Design and Implementation of a Finger-Print Verification System for Criminal Case

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ABSTRACT: The paper herein is the design and implementation of a finger print verification system for criminal cases. The design was developed to reduce the challenges faced in the manual system by providing a convenient platform for the person in charge to have full knowledge of the transactions carried out. APACHE server and PHP were used to create database and server interaction for this project purpose, MYSQL database was used for data storage on server and JAVA Programming was used for the interface design. But with the implementation of the crime reporting system designed this project; it will be much easier for police to keep record of crime information in other to have control over the state.

INTRODUCTION

Crime has become part of human activities and needs to be managed. No human society has ever been totally free of deviants, and it is unlikely that society will ever be (Oludele, 2015). The more populated and complex a society becomes the wider the range of anti-social conducts that must be controlled by the government through the armed forces and other agencies, especially the Police Force (James, 2010, Kawai and Samson, 2011). The incident-based system reports on a much broader range of crimes and includes data on the circumstances of the crime, the victim, and the defendant (Mustapha et al., 2023). 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 using a fingerprint verification process to validate

suspects for the Nigerian security agencies (Police Force, Navy, Army, etc). I shall discuss on the techniques that will be employed by me on accomplishing this research work, its limitation and scope will be highlighted (Govardhan, 2010).

Criminality is part and parcel of human nature and society (Hart, 1999). 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 (Govardhan, 2010). 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) [Madden, and Chiu. 1998], 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 which is worrisome, however, the police which are meant to be the antidote to criminality appear to be getting overwhelmed by the phenomenon (Ash. 1999). 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 (Awake Magazine. 2002). 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 (James, 2010, Kawai and Samson, 2011). These include inadequate manpower, lack of expertise, lack of adequate equipment, low level of education, low morale, lack of training facilities and lack of technology, 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' criminal history (Amer et al., 2022). 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 (Bhuvaneswari *et al.,* 2022). 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 technique 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 (Hart, 1999). In the recent past, fingerprint images were obtained by "ink-technique" which is also referred as off- line fingerprint acquisition (International council on archives, 2008). 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 (International council on archives, 2008). 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 fingerprint verification system for crime investigation for The Nigeria Police Force in my State, Using Biometrics approach (Fingerprint).Various problems are encountered in the manual system of operations in any organization, so as in the crime investigation system in Nigeria Police Force. Some of the problems encountered are: Criminal case is being investigated blindly or based on assumption, by facial look and appearance.

Accuracy about cases being treated by this security agency are not guaranteed a bit, because there might be a case of the accused being identical or forms of resemblance. Loss of important file. Protecting confidential information is requiring helping in protecting the free flow of information. Breach of security could lead to loss of important files (International council on archives, 2008).

These research will analyze the existing process of documenting information and accessing of it manually in the police stations, where information about a case are normally access manually. In other to overcome the loss of files and contemplation about a case, that what make me to develop a system that will handle the following things mention below: Maintain a database of all crime records and enables a quick search on the database toretrieve crime information which will enable the Nigerian police to terrace previous crimes committed by a suspect quickly using his thumb print. Easy and quick in reporting and accessing crime case by the police station.

METHODOLOGY

System analysis

This is an interface between the user and the system that allow the user to enter data. Data input is generally done through the standard terminal keyboard or with the mouse in case of combo boxes (or command buttons). At this stage, different screen (window or forms) are designed to guide data entry procedure. The input variables needed for this work are usernames (of administrator) and passwords, while, the forms includes login page, account creation form.

Analysis of the existing system

The research result collected from the police head division officer was that records are made manually by the use of pen, paper. The report is then inserted in a file which will serve as a source for referencing; the records are mostly collect using whitepaper (record book), pencil, pen, and file. The file is then forwarded to the right hands for storage of archiving via a predefined protocol that is to be followed.

