RECOGNITION SYSTEM AS A METHOD OF AUTHENTICATION:

A CASE STUDY OF MENGO SENIOR SCHOOL

BY

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Declaration

I Namirimu Aisha hereby declare that this dissertation is my original work and to the best of my knowledge has never been presented to any Institution of higher learning for any academic award.

Signed: _____

Namirimu Aisha

Date: _____

Approval

This is to certify that the dissertation entitled Recognition System as a method of authentication has been done under my supervision.

Signed…….

Mr. Ogere Bernard (Supervisor)

School of Business Administration

Date…… …….

Dedication

I dedicate this dissertation to my parents, Hajji Ali and Hajjati Zubeder Khasim my sisters Mariam, Zam Zam, Sarah, Qudra and Asha brothers Khasim, Ismaeal, Hamza Hassan and muhammed.

Acknowledgement

Praise be to Allah, Lord of the world and may the blessings of Allah Peace Be Upon His Apostle Muhammad (SAW).

I wish to start by thanking the exerted Allah for his guidance which has enabled me complete this task it has been a long journey.

I would love to thank my parents for the continued support as well as guidance they gave me throughout this course.

I would like to thank my supervisor Mr. Ogere Bernard for the reading through the manuscript and making constructive criticism that enabled this dissertation to be worth reading, May God bless them so much.

Profound gratitude is extended to the respondents who included the administration, staff and students of Mengo senior secondary school for the cooperation.

Lastly I would like to thank everyone most especially all those I have not mentioned, appreciations is here by expressed to all for the assistance you rendered.

Thank you

.

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List of acronyms

PCA	Principal Component Analysis
CIR	Correct Identification Rate
FIR	False Identification Rate
FAR	False Acceptance Rate
FRR	False Rejection Rate
2D	Two Dimension
3D	Three Dimension
TOF	Time Of Flight
AAM	Active Appearance Models
LPP	Locality Preserving Projections
ROI	Region Of Interest

ABSTRACT

The study investigated recognition systems as a method of authentication for recognition of students in Mengo Senior secondary school. The objectives of the study where (1) To study/examine the recognition technologies used as a method of authentication by Mengo Senior School. (2) To determine the requirements for a new Recognition Technology as a method of authentication for Mengo Senior School (3) To design a facial Recognition Technology for the purpose of authentication in Mengo senior School. (4) To implement a working prototype of the facial Recognition Technology as a method of authentication for Mengo Senior School

The methods used in data collection where structured questionnaires interviews.

The findings of the study reveal that relevant knowledge and ideas generated and attained by the staff and students of Mengo senior secondary school.

The study used C# programming language to develop the algorithms of the system. Visual Studio was also used to design interfaces and open CV libraries.

Conclusions of the study where that the system was designed, tested and it was successful.

The study recommended that in organizations, Backup systems should always be put place.

Chapter One

Introduction

1.0 Background

The study is about recognition system as a method of authentication in secondary schools in Kampala central district focusing on Mengo Senior School as a case study.

Recognition system is a category of biometric software that maps an individual's body features mathematically and stores the data as image print. The software uses deep learning algorithms to compare a live capture or digital image to the stored image print in order to verify an individual's identity (Chastain and Marion 1972). Recognition systems are widely used biometric systems in giving accessibility to specific facilities including buildings, shopping centers, banks and other areas.

Humans often use recognize systems to identify individuals and advancements in computing capability over the past few decades now enable similar recognitions automatically. Early recognition algorithms used simple geometric models, but the recognition process has now matured into a science of sophisticated mathematical representations and matching processes. Major advancements and initiatives in the past ten to fifteen years have propelled different recognition technology into the spotlight. Including swipe cards, fingerprints, palm recognition, voice recognition and Face recognition used for both verification and identification (open-set and closed-set) (Manjunath, R. Chellappa, C. von der Malsburg 1992)

According to Turk & Pentland (1991) Recognition system is a biometric application which captures image and uses it to identify individuals by applying analytical biometrics and comparing it with the existing database to ascertain the authenticity.

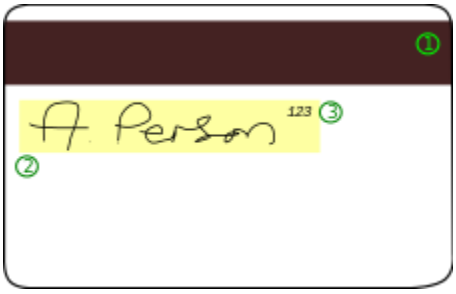
Currently Mengo Senior School uses a swipe card system to gain access to school facility,

services and to check for attendance of students. A swipe card system has many advantages over a regular clocking in system. This is mainly because it has multiple uses. A basic clocking in system allows students to clock in but does not provide the security benefits of a swipe card system. This system is regularly used worldwide by major companies to ensure the safety and security of the school. One of the main benefits it provides is that it is extremely easy and quick to use. Like a credit card, smart cards are small, lightweight and can be easily lost if the person is irresponsible. Unlike credit cards, smart cards can have multiple uses and so the loss may be much more inconvenient. If you lose a card that can give you access to Mengo Senior School premises, you could be severely inconvenienced for a number of days.

Swipe cards are plastic designed cards that work as keys, activated when they come in contact with card reader; this is done by tapping the card to pad next to the access entry. The card reader then transmits data through electronic information system for recognition to grant access to the cardholder (Chastain and Don Wetzel 1973)

Once a swipe card makes contact with a card reader that is synched with the card information is sent to the business's computers verifying the identity of the card holder and will unclock a door or record that the student is in the facility.

A specimen of the swipe cards used in Mengo Senior School.

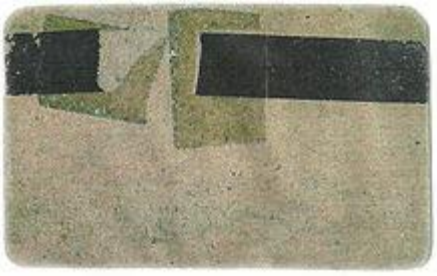


There is need for a backup system which can be used in case a student loses his or her swipe card or leaves it at home unknowingly which is the Authentication system based on body parts Recognition.

In case a student lives his swipe card at home, he or she may be recorded as absence. Students can be identified by the body parts Authentication System so as to prove their presence at school.

(Turk & Pentland, 1991) Automated recognition system is a relatively new concept. Developed in the 1960s, the first semi-automated system for body recognition system required the administrator to locate features (such as palm, fingers, eyes, ears, nose, and mouth) on the biometric machine before it calculated distances and ratios to a common reference point, which were then compared to reference data. In the 1970s, Goldstein, Harmon, and Lesk1 used 21 specific subjective markers such as hair color and lip thickness to automate the recognition.

According to (Turk & Pentland, 1991), the problem with both of these early solutions was that the measurements and locations were manually computed. In 1988, Kirby and Sirovich applied principle component analysis, a standard linear algebra technique, to the body parts and cards recognition problem. This was considered somewhat of a milestone as it showed that less than one hundred values were required to accurately code a suitably aligned and normalized plastic surfaces and body image.(Hsu & Klain, 2009)



This uses the first prototype of magnetic stripe card created by IBM in the late 1960s.

The human body and plastic cards play an important role in conveying individual's identity. Despite large variations in the viewing conditions such as lighting, expressions, differences in hair style and so on, the human ability to recognize people by specific identification aspects are

remarkable.

Comparison of the given image was done with the set of stored images to check if the parts and images really match.

Since different images have complex features, developing a recognition computer system is a very formidable but possible task. Automated system has to address all the various steps involved in recognition systems and detection. These various must be handled with care to ensure that all the basic features are represented in a way that best utilizes the available information to distinguish a particular image from all other images in the data base. Images pose a particularly difficult in categorization in specific image features need to be stored in the database for the system to synchronize generate the required information at a given time for retrieval and display at a particular point.

(Belhumeur, Hespanha, & Kriegman, 2010)Some recognition algorithms identify image features by extracting landmarks, or features, from an image of the subjects. For example, an algorithm may analyze the relative position, size, and/or shape of the eyes, nose, cheekbones, and jaw. These features were then used to search for other images with matching features. Other algorithms normalize a gallery of face images and then compress the face data, only saving the data in the image that is useful for face recognition. A probe image is then compared with the face data. One of the earliest successful systems is based on template matching techniques applied to a set of salient features, providing a sort of compressed representation.

Chastain and Don Wetzel (1973) explain that authentication is the process of recognizing a user's identity. It is the mechanism of associating an incoming request with a set of identifying credentials. The credentials provided are compared to those on a file in a database of the

authorized user's information on a local operating system or within an authentication server.

The authentication process always runs at the start of the application, before the permission and throttling checks occur, and before any other code is allowed to proceed. Different systems may require different types of credentials to ascertain a user's identity. The credential often takes the form of a password, which is a secret and known only to the individual and the system. Three categories in which someone may be authenticated are: something the user knows, something the user is, and something the user has in relation to a specific activity, subject or design process.

Authentication process can be described in two distinct phases - identification and actual authentication. Identification phase provides a user identity to the security system. This identity is provided in the form of a user ID. The security system will search all the abstract objects that it knows and find the specific one of which the actual user is currently applying. Once this is done, the user has been identified. The fact that the user claims does not necessarily mean that this is true. An actual user can be mapped to other abstract user object in the system, and therefore be granted rights and permissions to the user and user must give evidence to prove his identity to the system. The process of determining claimed user identity by checking user-provided evidence is called authentication and the evidence which is provided by the user during process of authentication is called a credential.

Recognition algorithms were divided into two main approaches, geometric, which looks at distinguishing features, or photometric, which is a statistical approach that distills an image into values and compares the values with templates to eliminate variances.

Popular recognition algorithms include principal component analysis using linear discriminant analysis, elastic bunch graph matching using the Fisher-face algorithm, the hidden Markov model, the multi-linear subspace learning using tensor representation, and the neuronal motivated dynamic link matching.

1.1 Problem statement

Currently Mengo Senior School monitors accessibility of services and the attendance of students in classes with a swipe card system. This requires every student to have a swipe card, which means a student, needs to have his or her swipe card at all times. However, these swipe cards can get lost in case they are mishandled and a student may not be in position to access the system and as well as the school premises. According to implementation report Mengo Senior School (July 2016) fifty four students lost their swipe cards and twenty eight students had cards which could not be swiped due the condition of the card. Pre-examination report of April 2017 indicated that eighty seven students had difficulty in registration for the first term examinations since they needed to replace their swipe cards which were either lost or damaged. The replacement of a lost or damaged swipe card is at a cost to the parent and inconveniences the student who has already paid the fees.

