# LITERATURE REVIEW

## INTRODUCTION

This chapter defines facts and findings based on crime reporting systems and police complaint processing system as well as reviews of the development of such systems in many countries. This chapter will analyse all such systems as web application in general.

**POLICE**

This is an organized civil force for maintaining order, preventing and detecting crime, and enforcing the laws. The online citizen police report system allows you to submit a report immediately and print a copy of the police report for free. All cases filed within this system will be reviewed, and if further investigation of your case is needed, you may be contacted for follow-up or additional details. The system consists of three functional modules:

* A report management and control module
* A data capture module
* A data utilization module.

The system maintains an event/case file and a police activity file. This is a management information system. That will help the police manage and track crimes reported to them.

## Management information system (MIS)

MIS is the use of information technology, people, and business processes to record, store and process data to produce information that decision-makers can use to make day-to-day decisions (Guru99, 2021).A management information system (MIS) is a set of systems and procedures that gather data from a range of sources, compile it, and present it in a readable format. Managers use an MIS to create reports that provide them with a comprehensive overview of all the information they need to make decisions ranging from daily minutiae to top-level strategy. (Ingram, 2019)

A management information system (MIS) is a computerized database of financial information organized and programmed in such a way that it produces regular reports on operations for every level of management in a company. It is usually also possible to obtain special reports from the system easily. The main purpose of the MIS is to give managers feedback about their performance; top management can monitor the company as a whole. (Inc, 2020):

* It should provide a basis to analyse warning signals that can originate both externally and internally; this is the main function of a database;
* It should automate routine operations thus avoiding human work in the processing tasks;
* It should assist management in making routine decisions;
* It should provide the information necessary to make non-routine decisions;
* It should serve as a strategic weapon to gain competitive advantages.

There are numerous definitions of MIS, for this research, MIS can be defined as a system providing bus operator management with accurate and timely information necessary to facilitate the decision-making process and enable the bus operator’s planning, control, and operational functions to be carried out effectively. By doing so, MIS will increase competitiveness between bus operators, reducing cost and improving processing speed.

## Security

G.J. Udo (2001) defined Security as the protection of data against accidental or intentional disclosure to unauthorized persons, or unauthorized modifications or destruction. Security concern has become one of the main reasons for not transacting online because as soon as a user accesses the Internet, anyone from anywhere around the world has access to the information being sent. The risk of data theft, theft of service, and corruption of data, and viruses becomes a reality. The lack of security, reliability and accountability make the Internet online transaction too risky for many users (T. Ramayah *et al*., 2003).

Devising the Internet security policy can be complex because a rational policy requires an organization to access the value of information. The policy must apply to information stored in computers as well as to information traveling through a network.

Nowadays, the society consisting of either the businesses or the government these internet security issues concern areas. These people are very dependent on the data communication networks for their daily performance especially in the business’ areas. The rise of the internet with opportunities to connect computers anywhere in the world has significantly increased the potential vulnerability of the organizational assets (Fitzgerald and Dennis, 2002). Emphasis on internet security also has increased because of well-publicized security.

For this project, the Internet security that should be taken into consideration is the unauthorized access. Unauthorized access can have defined as the use and access of information without getting the permission from the administrator. This problem is often viewed as the hacker or the employee gaining access to the information and resources from the organization through the internet.

## Analysis of Existing Crime Reporting Systems

This section will analyse some already existing crime reporting systems.

### **Analysis on Existing Paper-Based Notification Systems**

In our police stations today, most of the information is spread using posters, sheets or stickers. Before citizens, members, or any institutions receive this information, the information would have to be printed as hardcopy and pasted on noticeboards or distributed by hand to every member of the institution and also through newspapers.

# SYSTEM SPECIFICATION AND DESIGN

## 3.0 Introduction

System Specification and Design are essential elements that need to be discussed to come up with a successful system. In developing such a system, one cannot help but bring out the essential features that form the building blocks for its effective development and subsequent deployment. Therefore, coming up with the system design in the 1st phase of this chapter talks about the feasibility studies, the System Specification, Analysis & Methodologies, as well as Methods, tools and techniques used in eliciting information for the development of the system. Other elements that could be captured in the next phase of this chapter is the requirement specification of the system, the system design and the Data Modelling tools (ARP) that will be significant in the system development.

## 3.1 Feasibility Studies

A careful study has been made to capture the reality of the new system design. The outcome and recommendations of this feasibility study helped us as a sound basis for deciding how to proceed with the project. We undertook three types of feasibility studies; technical, economical and operational, which were used to elicit ideas for the system design.

### **3.1.1 Technical Feasibility**

Technical feasibility was conducted to find out current existing tools, techniques and technologies that would aid the design of the new system. Technical feasibility is concerned with specifying equipment and software that will satisfy the user requirement. From the outcome of this study, it was found out that the proposed system can run on any device with internet connectivity and a browser.

### **3.1.2 Economical Feasibility**

Some cost-benefit analyses are considered to find the government’s position to undertake this project. Throughout the Economic feasibility, we were able to determine whether there were sufficient benefits in creating to make the cost acceptable. As this signifies the cost-benefit analysis and savings. On the behalf of the cost-benefit analysis, the proposed system is feasible and is economical regarding its pre-assumed cost for making a system, we classified the costs of online notification systems according to the phase in which they occur.

