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The Real Time Face Detection and Recognition System

[I]N.Niranjani , [I]B.Tharmila, [I]C. Sukirtha, [I]K. Kamalraj, [I]S. Thanujan,
[I]P.Janarthanan, [II]N.Thiruchchelvan, [III]K. Thiruthanigesan
[I]College of Technology Jaffna, Sri Lanka.
[II]Dept. of Post-Harvest Technology, University College of Anuradhapura,
University of Vocational Technology, Sri Lanka.
[III]Information and Communication Technology Center,
University College of Jaffna, University of Vocational Technology, Sri Lanka.

Abstract
In the fast moving modern world everything is changed to provide a better life for humanity. New developments make this as a reality. So we were decided to develop the Real Time Face detection and recognition system. The importance of the automatic face detection and tracking system has increased as it is needed for video surveillance and new user interfaces. And providing higher security to the country. This system suitable for all people, but some people's face damaged on acid attack, war and etc. so we were used to password for these peoples. In this research our effort is to develop a system for face detection and recognition in the real time. That will be efficient and give solution for many problems. The system was developed using C# .Net programming, Viola-Jones algorithm (Haar Cascade Classifier), PCA (classified as either Feature based and image based) and EmguCV (Computer vision Library and wrapper class of Open CV).

Keywords
Face Detection, Face Recognition, Real time system.

I. Introduction

We are in the world that fast moving and modernization. Now a day the usage of manpower has been reduced by the digitalized systems. So, day to day needs of the human is changing in to machine based digital system. These changes have been making easier the activities for us and reduce our mistakes.

First, we need to know what Face detection and Face recognition they are two totally different things although one builds upon the other. Detection is the process by which the system identifies human faces in digital images and video streaming, regardless of the source while Recognition is the identifying a known face with a known name in digital images, still regardless of the source. The resource can be a scanned copy of an image to a live video stream. Face detection and recognition is a section of Machine learning with a good number of research topics focused on improving the existing algorithms.

This application has many features which have many advantages of Face detection and recognition in real time. Using a programmable system reduces the time and cost. It is an automated or semi-automated process of matching face images. Face recognition is the task of identifying an already detected object as a known or unknown face, and telling exactly who face it is and using for a database of faces in order to validate this input face. Face detection is identifying the object of face and locate in to the input image. The system was developed by C#.NET visual studio 2013, OpenCV library (EmguCV). PCA based Eigen face method is at the most primary level and simplest of efficient face recognition algorithms and Eigen faces method for recognition its supported by EmguCV library and Viola -Jones method for detection.

1. Motivation of the Research

The variety of fields required Face detection and recognition mechanism in the modern life. Face recognition algorithms are also used in many different applications apart from biometrics, such as video compressions, indexing etc. In this system help in forensic sciences, identification for law enforcement, surveillance, authentication for banking and security system, and giving preferential access to authorised users.

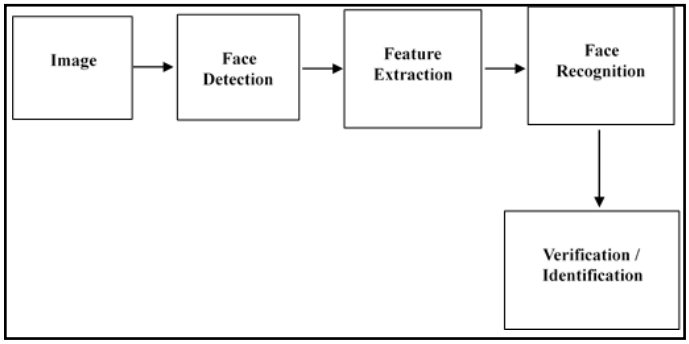

Fig. 1: Process of face detection

2. Objectives of the Research

The main objective of this research is consuming the time and old manual system in to a much easier and effective automated system, an advantage over the previous manual system to increase the efficiency. It is to construct an automatic face detection system using a standard PC camera in the real-time. This research is to provide the better security application.