It is upon such background that the study intends to examine recognition system as a method of authentication in Mengo Senior School.

1.2 Objectives of the study

1.2.1 General Objective

To develop a facial recognition system as a method of authentication for Mengo Senior School for recognition of students as a backup system for their existing swipe card system.

Specific Objectives

1) To examine the recognition technologies used as a method of authentication by Mengo Senior School.
2) To determine the requirements for a new Recognition Technology as a method of authentication for Mengo Senior School
3) To design a facial Recognition Technology for the purpose of authentication in Mengo senior School.
4) To implement a working prototype of the facial Recognition Technology as a method of authentication for Mengo Senior School

1.2.3 Research questions.

1) What are the outcomes of recognition technologies used as a method of authentication by Mengo Senior School?
2) What are the requirements for a new recognition technology in Mengo Senior School?
3) What are the requirements for facial recognition technology for authentication in Mengo senior school?

1.3 Justification

Biometric technologies currently in use often have errors in identification and recognition of students' due to their weak algorithms that can easily be modified by an unauthorized user like duplication of smart cards, however facial recognition technology come in handy to solve such duplication and loss of swipe cards since one cannot forget or lose a face on the way to school.

There is therefore need for a system that can accurately identify students at the fastest speed with ease which the facial recognition technology comes in handy.

1.4 Significance

The system will be the most accurate biometric system that will be easy to use, non-intrusive, and difficult to forget and, actually quite a fast system once initial enrolment will have taken place. The system will offer the highest security of an individual in terms of identification and authentication of students at Mengo Senior School.

The learners

the learners/students will benefit from this technology given that they will always have their fingers and this will reduce on the time wasted due to lose of swipe cards.

1.5 Scope of the study

1.6.1 Time scope

The scope is limited to the design of a facial recognition technology for Authentication students and knowledge of the biometric systems in Mengo Senior School for identification of the students.

1.6.2 Geographical Scope

The study was conducted at Mengo Senior School Kampala District.

1.6.3 Time Scope

The study focused on the time period of 2015 to 2017 and took five month bearing in mind the period of designing and developing the system.

Definition of key terms

Recognition system is a category of biometric software that maps an individual's body features mathematically and stores the data as image print. The software uses deep learning algorithms to compare a live capture or digital image to the stored image print in order to verify an individual's identity (Chastain and Marion 1972).

Swipe cards are plastic designed cards that work as keys, activated when they come in contact with card reader; this is done by tapping the card to pad next to the access entry. The card reader then transmits data through electronic information system for recognition to grant access to the cardholder (Chastain and Don Wetzel 1973)

Authentication is the process of recognizing a user's identity. It is the mechanism of associating an incoming request with a set of identifying credentials. The credentials provided are compared to those on a file in a database of the authorized user's information on a local operating system or within an authentication server (Ian Robertson (2004).

Design is a roadmap or a strategic approach for someone to achieve a unique expectation. It defines the specifications, plans, parameters, costs, activities, processes and how and what to do within legal, political, social, environmental, safety and economic constraints in achieving that objective

Facial recognition is a category of biometric software that maps an individual's facial features mathematically and stores the data as a face print. The software uses deep learning algorithms to compare a live capture or digital image to the stored face print in order to verify an individual's identity.

Chapter Two
Study literature

2.0 Introduction

This chapter contains three parts which include the literature survey, literature review and conceptual framework of the study variables. Literature survey looks at research works conducted locally by different scholars in Uganda in the area of recognition systems as a method of authentication with the purpose of establishing the gaps left in those studies. This provides a basis for the current study, by proposing how it addresses the established gaps left by previous studies. Literature review examines how the same study problem has been or is being handled elsewhere. The purpose is to provide the conceptual framework upon which the current study can be based on to design an appropriate technology for Mengo Senior School.

Biometric identification utilizes physiological and behavioral characteristics to authenticate a person's identity. Some common physical characteristics that may be used for identification include fingerprints, palm prints, hand geometry, retinal patterns and iris recognition. The behavioral characteristics include signature, voice pattern and keystroke dynamics. A biometric system works by capturing and storing the biometric information and then comparing the scanned biometric with what is stored in the database. (Viola & Jones, 2009)

recognition is the process of recognizing a person by analyzing the apparent pattern of his or her body features. Recognition provides one of the most secure methods of authentication and identification. This will make the technology very useful in areas such as Hotels. The technology will be accurate, easy to use, non-intrusive, and difficult to forge and, despite what people may think, it will actually be quite a fast system once initial enrolment has taken place.

According to Rein-Lien Hsu and Ani Klain (2010) several algorithms will be used for image

recognition. We have to locate points in the body image with high information content. We don't have to consider the image contour. We have to concentrate on the center of the image area, as most stable and informative features are found there. The high informative points in the image are considered around eyes, nose and mouth. To enforce this, we will apply Gaussian weighting to the center of the image.

In a computer based recognition system, each image is represented by a large number of pixel values. Linear discriminant analysis will primarily be used here to reduce the number of features to a more manageable number before classification. Each of the new dimensions is a linear combination of pixel values, which form a template.

(Turk & Pentland, 1991)Principal Component Analysis with Eigen images will be one of the popular algorithms to be used for image recognition. Principal component analysis is a mathematical procedure that uses orthogonal co-ordinates to convert a set of observations of possibly correlated variables into a set of values of uncorrelated variables called principal components. PCA is then applied on the Eigen images.

2.1 image Recognition Tasks

The three primary image recognition tasks are:

• Verification (authentication) - Am I who I say I am? (one to one search)

• Identification (recognition) - Who am I? (one to many search)

• Watch list - Are you looking for me? (one to few search)

2.1.1 Verification

The verification task is aimed at applications requiring user interaction in the form of an identity claim, that is, access applications. The verification test is conducted by dividing persons into two groups:

- ✓ Clients, people trying to gain access using their own identity.
- ✓ Imposters, people trying to gain access using a false identity, i.e. an identity known to the system but not belonging to them.

The percentage of imposters gaining access is reported as the False Acceptance Rate (FAR) and the percentage of client rejected access is reported as the False Rejection Rate (FRR) for a given threshold.

2.1.2 Identification

(Chuan-xu & Zuo-yong, 2008)The identification task is mostly aimed at applications not requiring user interaction, i.e. surveillance applications. The identification test works from the assumption that all images in the test are of known persons. The percentage of correct identifications is then reported as the Correct Identification Rate (CIR) or the percentage of false identifications is reported as the False Identification Rate (FIR)

2.1.3 Watch list

According to (Viola & Jones, 2009)The watch list task is a generalization of the identification task which includes unknown people. The watch list test is like the identification test reported in CIR or FIR, but can have FAR and FRR associated with it to describe the sensitivity of the watch list, meaning how often is an unknown classified as a person in the watch list (FAR).

2.2 image Recognition Process

recognition is a visual pattern recognition task. The three-dimensional human face, which is subject to varying illumination, pose, and expression, has to be recognized. This recognition can be performed on a variety of input data sources such as:

- A single 2D image.
- Stereo 2D images (two or more 2D images).

- 3D laser scans.

Also soon Time of Flight (TOF) 3D cameras will be accurate enough to be used as well. The dimensionality of these sources can be increased by one by the inclusion of a time dimension. A still image with a time dimension is a video sequence. The advantage is that the identification of a person can be determined more precisely from a video sequence than from a picture since the identity of a person cannot change from two frames taken in sequence from a video sequence (Viola & Jone 2009).

Recognition systems will consist of four steps, image detection (localization), image preprocessing (image alignment/normalization, light correction), feature extraction and feature matching.

2.2.1 Image detection

The aim of image detection is localization of the image in an image. In the case of video input, it can be an advantage to track the images in between multiple frames, to reduce computational time and preserve the identity of an image between frames. Methods used for face detection includes: Shape templates, neural networks and Active Appearance Models (AAM)

2.2.2 Image preprocessing

The aim of the image preprocessing step is to normalize the coarse image detection, so that a robust feature extraction can be achieved. Depending of the application, image preprocessing includes: Alignment (translation, rotation, scaling) and light normalization/correlation.

2.2.3 Feature extraction

The aim of feature extraction is to extract a compact set of interpersonal discriminating geometrical or/and photometrical features of the image. Methods for feature extraction include: PCA, FLDA and Locality Preserving Projections (LPP).(Hsu & Klain, 2009)

2.2.4 Feature matching

Feature matching is the actual recognition process. The feature vector obtained from the feature extraction is matched to classes (persons) of images already enrolled in a database. The matching algorithms vary from the fairly obvious Nearest Neighbor to advanced schemes like Neural Networks.

2.3 Variation in appearance

An image is subject to various factors like pose, illumination and expression as well as lens aperture, exposure time and lens aberrations of the camera. Due to these factors large variations of images of the same person can occur. According to (Chuan-xu & Zuo-yong, 2008)On the other hand, sometimes small interpersonal variations occur. Here the extreme is identical twins, as can be seen in Figure 2.1. Different constraints in the process of acquiring images can be used to filter out some of these factors, as well as use of preprocessing methods.

In a situation where the variation among images obtained from the same person is larger than the variation among images of two different surfaces more comprehensive data than 2D images must be acquired to do computer based recognition. Here, accurate laser scans or infrared images can be used.

2.5 Key technologies and their weaknesses

2.5.1 Finger print recognition

The fingerprint recognition technology identifies a person by comparing the code created from the fingerprint image captured at access attempt (live scan template) to one or more preregistered codes (reference templates). This technology however has a maximum limitation that it can be spoofed easily. Other limitations are caused by particular usage factors such as wearing gloves, using cleaning fluids and general user difficulty in scanning.

2.5.2 Signature recognition

Signature recognition technology analyses a series of movements that contain unique biometric data such as personal rhythm, acceleration and pressure flow as seen in. Since these movements can vary with each signing, differentiating between the consistent and the behavioral parts of a signature is difficult thus a weakness in such kind of biometric technology.

2.5.3 Palm print recognition

Palm print verification is a slightly modified form of fingerprint technology. Palm print scanning uses an optical reader very similar to that used for fingerprint scanning; however, its size is much bigger, which is a limiting factor for use in workstations or mobile devices.

