

# Design and Implementation of Crime Investigation System using Biometric Approach (Nigerian Police Force).

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## ABSTRACT

Reliable criminal suspects' recognition is an important problem in crime investigation process. Biometrics recognition is becoming an irreplaceable part of many identification systems. While successful in some niche markets, the biometrics technology has not yet delivered its promise of full proof automatic crime suspects' recognition, especially in a developing country like Nigeria. The study proposes and implements a biometrics-based crime investigation system for the Nigerian Police Force. The software was designed using Visual BASIC programming language.

(Keywords: biometric, convict, crime, criminal, evidence, scene, suspect, victim, witness, Visual Basic)

## INTRODUCTION

Criminality is part and parcel of human nature and society [7]. That is why no society can claim to be completely crime free. But the types of criminal behavior tend to follow the pattern of social and economic development of a given society [1]. It is therefore not unexpected that a society at a low level of development and as Madden and Chiu (1998) mentioned, uneven distribution of income (and wealth) [2], tends to experience an upsurge in the rate of violent crimes such as armed robbery, politically motivated killings, the use of illegal weapons, ethnic and religious clashes and the like. What is worrisome, however, is that the police which are meant to be the antidote to criminality appear to be getting overwhelmed by the phenomenon [10]. The criminals appear to be ahead of the police such that the latter now only react to the commission of crimes and usually

after the offenders might have left the scene making things appear as if the original emphasis on crime prevention has been completely lost [11]. Aside other complaints, there are institutional constraints, which contribute to the uncomplimentary image of the police and thereby undermining their capacity to deliver efficient crime control via proper and prompt investigation and policing services. These include inadequate manpower, lack of expertise, lack of adequate equipment, low level of education, low morale, lack of training facilities and lack of technological knowhow, etc.

In developed countries; computers have been used in crime detection for some decades. Computer- Based Criminal Records Systems were the first of such systems deployed as an attempt to record a person's criminal history. Before the introduction and the application of computers in criminal records, crime investigation, and detection, most criminal records or other criminal related activities was carried out using the manual or traditional approach in the process of data processing, which involves the use of paper files, manual skills and human brain work.

The traditional approach of crime investigation is usually time-consuming, resulting in a lot of delay and often generally inefficient leading to high cost. On the other hand, the use of computers in the management of criminal records and crime investigation tends to be very efficient due to the fact that less time is spent on the investigation of crimes since it is automated; giving accurate and reliable criminal investigation results.

With the introduction of biometrics technology which is an advanced computer techniques now widely adopted as a front line security measure for both identity verification and crime detection, and also offers an effective crime deterrent.

Biometrics embrace a range of techniques such as fingerprinting and handwriting recognition for identity verification using physical data and behavioral patterns [5]. In the recent past, fingerprint images were obtained by "ink-technique" which is also referred as off-line fingerprint acquisition [6]. It is essentially based on the development of pattern recognition systems, today electronic or optical sensors such as cameras and scanning devices are used to capture images, recordings or measurements of a person's unique characteristics. This digital data is then encoded and can be stored and searched on demand, via a computer. Such biometric search is not only very rapid (often taking place in real time), it is also a process that is accepted globally in establishing forensic evidence in a law court [3]. It cannot be over emphasized that there is need to provide for adequate, efficient and effective technological knowhow especially in the area of crime investigation which will make their job simpler and faster, as well as prompt and effective in their service delivery. Consequently, this project will seek to design a computerized criminal investigation system for The Nigeria Police Force in Minna, Niger State, Using Biometrics approach.

## STATEMENT OF THE PROBLEM

Various problems are encountered in the manual system of operations in any organization, so it is in the crime investigation system in Nigeria Police Force. Some of the problems encountered are:

- i. Generating a case filing number for each of the cases has been cumbersome because it is not easy to trace the file number of the last recorded case and this has led to duplication Cases File Numbers.
- ii. Accuracy about dates of filing various components of the cases are not readily available making referencing them very cumbersome.
- iii. Making references to existing Criminal cases is difficult because of the manual mode of documentation.

