nearest Neighbours
2. VJ: Viola Jones
3. HOG: Histogram of oriented gradients
4. NN: Neural Network
5. SVM: Support Vector Machine
6. LBP: Local Binary Pattern
7. PCA: Principal Component Analysis
8. GUI: Graphical User Interface

CHAPTER 1

INTRODUCTION

This chapter is a brief introduction to the rest of the thesis. This chapter includes a brief introduction to the basis of our work i.e. **Content Access Using Face Biometrics.** It is solely based on human age group classification and thus in this chapter, we will discuss different techniques followed in the thesis, and different approaches to classifying a person in his/her relative age group such that he/she may access the content targeted for their age group only.

1.1 Introduction to Age Group Classification

Predicting the correct age of a person is rather a very difficult task. As the age of a human being increases, the features of the face changes. Recognition of face is one of the various methods to identify individuals using machine learning. Each individual on the Earth has its own unique biometrics and using these biometrics for identification are far better than the traditional methods. Research area in the field of person identification is quite large and an actively growing area in machine learning and computer vision. There are various biometrics that are used for identification of a person that includes face, voice, fingerprint, iris, ear, retina etc. These are some of the most common biometrics used for authentication methods. Research has been going on in those areas for more than 30 years. Basically, an Age group classification system gives us the power to differentiate children from adults and thus obstructing the entry of the children wherever they are not required. Facial images are being used as additional means of authentication in applications of various high-security zone. But as the age advances further, the features of a person's face changes and the thus the database needs to be updated regularly and it increases the complexity of the system. Therefore, we need to address this issue and come up with an approach that identifies a person's age group in spite of his correct age.

Most of the research in this category is based on the classification of an age of a person into a group like child-adult and senior. This is possible by using a combined approach of both types of facial feature i.e. wrinkle features and geometrical features for the face pattern recognition. We all know that Wrinkle features standalone are well enough to differentiate between an adult and senior. Whereas geometrical features serve its purpose by differentiating the children from the rest. [1]

There occurs a lot of change in the facial features as the age keeps on increasing. In this phase, global features in combination with the local features are extracted from the face images. The geometric features include the distance between two eyeballs, chin to the eye, nose tip to eye and eye to the lip. But when it comes to differentiating a child from an adult, these features are of most use. Note that new-born babies have a number of wrinkles on their faces. Also, their head bone structure in new-born ones is not fully grown. Therefore, we can say that using geometric features will be proved more reliable when a person to be judged is baby. Hence we can say that it is more reliable to use geometric features as compared to wrinkle features when it is to be judged that whether an image is a baby or not. Wrinkle features of a person are based on the texture of cheeks and area around the eyes.

We have used the HOG approach to get the feature vector out of the face of the person. In this approach, the gradients computed in the localized portions are counted and their orientation is noted. It is computed on a dense grid of uniformly spaced cells. HOG approach uses overlapping local contrast normalization thus improving accuracy.

1.2 Viola-Jones algorithm

The Viola-Jones object detection algorithm helps in detection of an object in real-time. Paula Viola and Michael Jones proposed this algorithm in 2001. This algorithm is superior is such a way that, we can not only detect face but also different parts of the face like nose, mouth etc., but it is mainly used for detecting faces. The first step in our project is to detect the face of the person trying to access the data contents in the system. After which we can extract the features required to classify him into a particular age group. [2]

Why Viola-Jones algorithm?

Viola–Jones algorithm has its own unique characteristics that help in being called as a good detection algorithm.

- Robust – It has a very high detection rate up to 97%
- For real-time applications, it is the best algorithm processing at least 2 frames per second
- The goal is to differentiate faces from non-faces, hence it is used for face detection only

Detection of faces is completed in four steps:

a) Haar Feature Selection

b) Creating an Integral Image

c) Adaboost Training

d) Cascading Classifiers

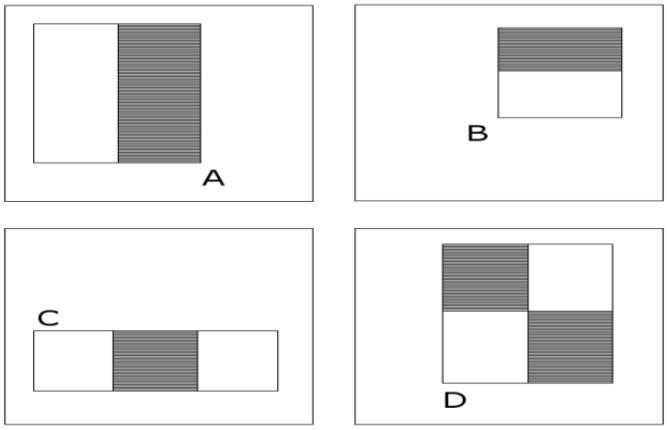


Fig. 1 Different types of Haar features used by the Viola-Jones algorithm to detect different parts of the face

Human faces among various persons have various similar properties. Haar Features can be used to match them. This method uses the features detected by the framework universally and the overall value can be calculated as the sums of image pixels within the rectangular areas. Thus, they are very similar to Haar basis functions. And Haar basis function has been used many times previously in various approaches. However, there are various rectangles used by Viola and Jones for detection purposes. In the figure above, all the four different types of features used in the algorithm. To find the value of any given feature using the Viola-Jones method, you just have to find the difference between all the pixels within the shaded region of the rectangle and pixels between the other region.

Fig. 2 Output of Viola-Jones algorithm

1.3 Problem Statement

Both adults and children have different minds and they react to different content in their own way. An approach is needed which can exclude kids from providing access to the content meant for adults only. Various approaches have been used so far in terms of defining the age group a particular person such that system can discriminate who is trying to access the contents stored in the system. Most of these approaches used geometric and wrinkle features as their basis for feature extraction but it fails when the surroundings are dark or illuminated as one can't detect wrinkle clearly then. Hence, an algorithm is to be used that is independent of the background surroundings of the person trying to access the database.

1.4 The motivation for the work

The human face is one of the characteristic, that can be used in a biometric security system to identify a user easily. There are various face biometrics that can be used to identify various parameters about a person's face. These biometrics can be used to design a system which can provide access to the data contents stored in it to a particular age group only. Thus age group classification of humans can be modelled into a system that can allow the privacy of data stored in the system. So, this system can prevent underage children from accessing the data stored in the system.

1.5 The objective of the work

To design a system that allows the access of data contents stored in a system based on the face biometrics of the person trying to access the data stored.

1.6 Thesis Organization

In the First Chapter, an introduction to the basic concepts used in the project has been covered along with its motivation and Objective

In the Second Chapter, Literature Review related to the project work is carried out. As the basis of our project work is age group classification, so the main focus of the chapter is how the techniques of age group classification were developed.

In the Third Chapter, the block diagrams, the flowchart of the related work, proposed work and its methodology is discussed in detail.

In the Fourth Chapter, all the results and performance evaluation that are obtained from the work are covered with proper screenshots of the outputs and the accuracy of the system is obtained.

In the Fifth Chapter, Conclusion of the work done, limitation of proposed work & future scope of the research work in this domain is presented.

CHAPTER 2

RELATED WORK

Our project work prevents a different age group to actually access the data in the system that is meant for another age group on a real-time basis. So, the basis of our work is definitely classifying a person into his/her respective age group. In the past, many proposals for assessment of different age groups have been proposed. The main steps used in the major group classification are mostly more common, such as image pre-processing, feature extraction, training, and testing. Therefore, some of the approaches related to our work are discussed below.

Lobo and Kwon, [3], proposed the age detection algorithm for the first time. They used geometric properties to differentiate between children and other groups. They classified the age group into three categories: child, adult and older. Their method is based on the analysis of skin wrinkles and geometric ratios, where facial features of wrinkles before the geometric ratio are evaluated to differentiate between adults and children. The difference between the eyes between the eyes and the nostrils between the eyes is done to separate the proportion of the child from the adults. After distinction of children, the properties of skin wrinkles are measured to identify the difference between adults and elder. Thus skin wrinkle characteristics and geometric ratios both combined give the age group. The performance rate of their approach was less than 68% for detecting children and they faced various issues in their way. They train the system on only 47 images but the results required high-resolution images.