2.5.4 Gait recognition

This technology captures a sequence of images for analysis of how an individual walk. Gait recognition is still in an early stage of research and development and thus not yet a technology for one to easily rely on.

2.6 Eigen images

The Eigen image method uses PCA to construct a set of Eigen image images. These Eigen images, can be linear combined to reconstruct the images of the original training set. When introducing a new image an error can be calculated from the best image reconstruction using the Eigen images to the new image. If the Eigen images are constructed from a large image database, the size of the error can be used to determine whether or not a newly introduced image contains a image.

2.7 Different kinds of pattern recognition

Techniques of pattern recognition can be classified into four categories: Template matching, statistical approaches, syntactic approach, and neural networks. The template matching category

builds several templates for each label class and compares these templates with the test pattern to achieve a suitable decision. (Turk & Pentland, 1991)

The syntactic approach is often called the rule-based pattern recognition, which is built on human knowledge or some physical rules, for example, the word classification and word correction requires the help of grammars. The term, knowledge, is referred to the rule that the recognition system uses to perform certain actions. Finally, the well-known neural networks are a framework based on the recognition unit called perceptron. With different numbers of perceptron's, layers, and optimization criteria, the neural networks could have several variations and be applied to wide recognition cases.

2.8 Swipe Card Systems

Swipe card systems work by swiping a plastic card through a device with a reader.

A magnetic strip on the card contains an authorized code. The reader decodes this information to grant access the user. Swipe card readers are often seen on access to reception areas or office blocks.

Similar systems use a 'swipe tag' or 'key fob' - these systems are known as 'Proximity Readers'.

Proximity readers can be combined with keypads or built into intercoms and are more commonly specified for external gate system applications.

Like a credit card, smart cards are small, lightweight and can be easily lost if the person is irresponsible. Unlike credit cards, smart cards can have multiple uses and so the loss may be much more inconvenient. If you lose a card that doubles as a debit card, bus pass and key to the office, you could be severely inconvenienced for a number of days.

If used as a payment card, not every store or restaurant will have the hardware necessary to use these cards. One of the reasons for this is since the technology is more secure, it is also more expensive to produce and use. Therefore, some stores may charge a basic minimum fee for using smart cards for payment, rather than cash.

2.9 Image Detection Using Color Information

We use color information for skin-color detection to extract candidate image regions. In order to deal with different illumination conditions, we can extract the 5% brightest pixels and used their

mean color for lighting compensation. After skin-color detection and skin-region segmentation, we can propose to detect invariant features for region verification.

According to (HU ,2006) Human eyes and mouths are selected as the most significant features of images and two detection schemes are designed based on chrominance contrast and morphological operations, which are called “eyes map” and “mouth map”.

Finally, we form the triangle between two eyes and a mouth and verify it based on luminance variations and average gradient orientations of eye and mouth blobs, geometry and orientation of the triangle, and the presence of a image boundary around the triangle.

The regions pass the verification are denoted as images and the Hough transform are performed to extract the best-fitting ellipse to extract each image.

The lighting compensation process doesn’t have a solid background, but it introduces the idea that despite modeling all kinds of illumination conditions based on complicated probability or classifier models, we can design an illumination-adaptive model which modifies its detection threshold based on the illumination and chrominance properties of the present image (Ian 2004).

2.9.1 Dimension reduction

Dimension reduction is one of the most important steps in pattern recognition and machine learning. It’s difficult to directly use the raw data (for example image patches) for pattern recognition not only because significant parts of the data haven’t been extracted but also because the extremely high dimensionality of the raw data. Significant parts (for recognition purposes or the parts with more interest) usually occupy just a small portion of the raw data and cannot directly be extracted by simple methods such as cropping and sampling. For example, a one-

channel audio signal usually contains over 10000 samples per second, and there will be over 1800000 samples for a three-minute-long song. Directly using the raw signal for music genre recognition is prohibitive and we may seek to extract useful music features such as pitch, tempo, and information of instruments which could better express our auditory perception.

The goal of dimension reduction is to extract useful information and reduce the dimensionality of input data into classifiers in order to decrease the cost of computation and solve the curse of dimensionality problem. There're two main categories of dimension reduction techniques: domain knowledge approaches and data-driven approaches. The domain-knowledge approaches perform dimension reduction based on knowledge of the specific pattern recognition case.

2.9.2 Survey on the weaknesses of existing systems

2.9.2.1 Swipe Card Systems

They can sometimes be unreliable. It might be quite a common occurrence that the machine the machine doesn't read the card that is swiped through that causes annoyance especially for those that are in a rush.

Students can get frustrated with swipe card systems because they have to be quite exact when swiping the card through. If a student does it too slowly or too quickly it will often not respond and not grant access.

These systems are also too costly to install and purchase.

2.9.2.2 Voice Recognition

Even the most efficient voice recognition systems very often may make mistakes, when there is disturbance or some noise in the surrounding. Voice Recognition systems works well only if the

microphone is actually close to the end user. Much more far-away microphones are likely to boost the number of errors. They may be hacked with prerecorded voice messages and largely expensive

2.9.2.3 Iris Technology

Iris scanners might be very easily fooled through a superior quality image of an iris or image instead of the real thing. The scanning devices are often hard to adjust and may annoy multiple people of various heights. The accuracy of scanning devices may be impacted by unusual lighting effects and illumination from reflective types of surfaces. Iris scanners tend to be more expensive in comparison with additional biometrics.

2.9.3 Strengths of the new system

- ✓ It does not require any co-operation of the test subject to do any work.
- ✓ Systems set up in airports, multiplexes, and other open public areas can easily identify an individual among the massive crowd. This performs massive identification which usually other biometric system can't perform.
- ✓ The systems don't require any direct contact of a person in order to verify his/her identity. This could be advantageous in clean environments, for monitoring or tracking, and in automation systems
- ✓ User-friendly design: Contact less authentication.
- ✓ Incident monitoring for security with photo which in turn taken by a camera, but there is no such evidence with the fingerprint technology to track these incidents

Conceptual design of the system

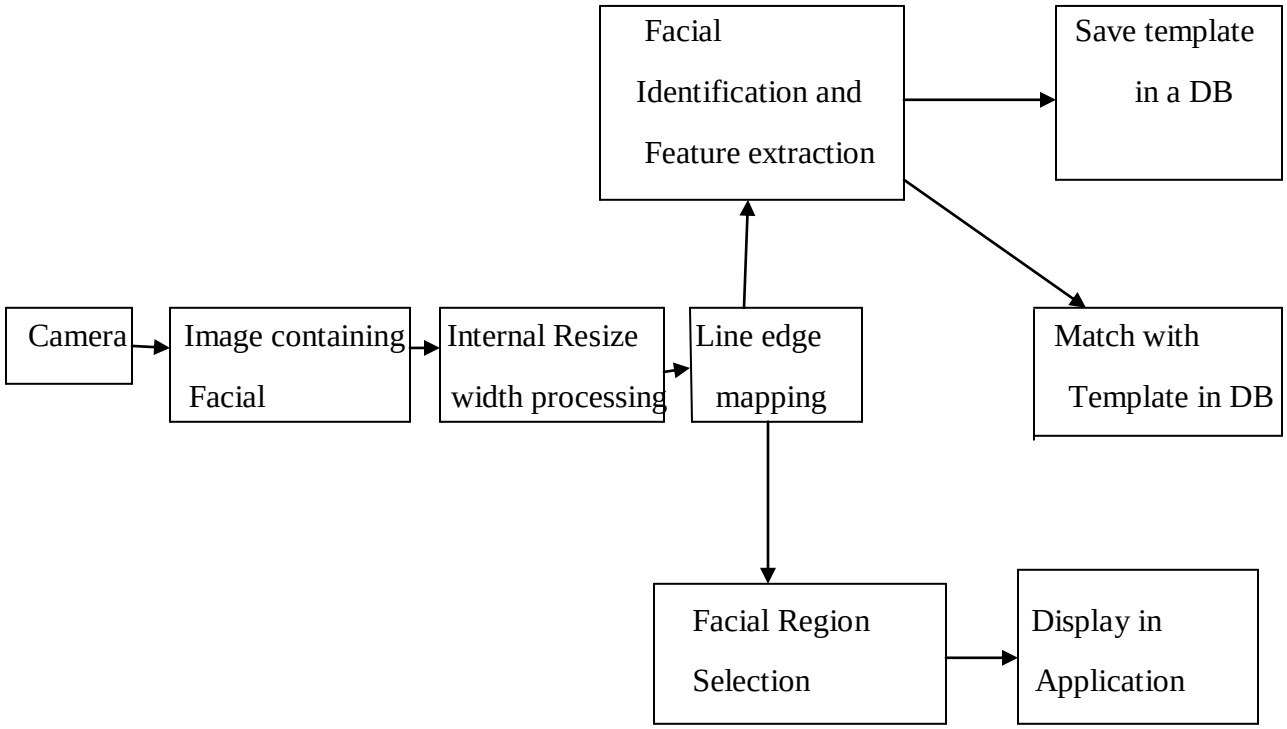


Figure 2.1: conceptual design of the recognition system

Source: Adopted from AAMVA Standard System Design (2012) and modified by the researcher.

Chapter Three

Methodology

3.0 Introduction

This section contains the details of the methods, the approaches and the strategies that were employed to execute the objectives intended for this project.

3.1 Research design

According to Osuola, (1994; 4), a research design is the basic plan which guides the data collection and analysis phase of the research project. The research design consists: research approach, research strategy, research duration and research classifications.

3.1.1 Research Approach

The research approach include: positivism approach, phenomenological approach and combination approach. So in this case the researcher embraced both positivism-phenomenological approaches called combination approach, using systems design and explaining, also using both quantitative and qualitative information.

3.1.2 Research Strategy

Basically research strategy is a general plan of how a researcher goes about answering the research question. Therefore research strategies include: experiment, survey and case study, so in this case the researcher employed purely case study strategy asking broad questions and collecting data from participants to find out the challenges posed by the current recognition system (swipe technology) used in Mengo senior school.

3.1.3 Research Duration

The research duration involves: cross sectional studies which is a study of a particular phenomena at a partial time and longitudinal studies which is studying changes and developments over a long period of time. Therefore the researcher used cross sectional study research design.

3.1.4 Research Classification

The research may be classified according their purpose such as: exploratory, descriptive, explanatory, and multi method. So the researcher used explanatory approach to investigate the research variables.

3.1.5 Data Collection and management

This includes the techniques that were used to obtain the requirements for the design of this system.