3. Scope of the Research

Scope of the system is completely identification of the face. Within the allocated time completing the system with the specified user requirements. One system is for the administrator and the other one is for the users. It can be used in many fields there are Bank, Hotel and Police Station.

A throughout survey has revealed that various methods and combination of these methods can be applied in development of a new face recognition system. Among the many possible approaches, we have decided to use a combination of knowledge-based methods for face detection part and neural network approach for face recognition part. The main reason in this selection is their smooth applicability and reliability issues. Our face recognition system approach is given in Figure 2

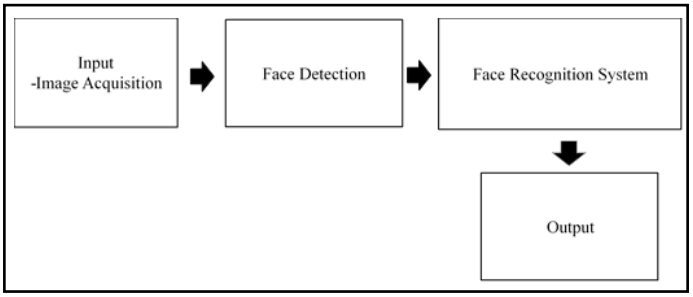

Fig.2: Process of Real Time Face Detection System Approach

4. Existing System

Neoface facial recognition have been developed and claimed to have accurate performance to tackle face detection and recognition problems these methods are the most successfully and widely used for face detection and recognition applications It is a high performance, highly scalable face recognition software application, providing the most accurate and fastest results for the most demanding real-time.

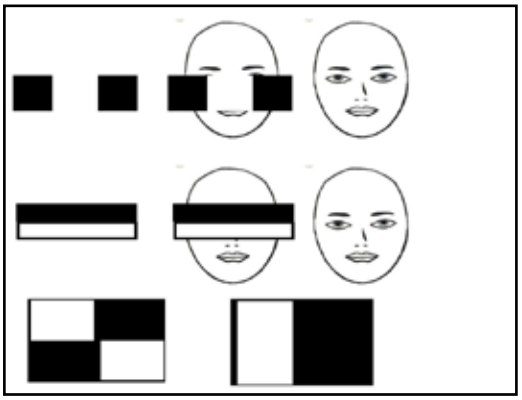
Fig. 3: Neoface facial recognition method

5. Proposed System

The proposed system is the real time face recognition system based on PCA. The proposed system utilizes the Eigen face method is information reduction for the images. This proposed system can easily be implemented, and its based on Emgucv coding. The resources that are required to implement these are easily available as open sources.

This application supports the modern trends of face detection and recognition technology and easily accessible, so more security of this system. The main aim of the research work is providing security to Peoples.

Step 1: Scan the input image/video for face detection.
Step 2: Capture image from video/image inputs.
Step 3: using Viola-Jones algorithm for its efficiency over Other face detection algorithms.
Step 4: Do Feature Extraction based on the extraction process Using Eigenvector selection (it can be transformed Into the reduced set of features).
Step 5: Face is recognized by green rectangle.
Step 6: Save that captured face with the name into the Database. Finally, the user can login into the system using face.

II. Literature Review

Face detection and recognition started in1960s. It is first semi-automated system. In this time using body parts or features (ear, eyes, nose, and mouth) using for detect the faces. Researches by Woodrow W. Bledsoe in 1960, Bledsoe, along other researches, started Panoramic Research, Inc., in Palo Alto, California. The majority of the work done by this company involved AI-related contracts from the U.S. Department of Defence and various intelligence agencies [1].

