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Project Report

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CENG 407

Innovative System Design and Development I

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Biometric Based on Face and Iris Recognition

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Abstract

Today, we are living in the technology age and because of this technology it is evolving rapidly and grows day by day. Most of the people and companies are using technological products which include their privacy, so they want to keep safe their information freely. In the light of that information, some scientists have tried to produce a new product to which provide people's private information keep in safely and avoiding the information theft. As a result of these, scientist developed Face and Iris recognition system which is the products that are the safest and easiest to use according to other security products, except those advantages, Face and Iris recognition system still has some shortcomings like illumination, external factors, so Face and Iris recognition algorithms should develop for reaching highest matching rate.

Key words:

Face Recognition, Iris Recognition, Biometrics, Identification.

Özet:

Bugün, teknoloji çağında yaşıyoruz ve bu teknoloji nedeniyle dünyamız hızla gelişiyor ve her geçen gün büyüyor. İnsanın ve şirketlerin çoğu gizliliklerini içeren teknolojik ürünler kullandığından, bilgilerini özgürce korumak istiyorlar. Bu bilgiler ışığında, bazı bilim insanları, kişilerin özel bilgilerini güvenli bir şekilde saklamak ve bilgi hırsızlığından kaçınmak için yeni bir ürün üretmeye çalışıyorlar. Bunun sonucunda bilim adamları, diğer güvenlik ürünlerine göre en güvenli ve kullanımı en kolay ürünler olan Yüz ve İris tanıma sistemini geliştirdiler; bu avantajlar dışında, Yüz ve İris tanıma sisteminin hala aydınlık ve diğer dış etkenler gibi bazı sorunlarla baş edebilme eksiklikleri var, dolayısıyla en yüksek eşleme oranına ulaşmak için Yüz ve İris tanıma algoritmaları geliştirilmelidir.

Anahtar Kelimeler:

Yüz Tanıma, İris tanıma, Biyometrik, Kimlik

1. Introduction

1.1 Problem Statement

There are some issues that still need to be solved like illumination, pose and facial expression [3]. Firstly, difference of illumination and pose and facial expression affect to face recognition in a bad way like lighting of ambient can change among indoor and outdoor environments and because of the 3D of human face shape, illumination angle makes shadow some points on the face so, nodal points can be affected in a bad way and some information cannot be reached, so experts still struggle with this problem and they go on improving new image preprocessing algorithm for illumination variations [3]. In addition, changing the pose and facial expression can cause loss of nodal points on the face because of changing the measure of existent parts at a human face like lip, nose so, recognition fail rate can increase than before, so experts need to robust the algorithms to ensure consistency. There are some problems about Iris Recognition like Iris Recognition devices can be fooled by an HD image and lighting effect to an accuracy of scanners in a bad way. Iris Recognition's cost is more expensive than other recognition systems. It is a new technology, so it is incompatible with most of the current technological devices. If the person who does not know about the Iris Recognition system, s/he may have some trouble because person's walking speeds need to be maximum up to 1 meter/sec and maximum identifiers distance is the almost 10 meter around [1]. In addition, researchers can trick Iris scanners with digital codes of stored Irises and also alcohol consumption affects pupil like dilates/constricts and it leads to deformation in the iris patterns so, it increases the rate of the false matches [1]. Also, researchers encounter with the rate of rejection of poor quality images, so they need to reduce delays the enrollment and verification because it can annoy the users while that all things happen consistently, they need to decrease failure to enroll rate (FTE) [3].

1.2 Solution Statement

We are using Scale-invariant feature transform (SIFT) which is the fastest and reliable algorithm for working security system process. It is also more accurate than any other descriptors and it is independent of rotation, luminance, and scale, so its acceptable level is higher than other algorithms. Also, the acceptable level of Face and Iris recognition can be adjustable according to company's request. While the people registration to the system, SIFT algorithm gets their image as a grayscale and create a matrix according to a pattern of iris and face, then it makes features personally from a created matrix and transfers the features to the database. When the people define their identity on the system, the SIFT algorithm gets current user's features and it searches that features exist in the database or not. If exist, login can be done correctly, but if not exist in the database, the user cannot access the document which includes high-level secret information.

1.3 Motivation

We are a group of senior students in computer engineering department who are interested in image processing and security system. As a group, we have taken the course of numerical computations for a better understanding in image acquisition area. We aimed to combine the

fields of education, image acquisition, and security systems technologies in this project. We have chosen the MATLAB scripting language and C# programming language which all of the members of the group are already familiar to develop our project.

2. Literature Review

2.1 Biometrics

Biometrics means parts of the human body which provide a unique identity for being an individual in the world, so these parts which are the unique have to be measurable, distinctive and characteristics for each person. For example, Speech, Face, Iris, Fingerprints, Palm Print and Hand-Writing are common and popular biometric identifiers which are used in the world nowadays.

2.1.1 Biometric Recognition

Biometric Recognition provides separate humans' identification according to their characteristics and most of the time it uses their physical characteristics because each person is different from each other according to genetic sequences, so this makes things easier [1]. Also, There is a relation between Biometric Recognition and Computer Science because we are living in the age of technology and most of the people and companies are using technological products so that products need to have reliable and consistent security for protecting their privacy. Verify authenticity, authorization purposes and enforcing security are examples of some working areas which biometric recognition are using with computer science [1].

2.2 About Face Recognition

Face Recognition is one of the biometric methods for identifying human face which comparing live capture or digital image data with a stored previous record about that person and it has a potential to be less invasive according to other recognition methods. "Face and iris recognition systems are among the top choices; because face recognition is friendly and non-invasive whereas iris recognition is one of the most accurate biometrics" [6]. It is generally used for security purposes like mobile payment system, airport security, but sometimes it is used for gaming area like the Kinect motion gaming systems [2].

2.2.1 Face Recognition Features

One of the biometric identification technique is Multimodal biometric systems. "Multimodal biometric systems take input from single or multiple sensors measuring two or more different modalities of biometric characteristics. For example, a system combining face and iris characteristics for biometric recognition would be considered a "multimodal" system regardless of whether face and iris images were captured by different or same imaging devices" [8]. Currently, numeric codes called faceprints are being used on face recognition for acquiring high yield and providing consistency [2]. There are several existent parts at a human face like the nose, eye sockets, lip, chin and cheekbones which separate humans'

unique identification. For example, nose's and lip's length and width, eye sockets' depth and shape of the cheekbones can be different person to person, so generally, face recognition systems make comparison according to 80 nodal points on a human face and information of these nodal points change according to people's face because of the differences mentioned above. "Automatic recognition of human faces by computer has been approached in two ways: holistic and analytic. The holistic approach treats a face as a 2D pattern of intensity variation. The analytic approach recognizes a face using the geometrical measurements taken among facial features, such as eyes and mouth" [7].

2.2.2 Shortcomings of Face Recognition

There are some issues that still need to be solved like illumination, pose and facial expression [3]. Firstly, difference of illumination and pose and facial expression affect to face recognition in a bad way like lighting of ambient can change among indoor and outdoor environments and because of the 3D of human face shape, illumination angle makes shadow some points on the face so, nodal points can be affected in a bad way and some information cannot be reached, so experts still struggle with this problem and they go on improving new image preprocessing algorithm for illumination variations [3]. In addition, changing the pose and facial expression can cause loss of nodal points on the face because of changing the measure of existent parts at a human face like lip, nose so, recognition fail rate can increase than before, so experts need to robust the algorithms to ensure consistency.

2.2.3 History and Projects which using Face Recognition

Face Recognition system has been started at the 1960s due to the rise of crimes, so Woodrow Wilson Bledsoe who is the father of Facial Recognition started the first step of Facial Recognition systems and when the years show 2011, the government of Panama did first major installation of Face Recognition in an airport with U.S and also, Osama Bin Laden was identified by the face recognition system and he was killed in U.S. raid [4].

2.3 About Iris Recognition

Iris Recognition is a least invasive biometric method within other known methods and it separates people from each other according to eye's colored circle with using mathematical pattern-recognition techniques on video images for each individual's eyes [5]. Iris Recognition generally used for military surveillance, security systems, counter-terrorism initiatives and recently on smartphones like Samsung's Galaxy Note8, Lumia 950/950XL, and iPhone X. Iris is a thin circular structure in the eye and it manages pupils' diameter and size according to light. If the pupil is a larger than before, the more light can enter. It can be different kind colors like blue, green and tons of brown. Iris recognition is a little bit complicated according to other methods because even the right and left iris of a single person, seems like very distinctive but from the good side, a structure of the iris does not change with age just if we can compare iris pattern according to past childhood, it can seem a very little [1]. Moment-to-moment dynamics is a very significant issue for iris because of the complicated interaction of the iris' muscles, small oscillation can happen with a constant state on the diameter of the pupil [1].