Problem of the existing system

The easy lost or destruction of documented crime reports maybe by hazardous or uncertainty is the major problem faced in this system. By the use of the manual system of documenting records, it becomes difficult to trace a particular record that is long forgotten. The lack of reliable central case recording systems for Nigerian police meant that cases were in effect impossible to trace without considerable resources, effort and a lot of luck. For criminal cases the impact of this has been felt in the practice of 'holding charge', where people are arrested and charged with capital offences in order to ensure their continued detention, whilst there is little or no evidence of their involvement. This issue has contributed significantly to the visible inefficiency of the Criminal Justice System, particularly the congestion of the prisons and the courts. The problem of the existing system are, there may be lost of file, fire born, stealing of file, misplace of record and inaccurate storing of record (James, 2010, Kawai and Samson, 2011).

Analysis of the proposed system

The proposed system will make used of an electronic means which is the use of computers to take in records of crime reports and stored in a database and view it with the help of Finger-Print machine when need, that will be designed and implemented for effective use and record tracking strategy. Patterns can be explored within a reporting system by searching places with elevated levels of crime against patrol deployment patterns across temporal dimensions. Trends can be uncovered by using past patterns to predict the locations of emerging hot sports of crime. In Jersey City for example, computerized crime reporting capabilities have been used by departmental planners to develop beat boundaries and to help match community service officers with particular ethnic and racial neighborhood. The proposed system will provide crime analysts and departmental planners with a means to spatially relate crime conditions, patterns, and trends. The propose system will allow analyst to search for places where high levels of crime correlate with relatively low levels of patrol assignments, accurate when storing record, easy to remember criminal, accurate and speediness when storing record (Kyobe et al., 2009, Mubaraka et al., 2013).

File and database design

One major consideration of the work is to determine a suitable file structure and organization so as to reduce redundancy maintain integrity and ensure easy retrieval of data from the application. This phase specifies all the files used for the system and their structures. The database is designed using MYSQL. The crime reporting information system to be designed specifically for the

case study police station in Kaduna state is made up of several database objects contained in a database The database named "Police" and all of its table are loaded into the root local folders with the aid of program such as Apache, PHP and MYSQL using the local machine server. The table names, number of fields, field names, data type, character length, attributes, null, default values, extra action and other descriptions for all tables used are also specified.

Entity relation diagram

ER diagram is the popular type of diagram that visually represents the structure of a database. In an E-R diagram, rectangles represent the entities (table). Foreign key restrictions determine relationships between the tables, and these relationships are represented as lines joining the corresponding rectangles (Figure 1). The primary key for each entity appears above the line in the rectangle for each entity (Pratt and Damski, 2005).

File design

In any good database design, effort should be made to remove completely or at worst reduce Redundancy. The database design in the software is achieved using Microsoft access database. Below is the structure of the file designed in the database.

Entity relation model

E-R model is an approach to representing data in a database. This model uses E-R diagrams exclusively as the tool for representing entities, attributes, and relationships. The E-R model is widely used and also forms the basis of some computerized tools. In 1976, Peter Chen of the M.I.T Sloan School of Management proposed the E-R model and since then it has been widely accepted as a graphical approach to database representation and database design. The basic constructions in the E-R model are the familiar entities, attributes, and relationships, all of which are represented in E-R diagrams (Figure 2). In the standard E-R model, entities are drawn as rectangles and relationships are drawn as diamonds, with lines connecting the entities involves in relationships. Both the entities and the relationships are named in E-R model. The lines leveled to indicate the type of relationship (Pratt and Adamski, 2005).