In 1964 and 1965, Bledsoe, along with Helen Chan and Charles Bisson, worked on using computers to recognize human faces. The finance of these researches was provided by an unnamed intelligence agency, little of the work was published. He continued later his researches at Stanford Research Institute. Bledsoe designed and implemented a semi-automatic system. Some face directs were selected by a human hand, and then computers used this information for recognition. He described most of the problems that even 50 years later Face Recognition still suffers - variations in illumination, head rotation, facial expression and continue the Researches on face Detection and recognition, trying to measure particular face features as ear size or between-eye distance.

For example, this approach was used in Bell Laboratories by A. Jay Goldstein, Leon D. Harmon and Ann B. Lesk. In 1970s Goldstein, Harmon and Lesk used 21 specific subjective markers such as hair colour and lip thickness to automate the recognition. The problem of this program both features are same on other peoples.

Fischler and Elschanger tried to size comparable features automatically [2]. Their algorithm used local template matching and a total size of fit to find and measure face features. There were other approaches back on the 1970's. Some tried to define a face as a set of geometric parameters and then perform some pattern recognition based on those parameters. But the first one that developed a fully automated face recognition system was Kenade in 1973. He designed and implemented a face recognition program. It ran in a computer system designed for this resolve. The algorithm removed sixteen face parameters automatically. In he's work, Kenade matches this automated abstraction to a human or manual abstraction, showing only a small difference.

He got a correct identification rate of 45-75%. He established that better results were got when unrelated features were not used. In the 1980's there were a variety of methods actively followed, most of them continuing with previous partialities. Some works tried to improve the methods used measuring particular features. For example, Mark Nixon presented a geometric measurement for eye spacing. The template matching style was improved with schemes such as "deformable templates". This period also brought new methods.

Some researchers build face recognition algorithms using artificial neural network. The first statement to Eigen faces in image processing, a technique that would become the main method in following years, was made by L. Sirovich and M. Kirby in 1986 [3]. Their methods were based on the Principal Component Analysis. Their aim was to represent an image in a lower dimension without losing much information, and then restructuring it.

In 1988s Kirby and Sirovich applied principle component analysis, a standard linear algebra technique, to the face recognition problem.

In 1992 Mathew Turk and Alex Puntland of the MIT presented a work which used Eigen faces for recognition. [4]. Their algorithm was competent to find, path and categorize a topic's head. Since the 1990's, face recognition part has expected a lot of devotion, with a noticeable increase in the number of journals. Many methods have been booked which has led to different algorithms. Some of the maximum relevant are PCA, ICA, LDA and their products. Different methods and algorithms will be argued later in this work. The technologies using face recognition techniques have also

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changed through the years. Nowadays diverse enterprises are using face recognition in their products.

Face recognition and detection techniques mainly depend-on image quality. If some time input image quality is low which most important information is lost. And some time faces are pictured from different angles or in poor lighting. Generally, a computer face recognition system will provide best match with database which have data about that person and from this data an operator makes the final decision. But these data tend to produce several very suitable that closely resembles another as the target, the operator's choice is a tough job with error rates as high as 50%. Using the viola Jones algorithm and captured 2D, 3D images from camera then convert to the data and match the data to which are already saved in database [5]. However, the human brain has limitations in the total number of persons that it can accurately remember. So computer system is capacity to handle large datasets of face image. The database also supports input in the form of a scanned 2D photograph [6]. In these systems consists of the three following tasks

1. Acquisition (Detection, identify images)
2. Feature abstraction (Separation, alignment & regularization of the face image)
3. Recognition

Vijay *et al*., stated Face detection methods are Knowledge based method developed the rules from the knowledge of human faces. Featured-based method - used for detecting skin colour. But that features are same to others. Pattern matching Input image is related with predefined face outline or shape. Appearance-based - Statistical analysis and machine learning techniques can be used to find the related characteristics of face. Face detection projected by Viola and Jones is most popular among the face detection approaches based on statistic methods. This face detection is a variant of the AdaBoost algorithm [7].