2.3.1 Iris Recognition Features

Iris is an internal organ, so it makes it valuable because it can be protected against damage according to other recognition systems. Iris's shape is generally like flat, so its shape more predictable than face [1]. In addition, Iris determined randomly since embryonic gestation and that makes it unique, so it decreases the rate of the false matches. Iris scan can be performed between 10cm to a few meters. In addition, there is no need to physically touch between any equipment and Iris. Currently, John Daugman's IrisCode is applying as an Iris Recognition algorithm and It has a rare false match rate like better than 10-11 and if we assume Hamming distance threshold of 0.26 is used, and it is meaning 26% of bits in two IrisCodes accept imaging noise and reflections [1].

2.3.2 Shortcomings of Iris Recognition

There are some shortcomings about Iris Recognition like Iris Recognition devices can be fooled by an HD image and lighting effect to an accuracy of scanners in a bad way. Iris Recognition's cost is more expensive than other recognition systems. It is a new technology, so it is incompatible with most of the current technological devices. If the person who does not know about the Iris Recognition system, s/he may have some trouble because person's walking speeds need to be maximum up to 1 meter/sec and maximum identifiers distance is the almost 10 meter around [1]. In addition, researchers can trick Iris scanners with digital codes of stored Irises and also alcohol consumption affects pupil like dilates/constricts and it leads to deformation in the iris patterns so, it increases the rate of the false matches [1]. Also, researchers encounter with the rate of rejection of poor quality images, so they need to reduce delays the enrollment and verification because it can annoy the users while that all things happen consistently, they need to decrease failure to enroll rate (FTE) [3].

2.3.3 History and Projects which using Iris Recognition

Leonard Flom and Aran Safir who are the Ophthalmology Professors took a broad patent with named as "Iris Recognition Technology" and they hired John Daugman who has the Ph.D. at Harvard Computer Science faculty to the company and after that time, Daugman improved the algorithm for Iris Recognition then, Professors and Daugman founded a company named as "IridianTechologies, Inc." [1]. In addition, Daugman algorithm is protected by Flom/Safir patent list. Winthrop University has a key role in Iris Recognition because they are using it on EagleEye attendance tracking system nowadays. In addition, Iris recognition is being used at the Otay Mesa US-Mexico land border for biometric border control pilot project underway. Lastly, Iris Recognition is used for project CERN which scientific facility in Geneva, Switzerland for providing a security at Large Hadron Collider [5].

2.4 Conclusion

To sum up, technology grows day by day and biometric identification based on Face and Iris Recognition are using at several different areas in a good way and it makes the world better and safer place. For example, Biometric Recognition is encouraged as a way to aid detect terrorists, provide better control of reach to physical simplicities and financial accounts, and increase the efficiency of access to services and their utilization. Also, Biometric Recognition has been applied to recognition of offenders, patient following up in medical informatics, and

the customization of sociable services, among other fields. In the light of all of them, our research concentrate on biometric based on Face and Iris Recognition to carry out the team purpose or demanded results.

3.1.0 Introduction

3.1.1 Purpose

The purpose of this System Requirement Specification document is describing the security system which is called Biometric identification based on Face and Iris Recognition. This system aims to provide a security system which holds a personal information keep in safe and decrease the rate of information theft against who want to steal your private information. This document includes detailed information about requirements of the project. It also identifies the function and non-functional requirements with a use case diagram. Overall, this document is used for how users interact with the system and understand how the mechanism works at backend without any problems and explains how concerns of the stakeholders are met.

3.1.2 Scope of Project

Most of the people use a private computer to do their jobs in the company and they may need to hide information in documents which relevant to work. Some information can be public and this files that are not important, if they are seized by someone else, but some files need a special protection system which is in the high-level secret status because people are wasting their time for hours on end and some hacker can steal their information from victim's computer easily without any protection system and worst of all, people are unprepared for this situation. The application to be improved is Recognition of Human Iris and Face Patterns for Biometric Identification. This project involves developing an iris detection system in order to verify the uniqueness of the human iris and face by detecting the iris pattern from the image.

We offer a high-level security system which is the Biometric based on Face and Iris Recognition for a company who want to save their information from a hacker or information theft. The company should identify chosen workers to the security system according to document while using their iris and face pattern on the camera. After registration done, only chosen workers can access the high-level secret documents, if iris and face recognition can be done correctly. We are using Scale-invariant feature transform (SIFT) which is the fastest and reliable algorithm for working security system process. It is also more accurate than any other descriptors and it is independent of rotation, luminance, and scale, so its acceptable level is higher than other algorithms. Also, the acceptable level of Face and Iris recognition can be adjustable according to company's request. While the people registration to the system, SIFT algorithm gets their image as a grayscale and create a matrix according to a pattern of iris and face, then it makes features personally from a created matrix and transfers the features to the database. When the people define their identity on the system, the SIFT algorithm gets current user's features and it searches that features exist in the database or not. If exist, login can be done correctly, but if not exist in the database, the user cannot access the document which includes high-level secret information.

There are actors in the security system which are the worker and admin. Admin should register worker to the system without any problem and the worker should adjust position

during interacting with the iris and face recognition on the camera for capturing best features. In addition, admin should update worker information on the database because some worker can wear a lens or worker can be injured in the face, so the admin should intervene to a situation with manually.

3.1.3 Glossary

Term	Definition
Worker	A person whose Iris and Face is to be recognized
Admin	A person who handles the application and enrolls a person image in the database
Database	Collection of all the information about the image of eye and data of a person
SIFT	Fastest and reliable algorithm for using security system process
Face and Iris Recognition	Control system for using human iris and face for login to the system
Stakeholders	Any person who has contributed to the project
Features	Result of information of the matrix which derives from grayscale image
Grayscale	A range of grey shades from white to black, as used in a monochrome display or printout[1]

3.1.4 References

[1] Rouse, M. (2010, May). What is grayscale? – Definition from WhatIs.com. Retrieved December 03, 2017, from http://whatis.techtarget.com/definition/grayscale

3.1.5 Overview of Document

This will be the content and organization of the rest of this document

- · Chapter 2 will provide the overall description of the application.
- · Chapter 2.1 will contain the System Environment for the application
- · Chapter 2.2 will contain the Functional Requirements Specification for the application
- · Chapter 2.3 will contain the User Interface Specification for the application
- · Chapter 2.4 will contain the Non-Functional Requirements for the application

- · Chapter 3 will contain the Requirement Specification for the application
- · Chapter 3.1 will contain the External Interface Requirements for the application
- · Chapter 3.1.1 will contain User Interfaces
- · Chapter 3.1.2 will contain Hardware Interfaces
- · Chapter 3.1.3 will contain Software Interfaces
- · Chapter 3.1.4 will contain Communication Interfaces
- · Chapter 3.2 will contain the Functional Requirements for the application
- · Chapter 3.2.1 will contain Employee Use Case
- · Chapter 3.2.2 will contain Register Use Case
- · Chapter 3.2.3 will contain Image Acquisition Use Case
- · Chapter 3.2.4 will contain System Login Use Case
- · Chapter 3.2.5 will contain Get Result Use Case
- · Chapter 3.2.6 will contain Update Employee Use Case
- · Chapter 3.2.7 will contain Set Configurations Use Case
- · Chapter 3.3 will contain the Detailed Non-Functional Requirements for the application
- · Chapter 3.4 will contain the System Evolution for the application
- · Chapter 3.5 will contain the Performance Requirements
- · Chapter 4.0 will contain References

3.2.0 Overall Description

3.2.1 System Environment

This application is Iris and Face Recognition System as seems as Figure 1. Firstly, A person's image should be provided using the camera. Then, camera transfers it to the Iris and Face Recognition System. Next, an image is preprocessed for features of face and iris. After that, they are compared with an image in the system database and matched. The System Admin can do add and delete operations in the database, can set appropriate match rate of accepting user and handle whole application.