System requirements

Hardware requirements

In the process of the design, the software developed needed the following hardware for an effective and efficient operation of the new system.
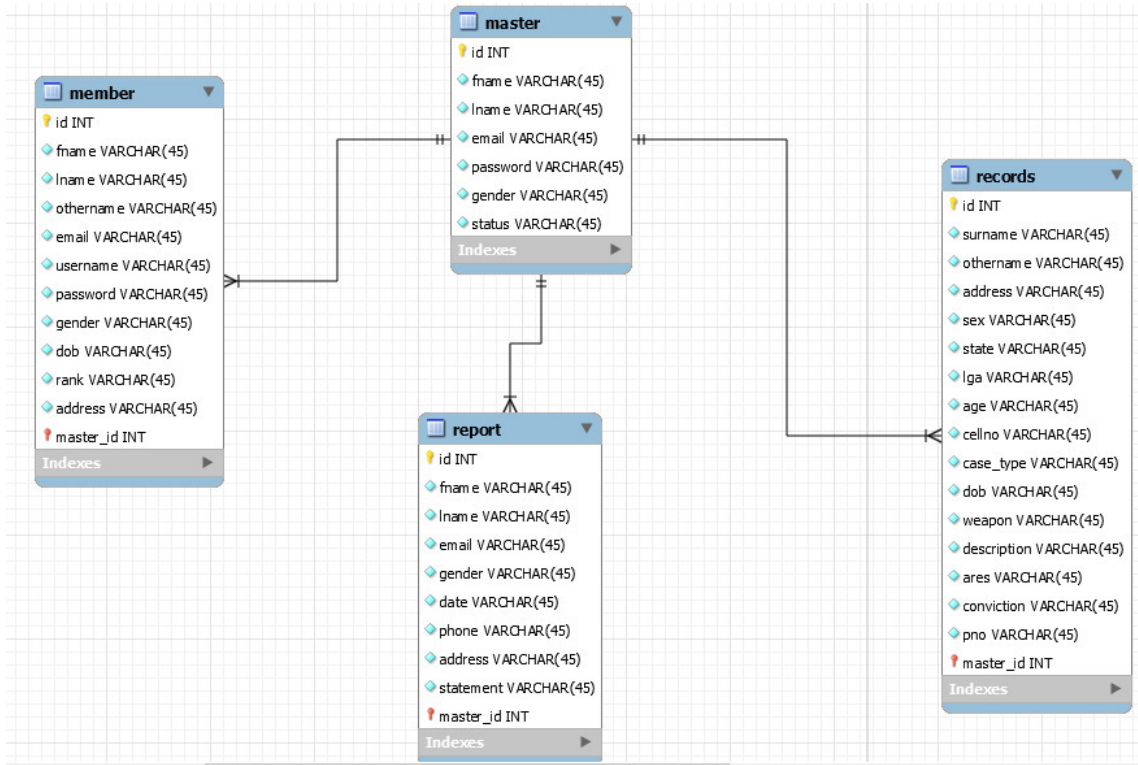
Figure 1: Entity relation diagram

Table 1: Criminal

Column	Type	Null
Sn	Int (10)	No
Surname	Text	No
Other name	Text	No
Sex	Text	No
Age	Int (10)	No
Date of birth	Varchar (30)	No
Date o conviction	Text	No
P_no	Int (10)	No
Case Type	Text	No
Cell no	Int (10)	No
Address	Varchar (50)	No

i.   Pentium IV

ii.   1GB RAM.

iii.   Enhanced keyboard.

iv.   At least 40GB hard disk.

v.   E.G.A/V.G.A, a coloured monitor.

vi.   An uninterruptible power supply (UPS) units

vii.   LaserJet or DeskJet printer.

viii.   Finger-print machine

Software tools requirement

There are various types of software tools that are required for the development of this design. From the basic server software that hosts the pages to the integrated development environments (IDEs) used to design the Web pages and the database. These tools are listed below:

a.   Web server
b.   Database server e.g. MYSQL
c.   Java programming
d.   Wamp, Myphp Admin

Input specification

The input specification or the new input requirements are the various data that are expected or required to be inputted during the execution of the program. This execution is described in the levels:

At the entry or registration level, the user clicks the

Table: 2: Admin

Column	Type	Null
Id	Int (10)	No
Fname	Varchar (50)	No
L name	Varchar (50)	No
Other name	Varchar (50)	No
Email	Varchar (50)	No
Username	Varchar (50)	No
Password	Varchar (50)	No
Gender	Varcahr (50)	No
DOB	Varchar (50)	No
Rank	Varchar (50)	No
Address	Varchar (50)	No