3.2.0 Study population

The study population comprised of 96 respondents including administrators (5), board of governors (8), teaching staff (21), systems operators (4) and students (58)

3.2.1 Sample Size

From the population of 96, a sample size of 77 was selected using both convenient sampling and simple random sampling.

The sample size for the current study was selected based on Mpoga (2000).

$$n = \frac{N}{1 + Ne^2}$$

Where: n = The required sample size

N = The study population

e = The level of significance/coefficient

e = 0.05

$$n = \frac{96}{1+96(0.05)^2}$$

$$n = \frac{96}{1+96(0.0025)}$$

$$n = \frac{96}{1+0.24}$$

n = 77

Thus, n = 77 which is the sample size

3.1.1 Data sources

3.5 Sources of data

3.5.1 Primary data

The study obtained data primarily by using interviews and questionnaires methods.

3.5.2 Secondary data

The researcher also collected data from secondary sources; data prepared or developed by some other persons for other purposes other than helping to solve the problem at hand. The researcher got the data from the company's accounting documents, sales journals, account books and reports.

3.6 Sampling methods

The study used simple random sampling, convenient sampling and census method.

3.6.1 Simple random sampling

Simple random sampling means that every member of the sample is selected from the group of population in such a manner that the probability of being selected for all members in the study group of population is the same (Moore 2008). Simple random sampling was used for giving everyone chance to be included in the study and reducing biasness. The respondents from the student population were selected using simple random sampling.

3.7 Data collection method

3.7.1 Questioning

A questionnaire is a research instrument consisting of a series of questions and other prompts for the purpose of gathering information from respondents. Questionnaires have advantages over some other types of surveys in that they are cheap, do not require as much effort from the questioner as verbal or telephone surveys, and often have standardized answers that make it simple to compile data.

3.7.2 Interviewing

Interviewing is the process of asking respondents questions face to face in research in order to achieve the objectives of the research. The purpose of interviewing is to explore the views, experiences, beliefs and/or motivations of individuals on specific matters.

Administrators and members of staff at Mengo Senior School and students as were interviewed to discover the problems they face with their current systems in order to meet their needs.

3.7.3 Document Review

This involved reading documents containing relevant literature that was obtained from textbooks, journal articles, newspapers, conference proceedings, technical reports, websites, journals and any other suitable sources.

3.8 Data collection instruments

The researcher used a variety of instruments like questionnaire administration and interview guides.

3.8.1 Self-administered Questionnaires

The researcher used structured questionnaires in gathering data from the respondents. Close ended questionnaires were designed in such a way to reflect the objectives of the study. The researcher personally distributed questionnaires to the respondents and collected them after the respondents had filled them. Questionnaires were used in data gathering because they are structured in a straight forward way and the information obtained from them is easily computed. Using questionnaires gave respondents convenient time to fill them without any pressure.

In Self-administered Questionnaires, respondents answer at their convenience, there is no need to set up interview appointments, and no interviewer is present to inject bias in the way questions are asked. The questionnaire was structured in a likert scale (1-strongly disagree, 2-disagree, 3-not sure, 4-agree and 5-strongly agree).

3.8.1 Interview guide

The researcher also used the interview guide in collection of data required for the study and this was based on the study objectives. This is a qualitative technique and a face to face method that is done in a formal personal interview involving structure interviewing, whereby there is a well-designed document layout of questions in a particular order, making recording down of responses possible and easy. The researcher made appointments with the respondents to be interviewed and asked questions and recorded them in the interview guide.

An interview allowed the participants to describe what is meaningful or important to him or her using his or her own words rather than being restricted to predetermined categories; thus participants may feel more relaxed. It also allows the researcher to probe for more details and ensure that participants are interpreting questions the way they were intended.

3.9 Data analysis

This section aims at analysing data that was collected so as to meet the requirements of the proposed system. In order to come up with effective recommendation and also clearly manipulate the loopholes in the existing systems to our advantage, a qualitative approach was taken and ensuring that data collected is consistent. After a clear analysis and interpretation of the relevant information was also done, a documentation report with all the findings and

challenges met was formed. This can be used by any other person who might be interested in enhancing or improving the performance of the system to be developed.

3.10 System Design

The design of the proposed facial Recognition System required various software components which included:

3.10.1 Software Tools

- ✓ Windows 10 Operating System
- ✓ Microsoft Visual Studio 2010 Ultimate
- ✓ Aforge frame work
- ✓ Emgu CV libraries

3.10.2 Programming language

The system was programmed in visual C# programming language.

3.4 Conceptual frame work of the system

The Figure 4 below shows the conceptual framework diagram which shows how the different components of the system worked together to form the Face Recognition System.

Conceptual model

Facial Recognition System for Mengo Senior School Students

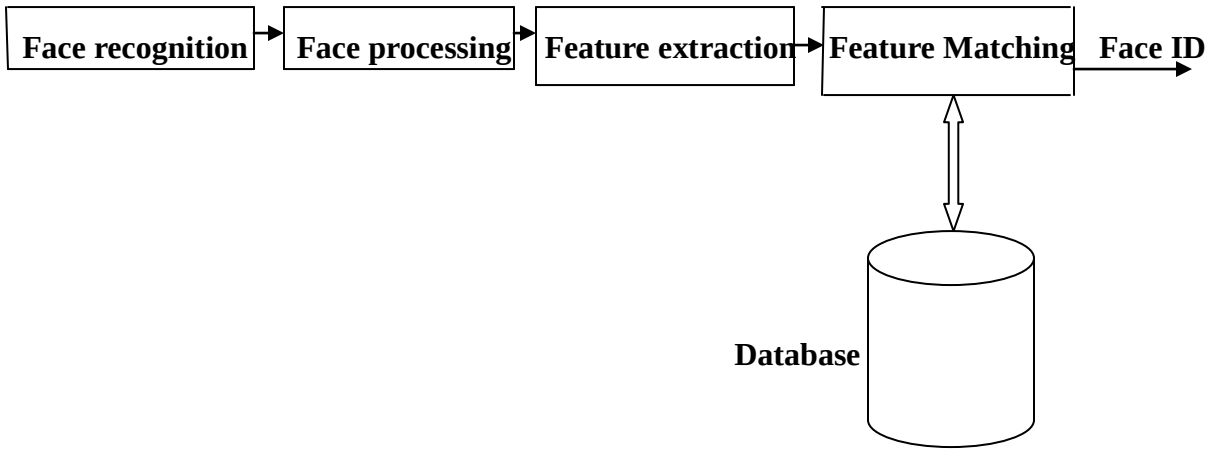


Figure 3.1 Conceptual diagram of the Face Recognition System

3.5System Implementation

The system was implemented as desktop application software that runs on and a laptop device. Other hardware equipment was connected to the system like the external webcam.

3.6 Testing and Validation

The system was tested at different stages as explained below:

3.6.1 Unit testing

The different software and hardware modules were tested independently to ascertain that they perform the desired function.

3.6.2 Integration testing

Different software and hardware modules can be connected together to test inter-module communication.

3.6.3 Systems Testing

This was done for the whole system in the designated environment.

3.6.4 Validation

The system was checked for any sources of errors and corrective measures and precautions were taken.

Chapter Four

Data Presentation and Analysis

4.0 Results, Presentation and Analysis

This chapter describes the results, presentation and analysis. It comprises of functional analysis, requirements analysis and system analysis tools such as entity relation and system design and physical design.

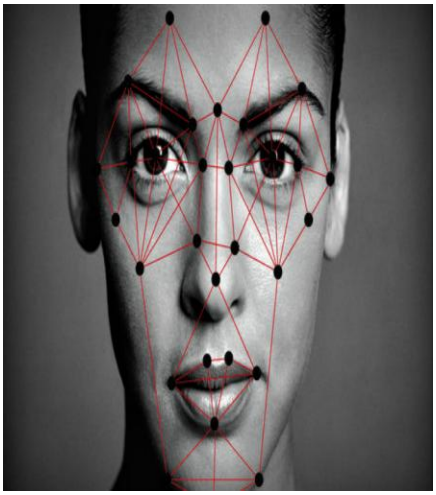
4.0.1 Findings

After the contour was found the researcher obtained the Region of interest. Features such as eyes, nose and mouth can was found within the ROI. We locate the mouth first. Once the mouth is detected we can determine the eyes and nose easily.

For finding the lips several methods were tried. Edge detection was performed using Sobel operator that finds the horizontal line within the ROI. Finding vertical position of the line between the lips was done by using horizontal integral projection ph of the binary image in the search region. ph is obtained by summing up the pixel's values in each row of the search. Because lip line will have the longest horizontal line, its vertical position can be located where ph has maximum value.

The researcher also used some prior knowledge about the face in order to determine the lips. Knowing that lips are centered horizontally in the lower half of the face and are isolated. The researcher took advantage of this information in order to constrain the vertical position of the search area.

Once we have located the lips finding the eyes and nose was done in similar fashion, each time constraining the search area in vertical direction.



ROI

Figure 1 Findings of the face

4.0.2 Results and Analysis

Number of images tested: 30 Success: 90%

The following Table shows the results of the first 13 images.

Image no	Name	Lips	Nose	Mouth
1	c1m.jpg	●	●	●
2	c2m.jpg	●	●	●
3	c37m.jpg	●	●	●
4	c4m.jpg	●	●	●
5	c5m.jpg	●	●	●
6	c6m.jpg	●	●	●
7	c7m.jpg	●	●	●
8	c8m.jpg		●	●
9	c9m.jpg	●	●	●
10	c10m.jpg	●	●	●
11	c11m.jpg	●	●	●
12	c12m.jpg			
13	c13m.jpg	●	●	●

The Results and analysis of the experiments conducted are explained below:

The experimental face images were taken using the webcam for different people. A total of 30 images of different people were selected randomly. The experimental results shown above illustrate that this method is quite good. A correct recognition rate of 90% is obtained using this method. There were some images which showed wrong detection of features. An analysis of these images shows that this method failed to extract enough contour points from these images which resulted from ill skeleton-extraction. Lack of contour points resulted into restricted ROI in which needed features failed to appear and also changes in light caused wrong detection as well.

One way of improving the skeleton extraction could be to more generalize the face region extraction process followed by sufficient dilation and erosion process. Better the effect of skin-region extraction process, better will be the resulting skeleton obtained and thus better will be the contour points extracted.