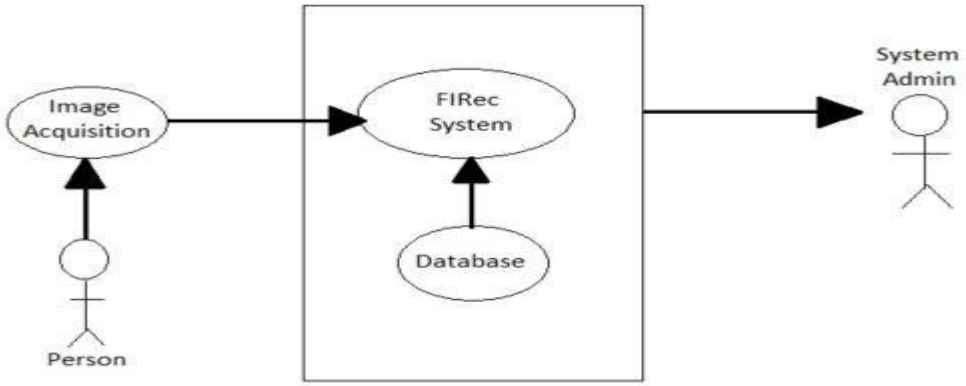

Figure 1 System Environment Use Case

3.2.1.1 Development methodology

While developing the project, we have decided to use Scrum which is an agile software development methodology. Scrum is part of the Agile movement. Agile is a response to the failure of the dominant software development project management and borrows many principles from lean manufacturing. In a scrum, it has a sprint which includes work to do in the project. It takes a while almost between 2 and 4 weeks. If you add work to the sprint, you can not remove that work from the sprint. The team who developed the project should have a daily meeting every morning which should be maximum 10-15 minutes. Scrum has three major roles which are a scrum master, project owner, and development team. Scrum master generally manages the development team, product owner delivers the requirements. A development team is the team of developers who work on the project together according to schedule. There are several advantages of Scrum, Firstly, sprint releases end of each sprint. The team does not have to act according to the product owner, the team identifies their priority. Delivery happens according to the velocity of the team and development tools work like cross-functional. The team should use burndown graphics in a project [9]. The scrum board rebuilds while the beginning of each sprint. In addition, the scrum methodology is incremental and iterative, so we can change required changes at project according to customer feedback.

3.2.2 Functional Requirements Specification

In this section, use cases are outlined for every single actor. System admin is the main actor and just one use case belongs to the user. Functional Requirements of Requirement Specification and this section are similar to each other.

3.2.3 User Interface Specification

The framework holder is anticipated to be able to utilize button, pull-down menus, and comparative devices. A window with graphical client interface will be utilized. To begin with, of all we have chosen to store the highlights of iris of the pictures of an eye of people and utilize those highlights for acknowledgment. In case the input image's highlights coordinate up with the already put away highlights in the database, at that point a message will be shown illuminating an effective acknowledgment along with the subtle elements of the comparing individual. This is a unique plan. In the planning stage of the Iris Acknowledgment framework, the layout of the required screen designs, report formats, and menu structures will be chosen on.

3.2.4 Non-Functional Requirements

In the Face and Iris Recognition system, the input is an image. The system will be implemented in MATLAB. MySQL database will be used. Windows operating system will execute the system.

3.2.5 Performance The System Requirements

The system will accept or reject user in 4 seconds, after scanning.

3.3.0 Requirements Specification

3.3.1 External Interface Requirements

3.3.1.1 User Interfaces

The user interface will run on Windows.

3.3.1.2 Hardware Interfaces

The Face and Iris Recognition system require a camera. The camera requires necessary driver installed within the operating system. Also, it requires 1 USB port on the PC.

3.3.1.3. Software Interfaces

There are no external software interface requirements.

3.3.1.4. Communication Interfaces

There are no external communications interface requirements

3.3.2 Functional Requirements

Use Case Diagram

Use Case Diagram (UCD) for this project is shown in Figure 2. After some analysis of the system development process, The Use Case Diagram is created. This User Case Diagram can be modified during later parts of the project.

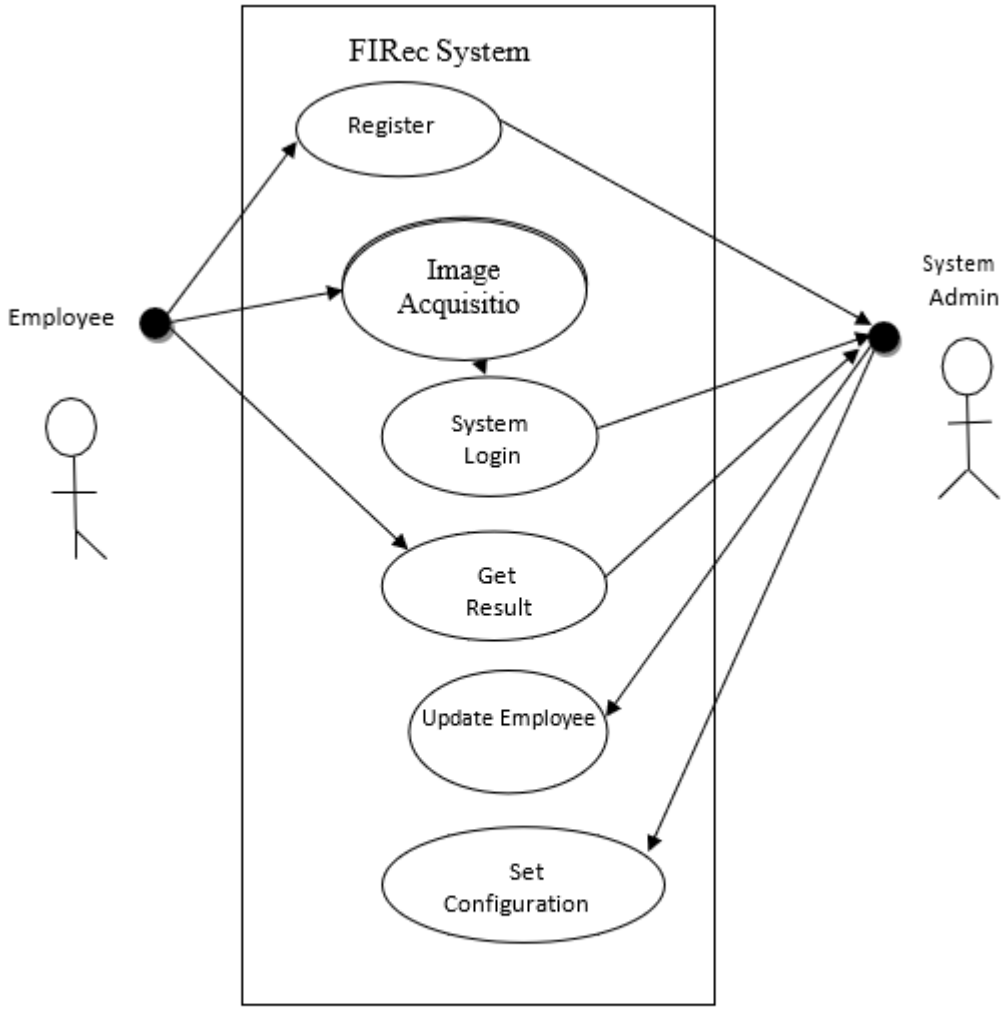

Figure 2 Functional Requirements Use Case

3.3.2.1 Employee Use Case

Specificaton of Actors

In the analysis stage of the Face and Iris Recognition System development process, actors below are described so far.

Employee

Employee	
Element	**Details**
Description	An employee whose face and iris are recognized
Examples	An employee whose face and iris features are detected and recognized, then added to the database

Admin

System Admin	
Element	**Details**
Description	A system admin is a person who handles the application
Examples	System admin who logins in the system, register a new person and add to the database, delete and update a registered person, change accepting match rate.