Table 3: Report Case

Column	Type	Null
Id	Int (10)	No
F name	Varchar (50)	No
L name	Varchar (50)	No
Email	Varchar (50)	No
DOB	Varchar (50)	No
Phone No	Int (11)	No
Suspect Add	Varchar (50)	No
Address	Varchar (50)	No
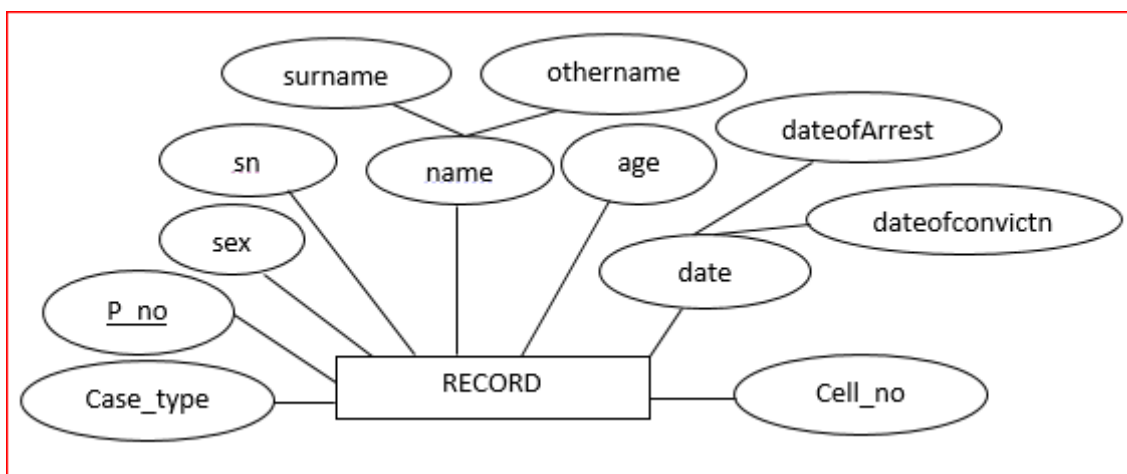
Figure 2: ER Model

Registration Perm sub-m no This form contains the following sets of input variable; The Personal information and these data are collected through a textbox control that is declared to have a string data type. However, before any entry can be made, the user must first initiate the action. And after filling the form for submission, the user clicks the SAVE button to commit the data to the database.

In every organization that deals with data entry, there is always a need for data modification and deletion. This form is made up of Data Grid control that has been programmatically configured to display student's records. This record is display in rows and columns. Each row is complete information of a student and the row are made up of cells or as it is called m database field. A field is one piece of information of a student such as age or sea. To modify or edit one piece of information in the database, the user clicks on the particular cell and edit the data. Once the Enter button is pressed on the keyboard, the record is automatically committed in the database.

To delete any record from the database, the user must click on the delete button on the screen before the delete action can take place.

Output specification

There are two main outputs in this new system design. These outputs are the query result and the report generated by the Data Environment control.