Zhang et al. in [4], proposed age group classification in the unconstrained environment by using various conventional approaches to overcome the variations in unconstrained inputs. They proposed a CNN based approach for classifying age groups using Residual Networks of Residual Networks(RoR). They tried to use two mechanisms for characterising age groups and inferred RoR was effective over CNN in the wild.

Blanz and Vetter, [5], illustrated face detection frame in the light of a retinal connected nervous system (RCNN), which used small windows of an image to decide whether there is a face in a window. They tried to increase performance in more than one system. Their framework determines between several systems.

Lanitis et al. [6], used different parts of face for age estimation. They discovered an algorithm solely based on the statistical face model. Their work consists of the following: the whole face, face except the hair, the lower area of the face, the upper area of the face. After the analysis, they found out that the area near the eyes is most crucial for correctly guessing the age of a person. They explained that when the face with the hair is used for predicting the age, the error percentage is increasing. Their approach was limited to only persons 0 to 35 years of age. That was somewhere the downside of their approach as they didn't train their algorithm for older people. And, generally, older people have more wrinkles. They used 330 images and the out of which the testing was performed on only 80 images.

In [7], an approach to identify faces is described. It uses a combination of two methods, vector classifier for age group estimates and subspace projection algorithm. Also, the face detection algorithm is used as a basis for achieving the goal of face identification. Their system includes face detection, generalization, and subspace projection. They have used Haar like features as well as CNN, for detection of face and increasing the performance. After the face has been detected, normalization of the output obtained is done. Also, geometric alignment is used to reduce the effects of face rotation. Now, a sub-space projection is used to reduce the noise in the image. It is achieved by using PCA and spectral regression mixed approach. Lastly, SVM Classifier is used for predicting the age group of the person.

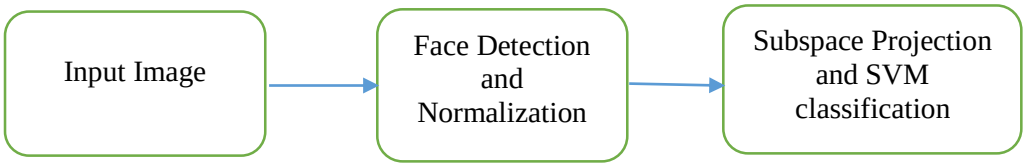


Fig. 3 Age Group Classification system of Tonchev, K, et al

In Gunav et al. [8], local binary pattern (LBP) was used to facilitate extraction, and the image was divided into N areas, from where each image's LBP histogram was made and all the histograms prepared were added to a form a vector. Neural networks is used to detect the face at the beginning. Eyes and eye pupil are also detected using the horizontal and vertical estimates of the image. Next, histogram equalization has been used to adjust the image contrast. This is done with the help of LBP histograms and finally, classification of the image into one of the age groups that are predefined is done. They also used K Nearest Neighbour (KNN) method for the classification of the age groups and achieved an accuracy of 80%.

Mohammad Ali et al. [9], discussed age group estimation using HOG features. They, the photo of the person taken as input to form the HOG feature vector algorithm. As a result, the

histogram outputs were obtained and concatenated as feature vectors. Histogram of local parts of the image was taken into account such as the forehead, eye corner, under the eyes and cheekbones. A feature vector was created for each image as input to the classifier and finally, neural networks were used to classify each image into a particular age group.

Ren in, [10], discussed an approach that was working on two levels. In the first stage image pre-processing and enhancement was done, while the other stage involved face detection algorithm using Haar-like features. Pre-processing on the images was done by converting them into grayscale images. Next Viola-Jones algorithm was used for detection of faces with the use of Haar –like features. As there exist many Haar-lie features within the image window, so they were concentrated just on the crucial features and not on the complementary ones. They used two datasets namely FG-NET and MORPH to train their algorithm for better efficiency. The Viola-Jones algorithm that they used applied chose just a single feature of the rectangle that differentiates positive and negative samples. The weak learning algorithm used for face detection. After the pre-processing of the image has been done followed by feature extraction, they used SVM based classifier to classify the images into groups. They achieved an accuracy of 76% for the first dataset that they used and 93% for the second one.

Weixin, Li et al. [11], used the FG - NET database for their experiment. Firstly, pre-processing of the image is done by normalizing the image. After that, Local Binary Patterns (LBP) is used to extract the facial texture features. Then after that, the Active Shape Model (ASM) was used to extract the shape features. They grouped the age of a person into two categories as a child to adult and adult to old. The shape of a face changes drastically when we are growing in the first age group as a child to an adult because of the bone movements of our growth and this doesn't happen during the 2nd stage. So the facial features are different between the two specified stages. Hence, they used a quadratic function to classify the images into one of the groups. And in the latter step, pre-processing of the image was done for age estimation by using Sparse Representation based Classification (SRC). As SRC requires a lot of training samples for each class, so the efficiency of this method of classification was very limited. They also used Ordinal Hyper-Planes Ranker (OHR) to improve their results. They used two parameters for performance evaluation: one is Mean Absolute Error (MAE), which basically means a difference of the true age and estimated age. Secondly, they used Cumulative Score (CS) that is defined as the absolute error between the actual age and predicted age.

Thukral et al. [12], applied the hierarchical approach in which they used images of a face which were divided into the different age groups. A regression model for each age group was being learned. FG-NET database was used by them as their basis for training as well as a test set. They used geometric features for making the feature vector after the feature extraction. Relevance Vector Machine (RVM) method is used as a technique for regression. They used RVM approach to get the detailed relationship between two variables. During the training phase, some samples are allowed to overlap as it will help the model in classifying the errors while classifying the mage to one of the groups. Finally, for the classification of test dataset, they used five different classifiers such as NN, Partial least squares (PLS), μ-SVC and they classified the images into one of the class using the majority rule so that the image will be classified into the most appropriate age group.

Blanz and Vetter 2003, [13], demonstrated the face detection frame in the light of a retinal connected nervous system (RCNN), which inspects small windows of an image to choose whether there is a face in every window to increase performance in more than one system, the framework determines between several systems.

Yang, Xi, et al. [14], used the framework of Multiple Instance Learning (MIL) for implementation of age estimation and proposed an algorithm called Witness based Multiple Instance Regression (WMIR). Their main idea was to find both type of instances: positive and negative and using them for training the classifier. Firstly, to reduce the noise in the image, pre-processing was done with a clear motive of noise reduction in the image using Principal Component Analysis (PCA). Also, the probabilistic weighted Support Vector Regression (pw-SVR) method was designed specifically for age estimation. For making the feature vector they used Logistic discriminant metric learning (LDML). Lastly, pw-SVM was used to train the samples and later to classify the age group accordingly.

Most of the research in the area of classifying age group of a person is somewhat limited due to different reasons that include a good database and the size of the available databases. Many researchers have mainly focused on the certain age groups, whereas others have tried to increase the range of classification by involving various age groups of correctly predicting the age. Now, lack of a quality database leaves the specific age prediction task as it is. Looking at the previous works, it can be said that the region around the eyes is most crucial for age prediction and hair hinders the results negatively. In this thesis work, our focus is to create a real-time system that gives you access to content belonging to your age group only. For this

Viola-Jones algorithm along with Histogram of Gradients(HOG) has been used. Finally, for classification purposes, we have used the basic KNN classifier. The system classifies your age group in real time and gives you access to the specific age group content.

CHAPTER 3

METHODOLOGY

The chapter introduces the proposed work for content access using face biometrics. It explains the methodology involved in the proposed work and the brief description of each step.

3.1 PROPOSED WORK

Biometrics nowadays is emerging as one of the most accurate, convenient, and cost-effective forms of security. There are various biometrics that are used for personal recognition based on the physical characteristics which include the face, fingerprint, hand geometry, handwriting, iris, retina, and voice. We have used age group classification as the basis of our work and have designed an algorithm that prevents the sensitive adult content in the system to be accessed by the underage. Basically, an Age group classification system gives us the power to differentiate children from adults and thus obstructing the entry of the children wherever they are not required.

Access control is a security technique which is used to regulate who or what can view or use resources in a computing environment. We have designed a real-time system that gives access to specific contents in the system to a particular age group only. Thus we are limiting the access based on the age group of the particular person.