3.3.2.2 Register Use Case

Specification of Use Cases

Register

Register	
Element	**Details**
Actor	System Admin
Trigger	System Admin must enroll the image of face and iris of a person
Pre Conditions	The person is not registered and the system menu is displayed.
Post Conditions	The person is registered and has his/her face and iris features recognized
Normal course	1. The system admin collects data and image of a person 2. The system admin stores the data and features of image on database
Alternative courses	The person is already registered

3.3.2.3 Image Acquisition Use Case

Image Acquisition

Image Acquisition	
Element	**Details**
Actor	System Admin
Trigger	System Admin must take the image of face and eye of a person
Pre Conditions	1. The person is not registered i.e not yet enrolled and the system menu is displayed. 2. The person is registered i.e not yet recognized and the system menu is displayed.
Post Conditions	1. The person is registered and has his/her face and iris features recognized 2. The image is fed to Face and Iris Recognition System
Normal course	1. The System Admin collects personal data and image of a person 2. The System Admin takes the face and eye image of a person

3.3.2.4 System Login Use Case

System Login

System Login	
Element	**Details**
Actor	System Admin
Trigger	The System Admin wish to start using the system.
Pre Conditions	The System Admin is not logged into the system.
Post Conditions	The System Admin is logged into the system, and the system menu is displayed
Normal course	1. The System Admin click the link for the application and a login form appear on the screen. 2. The System Admin types his username and password into the form and press the login button. 3. The system confirms that the user is logged on

3.3.2.5 Get Result Use Case

Get Result

Get Result	
Element	**Details**
Actor	System Admin, Person
Trigger	When the face and iris pattern is recognized by the application
Pre Conditions	Image is fed to the system and processed
Post Conditions	Information about either the face and iris patterns matches with that stored in the database or not and the details of the person is displayed in the screen

3.3.2.6 Update Employee Use Case

Update Person

Update Person	
Element	**Details**
Actor	System Admin
Trigger	When admin start using update system
Pre Conditions	The System Admin is logged into the system.
Post Conditions	The Person will be accepted with his/her new features

3.3.2.7 Set Configurations Use Case

Set Configurations

Set Configurations	
Element	**Details**
Actor	System Admin
Trigger	When admin start using set configurations system
Pre Conditions	The System Admin is logged into the system.
Post Conditions	The Person will be compared with entered new accept match ratio

3.3.3 Detailed Non-Functional Requirements

Features of the face and iris of the image will be stored in the database instead of the whole image because it will use less memory and processing will be fast.

3.3.3.1 Logical Structure of the Data

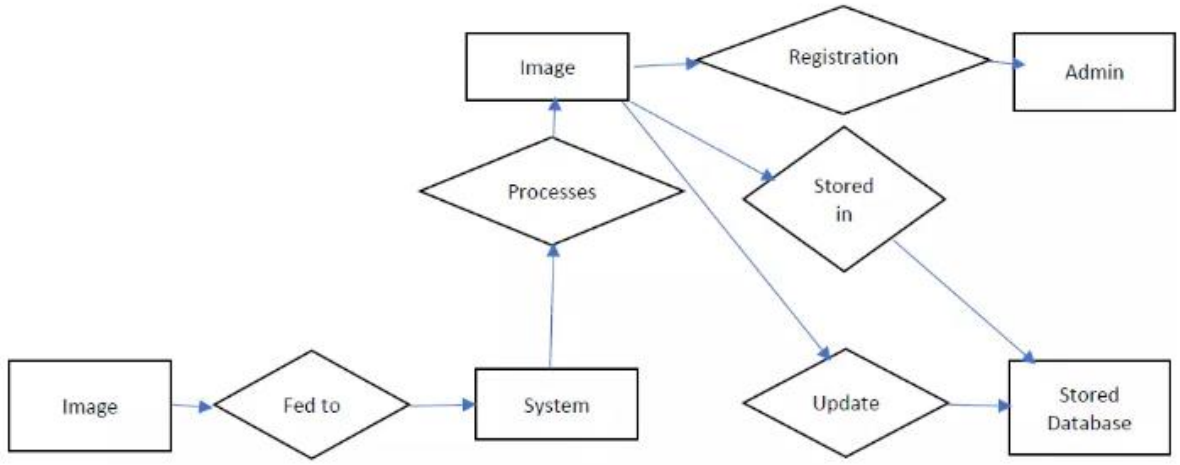

Figure 3 Logical Structure of the Data

3.3.3.2 Security

The computer that runs the program will have its own security. Only the System Admin will log in to the system with his/her username and password. The person whose face and the iris are recognized will access to view the output.

3.3.3.3 Maintainability

As a tool to obtain the ease of maintainability UML will be used in the development process.

3.3.3.4 Portability

To ensure portability, the application will be developed in MATLAB language.

3.3.4 System Evolution

The Face and Iris Recognition application are developed in MATLAB. The database we will use is MYSQL.

3.3.5 Performance Requirements

Camera's visual must run smoothly without any error and delay more than 4sec to get the image of the user. This requirement is depended on many aspects of the user pc. Minimum requirements for running FIRec are:

1. GPU: Intel HD Graphics
2. CPU: Intel Celeron
3. Camera: Minimum 2MP Camera
4. USB port: 1x USB 2.0 or better port
5. Operating system: Windows XP or better

4.1 INTRODUCTION

4.1.1 Purpose

The purpose of this Software Design Document is providing the details of project titled as "FIRec: Biometric Identification based on Face and Iris Recognition".

The target audience is especially, technological companies which want to keep in safe their information against threats. FIRec will provide private security to protect companies' information with using face and iris pattern which employee authorized at the project. We goal to provide consistent, perfect security system for the companies which want to protect their private information.

The purpose of the FIRec project is to design to provide a security system which holds a personal information keep in safe and decrease the rate of information theft against who want to steal your private information. This document includes detailed information about requirements of the project. It also identifies the function and non-functional requirements with a use case diagram. Overall, this document is used for how users interact with the system and understand how the mechanism works at backend without any problems and explains how concerns of the stakeholders are met.

In order to provide a better comprehension, this SDD includes various diagrams such as UML diagram of the project, activity diagram and block diagram.

4.1.2 Scope

This document contains a complete description of the design of FIRec: Biometric Identification based on Face and Iris Recognition.

Most of the people use a private computer to do their jobs in the company and they may need to hide information in documents which relevant to work. Some information can be public and this files that are not important, if they are seized by someone else, but some files need a special protection system which is in the high-level secret status because people are wasting

their time for hours on end and some hacker can steal their information from victim's computer easily without any protection system and worst of all, people are unprepared for this situation. The application to be improved is Recognition of Human Iris and Face Patterns for Biometric Identification. This project involves developing an iris detection system in order to verify the uniqueness of the human iris and face by detecting the iris pattern from the image.

We offer a high-level security system which is the Biometric based on Face and Iris Recognition for a company who want to save their information from the hacker or information theft. The company should identify chosen workers to the security system according to document while using their iris and face pattern on the camera. After registration done, only chosen workers can access the high- level secret documents, if iris and face recognition can be done correctly. We are using Scale-invariant feature transform (SIFT) which is the fastest and reliable algorithm for working security system process. It is also more accurate than any other descriptors and it is independent of rotation, luminance, and scale, so its acceptable level is higher than other algorithms. Also, the acceptable level of Face and Iris recognition system can be adjustable according to company's request. While the people registration to the system, SIFT algorithm gets their image as a grayscale and create a matrix according to a pattern of iris and face, then it makes features personally from a created matrix and transfers the features to the database. When the people define their identity on the system, the SIFT algorithm gets current user's features and it searches that features exist in the database or not. If exist, login can be done correctly, but if not exist in the database, the user cannot access the document which includes high- level secret information.

There are actors in the security system which are the worker and admin. Admin should register worker to the system without any problem and the worker should adjust position during interacting with the iris and face recognition on the camera for capturing best features. In addition, admin should update worker information on the database because some worker can wear a lens or worker can be injured in the face, so the admin should intervene to a situation with manually.

4.1.3 Glossary

Term	Definition
BLOCK DIAGRAM	The type of schema which the components in the system are displayed in blocks.
GRAYSCALE	A range of grey shades from white to black, as used in a monochrome display or printout [9]
SIFT	Fastest and reliable algorithm for using security system process
FEATURES	Result of information of the matrix which derive from grayscale image
EMPLOYEE	A person whose Iris and Face is to be recognized

SDD	Software Design Document
UML DIAGRAM	It is a modelling language which is used in Software Engineering

4.1.4 Overview of Document

The remaining chapters and their contents are listed below.

Section 2 is the Architectural Design which describes the project development phase. Also, it contains class diagram of the system and architecture design of the simulation which describes actors, exceptions, basic sequences, priorities, pre-conditions and post-conditions. Additionally, this section includes activity diagram of scenario generator.

Section 3 is Use Case Realization. In this section, a block diagram of the system, which is designed according to use cases in SRS document, is displayed and explained.

Section 4 is related to Detection. In this section, we have shown the sample images of the employee for how the recognition system determine while scanning the employee face and iris.