The query result is an output specification that is displayed on the Data Grid control based on the management or user's filtration. This filtration can be in terms of student names state of origin department, faculty, level, etc. The general report retrieves all the
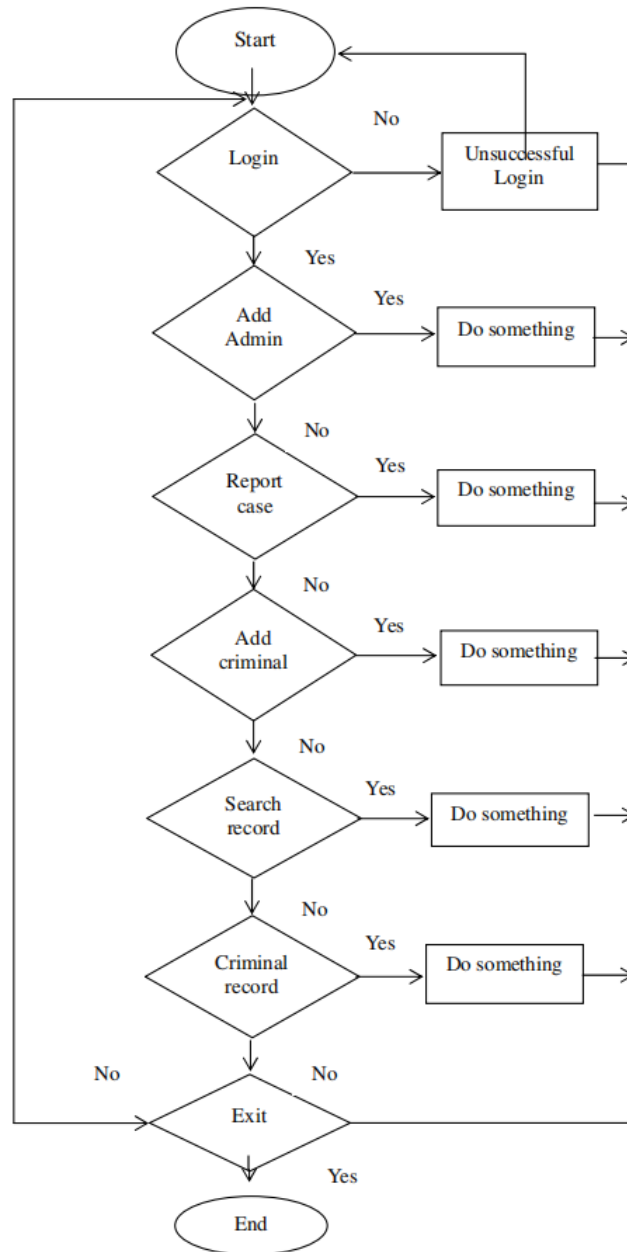
Figure 3: System Chart

information in the database and displays it on the Data Environment control. This information can further be process and printed on a paper.

RESULTS AND DISCUSSION

System development

The output form is designed to generate printable reports from the database. The output is placed on a database grid and contains crime information. The output produced can view on the screen.

The output generated includes:

a.   Crime Report
b.   Male and Female Crime Report

Software implementation

Software implementation occurs when the new or proposed software might have been realized after which the new software is tested and found to be working properly without errors. It is the installation of new
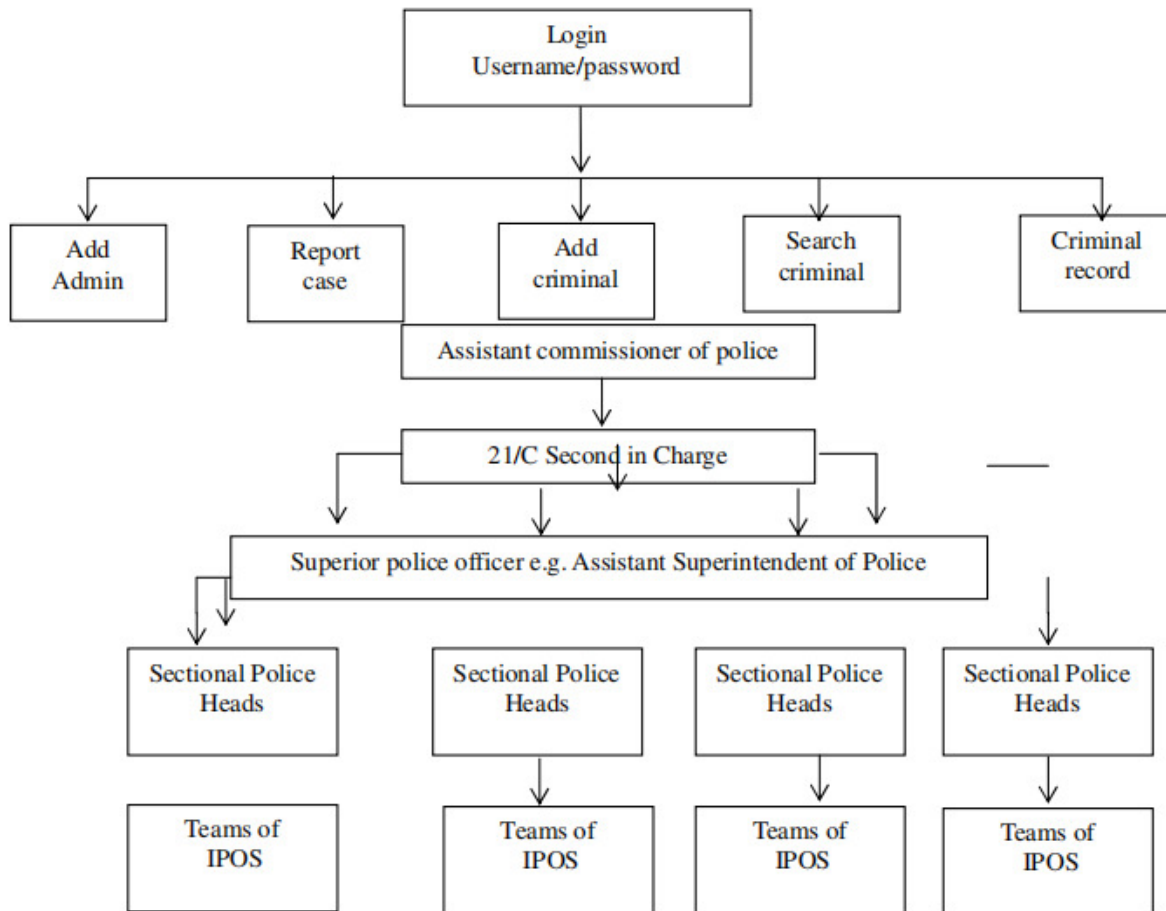
Figure 4: Information flow chart

software after all requirements are met based on user definition of quality. The new system must have additional functionality before it can be considered to replace (if necessary) the old system. Such functionality includes; reliability of the software, performance of the software and security of the software. As outline earlier, the application is design to allow the police station staffs perform basic station operation like staff registration, recording, reporting of crime, etc. Therefore, the web based applications comprises of different interfaces for the category of users.

System documentation

System testing of software or hardware is a test conducted on a completed, integrated system to evaluate the system's compliance with its specified requirements. System testing falls within the scope of black box testing, and as such, should require no knowledge of the inner design of the code or logic. As a rule, system testing takes, as its input, all of the "integrated" software components that have successfully passed integration

testing and also the software system itself integrated with any applicable hardware system(s). The purpose of integration testing is to detect any inconsistencies between the software units that are integrated together (called *assemblages*) or between any of the assemblages and the hardware. System testing is a more limiting type of testing; it seeks to detect defects both within the "inter-assemblages" and also within the system as a whole.
The following are the strategies adopted at the testing phase of the system:

Unit testing

Unit testing is a procedure used to validate that individual units of source code are working properly. A unit is the smallest testable part of an application a webpage is taken as an individual unit in the present application.

Integration testing

Integration testing is a systematic technique for constructing the software architecture while at the same

time conducting tests to uncover errors associated with interfacing. The purpose of integration testing is to verify functional performance and reliability requirements placed on major design items. These "design items", or groups of units, are exercised through their interfaces. Using Black Box testing, success and error cases being simulated via appropriate parameter and data inputs. Simulated usage of shared data areas and inter-process communication is tested and individual subsystems are exercised through their input interface. Test cases are constructed to test that all components within assemblages interact correctly, across procedure calls of process activations. The unit tested components are integrated to build a program structure that has been dictated by design. The strategy adopted here is incremental integration testing, a combination of top-down and bottom-up testing.