A GUI has been made in which the content of different age groups has been clearly sorted out. So, each age group's content is only accessible to that particular age group only. We have created a data space that contains just six videos out of which three belongs to the adult category and rest three belong to child's category. The category of Adult includes both adults as well as seniors. You can also check your age group before trying to access any content, such that you can know which age group category you belong to.

3.2 PROJECT METHODOLOGY

The complete overview of the working of the project is explained using the flow diagram below.

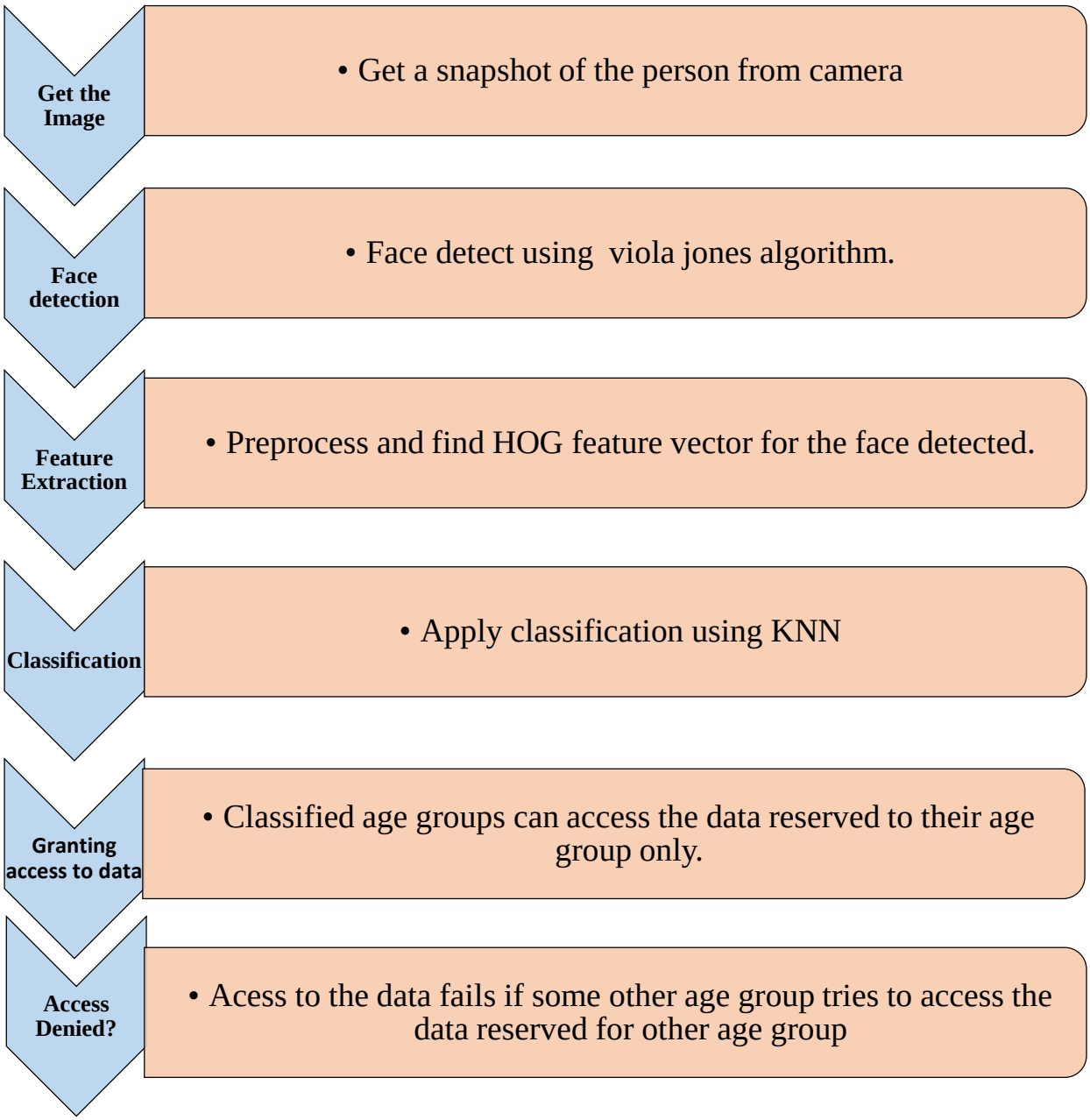


Fig 4 Block Diagram of the Project Methodology

These steps can further be clearly understood using the flowchart described below that specifies what happens when a person tries to access the content reserved to his age group or any other

different age group. There can be four scenarios in our project which are described below with the help of flowcharts in this chapter further.

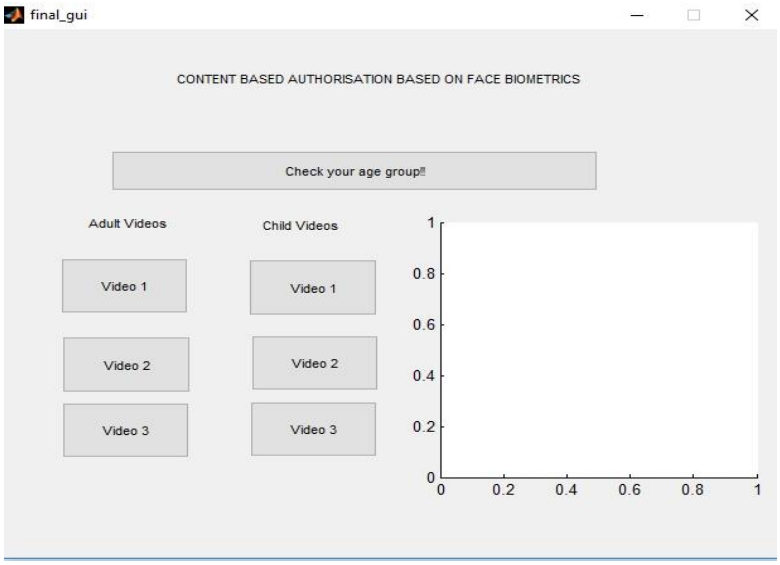


Fig 5 GUI of the project

3.2.1 Face detection and pre-processing

A person accessing the data contents through the GUI is required to get his picture clicked by the system and then the pre-processing on the image begins. Then the image is resized in 512x512. Now, we detect the face of the person trying to access the data contents in the system. After which we can extract the features required to classify him into a particular age group. Viola and Jones's algorithm [15] is being used to detect the faces of the person accessing the data contents in real time. After detecting the face of the person who is trying to access the data contents, the face is cropped out of the image and resized in 50x50. Then, finally, it is converted to the gray format for further processing.

3.2.2 Histogram of Oriented Gradients (HOG) Feature Vector:

The next step is to extract the features of the face to identify the age group it belongs to. We have used the HOG descriptor (Histogram oriented gradient) for this purpose. A feature descriptor is a representation of an image in the form of a feature vector. It simplifies the image by extracting only the useful information and removing the extraneous information. It counts the number of times a gradient orientation occurs in the selected area of the image. HOG feature descriptor used for age group detection is calculated on 50 x 50 patch of the detected face

image. The image can be of any size; the only constraint is that all the image being analysed should have a fixed aspect ratio for better results.

Now, to calculate the HOG feature vector, we first need to first calculate the horizontal(p_x) and vertical gradients(p_y) as we want to calculate the histogram of gradients. Next, we find the magnitude and direction of the gradient using the horizontal and vertical gradients using the formula:

Magnitude gradient = $\sqrt{(p_x^2 + p_y^2)}$ ……(1)

Direction of Gradient = $\tan^{-1}(p_y/p_x)$ ……....(2)

The image is divided into smallest possible regions called as cells. For each of these cells, a histogram of gradient orientations or edge orientations is computed. For each cell, its gradient orientation is computed and stored. The weighted gradient of each cell is contributed to its respective angular bin. The adjacent cell with similar gradient orientation are grouped together and these spatial regions are known as blocks. These groupings into blocks are the basis for histogram normalization. The normalized group represents the block histogram which in turn represent the HOG feature vector. We have selected a 50x50 image that gives a HOG feature vector of length 900. HOG feature vectors during the training phase for all the training database of the age groups have been calculated and stored. It acts as the base for the classification of testing images. As the HOG feature vector of the image under test will be compared with the stored trained database. [7]

This approach withstands the change of shadow and illumination. Therefore, it is a better algorithm than most of the approaches which fail when the surroundings are shadowed or illuminated.