4.1.5 Motivation

We are a group of senior students in computer engineering department who are interested in image processing and security system. As a group, we have taken the course of numerical computations for a better understanding in image acquisition area. We aimed to combine the fields of education, image acquisition, and security systems technologies in this project. We have chosen the MATLAB scripting language and C# programming language which all of the members of the group are already familiar to develop our project.

4.2. ARCHITECTURE DESIGN

4.2.1 FIRec Design Approach

While developing the project, we have decided to use Scrum which is an agile software development methodology. Scrum is part of the Agile movement. Agile is a response to the failure of the dominant software development project management and borrows many principles from lean manufacturing [9]. In the scrum, it has a sprint which includes work to do in the project. It takes a while almost between 2 and 4 weeks. If you add work to the sprint, you can not remove that work from the sprint. The team who developed the project should have a daily meeting every morning which should be maximum 10-15 minutes. Scrum has three major roles which are scrum master, project owner, and development team. Scrum master generally manages the development team, product owner delivers the requirements. The development team is the team of developers who work on the project together according to schedule [9]. There are several advantages of Scrum, Firstly, sprint releases end of each sprint. The team does not have to act according to the product owner, the team identifies their

priority. Delivery happens according to the velocity of the team and development tools work like cross-functional. The team should use burndown graphics at the project. The scrum board rebuilds while the beginning of each sprint. In addition, the scrum methodology is incremental and iterative, so we can change required changes at project according to customer feedback.

Gantt Chart in Figure 1 includes two parts which are research & documentation part. This Gantt Chart explains the work to be done with using timeboxes. We approximately 50 days are spent using waterfall for research and documentation which include information regarding the project.

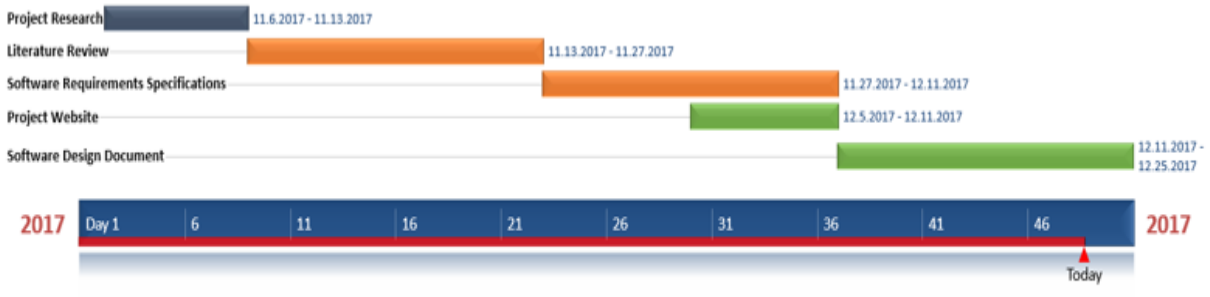

Figure 1 Gantt Chart of Work Plan

4.2.1.1 Class Diagram

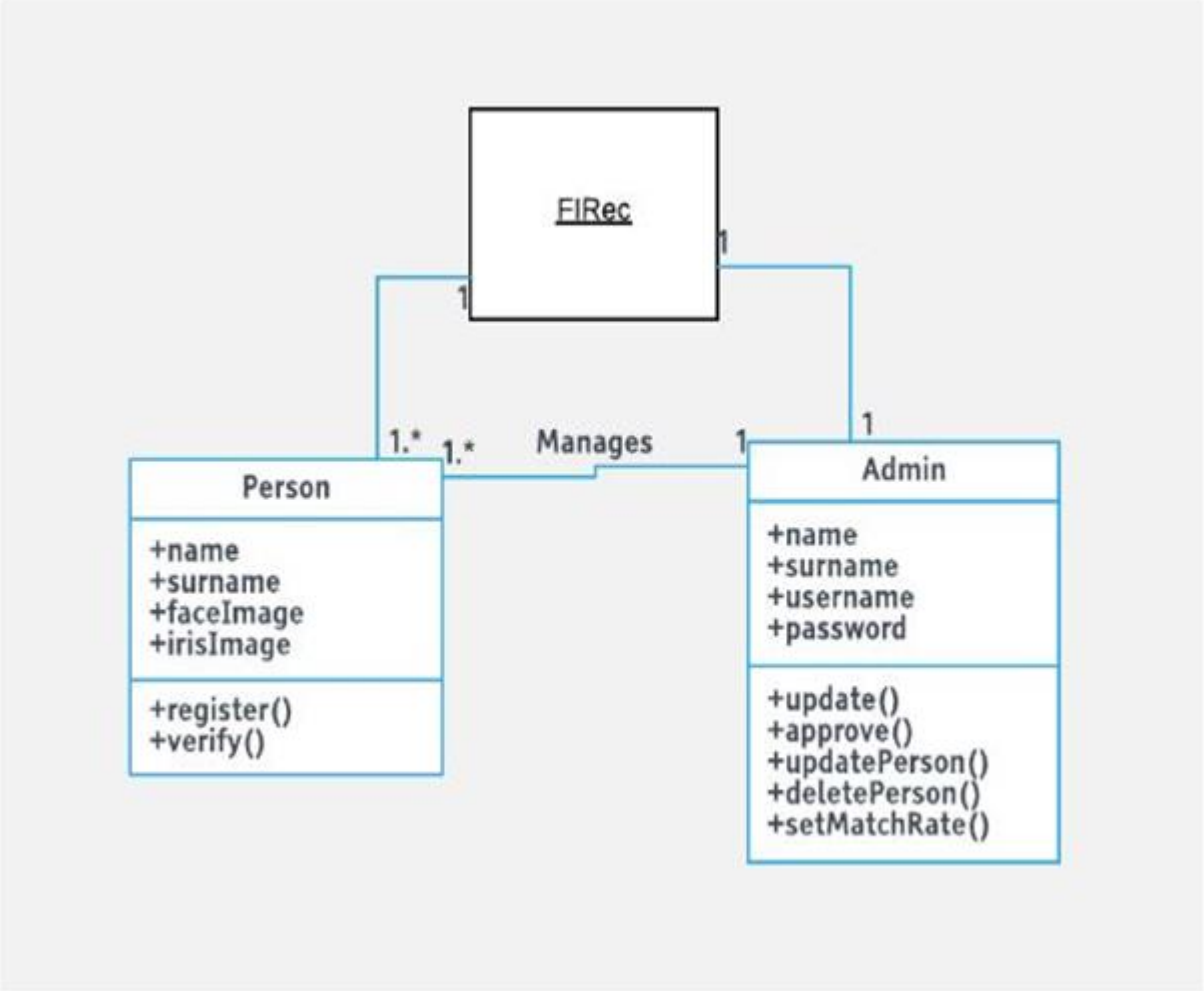

Figure 2 Class Diagram of Face and Iris Recognition project

Figure 2 displays information about connections between the systems within the Face and Iris Recognition System. FIRec is the main system, which contains other systems. It is responsible for face and iris recognition and connections between other systems such as Admin and Person. Person class represents all the users who use the system except admin. Admin class is for users who will use the system to manage employee and set some system configurations. Admin class is for actor which manages the system.

4.2.2 Architecture Design of FIRec

4.2.2.1 Admin Menu

Summary: System admin will use this system. System admin can login, update personal information and exit from the system. Also, System admin can update a person's information, delete a person, save a person to the system. In addition, Admin can set matching rate.

Actor: System Admin

Precondition: System admin must run the program and select admin menu.

Basic Sequence:

1. System admin will enter his/her username and password and login to the system.
2. System admin can select update from the menu for updating his/her personal information.
3. System admin can select delete from the menu for deleting a person from the system.
4. System admin can select requests from the menu to accept or reject registration applications of people.
5. System admin can select a set face and iris matching rate which is used for verifying an employee.
6. System admin can select exit button to exit the system.

Exception: Database connection can be failed.

Post Conditions: None

Priority: High

4.2.2.2 Registration System

Summary: Employee will use this system. The employee can show his/her face and eyes to the camera to create a registration application.

Actor: Employee, system admin

Precondition: Person should not be registered before, and employee should select register button.

Basic Sequence:

1. An employee can show his/her face and eyes to the camera.
2. After system reads his/her face and eyes, the employee can enter his/her personal information and then, send the application to the admin by selecting send button.
3. After system reads his/her face and eyes, the employee can cancel the operation by selecting cancel button.
4. The employee can exit from the system by selecting exit button.