- iv. Delay in accessing information in paper files, paper files are sometimes damaged by water, pest or fire outbreak and can easily be altered by an unauthorized user.
- v. Missing criminal record files which might have been caused by theft or wrongly placed or kept by the officer(s) in charge.
- vi. Manual searching for information about crime cases handled by the Crime Investigation Department has been very tedious because the cases files are not arranged in a logical manner.

## LITERATURE REVIEW

### Concept of Crime

A normative definition views crime as deviant behavior that violates prevailing norms – cultural standards prescribing how humans ought to behave normally. This approach considers the complex realities surrounding the concept of crime and seeks to understand how changing social, political, psychological, and economic conditions may affect changing definitions of crime and the form of the legal, law-enforcement, and penal responses made by society.

These structural realities remain fluid and often contentious. For example: as cultures change and the political environment shifts, societies may criminalize or decriminalize certain behaviors, which will directly affect the statistical crime rates, influence the allocation of resources for the enforcement of laws, and re-shape the general public opinion.

Similarly, changes in the collection and/or calculation of data on crime may affect the public perceptions of the extent of any given "crime problem". All such adjustments to crime statistics, allied with the experience of people in their everyday lives, shape attitudes on the extent to which the State should use law or social engineering to enforce or encourage any particular social norm. Behavior can be controlled and influenced by society in many ways without having to resort to the criminal justice system.

Indeed, in those cases where no clear consensus exists on a given norm, the drafting of criminal law by the group in power to prohibit the behavior of another group may seem to some observers

an improper limitation of the second group's freedom, and the ordinary members of society have less respect for the law or laws in general — whether the authorities actually enforce the disputed law or not.

According to the United Nations Interregional Crime and Justice Research Institute Imrohorglu et al. (2006), people victimized by property crime (as a % of the total population) varied between 14.8% in New Zealand to 12.7% in Italy, 12.2% in U.K., 10% in U.S., 3.4% in Japan and 31.7% in Nigeria [4]. The possible explanations for cross country differences are many, ranging from distinct definitions of crimes and different reporting rates (percentage of the total number of crimes actually reported to the police), to real differences in the incidence of crime and even to different cultural aspects. It can even be contributed to democracy as explained by Lin (2007), whereby compared to non-democratic governments, democratic government punish major (minor) crime more (less) and hence this crime rate is lower (higher).

No matter how we look at it, it is still an utmost important subject due to its large impact on a psychological aspect as well as economical aspect. Its pernicious effects on economic activities and more generally on the quality of life of people contribute to the emerging fact that crime is merging as a priority in policy agendas worldwide. The relationship between crime and development is a very crucial economic issue. Crime can hinder growth in a country. Higher crime rates have been found to reduce both domestic and foreign investment [8] and have been linked to lower job creation and sales growth [9]. Due to the complexity of the phenomenon and lack of consensus among policy makers or scholars, research on this issue continues to be conducted in many areas.

### **Overview of the Current System**

Investigating the existing system of crime investigation using the Nigerian Police Force, Bossso Minna, Niger State as case study, we were able to establish that there are stepwise processes in carrying out crime investigation. Usually, when a crime scene is noticed or detected, the first thing an officer does is to secure the scene. The officer or crime investigator ensures that not only one aspect of the crime is preserved but also all areas are covered.

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Next, the crime scene is examined by making proper documentation of the scene which is usually done by gathering evidence, taking pictures of the crime scene. Taking photocopies of the crime scene usually begins the very minute the investigation officer arrives. It was also gathered that such documentation are done manually using paper files. The investigation officer also gathered relevant fact from onlookers or anyone who possibly could have spotted the criminal before escaping the crime scene.

Finally, after all relevant facts are gathered and appropriate photograph taken, the facts (evidence, whether physical or photographic) are analyzed by placing them side by side with all the testimonies gathered along with all observation made while examining the crime scene. Some of this evidence is examined in the laboratory in order to get more in-depth analysis of the evidence, such as prints that will point to the identity of the criminal.

### **Problem Identification of the Current System**

From the aforementioned processes or activities of crime investigation, it is clear that the police force still makes use of manual process using paper files in the documentation of the crime investigation findings.