Vijay *et al*., proposed Recognition analyses is the face in terms of local features such as eyes, nose, etc. Here also a realistic representative models is necessary for good results. A recognition system based on sparse representation. It's build an automated system which equals human ability to recognize faces. The face recognition system is based on the Eigen-faces method introduced by Turk et al in 1991 [7].

III. Material And Methodology

The Real Time Face Detection and Recognition system technology were improved day by day. It mostly used security purposed because it is more secure than other technologies. We were used C#.Net programming language, Viola-Jones algorithm, EMGU CV [8] and Dev Components plugins. By using the C#.Net face detection and Recognitions [9] are possible but not 100 percent accuracy results because C# language don't have a face detection API.

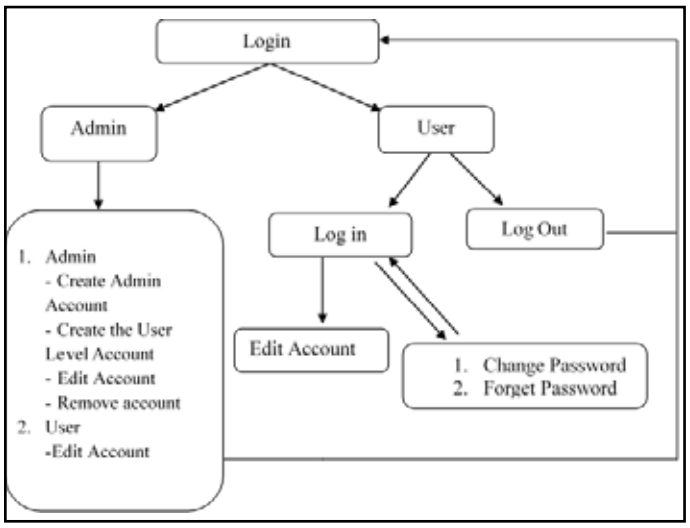


Fig. 4: System Implementation.

The figure 4 show the actual developed system in this system admin and users are able to access the system but admin has all the authority to access the entire module. The admin login providing the facility to create another administrator and create the user logins and edit, remove the accounts but user only access the system with the face recognition login.

1. Viola-Jones algorithm

Viola and Jones introduced an impressive face detection system capable of detection frontal-view faces in real time.

The Viola–Jones object detection algorithm is the first object detection framework to provide competitive object detection rates in real-time proposed in 2001 by Paul Viola and Michael Jones. The algorithm, it can be trained images to detect a variety of object classes it was a solution for the problem of face detection. This algorithm is implemented in Open CV as CV Haar Detect Objects. Features used by Viola and Jones. Hundreds of features can quickly be calculated by introducing a new image representation called the "Integral Image" In here, viola Jones algorithm has many Feature and evaluation, which make it a good detection algorithm are

Robust – very high detection rate (true-positive rate) & very low false-positive rate always.

Real time – For practical applications at least 2 frames per second must be processed.

Face detection only (not for recognition) - The proposed is to distinguish faces from non-faces (detection is the first step of the recognition process).The algorithm has four stages such as Haar Feature Selection, Creating an Integral Image, Adaboost Training and Cascading Classifiers

Haar Features – All human faces are unique, but some are similar properties. These regularities may be matched using Haar Features. A few properties common to human faces such as The eye region is darker than the upper cheeks and The nose bridge region is brighter than the eyes [10].

The composition of properties forming match able facial features

Location and size: eyes, mouth, bridge of nose
Value: oriented gradients of pixel intensities

The four features matched by this algorithm are then sought in the image of a face (shown at below). Rectangle features

Value = Σ (pixels in black area) - Σ (pixels in white area)

Three types: two, three, four-rectangles, Viola & Jones used two-

rectangle features
For example, the difference in brightness between the white &black rectangles over a specific area
Each feature is related to a special location in the sub-window
The integral image at location x, y contains the sum of the pixels above and to the left of x, y, inclusive:

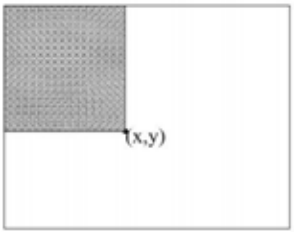
$$ii(x,y) = \sum_{x' \le x, y' \le y} i(x',y')$$

Using the following pair of recurrences:

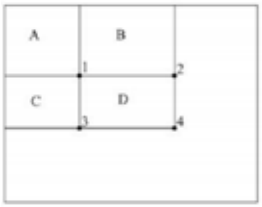
$$s(x,y) = s(x,y-1) + i(x,y)$$

$$ii(x,y) = ii(x-1,y) + s(x,y)$$

Where s (x, y) is the cumulative row sum, the integral image can be computed in one pass over the original image.



The sum of the pixels within rectangle D can be computed with four array references:
The value of the integral image at location 1 is the sum of the pixels in rectangle A.
The value at location 2 is A + B, at location 3 is A + C, and at location 4 is A + B + C + D.
The sum within D can be computed as 4 + 1 − (2 + 3).
A two-rectangle feature can be computed in six array references – for any scale



2. AdaBoost

A different of AdaBoost was used both to select the features and to train the classifier[11].
The first two features selected by AdaBoost for the task of face detection are easily interpreted
First feature: the region of the eyes is often darker than the region of the nose and cheeks second feature: the eyes are darker than the bridge of the nose.

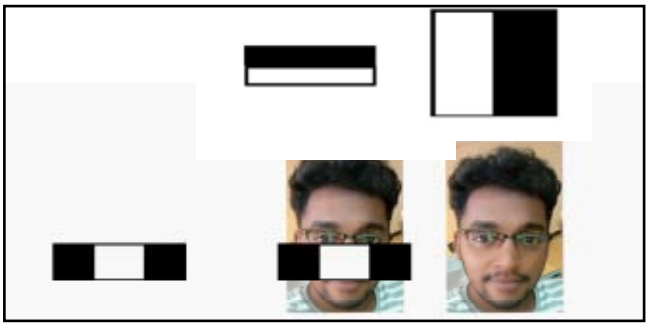


Fig. 5: AdaBoost Selection.

So, the systems were essentially based on correlation

3. Cascaded classifier

Smaller, and therefore more efficient, classifiers can be constructed which reject many of the negative sub windows while detecting almost all positive instances [12,13].
Simpler classifiers are used to reject the majority of sub windows. More complex classifiers are called upon to achieve low false positive rates. An image representation called the entire image evaluates rectangular features in constant time, which gives them a considerable speed advantage over more
sophisticated alternative features. Because each feature's rectangular area is always adjacent to at least one other rectangle, it follows that any two-rectangle feature can be computed in six array references, any three-rectangle feature in eight, and any Four-rectangle feature in nine.The integral image at location (x, y), is the sum of the pixels above and to the left of (x,y), inclusive.

Fig. 6: Cascaded Classifier Step 1.

Haar Feature that looks similar to the bridge of the nose is applied onto the face

Fig. 7: Cascaded Classifier Step 2.

Haar Feature that looks similar to the eye region which is darker than the upper cheeks is applied onto a face.
Fig. 8: Cascaded classifier Step 3.
2nd and 3rd kind of Haar Feature. Haar-like features the proposed algorithm uses features instead of the through value of the pixels. The features users by the outline look like the Haar wavelets, but they rely on more than one rectangular areas. We were use four different types of features. The value of the feature is computed as the change between the sum of the pixels in the followed areas and the sum of the pixels within the clear areas. Those rectangular filters provide a coarser representation of the image compared to some alternatives, such as the steerable filters, but they are proved to capture the face characteristics and can be computed extremely fast at any scale and location.