3.2.3 Classification

After the HOG feature vector has been extracted, the next step is to identify the class that the person belongs to. As our ultimate goal is to give him access to the data contents he is trying to access. This is achieved by classification and recognition, i.e. classifying the age group label with the existing labels present in the system and then recognizing the age group label of the person in action. Thus, this step will give the output with a recognized age group label. We

have used KNN classification There are many techniques available for classification like KNN, SVM, Fuzzy logic, Neural Network, and many others.

KNN Classification: The k-nearest neighbour (KNN) algorithm is also known as instance-based learning algorithm because, in this learning method, a model is not actually being constructed. Here, simply the training examples are stored and it postpones the generalization (building a model) until a new instance must be classified or prediction made. This is also the reason it is called a lazy learning algorithm. Since this method delays the processing until a new instance is classified. In this method, an object that is being classified is classified based on the majority of the neighbours it belongs to. In this method, all instances are assumed to be corresponding points in the n-dimensional space. The nearest neighbours of an instance are defined in terms of standard Euclidean distance or any other distance. Classification is done based on the majority voting.

KNN algorithm works in two steps:

Training: In the training phase we assign the age group label to all the images in the database and store the results. These results are then used during the classification phase.

Classification: Given a query instance Y_q to be classified, Let $Y_1, Y_2, Y_3, \dots Y_k$ denote the k instances from Database that are nearest to Y_q. Then a label is assigned based on the labels of its k nearest neighbours by majority voting. The choice of the number of neighbours is up to the choice of the user. If k is 1 then it is classified whichever class of neighbour is nearest. If k has a value greater than 1 we use majority voting for the neighbour. After we have converted an image to a vector of fixed-length with real numbers, we used the most common distance function for KNN i.e. Euclidean distance.

3.2.4 Access Control

After the age group label has been assigned, now the last step is to check when the person trying to access the data belongs to the same age group label, as the data contents are. If he is then he is granted access, otherwise, the access is denied and a message is displayed on screen showing his/her age group written as "You are an ‘age_group’, sorry video can’t be played”.

This complete phase of access control is explained by using flowcharts covering all the scenarios our project might have.

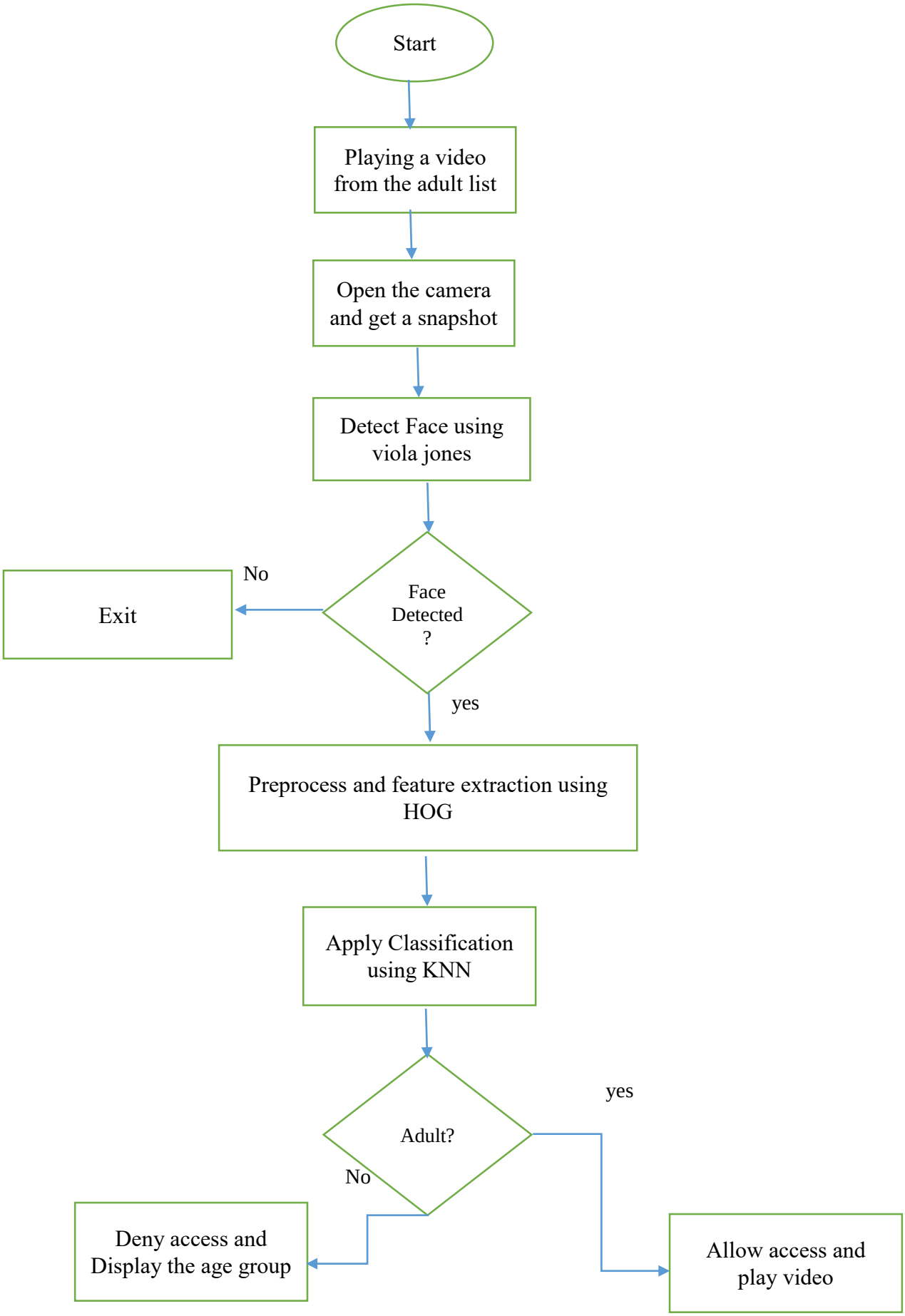


Fig. 6 Flow chart showing an adult accessing the contents of the system.