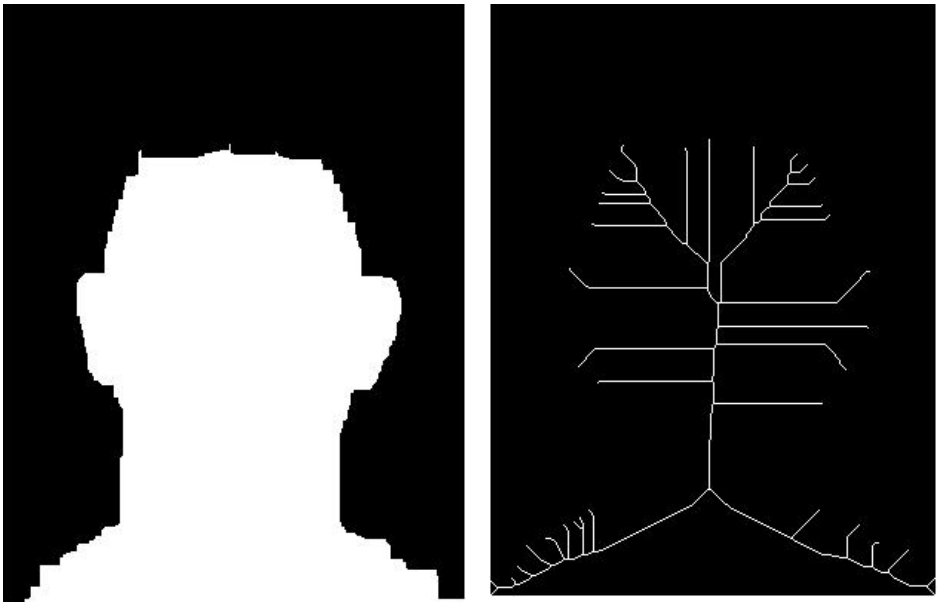


Figure 7: After Dilation & Erosion Skeleton of the image

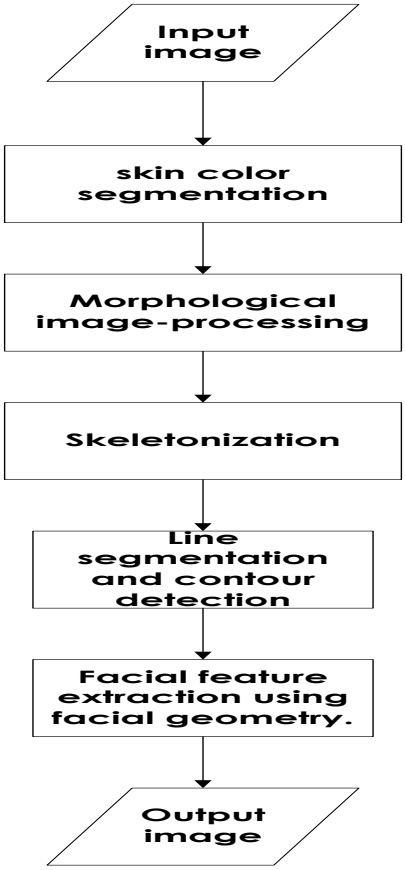


Figure 8.

4.0.3 Findings from questionnaires

This Sub section presents findings from the questionnaires and the respondents of the questionnaires are in the categories as follows;

4.2.0. Bio Data of the Respondents

This see gives detailed information about the nature of the respondents by sex and education levels of those who participated in the study.

4.2.1 Gender of Respondents

Table 4.1: Gender of Respondents

Valid	Frequency	percentage	Valid percentage	Cumulative percentage
Boys	48	62.3	62.3	62.3
Girls	29	37.7	37.7	100.0
Total	77	100.0	100.0	

Source: Primary Source

The results in table 4.1 above show that 48 (62.3%) of the respondents where male and only 29 (37.7%) were female. This means that both male and female respondents participated in the study on face recognition technology as a method of identification in Mengosenior school.

4.2 Swipe Card Technology

This is the current technology used in Mengo senior school as a method of monitoring the attendance of the students in classes.

OBTAINED DATA

SECTION A: The swipe card technology

NO	Statement	1	2	3	4	5
1	The swipe card technology has low accuracy in identification.	45	20	12		
2	The swipe card technology is costly.		5	2	20	50
3	The swipe card template settings are very difficult.			7	50	20
4	The swipe card technology is not durable enough.		7	10	40	20
5	The swipe card technology has a low security level.	45	20	12		

The table below displays the responses

Table 4.2: Accuracy

Valid	Frequency	percentage	Valid percentage	Cumulative percentage
Strongly Agree	45	58.5	58.5	58.5
Agree	20	25.9	25.9	84.4
Neutral	12	15.6	15.6	100.0
Total	77	100.0	100.0	

Source: Primary Data

Accuracy

None of respondents rejected the opinion. Therefore it does not favour small organizations because it advanced wiring to set it up.

Findings as summarized in Table 4 above reveal that 84.5 percent (65) respondents agreed that Swipe card technology has low accuracy in identification 15.6 percent (12) of the respondents did not commit themselves in any opinion. They reminded neutral. Therefore S card does not favour work horic organizations like schools

Table 4.3: Costly

Valid	Frequency	Percentage	Valid percentage	Cumulative Percentage
Neutral	2	2.6	2.6	2.6
Agree	25	32.5	32.5	35.1
Strongly Agree	50	64.9	64.9	100.0
Total	77	100.0	100.0	

Source: Primary Data

Ccstly

It truly acknowledged that Swipe cards technology is costly for small organizations like schools. This is based from the above table 4 on the fact that 97.5 percent (75) of the 77 sampled

populations agreed that Swipe card technology is very expensive hence there is a need to minimize costs although 2.6 percent (2) remained undecided about the opinions

Table 4.4: Size of Temperature

Valid	Frequency	percentage	Valid percentage	Cumulative percentage
Disagree	5	6.5	6.5	100
Neutral	7	9.1	9.1	9.1
Agree	50	64.9	64.9	74
Strongly Agree	15	19.5	19.5	93.5
Total	77	100.0	100.0	

Source: Primary Data

Size of templates

From the above, (65) respondents agreed that Swipe card temperature settings are very difficult 9.1 percent (7) remained un decided however, 6.5 percent (5) of respondents were opposite. They agreed with the opinion.

Table 4.5: Long Term Stability

Valid	Frequency	percentage	Valid percentage	Cumulative percentage
Strongly Disagree	9	11.7	11.7	11.7
Disagree	7	9.3	9.3	21
Neutral	1	1.2	1.2	22.2
Agree	40	51.9	51.9	74.1
Total	77	100.0	100.0	

Source: Primary Data

Long term stability

From the above, it indicated that 79 percent (60) of the respondents agreed that Swipe cards are not durable in terms of stability.

20.2 p(16) o the respondents rejected the opnion. They disagreed. 1.3(1) of the respondents remained undecided. Therefore according to the above percentage it indicates that Swipe cards are not disable.

Table 4.6: Security Levels

Valid	Frequency	percentage	Valid percentage	Cumulative percentage
Disagree	10	12.9	12.9	12.9
Neutral	11	14.1	14.1	27
Agree	44	57.2	57.2	84.2
Strongly Agree	12	15.5	15.5	100.0
Total	77	100.0	100.0	

Source: Primary Data

Security levels

It was observe that Swipe card technology have low security levels. This is evident from the observed data that is to say 72.7 p(56) agreed S.C technology is low 12.9 p(10) where opposite did not agree.

14.1 percent of the respondents remained un decided. Therefore from the above findings Swipe card technology does not serve efficiently and effectively in identification and recognition of individual most especially in organization like schools

4.3. Face Recognition System Technology

SECTION B: The use of face recognition system.

NO	Statement	1	2	3	4	5
1	Facerecognition system is more accurate in identification.			5	27	45
2	Facerecognition system is relatively cheaper.			12	20	45
3	Is Facerecognition system easy to set up as template?			5	27	45
4	Facerecognition system is more reliable and durable.			12	20	45
5	Facerecognition system has a high security level.			5	27	45

Table 4.7: ACCURACY

Valid	Frequency	percentage	Valid percentage	Cumulative percentage
Strongly Disagree	55	71.4	71.4	71.5
Agree	17	22.1	22.1	93.5
Neutral	5	6.5	6.5	100.0
Total	77	100.0	100.0	

Source: Primary Source

From the above table 8, reveal that 93.5 percent (72) respondent agreed that face recognition system technology is accurate

The finding above are support of Bechumeur and Kriegman (2010) face recognition algorithms analyses relative position hence accuracy that is say it analyses size shape o eyes, nose, mouth, Jaw and others. It is easy to use, and difficult to forge.

However, 6.5 percent (5) respondents remained un-decided. Therefore, face recognition technology is accurate in identifying students at a fastest speed.

Table 4.8: Cost

Valid	Frequency	Percentage	Valid percentage	Cumulative percentage
Strongly Disagree	35	45.5	45.5	45.5
Agree	40	51.9	51.9	97.4
Neutral	2	2.6	2.6	100
Total	**77**	**100.0**	**100.0**	

Source: Primary Data

The results in table 9 indicate that 97.4 percent (65) respondents agreed with the opinion face recognition is cheaper.

Face recognition is cheaper especially for small scale organizations like schools since these is less processing involved like in other biometric techniques.

Therefore the researcher concluded from observed data biometric can do well in small organization.

Table 4.9: Size of Temperature

Valid	Frequency	percentage	Valid percentage	Cumulative percentage
Strongly Disagree	3	3.9	3.9	3.9
Strongly Agree	39	50.9	50.9	54.5
Agree	19	24.7	24.7	79.2
Neutral	16	20.8	20.8	100.0
Total	**77**	**100.0**	**100.0**	

Source: Primary Data

From table 10 indicate that 75.3 percent (58) biometric technology have easy template settings. This is based on template matching algorithms techniques applied while developing the system.

Biometric has photometric approach that distills an image into values and compares tha values with template to eliminate variances

About 3 respondents out of 77 respondents by 3.9 percent disagreed with above opinion therefore biometric technology is easy to set up as template.

Table 4.10: long Term Stability

Valid	Frequency	percentage	Valid percentage	Cumulative percentage
Strongly Disagree	45	58.4	58.4	58.4
Agree	21	27.3	27.3	85.7
Neutral	11	14.3	14.3	100
Total	**77**	**100.0**	**100.0**	

Source: Primary Data

From the above table 11 85.7 percent (66) out of 77 respondents agreed that recognition system is durable. It cannot get lost, cannot be misplaced and it is easy to use biometric have backup systems.