IV. Result and Discussion

In The Real Time Face Detection and Recognition System Interface of the admin module (Figure 9) has following basic futures such as add a new user, edit the user account and delete the user from the database. To add the new user to this system admin wants to click the add user button then the interface of user registration form will be open (figure 10)

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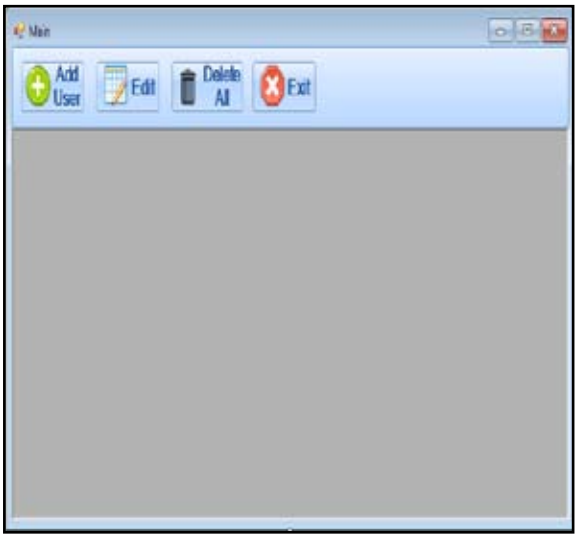

Fig. 9: Admin Module.

Fig. 10: User Registration Module.

Figure 10 is the user register form for Admin when the admin selects the Add User Button then it will be open. First admin wants to select the camera from the module then automatically lab camera is go to on stage with the click of the extract face button system detects face automatically. Sometime face not detected then need to click the resume button for retry.

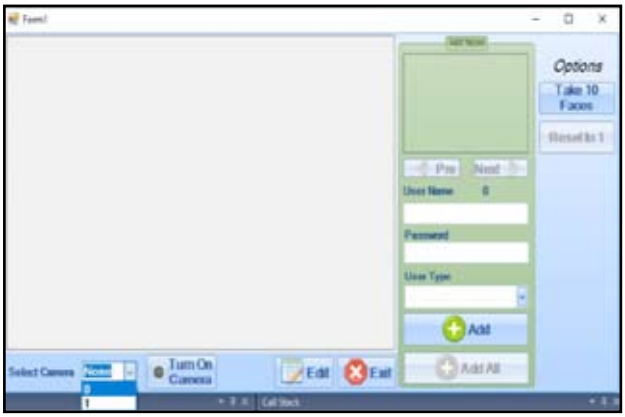

Fig. 11: Camera selection.

First user select the camera using dropdown because if there are more than camera plugin the computer user need to select which camera want to take the picture for the registration progress (Figure 11).

Fig. 12: Face Extraction.

After selection of the camera then need to click the extract face button to extract the face by using the face extraction module (Figure 12).

Fig. 13: Face identification.

Face identification were make sure with the red color rectangle on the face like Figure 13. Sometime face is not recognized click the Resume button then the identification process was repeated again. If the face identified properly then it will be added to the database with in 10 second by the admin.

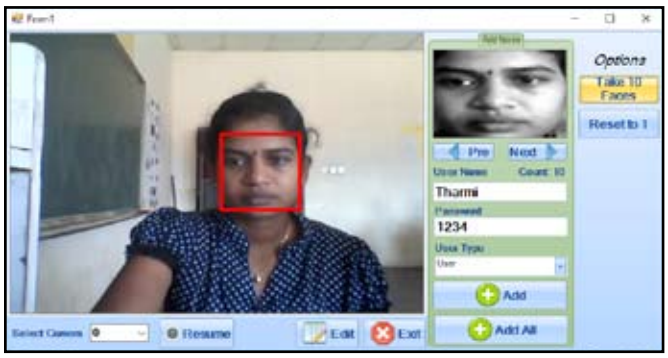

Fig. 14: Take 10 faces.

The module is to taking 10 faces of the user it will be added to the database when the user login the module these faces were checked with the login face (Figure 14).