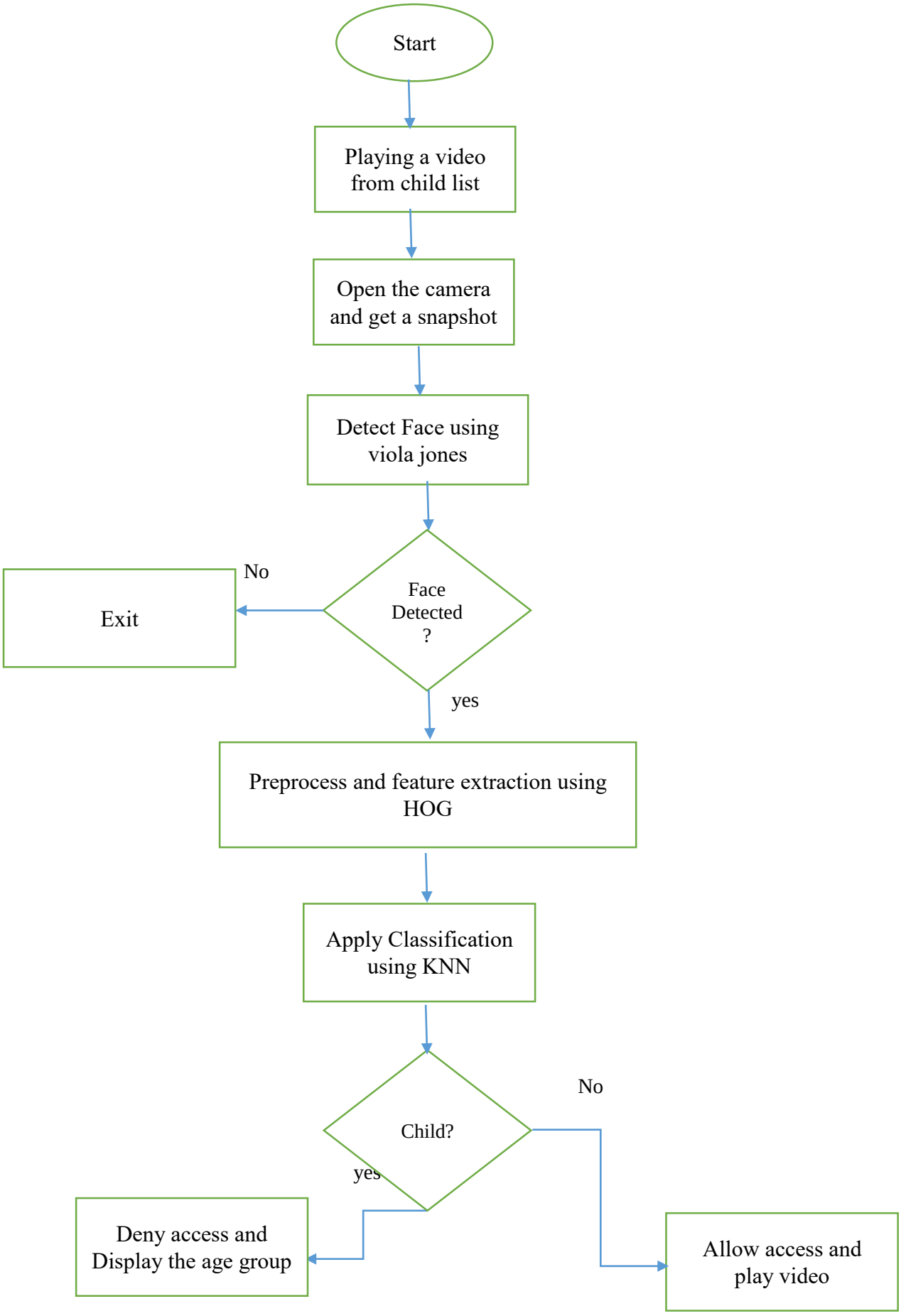


Fig. 7 Flow chart showing an adult accessing the contents of child playlist.