Exception: Database connection can be failed.

Post Conditions: Application will be accepted or rejected by the system admin.

Priority: High

4.2.2.3 Recognition System

Summary: Person will use this system. The employee will show his/her face and eyes to the camera and then, the system will verify the user by comparing and matching his/her face and

iris features with the features stored in the database. Also, the employee can exit from the system.

Actor: Employee

Precondition: Program should be run and the employee should select verify button.

Basic Sequence:

1. The employee can show his/her face and eyes to the camera.
2. The employee can exit from the system by selecting exit button.

Exception: Database connection can be failed.

Post Conditions: Accept or reject message will appear on the screen.

Priority: High

4.2.3 Activity Diagram

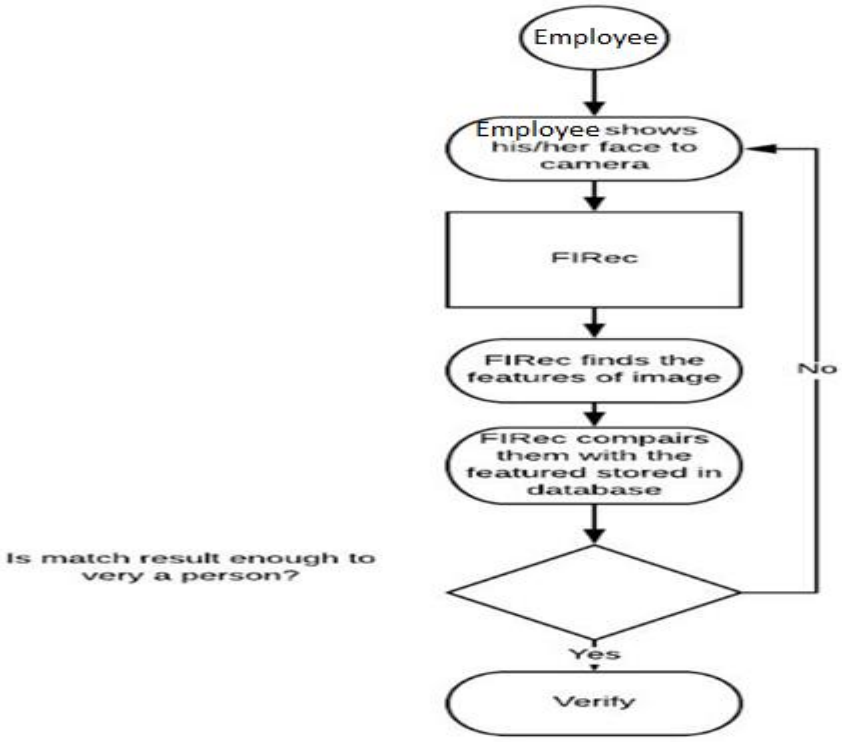

Figure 3 Activity Diagram

Figure 3 shows how the FIRec works as an activity diagram. When the employee shows his/her face to the camera, then FIRec system finds the features of image and FIRec compares them with the features which stored in the database. If matched features are equal or more than identified correction level of FIRec system, the employee can access to the protected file, else s/he needs to show his/her face to the camera again.

4.3. USE CASE REALIZATIONS

FIRec Project

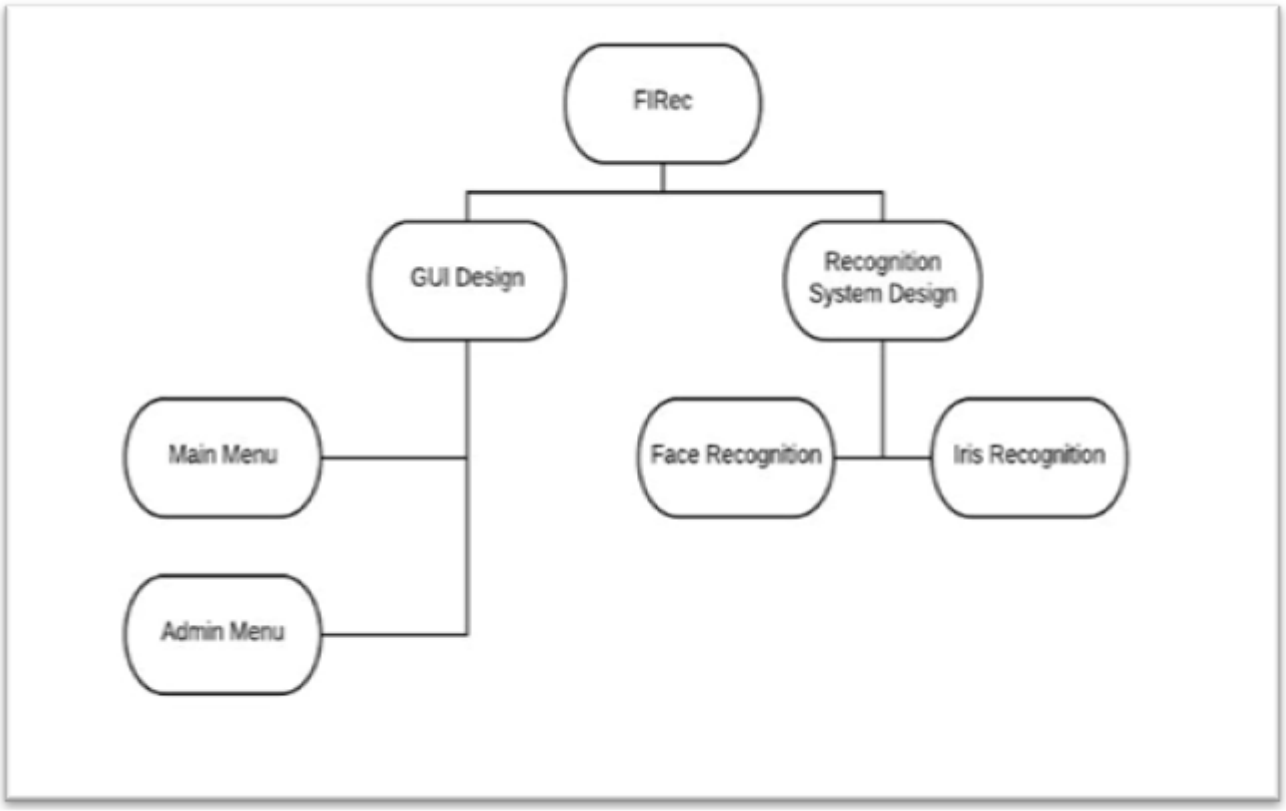

Figure 4 Project Components of FIRec

Brief Description of Figure 4

Components of the FIRec Project are shown in Figure 4. Block diagram in the figure shows all designed systems of the FIRec. FIRec contains two main components which have their sub-systems.

4.3.1 GUI Design

GUI design takes responsibilities of interactions between actors and the system. GUI design contains two sub-systems. Sub-systems of GUI design are Main Menu and Admin Menu. The start page is Main Menu. The employee can register and verify his/her face and iris. Admin can login the system to the main menu. There is only one way to reach admin menu, after an admin logins the system, admin menu will appear. Admin can update his/her personal information, approve a person's register application, update a person's personal information, delete a person or set matching rate.

4.3.1.2 Recognition System Design

Responsibilities of recognition part belongs to recognition design for all recognition operations which are used in FIRec in order to verify an employee for other systems security. This system contains Face Recognition and Iris Recognition.

4.4. DETECTION

4.4.1 Face and Iris Detection

In this project, image acquisition technique is used to create the face and iris detection in FIRec. Firstly, As seems at Figure 5, when employee stands his/her face in front of the camera, face image acquisition actualize thanks to Matlab, then face detection step is happening, then eventually, employee identity recognized.

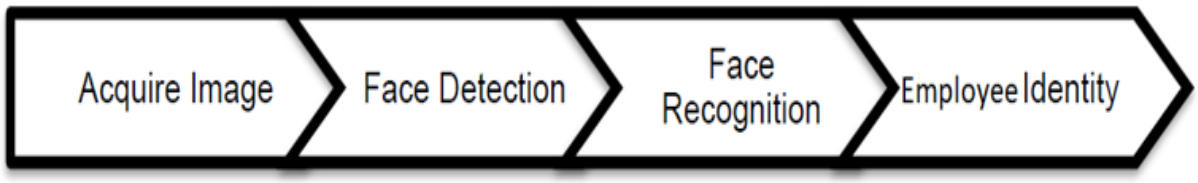

Figure 5 Steps of Face Recognition System Application

In figure 6, when employee stand his/her eye in front of the camera, iris image acquisition actualize thanks to Matlab, then image of localization of the demarcated zones are identified, then we reached iris code of the employee end of the polar representation is converting to Gabor filters.