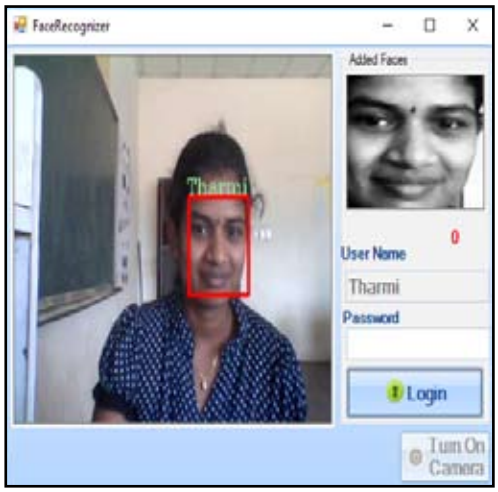

Fig. 15: User Login Module.

After user registration progress user can login the system by using the faces. To login the system first turns on camera then face was automatically detect with the red rectangle if your face match with your database then the main module will be open. Sometime user had any damage with his face then he can use his own username and the password to login the system.

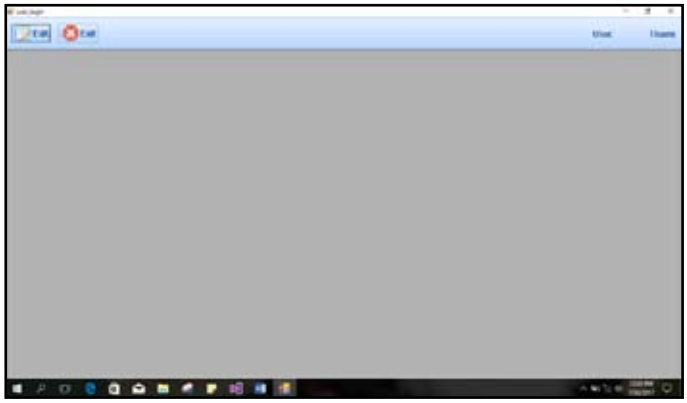

Fig. 16: Main module.

User successfully login the system he can access the main module Figure 16.

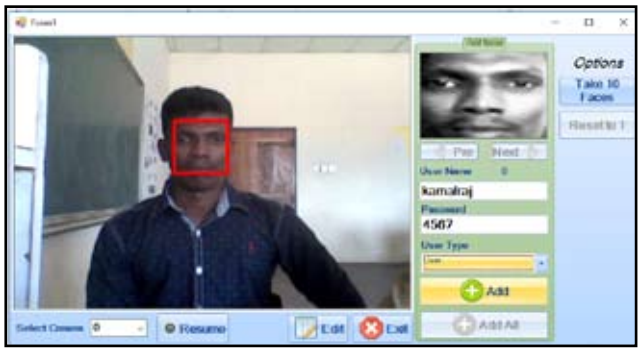

Fig. 17: Admin registration module.

In this system the administrator has authority to create the new admin account. Using the admin registration module Figure 17. First admin wants to select the camera then place the face for the face detection. If the face detected properly it will be added to the admin database

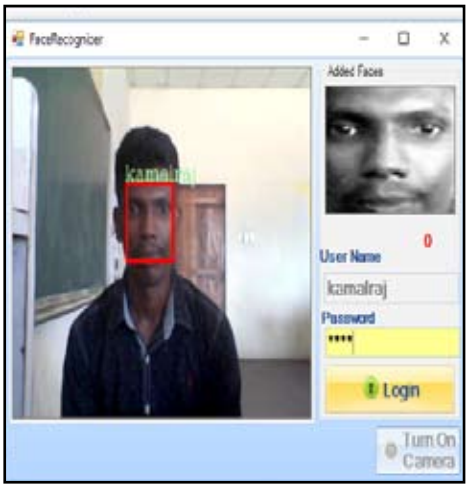

Fig. 18: Admin login module.