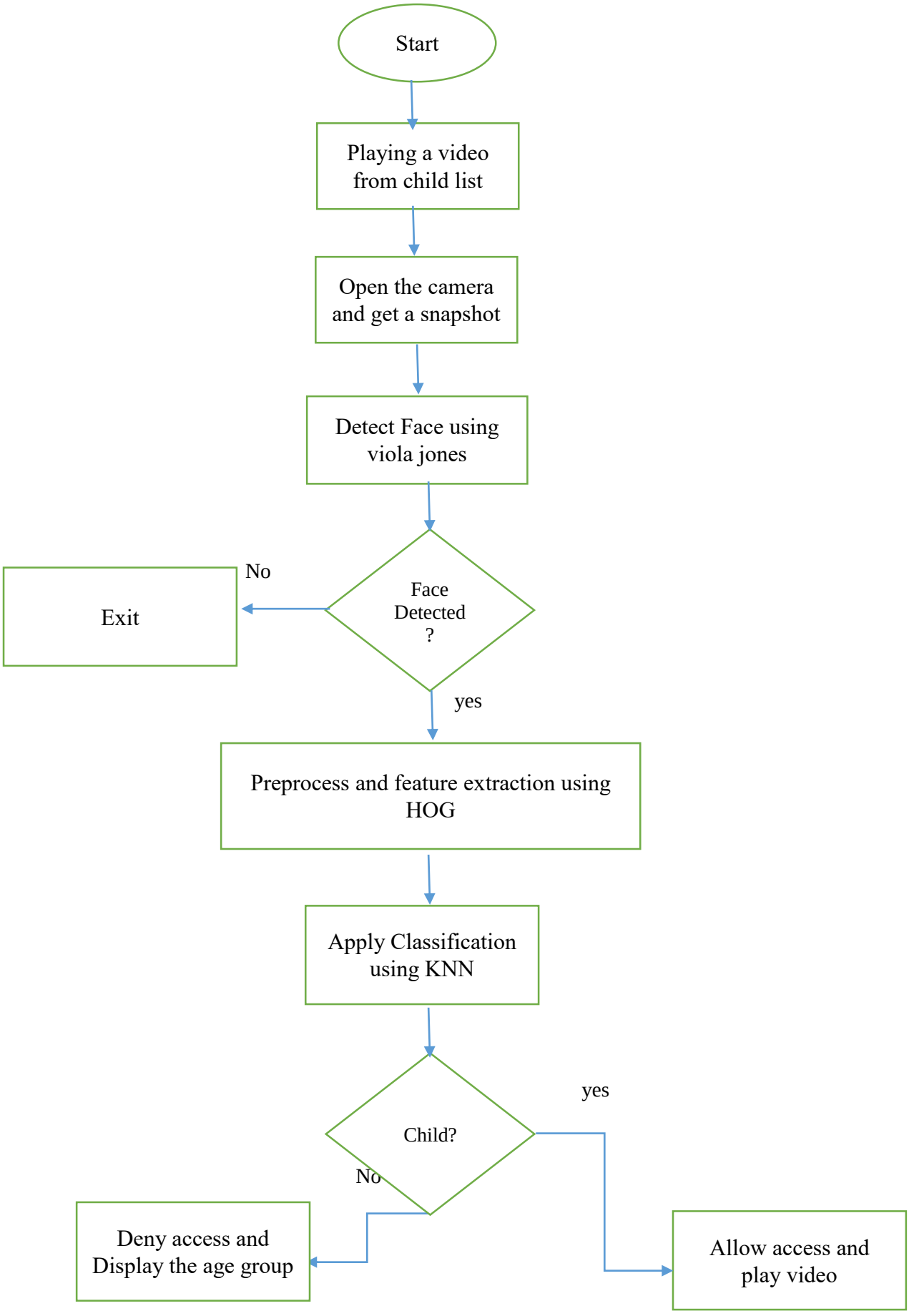


Fig. 8 Flowchart showing a child accessing the contents of child playlist

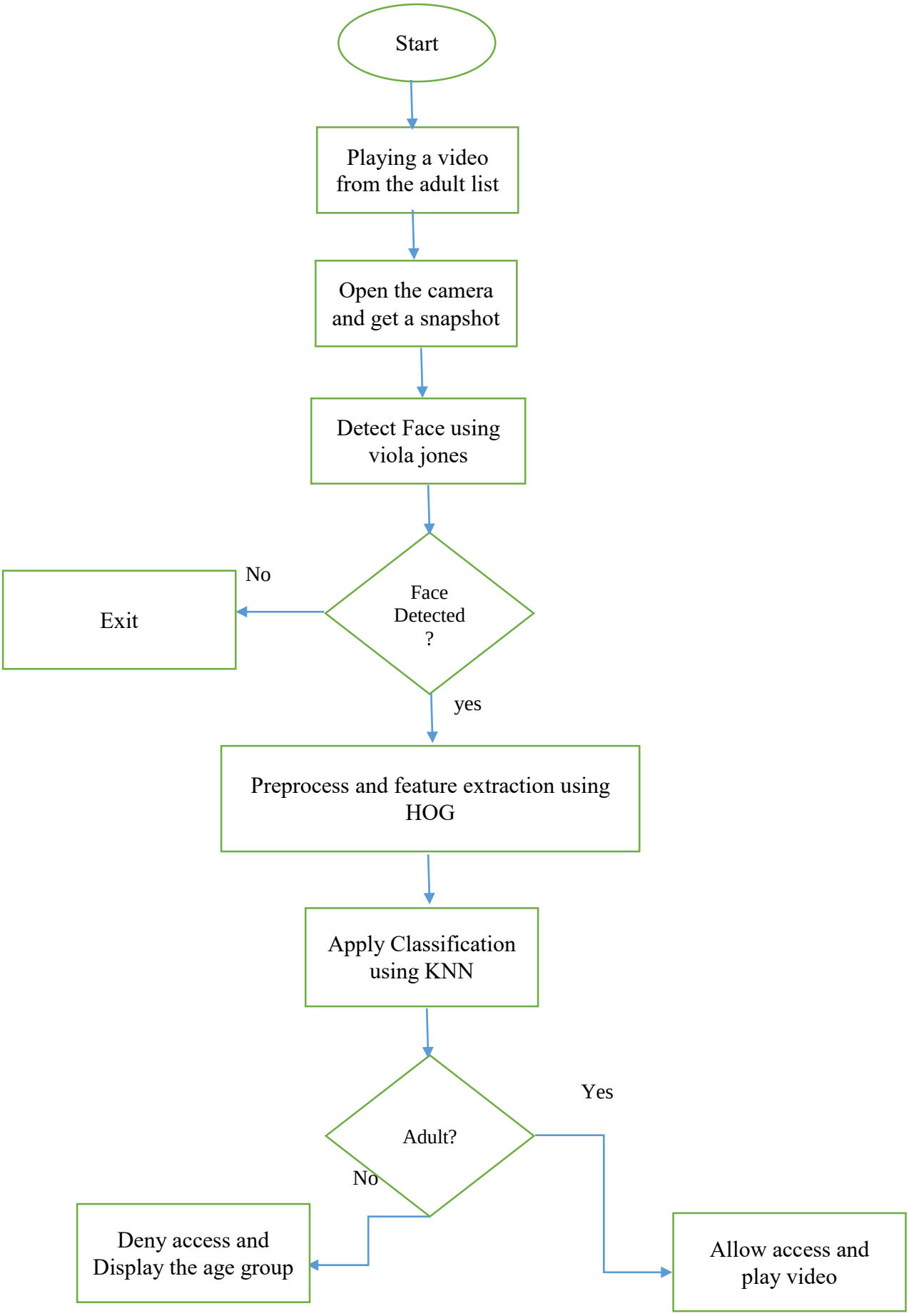


Fig. 9 Flowchart showing a child accessing the contents of the adult playlist.

CHAPTER 4

EXPERIMENTAL RESULTS

In this section, we have discussed the results obtained by the processing approach in a real-time environment. The proposed method is implemented on MATLAB 2013a software [16]. We have trained the system using a publically available dataset and the approach is being tested in real time. The obtained results are shown below.

4.1 Dataset Description

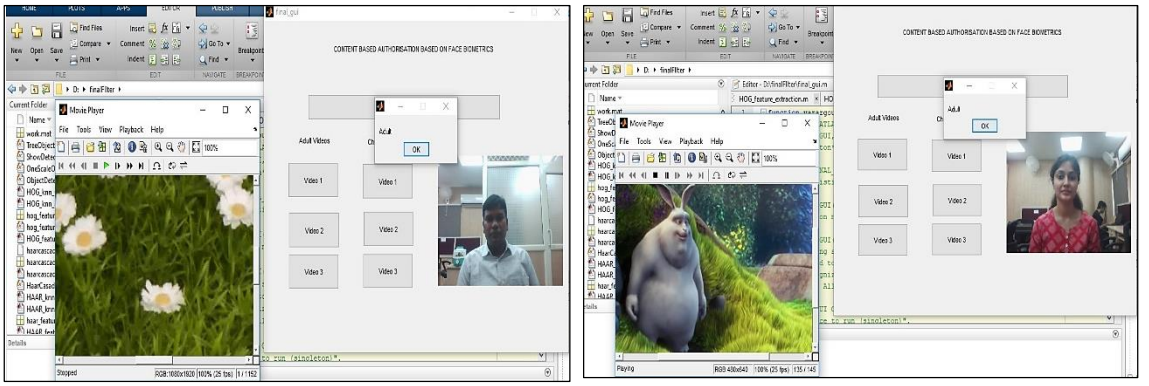
At first, the system is trained using the dataset that has been downloaded from the following site: http://www.cslab.openu.ac.il/download/ [17]. The dataset consists of images classified into 3 different age groups (Adult, Child, and Senior) of hundreds of people across the world. We have clubbed the image of the adults and senior into a single category as adults. The size of the images used during the training period is then standardized to 512x512 to ensure better efficiency

4.2 Results

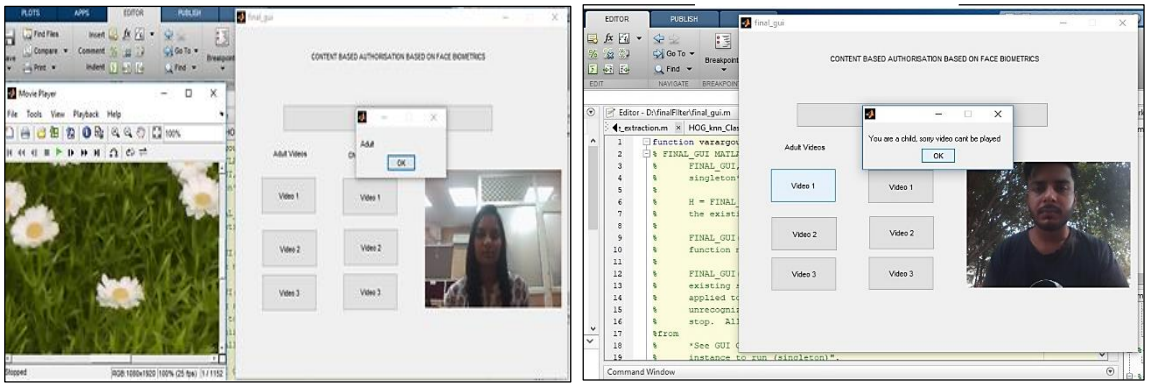
A graphical user interface(GUI) has been made in which the contents of different age groups have been clearly sorted out as clearly seen in the figure. So, each age group's content is only accessible to that particular age group only. Adult content can be accessed by both adults and seniors.

Every person who wants to access the data stored in the system needs to be of a particular age group to access the data reserved for that age group. We have distinguished the data into two categories i.e. Adult Videos and Child Videos. We have used around 80 images of adult age group and 40 images of child age group to train the system. Although more images should be used for better accuracy that will increase the time for processing.

Now, the screenshots for various age group people trying to access different data videos from both groups are discussed. In the first case results when an adult try to access the data contents are shown in Fig 10 and Fig 11.

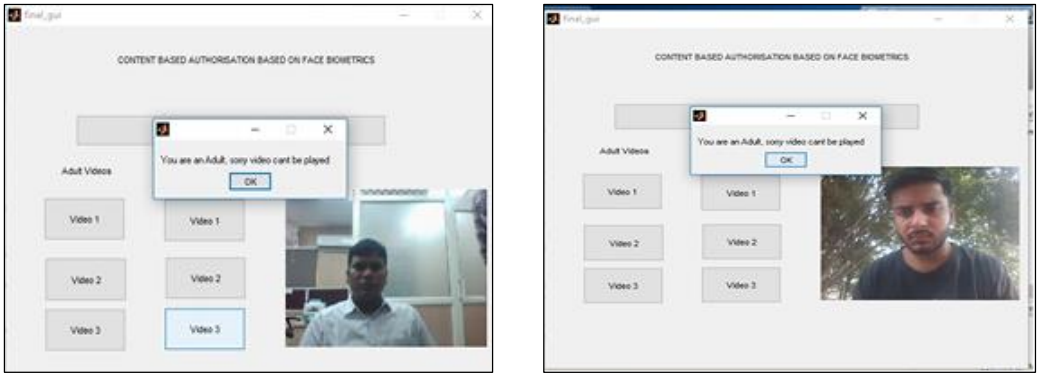


(a) b.



(c) (d)

Figure 10. Shows various output results when an adult try to access the data contents of his age group. Outputs (a), (b), and (c) shows the successful attempts whereas output (d) is the case of failure.