Validation testing

Validation testing is a concern which overlaps with integration testing. Ensuring that the application fulfils its specification is a major criterion for the construction of an integration test. Validation testing also overlaps to a large extent with system testing, where the application is tested with respect to the typical working environment. Consequently, for many processes no clear division between validation and system testing can be made. Validation succeeds when the software functions in the manner that can be reasonably expected by the client.

Output testing

The integrated system is tested for the predefined output for the specified input. This testing is done at the unit level. It is ensured that the system generates valid and consistent outputs.

User acceptance testing (UAT)

UAT is one of the final stages of a project and often occurs before a client or customer accepts the new system. This test ensures that the system is developed as per the requirements specifications. UAT acts as a final verification of the required business function and proper functioning of the system, emulating real-world usage conditions. The software works as intended and without issues during a simulation of normal use, it is reasonably inferred the same level of stability in production.

Stress testing

Stress testing is done to put a greater emphasis on robustness, availability and error handling under a heavy load. In particular, this test ensures that the software does not crash in conditions of insufficient computational

resources (such as memory or disk space), unusually high concurrency, or denial of service attacks. The boundary conditions are also tested for arrays and other data structure used in system.

Performance testing

Performance testing serves to validate and verify the quality attributes of the system, such as scalability and reliability. Performance test is also coupled with stress testing and require both software and hardware instrumentation. It is necessary to determine resource utilization. The actual runtime performance for the application is tested. The runtime taken to test and locate data is found out. The data conversion accuracy and speed is also tested.

Links testing

A list of links associated with the interface layout, for example members, index items, etc. are prepared and executed individually. Links within each content object is tested for bad URL or for improver linking.

Forms testing

Here tests are performed to ensure that; Labels correctly identify fields within the form and mandatory fields are identify visually for the user. The server receives all information contained within the form and that no data is lost between the client and the server. Appropriate defaults are used if the user doesn't select from a list or menu. Browser functions do not correct data in the form. Scripts that perform error checking on inputs work properly and give meaningful error messages. Form fields have proper width and data types. The Tab key ensures proper movement from fields.

System documentation

This gives an insight of the information in the main structure of the program. The program is designed in such a way that it will take care of almost all aspects involves in keeping adequate criminal data and records, example; names and address.

Software maintenance

This is also known as the support phase that focuses on changes associated with error, correction, adaptations required as the software environment evolves, changes due to enhancements brought about by changing customer's requirements. In general, four types of changes are encountered during this phase which are:

Correction
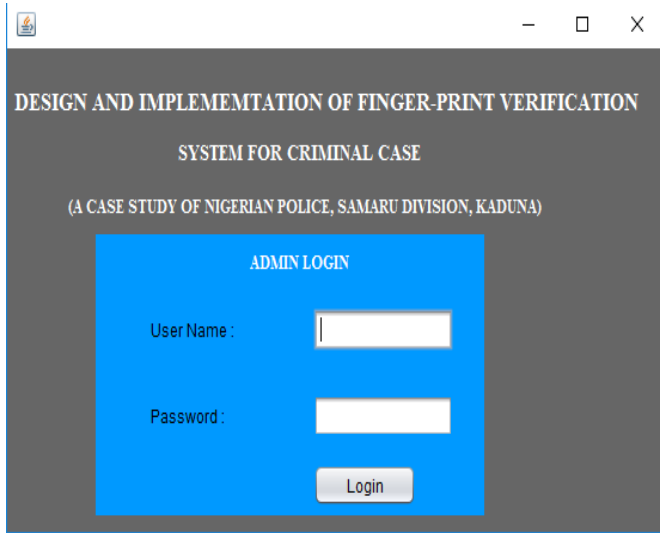Defect discovered during the use of the software can be

Figure 5: Home Page

Figure 6: Admin Page

corrected by the software developer which is known as corrective maintenance.

Adaptation

Over time, original environment such as Operating System, Central Processing Unit (CPU) for which the software was developed is likely to change. Thus, adaptive maintenance results in modification of software to accommodate changes in its external environment.