The manual process of documentation and managing criminal records or crime scenes information has some limitations. There is the problem of delay in accessing information in paper files, paper files are sometimes damaged by water, pest or fire outbreak and can easily be altered by an unauthorized user. There is also the problem of missing criminal record files which might have been caused by theft or wrongly placed or kept by the officer(s) in charge. These problems, all this and much more leads to unavailability of criminal investigation for necessary prosecution.

### **OVERVIEW OF THE PROPOSED SYSTEM**

As a result of the limitations encountered with the use of manual method in investigating, documentation, processing and managing criminal records, the need for an alternative system for crime investigation cannot be undermined. The proposed alternative system is a Biometric-Based Computerized Crime

Investigation System. The implementation of the automated system will ensure that crimes are well investigated and criminal records are well managed.

### **Proposed System Process Description**

This highlights in detail the processing steps which convert input into output. The processing tasks to be carried out by the Investigation System are basically the entering of criminal details into the database file tied to their corresponding fingerprints, retrieval of criminal suspects' personal information based on a specified criterion.

To enter a criminals' detail into the database file, the user have to enter basic information about the criminal, upload passport, capture and load finger prints and submit to the database file by saving changes.

To retrieve a criminals' detail, the user will have to enter a specific search criteria and click on search, the system then searches through the database file for a record that matches the given criteria. If a match is found, the record is then displayed. Otherwise, the system should display a message saying such record does not exist.

To retrieve all existing criminal details in the database, the user should click on the "Full Records" button, the system the retrieves the records of all existing criminal. To access the full detail of a criminal as well as all information about the crimes committed, user will then click on any part of the retrieved criminal detail and click on open records. The system then displays the full record of that particular criminal.

Another processing task involves comparing Finger prints. Suppose a criminals' finger print was recovered from a crime scene, the user loads this print into the system and searches for a match. This can be achieved by clicking the "Local Check" button on the Investigation System Main Menu, the system then pops up the window where the search for a match will be made, the user should click on the "Load Finger Print" button to load the recovered print into the system, then he/she should click on "Direct Compare".

Following a sequential order, the systems searches the available finger prints in the database for a match and if a match is found it

pops up a box that displays "A direct match was found with the criminal's convict number and the finger id". The user should then click on the "ok" button, the criminal convict number and names will be displayed. To have full access to such criminal details, the user should click on "Open" and the crime full details will be retrieved from the database.

### **Advantages of the Proposed System**

A successful implementation of the Biometrics-Based Crime Records Investigation System will greatly increase the efficiency of the Nigerian Police Force officers and will help to ensure that criminal records are managed properly monitoring of criminal suspects in the country. It will as well ensure the following:

- i. Reduction of redundancies and inconsistencies.
- ii. Ensure user defined rules to ensure the integrity of data.
- iii. Enables data sharing across all applications.
- iv. Ensures data access authorization.
- v. Has an automatic intelligent backup and recovery procedure of data.
- vi. Integrity can be improved.

Thus, the problem of delay in retrieving criminal suspects records for reference purposes and for appropriate court action or prosecution to be taken can be reduced drastically and the efficiency in the management of criminal records and investigation of criminal case being rendered by the Nigerian Police Force will greatly be improved upon.

## **SYSTEM COMPONENTS**

### **Output Design of the Proposed System Process**

The computer accepts raw data as input processes these data and produces the output as Result. The output normally depends on the input of the data as the case may be. The investigation system' outputs are as follow:

- i. Basic criminal Details: This shows information about a particular criminal detail with respect to the name of the convict, offence committed, date amongst other personal information.
- ii. Local check for fingerprints match: This shows if there is or isn't a fingerprint match in the local database. This would be achieved based on direct comparison of suspected criminals' fingerprints with existing finger prints.
- iii. Online check for fingerprint match: This is a report with the criminal details that will show if there is a match for a fingerprint sent for check.
- iv. Full criminal record: This is a list of all criminal records in the local database.
- v. Search: this is the retrieval of certain criminal records based on specified criteria.
- vi. Help: This is for ease of users use. It gives details on how to use the software.
- v. It simple: designed to be easy to use and therefore easy to write, debug, compile and learn
- vi. Object oriented: program in visual basic is centred on creating object manipulating object and making object work together.
- vii. Distributed: it has networking capability that is inherently integrated into it.