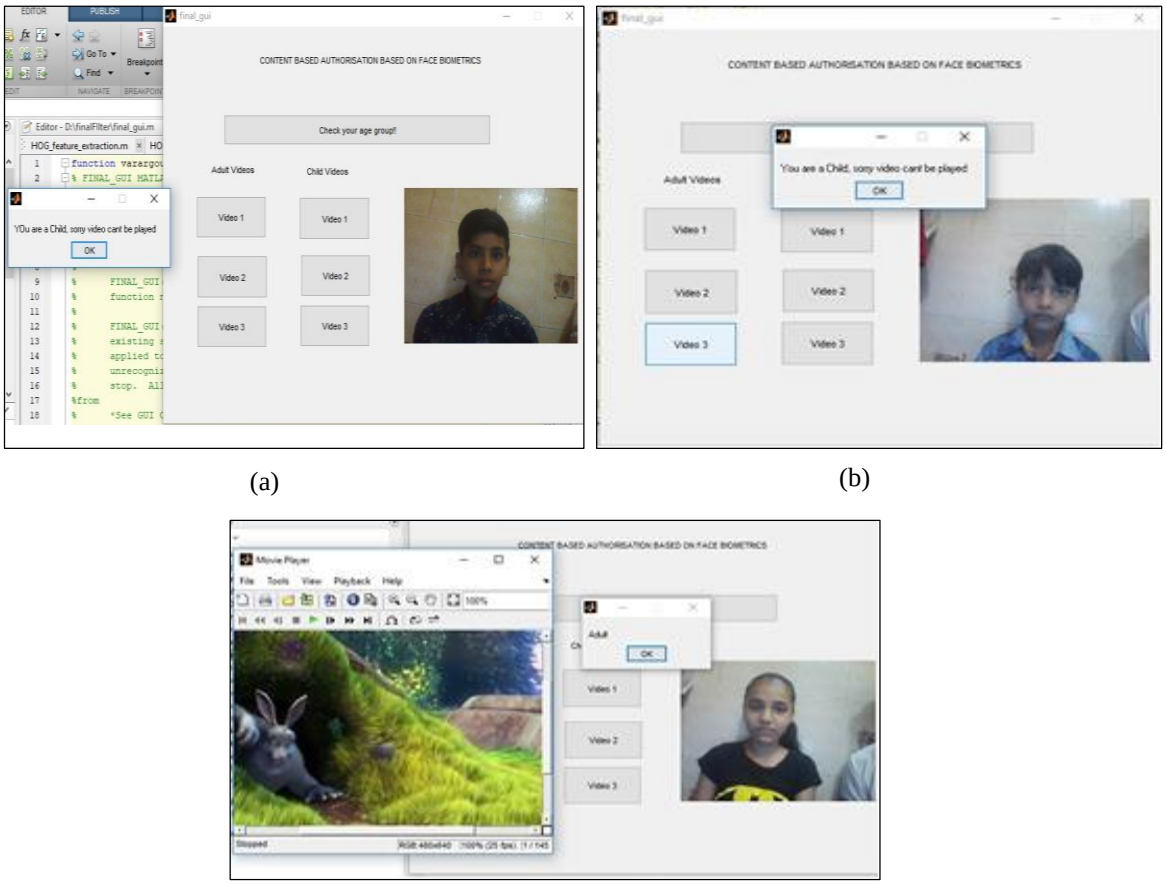


(a) b.

Figure 11. Shows various output results when an adult try to access the data contents of child's age group.

Thus, as can be seen from the outputs our approach is working in real-time with a great accuracy. Therefore, an adult is able to access the data contents reserved for his age group only. But there might be the case where we can allow access to the particular data contents of child's age group to adults for practical purposes.

Now, the major aim of the project is to put a check on the children accessing adult content present in the system. Outputs of this case i.e., whenever a child tries to access the data contents of adult age group, are shown in fig 12. And he is shown a message in the message box that reads “You are a child, sorry video can’t be played”. Hence, he was not able to play the video in the adult category. There are certain cases of errors, that too is shown by an example in 12(c).

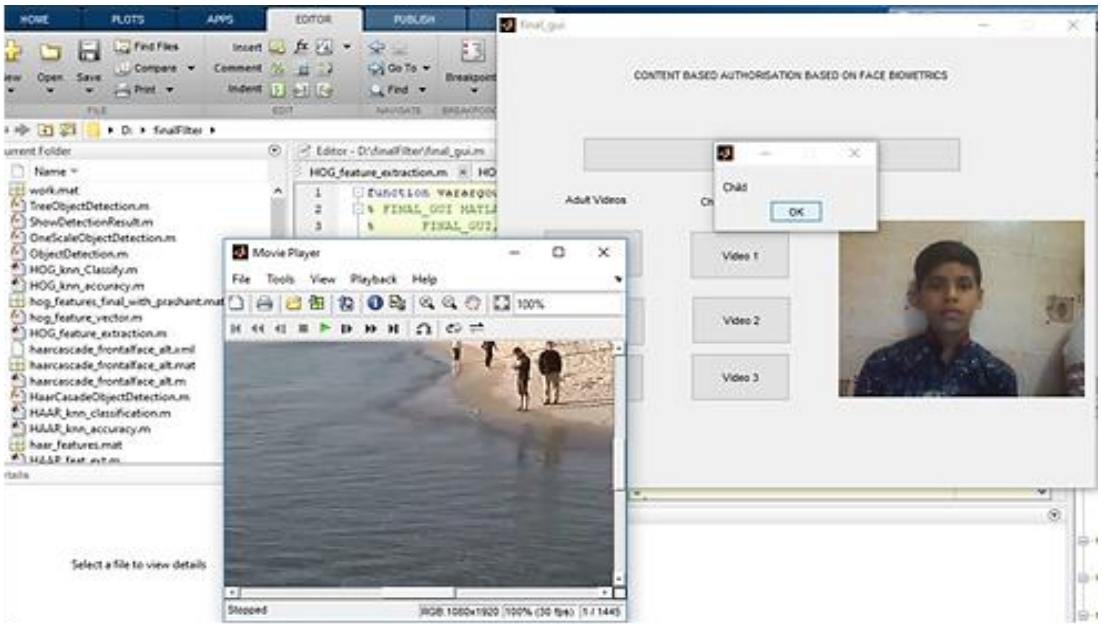


(a) (b)

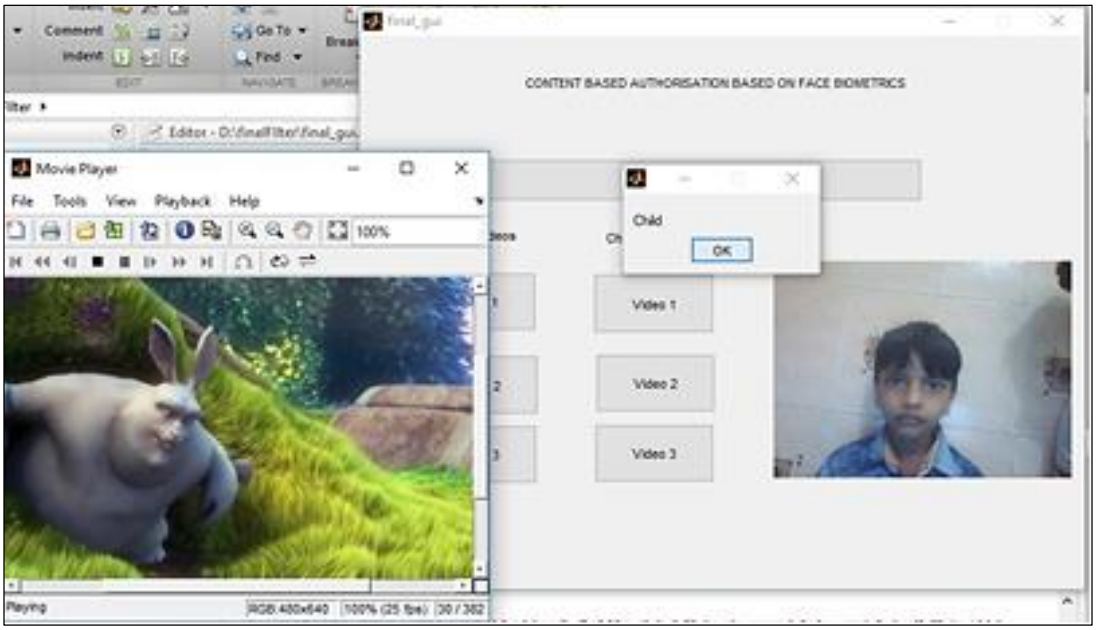
(c)

Figure 12. Shows various output results when a child tries to access the data contents of adult’s age group. Outputs (a) and (b) shows the successful attempts whereas output (c) is the case of failure.