Enhancement

As software is used, the user will recognize additional functions to increase productivity of software. Perfective

maintenance extends the software beyond its original functional requirements.

Preventive

Software deteriorates due to change, and because of this preventive maintenance called software reengineering, and changes to software so that it can be more easily corrected, adapted, and enhanced.

Features of the system

The home and login page

This provides a brief description of the application, its objectives and links for all the category of users (i.e. admin) to access different aspect of the application, depending on their privileges defined by the application (Figure 5).

Admin page

This page provides a brief description of the work of an administrator, links for all categories of users is listed in this page and the personal information of an admin is display here in this page (Figure 6).
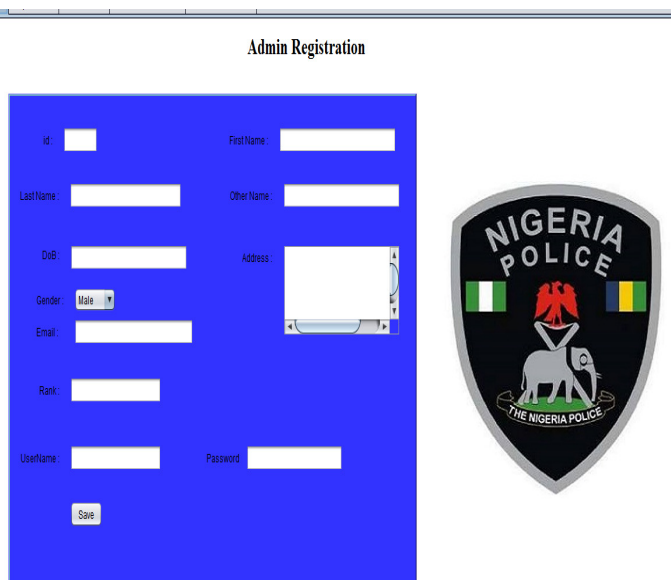
Add criminal record page

This page allows a user to add a criminal record the user will ask the names, address, state, local
government, case type, date of birth, weapon used, crime description and the user will provide personal number to the criminal, cell number to the criminal and save it (Figure 7).

Figure 7: Add Criminal Record Page

Reporting page

This page provides a brief description of how a reporter can report a suspecting incidence of a place and the

Report Case

Figure 8: Reporting Page

Search Record

Figure 9: Searching Page

Figure 10: Criminal Record Page

admin will collect the reporter's name and personal information and he then save it including suspecting address of the incidence (Figure 8). This page allows an admin to quickly search the criminals from the criminal's record and the admin will put personal number of the criminals and his surname and display them in tabular form so that he can make a print of record if needed by any means (Figures 8 and 9).

Criminal record page

This page it will allow admin to view all a record of the criminals in the police station in a tabular form and in this page the admin has the ability to delete a criminal from the record of the criminals (Figure 10).

Conclusion

The complexity and anonymity of computer systems may help criminal camouflage their operations. The victims of the costliest scams include banks, brokerage houses, insurance companies, and other large financial institutions. Most people guilty of embezzlement do not have criminal histories. Embezzlers tend to have a gripe against their employer, have financial problems, or simply an inability to resist the temptation of a loophole they have found. Screening and background checks on perspective employees can help in prevention; however, many laws make some types of screening difficult or even illegal. Fired or disgruntled employees sometimes sabotage their company's computer system as a form of "payback". This sabotage may take the form of a logic bomb, a computer virus, or creating general havoc. Some police stations have developed measures in an attempt to combat and prevent crime. Police sometimes implement security measures such as cameras, fingerprint records of crimes, and background checks. Not only do these methods help prevent crime, but they help police to keep reporting of crimes and maintain a database of criminal records.

Recommendations

Based on the limitations of this project, it is recommended that the following for the future work:

i. A camera should be added so that it can be able take the picture of the criminal.
ii. Further research should be taken, on how to create a single database for the entire Kaduna state to keep record with the help of finger-print.
iii. Further research should be carried out so that necessary amendments as well as improvement can be made

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