Table 4.11: Security level

VALID	FREQUENCY	P	V.P	C.P
Strongly Disagree	1	1.3	1.3	1.3
Strongly Agree	67	87.0	87.0	88.3
Agree	9	11.7	11.7	100.0
TOTAL	**77**	**100.0**	**100.0**	

Source: Primary data

Findings as summarized in table 12 above reveal that 76 respondents out of 77 who account for 98.7 percent agreed that biometrics technology offers high levels of security of an individual in terms identification and authentication.

However I respondent accounting for 1.3 percent disagreed that recognition system have high levels of security.

Therefore recognition technology provides significant to the user in terms of security,

4.4. Finger print technology .

Table 4.12: Accuracy

VALID	FREQUENCY	P	V.P	C.P
Disagree	45	58.4	58.4	58.4
Neutral	5	6.5	6.5	64.9
Agree	9	11.7	11.4	76.6
Strongly Agree	18	23.4	23.4	100.0
TOTAL	**77**	**100.0**	**100.0**	

Source: Primary Data

From the above 13 it reveals that 58.4 percent (45) did not agree with the opinion. That is to say this technology has a unit its limitation that can be easily spoofed easily. Other limitation caused by particular usage factors such as wearing gloves, using clearing fluids and general difficulties in scanning.

35.1 percent (27) of respondents agreed that fingerprint recognition technology is accuracy. The user does not use a lot of time. It is in other words it is easy to use.

However 5 respondents out of 77 making 6.5 percent remained un decided about the opinion.

Table 4.13: Cost

VALID	FREQUENCY	P	V.P	C.P
Strongly Disagree	15	19.5	19.5	19.5
Disagree	5	6.5	6.5	26
Neutral	5	6.5	6.5	32.5
Agree	27	35.1	35.1	67.6
Strongly Agree	25	32.4	32.4	100.0
TOTAL	**77**	**100.0**	**100.0**	

Source: Primary Data

From the above table 19 indicates that 67.5 percent (52) respondents agreed with the opinion. Fingers print is cheap. Since it is not intrusive and it is easy to use,

About 65 percent (5) respondents neither disagreed not agree with the opinion.

However 25.9 percent (20) where opposite with the opinion since the 5 years requires a lot of testing, it is very immersive.

Therefore finger print recognition cannot serve in organizations like schools.

Table 4.14: Size of template

VALID	FREQUENCY	P	V.P	C.P
Strongly Agree	45	58.4	58.5	59.5
Agree	20	25.9	25.9	84.4
Neutral	10	12.9	12.9	97.4
Disagree	2	2.0	2.6	100.0
TOTAL	**77**	**100.0**	**100.0**	

Source: Primary Data

From the above table 15 it was observed that 84.4 percent (65) agreed that finger print technology is user friendly in terms of setting templates.

Finger print requires small storage space for biometric template which reduce the size of data base memory.

However 10 respondents accounting 15.6 percent did not decide.

And 2.6 percent (2) respondents where opposite about the opinion.

Therefore finger print recognition has easy template setting.

Table 4.15: Long term stability

VALID	FREQUENCY	P	V.P	C.P
Strongly Disagree	21	27.3	27.3	27.3
Disagree	45	58.4	58.4	85.7
Neutral	6	7.8	7.8	93.5
Agree	5	6.5	6.5	100.0
TOTAL	**77**	**100.0**	**100.0**	

Source: Primary data

According to the findings in table 16 above, shows that 85.7 percent (66) disagreed with the opinion.

This technology is very intensive to addition have can make mistakes due to varies changes like dryness or dirtiness of the finger print and wearing of gloves.

7.8 percent (6) respondents did not marry any decisions about the opinion.

Though 6.5 percent (5) respondents where opposite about the opinion.

Table 4.16: Security levels

VALID	FREQUENCY	P	V.P	C.P
Strongly Disagree	7	9.1	9.1	9.1
Disagree	55	71.4	71.4	80.5
Neutral	0	0	0	80.5
Agree	6	7.8	7.8	88.3
Strongly Agree	9	11.7	11.7	100.0
TOTAL	**77**	**100.0**	**100.0**	

Source: Primary Data

Findings from the above table 17, it was observed that 80.5 percent (62) disagreed. Finger print recognition has low security levels.

Face recognition is very intrusive, about 19.5 percent (15) of the respondents agreed with the above opinion that finger print technology has security levels, this is because it involves many tests which makes it accurate.

Therefore finger print biometrics are not friendly with organizations like schools.

4.5 PalmPrint System

Table 4.17: Accuracy

VALID	FREQUENCY	P	V.P	C.P
Strongly Agree	42	54.5	54.5	54.5
Agree	33	42.9	42.9	97.4
Neutral	2	2.6	2.6	100
TOTAL	**77**	**100.0**	**100.0**	

Source: Primary data

From the above table 18, it was observed that 97.4 percent (75) agreed with the opinion that palm print technology is not accurate just like finger print technology. It has limitations like user cannot have access in case of wearing gloves.

2.6 percent (2) out of 77 respondents did not decide.

Table 4.18: Cost

VALID	FREQUENCY	P	V.P	C.P
Strongly Disagree	7	9.2	9.2	9.2
Disagree	9	11.7	11.7	20.9
Neutral	1	1.3	1.3	22.2
Strongly Agree	40	51.9	51.9	74.1
Agree	20	25.9	25.9	100
TOTAL	**77**	**100.0**	**100.0**	

Source: Primary Data

Therefore such hosting does not

Table 4.19: Size of Template

VALID	FREQUENCY	P	V.P	C.P
Strongly Disagree	10	12.9	12.9	12.9
Neutral	5	6.5	6.5	19.4
Strongly Agree	35	45.5	45.5	64.9
Agree	27	35.1	35.7	100
TOTAL	**77**	**100.0**	**100.0**	

Source: Primary Data

Table 4.20: Long Term Stability

VALID	FREQUENCY	P	V.P	C.P
Strongly Disagree	5	6.5	6.5	6.5
Disagree	6	7.8	7.8	14.3
Neutral	1	1.3	1.3	15.6
Strongly Agree	25	32.5	32.5	48.1
Agree	40	51.9	51.9	100
TOTAL	**77**	**100.0**	**100.0**	

Source; Primary Data

Table 4.21: Security Levels

VALID	FREQUENCY	P	V.P	C.P
Disagree	12	15.6	15.6	15.6
Agree	65	84.4	84.4	100
TOTAL	**77**	**100.0**	**100.0**	

Source: Primary Data

Table 4.22: Signature System

VALID	FREQUENCY	P	V.P	C.P
Strongly Agree	39	50.6	50.6	50.6
Agree	38	49.4	49.4	100
TOTAL	**77**	**100.0**	**100.0**	

Source: Primary Data

Table 4.23: Cost

VALID	FREQUENCY	P	V.P	C.P
Strongly Disagree				
Disagree				
Neutral				
Strongly Agree	75	97.4	97.4	97.4
Agree	2	2.6	2.6	100
TOTAL	**77**	**100.0**	**100.0**	

Source; Primary Data

Table 4.24: Size of Template

VALID	FREQUENCY	P	V.P	C.P
Strongly Disagree	55	71.4	71.4	71.4
Agree	17	22.1	22.1	93.5
Neutral	5	6.5	6.5	100
TOTAL	**77**	**100.0**	**100.0**	

Source; Primary Data

Table 4. 25: Long Term Liability

VALID	FREQUENCY	P	V.P	C.P
Strongly Disagree	22	28.6	28.6	28.6
Disagree	43	55.8	55.8	84.4
Agree	11	14.3	14.3	98.7
Neutral	1	1.3	1.3	100
TOTAL	**77**	**100.0**	**100.0**	

Source; Primary Data

Table 4.26: Security Levels

VALID	FREQUENCY	P	V.P	C.P
Strongly Disagree	75	97.4	97.4	97.4
Agree	2	2.6	2.6	100
TOTAL	**77**	**100.0**	**100.0**	

Source; Primary Data

Table 4.28 The study of the current technologies, their applications and appreciation

Technology	Accuracy	Cost	Size of Template	Long-term stability	Security Level
Face Recognition	High	Low	Small	High	High
Swipe Card	Medium	High	Medium	Medium	Low
Fingerprint	High	Medium	Small	Low	Low
Iris Scan	High	High	Small	Medium	Medium
Palm print	Medium	High	Large	Medium	Medium
Signature	Low	Low	Medium	Low	Medium

4.1 Functional requirements

These refer to what functions the system performs.

- The photos were taken with a web camera. Over 10 photos were taken for each user. The software makes the user look at different directions. The majority of photos were taken for a neutral expression face while some for smiling and annoyed expression face.
- Given a pre-processed face image, the software should apply a center-surround-filter to the image; the output image would be the face with its features (eyes, nose, mouth, and so on) outstanding
- Finding useful features for recognition
- Instructions for acquiring face images makes users clear enough as to where they should look at when taking photos

4.2 Non-functional requirements

The following are the non-functional requirements;

- It should be extremely convenient to take a photo. For example, once the user clicks on 'Taking a photo' button, the snapshot would be done and the image file would be saved immediately. It should just need a 'one-click' effort
- Instructions for acquiring face images should make users clear enough as to where they should look at when taking photos
- The software should be able to perform batch processing. That is, the user can select multiple files or even a whole directory for processing.