After the directing face current face compare with the admin database both faces were matched then admin login module username automatically display in top of the rectangle box and also in the username text box and the password also detected automatically based on the face form the database. Admin wants to click the login button to access the system.

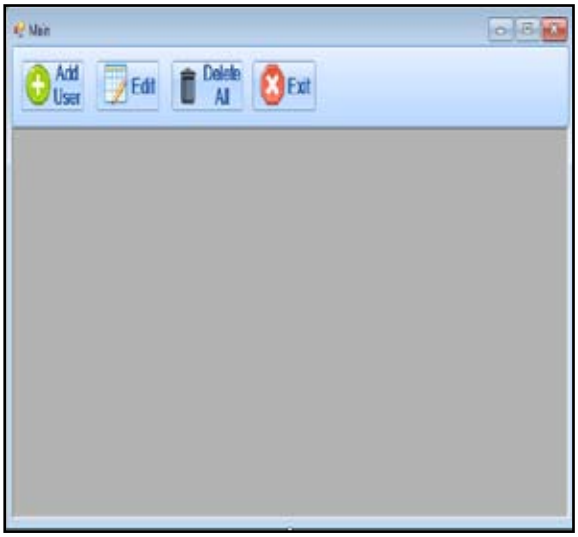

Fig. 19: Main module

Admin successfully login the system he can access the main module of the system Figure 19.

V. Conclusions

Our main aim of this research work to introduce new face recognition method. Face detection and recognition technology was used for many purposes. Especially for security purposes. Real-time detection and recognition of people in a camera setup. A face detector integrated with a people tracker for higher accuracy and faster detections is proposed.

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Author's Profile

Niranjani Nadarajah is a National Vocational Qualification (NVQ) Level 5 High National Diploma in the field of Information and Communication Technology, at College of Technology Jaffna, Sri Lanka.

Tharmila Baskaran is a National Vocational Qualification (NVQ) Level 5 High National Diploma in the field of Information and Communication Technology, at College of Technology Jaffna, Sri Lanka.

Sukirtha Chandran is a National Vocational Qualification (NVQ) Level 5 High National Diploma in the field of Information and Communication Technology, at College of Technology Jaffna, Sri Lanka.

Kamalraj Kubenthiran is a National Vocational Qualification (NVQ) Level 5 High National Diploma in the field of Information and Communication Technology, at College of Technology Jaffna, Sri Lanka.

Thanujan Sathasivam is a National Vocational Qualification (NVQ) Level 5 High National Diploma in the field of Information and Communication Technology, at College of Technology Jaffna, Sri Lanka.

Ponnampalam Janarthanan presently as a Lecturer attached to the College of Technology Jaffna, Sri Lanka. He is B.Sc graduate from the University of Jaffna. present M.Sc. Computer Science at University of Peradeniya. His engaged research areas are Networking, Artificial Neural network, Bioinformatics and Embedded system design.

Kanagasabai Thiruthanigesan presently as an Instructor attached to the Information and Communication Technology Center, University College of Jaffna, University of Vocational Technology, Jaffna, Sri Lanka. And Visiting Lecturer College of Technology Jaffna, Sri Lanka. He is graduate from the Loyola College Chennai, India. Affiliated University of Madras, and at present M.Sc. Computer Science at University of Peradeniya. His engaged research areas are Software Programming, Database Management System, Bioinformatics, Object-Oriented Programming and Embedded system design.

Nagarathnam Thiruchchelvan presently as a Lecturer attached to the Department of Post-Harvest Technology, University College of Anuradhapura, University of Vocational Technology, Anuradhapura, Sri Lanka. He is graduated from University of Jaffna and at present M.Phil. Scholar in same University in the field of Biological control. His engaged research areas are Entomopathogenic nematodes, Biological control of insect pests, Plant pathology, Nature conservation, Integrated Pest Management, Aquaponics, Storage pest control and Biotechnology.