## PHYSICAL DATA SECURITY METHODS

To have access to the information system, every authorized user must be given a new username and a password.

### System Security

System security is the use of software, hardware, and procedural methods to protect applications from external threats and unauthorized users. The use of password and access permission will ensure that only authorized personnel are granted access to the system to perform an operation.

"Password", a protected lock is an advanced security lock that can be used to secure computers, software's and some electronic devices as well as protect your privacy. It is helpful, secure and very easy to use. They are used to control access to protected computer operating systems and their resources.

Password is a form of secret authentication data that is used to control access to a resource. The password is to protect data from unauthorized users of a program. An individual is thereby tested and trusted before he/she is granted access to the system. The administrator grants such access by giving the user a "Username" and "Password" in order to have access to the system. The administrator can also revoke such access in the case of abuse or misuse of access.

Also, another security measure implemented on this software is the use of a security log called "SecLog". This log keeps track of every activity that occurs on the Investigation System. It keeps log of the following processes:

- i. Logged in user with the time and date of login

## SYSTEM ARCHITECTURE DESIGN

### Choice of Programming Language

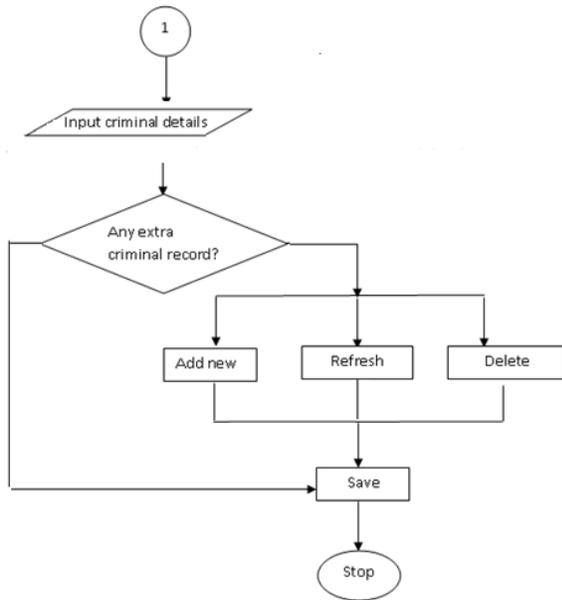
Visual Basic programming language was used for the design of the social software (Customized VoIP). Visual basic consist of several part: API class libraries that contains all built in function that makes the windows platform to function the way it does, An IDE that gives you the ability to tap from the power and functionality of these API libraries. Visual basic language was chosen for this project because it is:

- i. Secured: visual basic was built with security in mind
- ii. Easy to program with: visual basic is very easy to use programming tool.
- iii. Robust: It is reliable. Visual basic puts a lot of emphases on early checking for possible errors
- iv. Platform independent: visual basic application can be easily moved to different computer system.

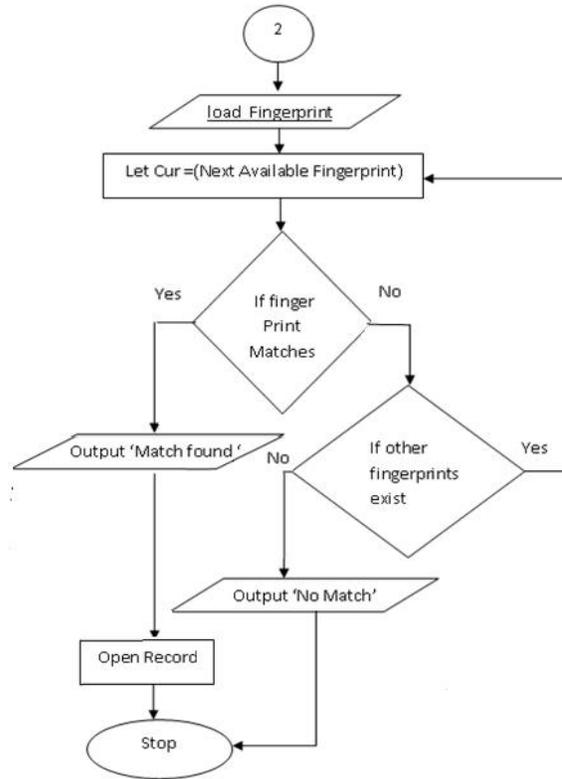
- ii. Edited record with dates and time of activity
- iii. Fingerprints update
- iv. Deleted records with details
- v. Time of logout by a user