4.3 Schematic diagram of the Recognition System

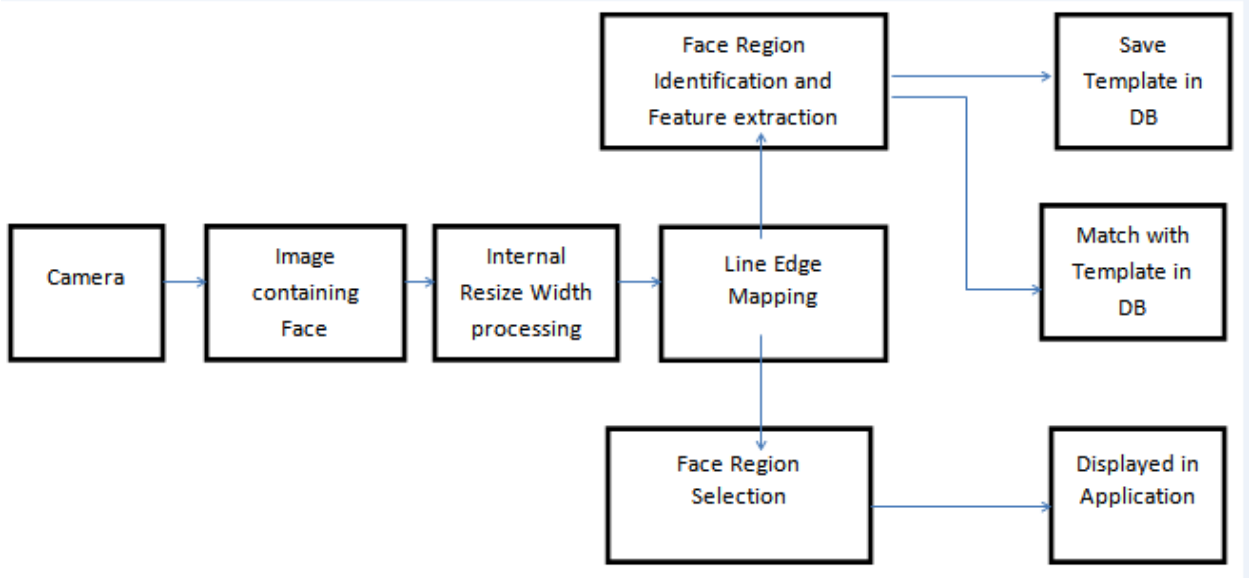


Figure 2 Schematic illustration of the recognition *system*

4.4 Facefeature detection

Face feature detection is a multi-step process. We have incorporated several methods and suggestions proposed in the articles mentioned in the above section. We tried several methods for each step and the one that gave the best results was selected.

Flowchart depicting the entire process

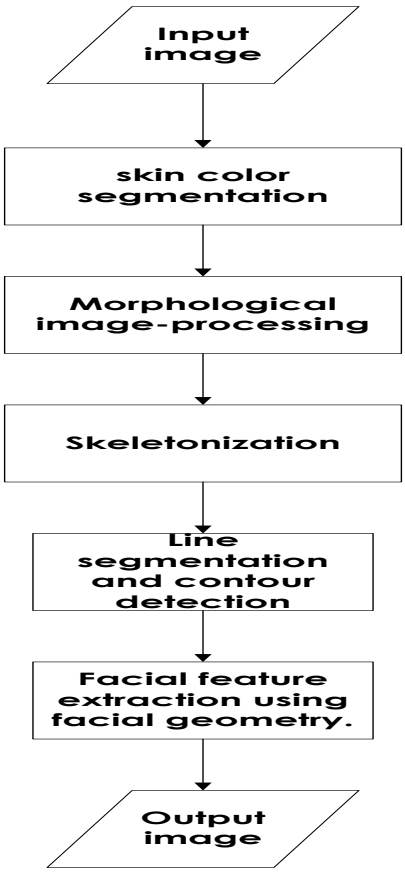


Figure 3 Feature Detection Phase

Skin segmentation; This is one the important steps in face feature extraction process. The efficiency of the color segmentation of a human face depends on the color space that is selected.

Morphological image processing; is a collection of techniques for digital image processing based on mathematical morphology. Since these techniques rely only on the relative ordering of pixel values, not on their numerical values, they are especially suited to the processing of binary images and grayscale images whose light transfer function is not known.

Color contouring; Some vertices of the skeleton lines can fit the contour of the human face while excluding the points that lie on the ears and the neck.

The fitting points can be found using the set of rules.

Rule 1. Some face contour fitting points can be found from the line tracing as a result of the skeleton. The contour points should satisfy

Rule 1.1 The contour fitting points should be the vertices of the roughly horizontal skeleton line segments that are long enough (the threshold is set proportional to the longest skeleton line segment).

Rule 1.2 The left vertex will be selected as candidate for contour fitting if most of the horizontal line segments are positioned at the left of the symmetry axis.

Rule 1.3. The right vertex will be selected as candidate for contour fitting if most of the horizontal line segments are positioned at the right of the symmetry axis.

Rule 1.4. The contour points should be above a vertical position that is set at 3/4 of the height from the top of the symmetry axis

Rule 1.5. The points satisfying the above conditions are separated into two sets (left and right contour points, respectively). They are each sorted from top to bottom, respectively.

Rule 1.6. If the difference between the horizontal coordinates of a point from right sorted points set and any one of its previous and succeeding point is large enough (a threshold is set), then the

Rule 2. The point set satisfying the above will be doubled using symmetry axis, i.e., for a left fitting point there exists a right point that can be calculated using the symmetrical axis and vice versa.

Feature extraction within the ROI (Region of Interest); After the contour has been found we obtained the Region of interest. Features such as eyes, nose and mouth can be found within the ROI. We locate the mouth first. Once the mouth is detected we can determine the eyes and nose easily.

4.5 Use Case Diagram

A use case diagram shows the goal oriented set of interactions between the external actors and the developed system.

Actors are parties outside the system, which in this case are the users that interact with the system.

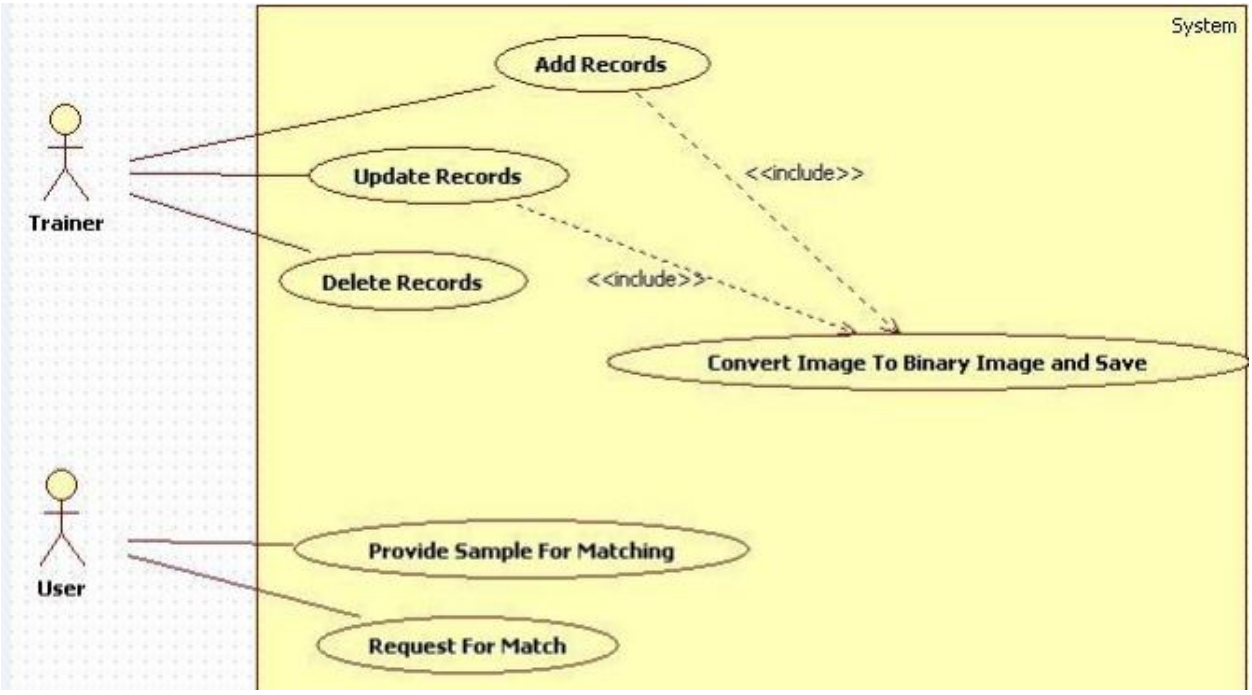


Figure 4 Use Case Diagram

- **Face Detect:** Detecting features in digital images
- **Face Train:** Teaching Recognition to memorize the name of the face.
- **Face Cluster:** Face Cluster API is able to organize your image datasets by grouping similar faces together to form a 'cluster'.
- **Face Crawl:** Using photos for face training.
- **Face Recognize:** Recognizing people in a new image, after Recognition is trained with the nametags.
- **Face Visualize:** Displaying the index of training images of all (or subset) of tags that you have added or crawled**.**
- **Face Search:** Finding the correlation among images is one of the basic elements of Recognition's consciousness.
- **Face Delete:** Deleting the wrong training images
- **Face Rename:** Changing tags, assigning an image to a tag, or merging two tags.

Chapter Five

System Implementation and Testing

5.0 Implementation and Testing

5.1 Overview

This chapter gives an overview of the implementation and explains how users can interact with the system and hardware. It describes the different platforms used during development so as to realize the functionality of this system for example the code designs involved, validation and evaluation.

5.2 Development Platforms

5.2.1 C# Programming language

The researcher used this language because the researcher found it easy to work with it to develop my algorithms for the system.

5.2.2 Microsoft Visual Studio 2010 Ultimate

This was used to develop the user interface for the system and also for compiling the source code Visual Studio provides a cross-platform, complete integrated development environment (IDE) for application developers to create applications for multiple desktop, embedded, and mobile device platforms, such as Android and iOS. It is available for Windows operating systems. Visual Studio was used to implement the interface using C# and the backend using OpenCV libraries.