As seen a child or a non-adult is not able to access the data contents reserved for adults. But whenever a child tries to access the data meant for his age group only, he can access it without any difficulty. Now the results for that case are shown in fig 13.



(a)



(b)

Figure 13(a) and 13(b) shows various output results when a child tries to access the data contents of his age group only.

In both of the figures, a child can be seen easily accessing the data contents of his age group and we can see that video is being played that the child was to trying to access at that time.

Above shown results have specified every possible case of our approach and the outputs for every case are shown and explained. From the results, we can clearly see that a person can only access his/her age group data contents.

4.3 Performance Evaluation

To test the performance of the developed framework, an experiment is conducted in real-time where there were 20 adults and 20 children were taken for the computation of accuracy of the approach.

The accuracy of the approach is measured in terms of the result obtained when a person tries to access the data contents. There can be four scenarios and accuracy of every case is found out separately. Overall accuracy of the approach is found out as the average of all the four accuracies.

a) Accuracy of the approach when an adult try to access the data contents belonging to his age group: It is calculated as number of successful attempts divided by the total number of the attempts i.e.

   Accuracy of case (a) = $\frac{\text{Number of successful attempts}}{\text{Total number of the attempts}} = \frac{19}{20} = 95\%$

   Successful attempts here imply that an adult has successfully accessed the data contents.

b) Accuracy of the approach when an adult try to access the data contents belonging to child age group: It is calculated as number of successful attempts divided by the total number of the attempts i.e.

   Accuracy of case (b) = $\frac{\text{Number of successful attempts}}{\text{Total number of the attempts}} = \frac{19}{20} = 95\%$

   Successful attempts here imply that an adult has been blocked from accessing the data contents of the child age group.

c) Accuracy of the approach when a child tries to access the data contents belonging to his age group: It is calculated as number of successful attempts divided by the total number of the attempts i.e.

   Accuracy of case (c) = $\frac{\text{Number of successful attempts}}{\text{Total number of the attempts}} = \frac{14}{20} = 70\%$

   Successful attempts here imply a child has successfully accessed the data contents.

d) Accuracy of the approach when a child tries to access the data contents belonging to adult age group: It is calculated as number of successful attempts divided by the total number of the attempts i.e.

   Accuracy of case (d) = $\frac{\text{Number of successful attempts}}{\text{Total number of the attempts}} = \frac{13}{20} = 65.5\%$

   Successful attempts here imply that a child has been blocked from accessing the data contents of the child age group.

Now the overall accuracy of the system can be found by averaging the above four accuracies of different cases.

Hence overall accuracy of the approach = $\frac{19+19+14+13}{80} = \frac{65}{80} = 81.25\%$

The above performance shows that the project works with an accuracy that needs to be improved for better results. Particularly for children as the accuracy of recognition of adults is far better than that of children. Thus, we need to upgrade the system by training it with more samples of child images from the dataset or we can increase the accuracy by using a different better classifier.

CHAPTER 5

CONCLUSION AND FUTURE SCOPE

5.1 Conclusion

The aim of the project was to design a system that allows the access of data contents stored in a system based on the face biometrics of the person trying to access the data. Privacy and security have become a major challenge in the recent years to all of us. Face biometrics used in the project are defined by the age group of the person i.e. whether the person is an adult or a child. The major aim of the project was to prevent children from accessing the contents meant for adults only. Our system works according to the specifications and requirements of the project. The techniques used have been clearly described and the accuracy of the system is calculated. The experiments showed that our method accuracy was close to 80% and further needs to improved. Finally, the research work is concluded and future research direction, as well as possible future applications, are discussed.

5.2 Future Scope and Applications

In the proposed approach there is the lack of a strong classifier in the system as KNN is a distance-based learning and doesn't provide excellent results. This can be seen by seeing the accuracy of the system. Thus we need a classifier that is strong enough to meet our expectations. The neural network is the most recent advancement in the field of machine learning and computer vision. A neural network classifier can be used to improve the system by improving its accuracy of classification.

Future work might also incorporate any other approach combined with HOG to get a better feature vector that the proposed, which will further increase the accuracy of the system.

Also, the project as a whole can be used to create a dot net assembly file, which can be used in web applications to control the data access based on age group with our approach.

The Matlab file can be deployed into a .dll file for this purpose. This opens up a whole new area in the field of web applications.

REFERENCES

[1] A. K. Soni, R. Kumar, and D. K. Kishore, "Estimation of age groups based on facial features," *2015 International Conference on Applied and Theoretical Computing and Communication Technology (iCATccT)*, Davangere, 2015, pp. 681-687.

[2] K. Vikram and S. Padmavathi, "Facial parts detection using Viola Jones algorithm," *2017 4th International Conference on Advanced Computing and Communication Systems (ICACCS)*, Coimbatore, 2017, pp. 1-4.

[3] Young Ho Kwon and da Vitoria Lobo, "Age classification from facial images," *1994 Proceedings of IEEE Conference on Computer Vision and Pattern Recognition*, Seattle, WA, USA, 1994, pp. 762-767. doi: 10.1109/CVPR.1994.323894

[4] A. K. Zhang, B. L. Guo, C. C. Gao, D. Z. Zhao, E. M. Sun and F. X. Yuan, "Age group classification in the wild with deep RoR architecture," *2017 IEEE International Conference on Image Processing (ICIP)*, Beijing, 2017

[5] V. Blanz and T. Vetter, "Face recognition based on fitting a 3D morphable model", *IEEE Transactions on Pattern Analysis and Machine Intelligence*, 25(9):1063 –1074, September 2003.

[6] A. Lanitis, "On the significance of different facial parts for automatic age estimation," *2002 14th International Conference on Digital Signal Processing Proceedings. DSP 2002 (Cat. No.02TH8628)*, Santorini, Greece, 2002, pp. 1027-1030 vol.2.

[7] "Human age-group classification of facial images with subspace projection and support vector machines." *Intelligent Data Acquisition and Advanced Computing Systems (IDAACS), 2011 IEEE 6th International Conference* on. Vol. 1. IEEE, 2011

[8] A. Gunay and V. V. Nabiyev, "Automatic age classification with LBP," *2008 23rd International Symposium on Computer and Information Sciences*, Istanbul, 2008, pp. 1-4. doi: 10.1109/ISCIS.2008.4717926

[9] M. A. Hajizadeh and H. Ebrahimnezhad, "Classification of Age Groups from Facial Image Using Histograms of Oriented Gradients," *2011 7th Iranian Conference on Machine Vision and Image Processing*, Tehran, 2011, pp. 1-5.

[10] R. C. Luo, Li Wen Chang and Shih Che Chou, "Human age classification using appearance images for human-robot interaction," *IECON 2013 - 39th Annual Conference of the IEEE Industrial Electronics Society*, Vienna, 2013, pp. 2426-2431

[11] W. Li, Y. Wang and Z. Zhang, "A hierarchical framework for image-based human age estimation by weighted and OHRanked Sparse Representation-based classification," *2012 5th IAPR International Conference on Biometrics (ICB)*, New Delhi, 2012, pp. 19-25.

[12] P. Thukral, K. Mitra and R. Chellappa, "A hierarchical approach for human age estimation," *2012 IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP)*, Kyoto, 2012, pp. 1529-1532

[13] I. Choi and D. Kim, "3D Face Fitting Using Multi-stage Parameter Updating in the 3D Morphable Face Model," *2008 Tenth IEEE International Symposium on Multimedia*, Berkeley, CA, 2008, pp. 274-279. doi: 10.1109/ISM.2008.84

[14] Yang, Xi, et al. "Facial age estimation from web photos using multiple-instance learning." *Multimedia and Expo (ICME), 2014 IEEE International Conference on*. IEEE, 2014

[15] K. Vikram and S. Padmavathi, "Facial parts detection using Viola Jones algorithm," *2017 4th International Conference on Advanced Computing and Communication Systems (ICACCS)*, Coimbatore, 2017, pp. 1-4.

[16] www.mathworks.com/

[17] http://www.cslab.openu.ac.il/download/.

[18] https://in.mathworks.com/products/computer-vision.html?requestedDomain=