**Systems Flowchart**

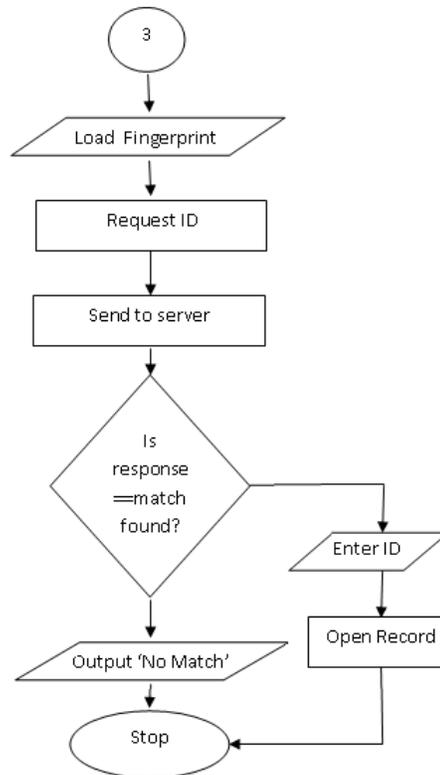
A flowchart is a diagrammatic representation of the (finite) sequence of steps to be followed or sequence of operations to be executed in order to solve a problem. This tool is especially useful in the system analysis and design phases of the software development process. It is used to represent the algorithm of the old system being studied (during analysis), or the new system being developed (during design). The system flowchart gives a summary representation or specification of the overall system while the program flowchart gives detail representation of the overall system.



**Figure 1: Basic Criminal Details.**



**Figure 2: Local Finger Print Match.**



**Figure 3: Online Check**

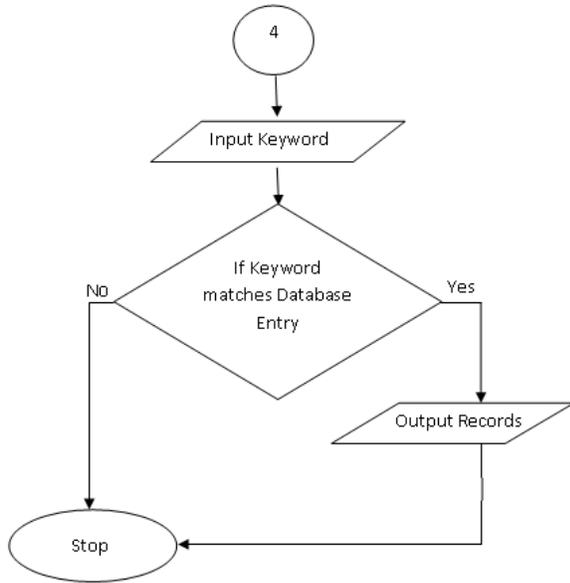


Figure 4: Online Check

**PROGRAM INTERFACE**

In the field of computer science an interface refers to a point of interaction between components and is applicable at the level of both hardware and software.



Figure 6: The Trial Fingerprint Control.



Figure 7: The Login Page.



Figure 5: The Splash Screen.