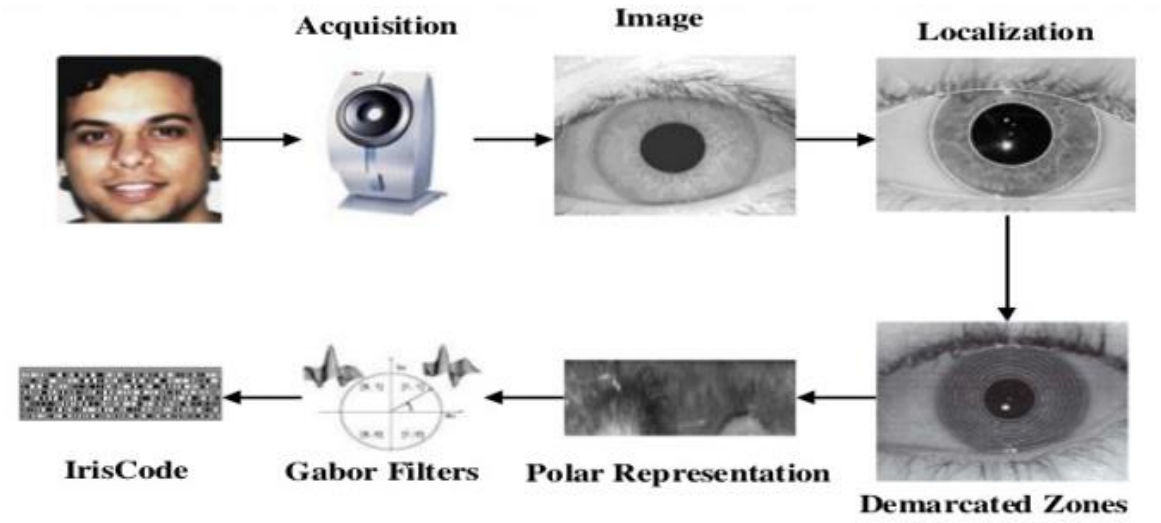

Figure 6 Steps of Iris Recognition System Application

In figure 7, we draw an approach of the face recognition, In this 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 & iris recognition part. The main reason for this selection is their smooth applicability and reliability issues [10].

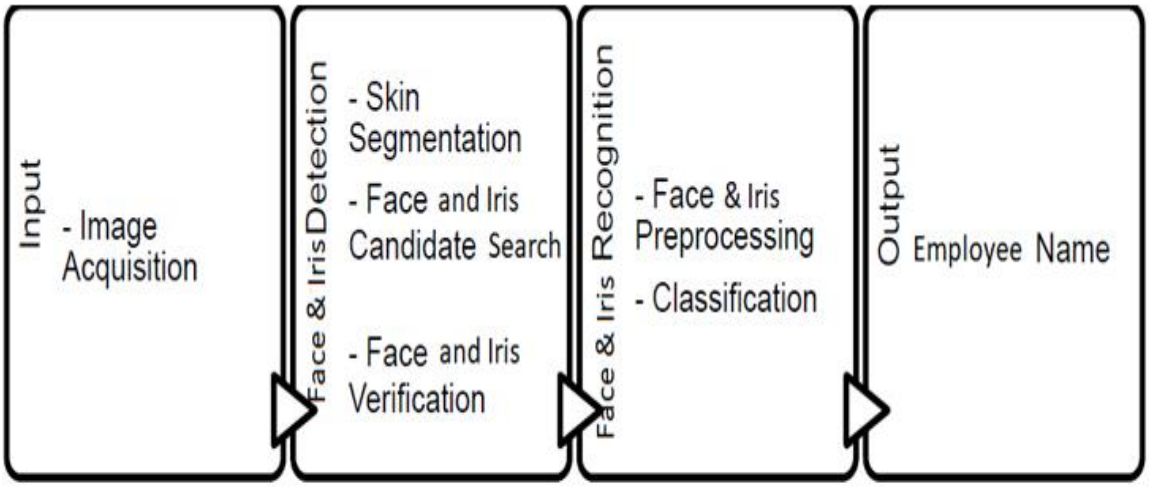

Figure 7 Face Recognition Approach

In figure 8, we design a FIRec Algorithm for detection part. It reduces computational time for searching the whole image. While segmentation is applied, only segmented region is searched whether the segment includes any face, iris or not [10].

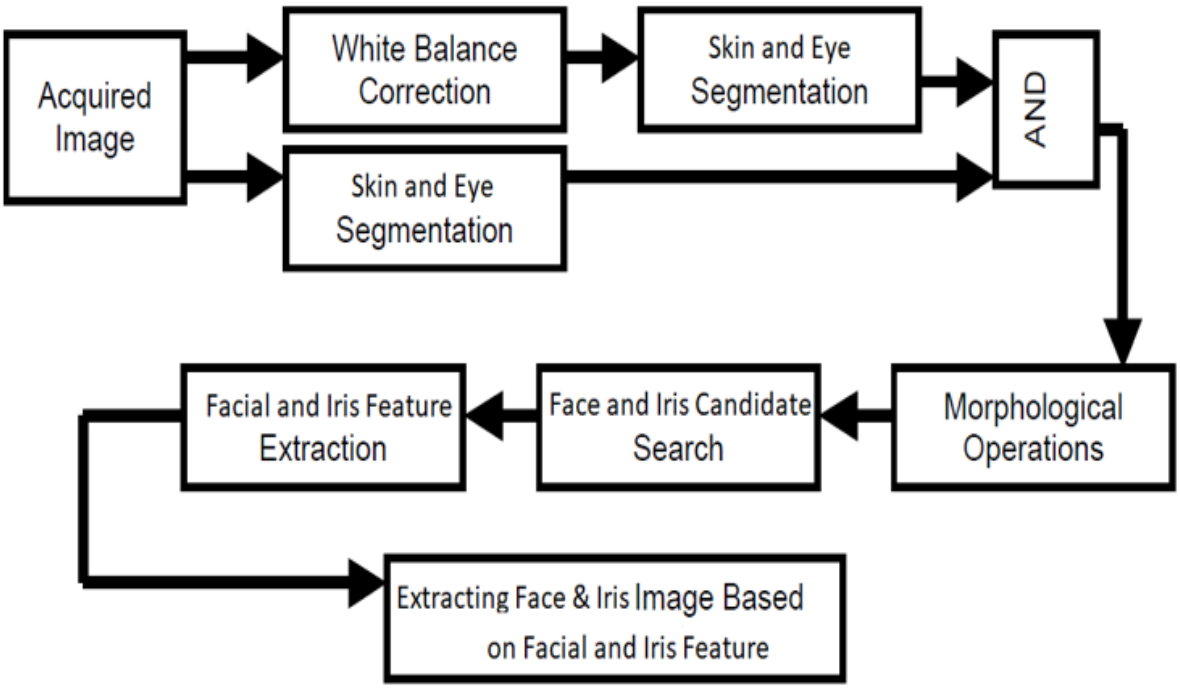

Figure 8 Algorithm of FIRec detection part

In figure 9, white balance of images differs due to change in lighting conditions of the environment while acquiring an image. This situation creates non-skin objects that belong to skin objects. Therefore, white balance of the acquired image should be corrected before segmenting it. Results of segmentation on original image and white balance corrected image [11].