5.3 User Interface of the system.

a. Main interface for the system

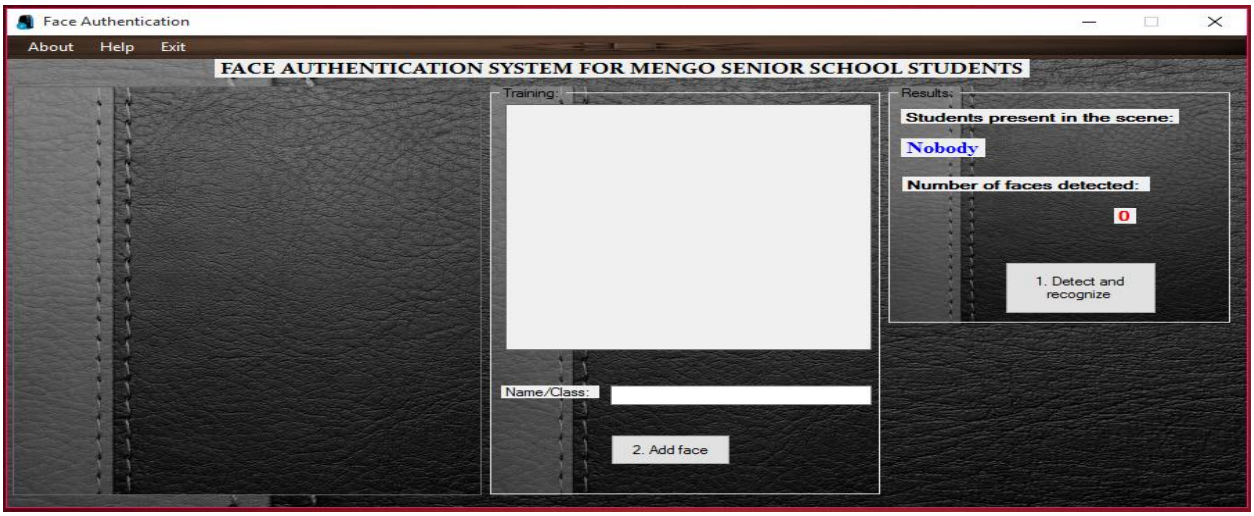


Figure 5.1 Main system interface

b. Identification and registration of student

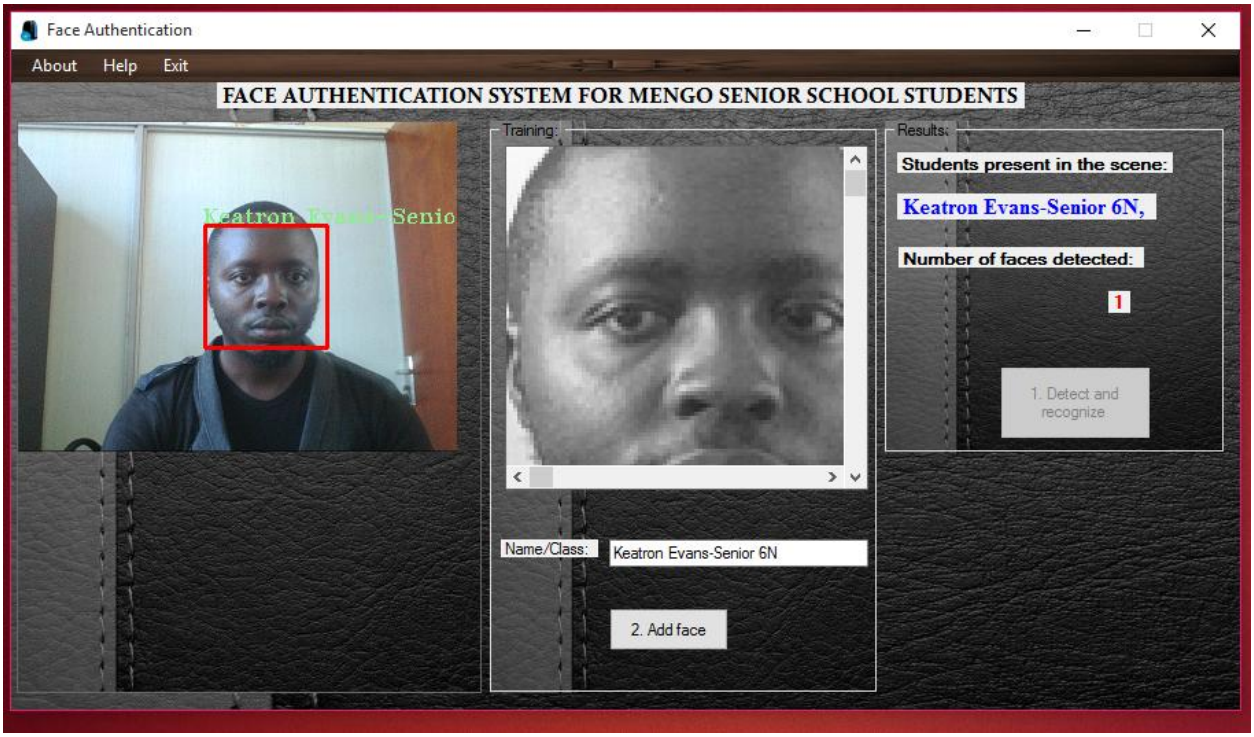


Figure 5.2 Registration and Recognition of Student

This figure above shows how a student named Keatron Evans was registered into the system and the system can recognize his identity anytime he reports to school as Keatron Evans using face recognition technology.

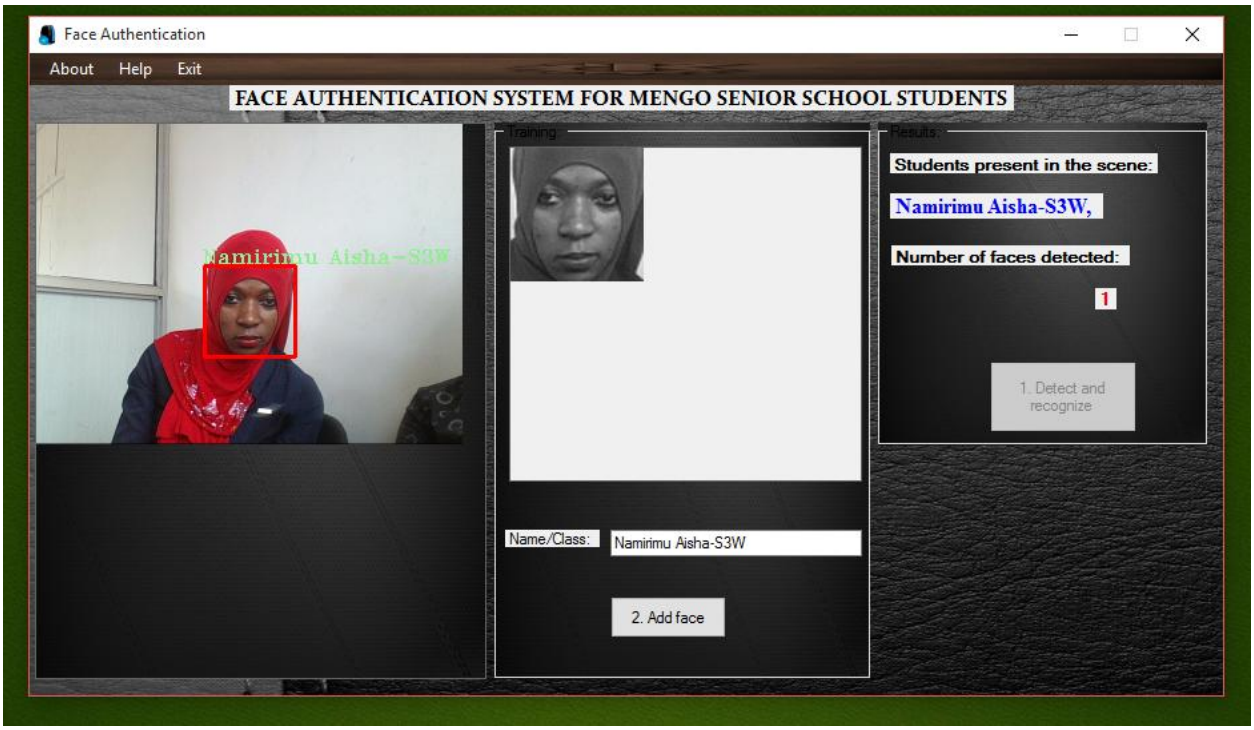


Figure 5.3 Aisha being recognized by the system

5.4 Testing

The system tests conducted included; component testing, user acceptance testing as described in chapter 3.

5.4.1 Component Testing

Each component of the system was tested separately and the errors found were fixed and the test which revealed the bug is repeated after the bug was fixed

5.5 Validation

During the implementation process, validation of the system was performed by checking if the system was meeting the specified functional and non-functional requirements. This was done to

ensure that the system was meeting its specification and delivering the functionality it was expected to do.

Chapter Six

Recommendations and Conclusions

6.0 Introduction

This chapter tables down the discussions, summary of the work done in developing the system, critical analysis of the system as well as the recommendations for future improvements.

6.1 Summary of my work

This report describes the chronological steps involved in the creation of Face authentication system from the idea creation to the implementation and testing.

This project idea originated from the demise of a learning that the swipe cards used by Mengo Senior School could at times bring about issues that is in case the student lost the card or either left it at home. So, there was need to come up with a backup system that was able to do face recognition of students.

After archiving this idea, a number of activities ranged on from problem identification, problem modeling, system analysis, researching, design and development, documentation, and management among many others. I went ahead to do research using online documentations, journals, and newspaper articles and technical and non-technical personnel for the project report.

The final stage of this work was the implementation, testing and validation. This project was developed slowly using research from previous documentations and help from source forge site for very complex sessions of development. Later the project was documented and finally producing the report.

6.2 Recommendations for the future work

The study recommends that the future systems should have the following features: -

Inclusion of all workers for Mengo Senior School, that is Teaching and Non-Teaching Staff

More customizable report options.

6.3 Challenges

Face recognition doesn't work effectively in bad/weak lighting, sunglasses/sunshades, lengthy hair, or other objects partly covering the subject's face. This was one of the challenges that was faced during the design and implementation of the system.

6.4 Conclusion

The Face Recognition system is a very vast tool in operation and usefulness, to say that it has been exhausted is a lie for new needs per organization are created each day.

In conclusion, the use of an application does not depend on the mind of the developer but on the infinite possibilities imagined by the user. If this application is maintained and improved, it can become the next generation of Face Authentication Systems for Ugandan schools.

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Appendices

Appendix 1

Research questionnaire

My name is Namirimu Aisha a student of Masters of Business Administration-Information Technology of Nkumba University. In partial fulfillment of the requirements for the degree, I am required to conduct a research in an area of interest. My topic is a Face Recognition system as a method of authentication, a case study of Mengo Senior School. You have been sampled to participate in this study and the information you give will be used strictly for academic purposes and will never be used against you or your office and the information got from you will be kept confidential. You are also requested not to write your name, fill the questionnaire and return to me.

Section A

Security associated with swipe card technology

	Strongly Agree	Agree	Neutral	Strongly Disagree	Disagree
It is convenient for access					
It is time conscious					
It is not user friendly					
Frequently get lost					
It is unreliable					

Section B

Technology Two: Face Recognition System for Mengo Senior School

Convenient use of Face Recognition

	Strongly Agree	Agree	Neutral	Strongly Disagree	Disagree
It is convenient for access					
It is time conscious					
It is not user friendly					
Frequently get lost					
It is unreliable					