Figure 8: The Login Failed page

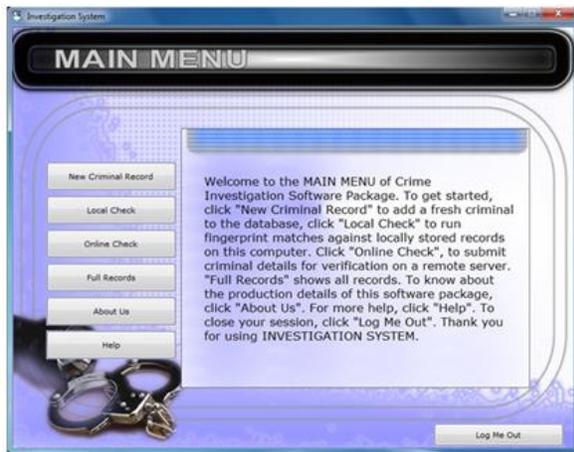


Figure 9: The Main Menu.

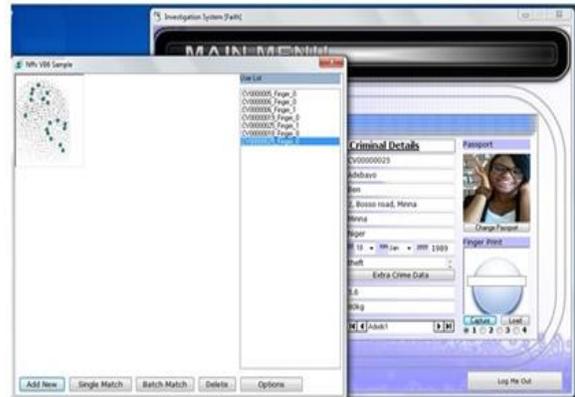


Figure 12: Fingerprint Capture.



Figure 10: New Criminal Record Screen.

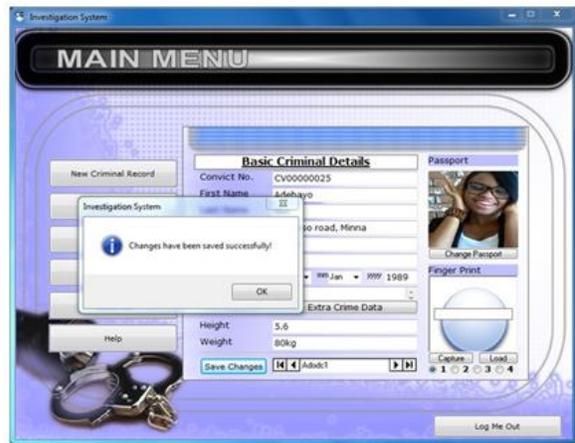


Figure 13: Saving New Criminal Record



Figure 11: Extra Crime Data



Figure 14: Fingerprints Local Check

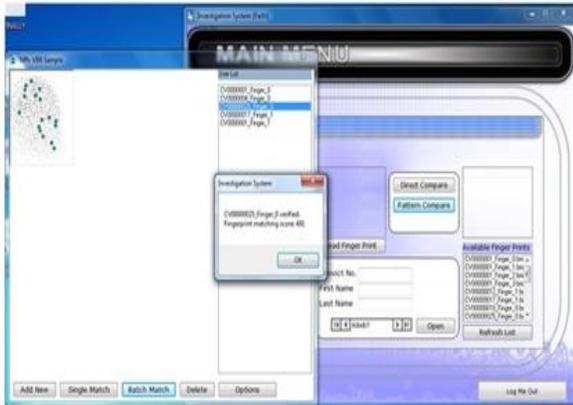


Figure 15: Fingerprint Check using Pattern Compare.



Figure 18: Fingerprint Match not Found.



Figure 16: Result for Pattern Compare.



Figure 19: Online Check for Fingerprint Match.



Figure 17: Fingerprint Match Found.



Figure 20: Online Check-Load Fingerprint.



Figure 21: Existing Criminal Records.



Figure 22: Search based on Particular Criteria.



Figure 23: The Help Page.

## SYSTEM IMPLEMENTATION

The purpose of "System Implementation" can be summarized as follows: making the new system available to a prepared set of users (the deployment), and positioning on-going support and maintenance of the system within the Performing Organization (the transition). At a finer level of detail, deploying the system consists of executing all steps necessary to educate the Consumers on the use of the new system, placing the newly developed system into production, confirming that all data required at the start of operations is available and accurate, and validating that business functions that interact with the system are functioning properly. Transitioning the system support responsibilities involves changing from a system development to a system support and maintenance mode of operation, with ownership of the new system moving from the Project Team to the Performing Organization.