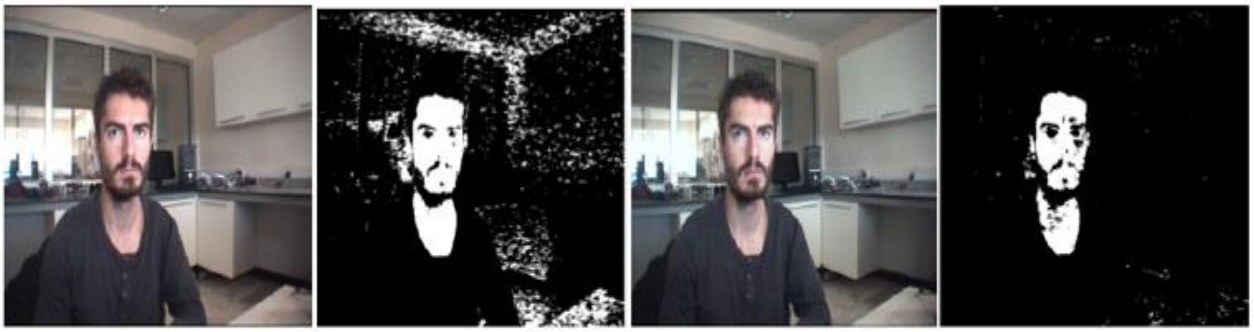

Figure 9, Example of taken/white balance corrected image and skin color segmentation (a.) Original Image (OI), b.) Segmentation on OI, c.) White Balance Correction on OI (WBI), d.) Segmentation on WBI)

In figure 10, After face cover corner points are calculated, face image can be extracted [12]

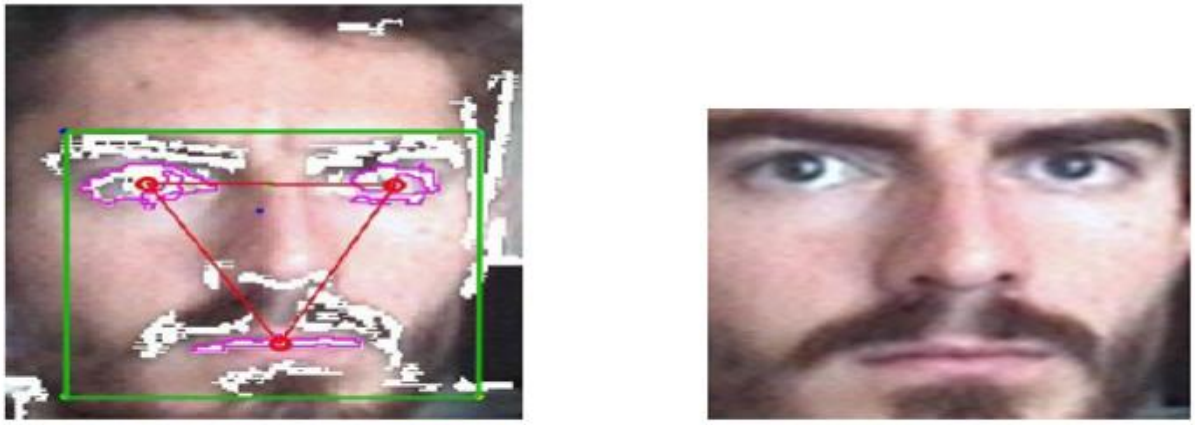

Figure 10, Facial Feature Extractions (Left) and Face Image (Right)

In figure 11, a modified face image which is obtained in the Face recognition system, should be classified to identify the person in the database. Face recognition part is composed of preprocessing face image, vectorizing image matrix, database generation, and then classification.

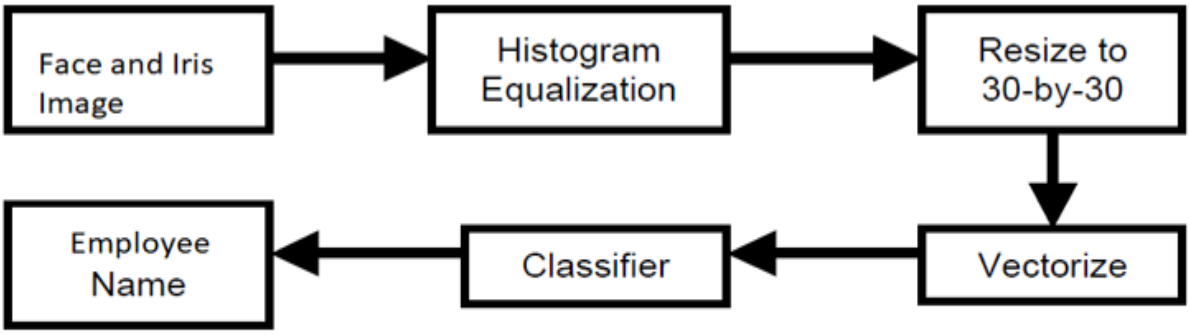

Figure 11, Algorithm of FIRec Recognition Part

In figure 12 and figure 13, Finally, face detection and recognition parts are merged to implement face recognition system. The system can also handle more than one faces in the acquired image. Code is generated on MATLAB environment [10].

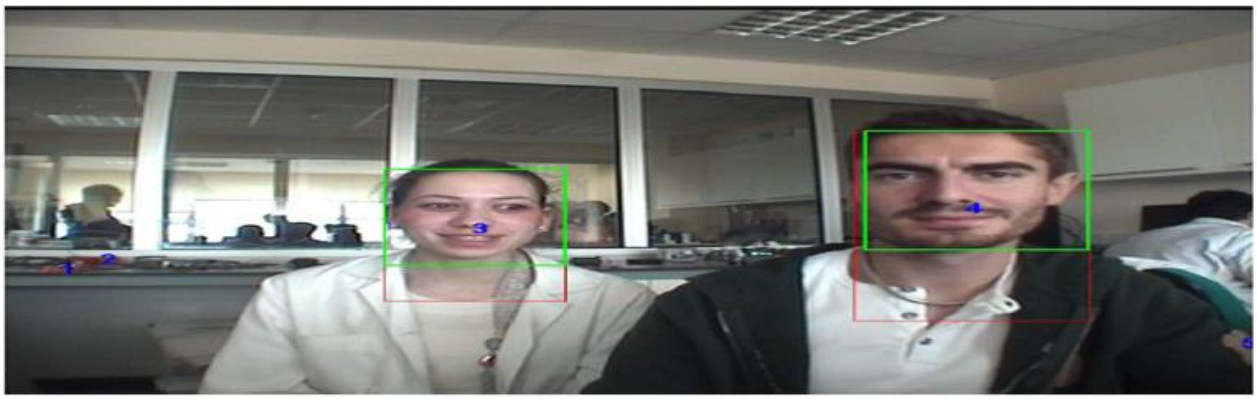

Figure 12, Acquired Image and Found Employee

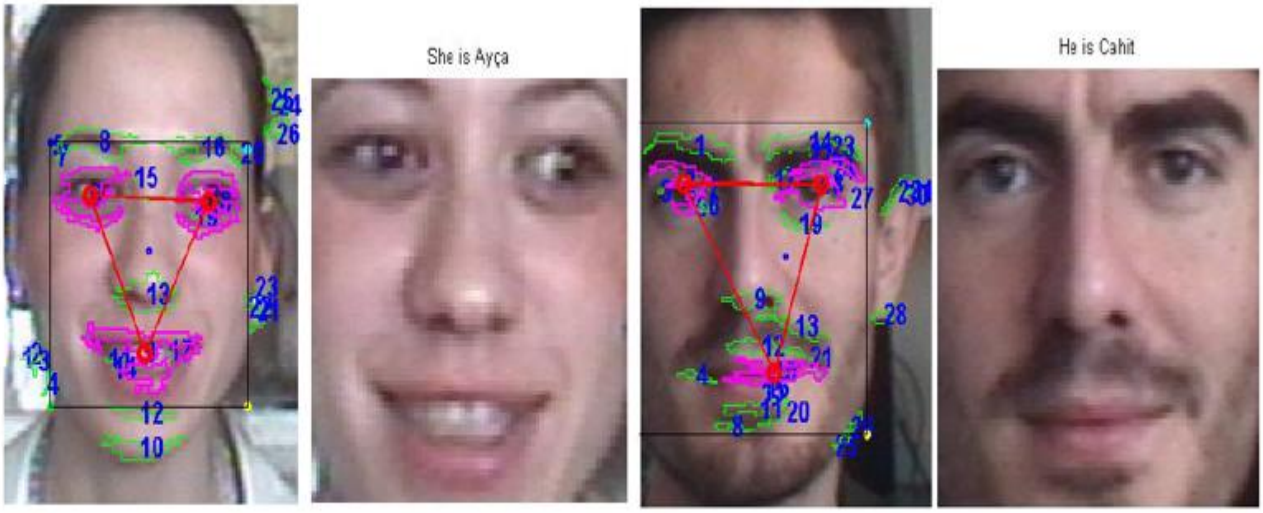

Figure 13, Facial Features Extraction on Face Employees and Classification of Face Image (MATLAB Output)

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