## RESULTS AND DISCUSSION

Below is the description of all interfaces.

Figure 5: The splash screen: This gives a nice user interface and an abstract of what the software is meant for. It is displayed as soon as the investigation system icon is clicked on the desktop.

Figure 6: The Trial Fingerprint Control: This window displays the loading time remaining before the application Login page comes up.

Figure 7: The Login page: This is the page that pops up immediately after the splash screen. A user is required to enter his/her user name and password for authentication.

Figure 8: The Login Failed page: This message box pops up when a wrong username or password is entered.

Figure 9: The Main Menu: This is the window through which all other part of the program can be accessed. It also displays the welcome note and brief information on how to work on the software.

Figure 10: New criminal Record Screen: This is window where all new criminal details are inserted. From this window, a user can change passport, Load fingerprints, add all extra crime data attached to that particular criminal.

Figure 11: Extra Crime Data: This is the window where a user can add more detailed information about a criminal. The user can add Witness Information, Audio files, Video files, Scanned Documents, Typed Documents, Pictures, etc.

Figure 12: Fingerprint Capture: From this window, a user can capture the criminal's fingerprints. This can be entered as a new print or as an update to the criminal's details.

Figure 13: Saving New Criminal Record: This is the message box that pops up after a criminal's record have been entered or edited.

Figure 14: Fingerprints Local Check: This is where a suspected criminals' fingerprint is loaded in order to begin a search for match from the local database.

Figure 15: Fingerprint check using pattern compare: From this window a user can compare a criminal's fingerprints by cross matching it with the fingerprints in the database.

Figure 16: Result for pattern compare: This is the window that pops up when a print run by pattern compare comes up with a match. From this window user can open the criminal's detail.

Figure 17: Fingerprint Match Found: This is the window display and the message box that pops up when a fingerprint match is found on the Local database. The window also display information about the criminal who owns the found match an user can click open to view full details about the criminal.

Figure 18: Fingerprint Match Found: This is the window display and the message box that pops up when a fingerprint match is found on the Local database. The window also display information about the criminal who owns the found match an user can click open to view full details about the criminal. Fingerprint Match not found: This is window state and the message box that pops up when a fingerprint match is not found on the local database.

Figure 19: Fingerprint Match Found: This is the window display and the message box that pops up when a fingerprint match is found on the Local database. The window also display information about the criminal who owns the found match an user can click open to view full details about the criminal. Online check for Fingerprint Match: From this window, a user can load a suspects' fingerprint (whose match was not found on the local database) online to request for a search by the central database which is in a different location.

Figure 20: Online Check-Load Fingerprint: This is the window from which a criminal's finger print is loaded for an online search. This window is similar to the window pop up for loading fingerprints in other part of the application.

Figure 21: Existing Criminal Records: This is the window that displays all existing criminal records in the database. From this window a user can access the search box.

Figure 22: Search based on particular criteria: This is a window that displays the search results of criminals based on specified criteria. "The example used was rape". Any part of the criminal name remembered can also be used to search.

Figure 23: The Help Page: This window describes the procedure required to use every module in the software.

## CONCLUSION

A successful implementation of the Biometrics-Based Crime Records Investigation System will greatly increase the efficiency of the Nigerian Police Force officers and will help to ensure that criminal records are managed properly monitoring of criminal suspects in the country. the problem of delay in retrieving criminal suspects records for reference purposes and for appropriate court action or prosecution to be taken can be reduced drastically and the efficiency in the management of criminal records and investigation of criminal case being rendered by the Nigerian Police Force will greatly be improved upon.

Thus, this study on successful deployment would have great importance to the Minna Nigerian police as the Computerized Criminal Investigation System aiding prompt tracking of criminals,

proper management of criminal records and detection of criminals. It would also be relevant to the court of law as it can be admitted as evidence in a criminal law suit. The academia will also benefit from the study in the area of knowledge acquisition.

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