### **3.1.3 Operational Feasibility**

The operational feasibility criteria measure the urgency of the problem or the acceptability of a solution. The purpose of this operational feasibility was to find out how the new system will operate upon completion in terms of how information would be dispensed to the citizens without the constraints of time.

### **System Scope**

The outcome of the feasibility studies enlightens us to define the scope of the system. The system therefore is designed in such a way that it will help the citizens and the police to perform the following tasks:

* Keeps any information uploaded by either the citizen, police or the administrator and appropriately display it to any when it is requested.
* The system accepts and keeps records of every user and the task or activity performed at any time using the system to establish an audit trail of every action thus, whoever is responsible for any problem or loss to the company.
* The system allows the administrator to add or delete any user accounts from the system.
* Only the administrator can cause modifications to any account on the system and a user can navigate records on the system without making any changes to it.

**3.1.5 Methodology**

It is important to fulfil the planning for the implementation phase. This can only be done if proper methodology is selected. Methodology is important to make sure all project life cycle activities are being carried out without any shortcuts. Methodology helps the system developers to take one-step at a time towards accomplishing the full system.

**Research Methodology**

The main purpose of research methodology is to find the benefits and problems concerning the crime reporting system. The following will further explore on research methodology that is used to complete the research. Various methods can be adopted to gather information from a variety of sources such as sampling, research and site visits, observation of the work environment, questionnaires, interviews, prototyping and joint requirements planning (Whitten J.L *et al*., 2002). Not all the fact-finding methods are suitable to adopt. The methods are selected based on the research purpose. The procedure that had been followed to accomplish the project’s objective is by first identifying the purpose of the dissertation and further moving into depth where the purpose, obstacles, benefits, suggestion and recommendation on E-Notice system implementation.

**3.1.6 Fact Finding**

The fact-finding methods that have been selected for this research project consists of

observation, interview and questionnaires. Once information is gathered, a prototype is

developed as to support the findings. Development of the prototype of crime reporting system is developed to support the objectives of the research. The following

will be the research methodologies discussed in detail.

**3.1.7 Choice of Methodology**

The methodology that might be useful is the project life cycle and prototype. The project life cycle methodology and prototyping are a methodology that allows users to review all phases until the users are satisfied with crime reporting system.

Agile SDLC model is a combination of iterative and incremental process models with focus on individuals and iterations over processes and tools, working software over comprehensive documentation, customer collaboration over contract negotiation and responding to change over following a plan (Beck, Kent, et al.2001. “Manifesto for Agile software Development”. http://agailemanifesto.org/.Retrieved 2010-06-14). Agile Methods breaks the tasks into small increments with minimal planning. Iterations are short time frames (time boxes) that typically last from one to four weeks. Each iteration involves a cross functional teams working simultaneously through a full software development cycle including;

* **Planning:** Once an idea is deemed viable and feasible, the project team comes together and works to identify features. The goal of this phase is to break down the idea into smaller pieces of work (the features) then to prioritize each feature and assign it to an iteration.
* **Requirement** **Analysis:** is an important phase where many meetings with project supervisors, lecturers and common Ghanaians to discuss and identify the requirements of the proposed crime reporting information system. The team needs to gather information like who will use the proposed crime reporting and information system and how they will use it. These requirements must be quantifiable, relevant and detailed.
* **Design:** The system and software design are prepared from the requirements identified in the previous phase. The team then thinks about what the proposed crime reporting and information system will look like. A test strategy or plan to proceed is then drafted.
* **Coding:** This phase is all about creating and testing features, and scheduling iterations for deployment (following the iteration and incremental development approach). The development phase starts with iteration 0, because there are no features being delivered. This iteration lays down the foundation for development, with tasks like finalizing contracts, preparing the environments and funding.
* **Testing:** Once the code has been developed, it is tested against the requirements to make sure the product is solving the user’s needs and matching user stories. During this phase, unit testing, integration testing, system testing, and acceptance testing are done.
* **Deployment:** After testing, the product is delivered to customers for them to use. However, deployment is not the end of the project. Once customers start using the products, they may run into new problems that the project team will need to address.

Agile model believes that every project needs to be handled differently and the existing methods need to be tailored to best suit the project requirements. In Agile, the tasks are divided to time boxes (small periods) to deliver specific features for a release. Each build is incremental in terms of features; the final build holds all the features required by the customer.

**Here is a graphical illustration of the Agile Model**



**Figure 3.1 Agile Model Source: www.slidegeeks.com/agilemethods**

The Agile thought process had started early in the software development and started becoming popular with time due to its flexibility and adaptability.

The most popular agile methods include Rational Unified Process (1994), Scrum (1995), Crystal Clear, Extreme Programming (1996), Adaptive Software Development, Feature Driven Development, and Dynamic Systems Development Method (DSDM) (1995). These are now collectively referred to as **Agile Methodologies**, after the Agile Manifesto was published in 2001.

Following are the Agile Manifesto principles –

* **Individuals and interactions** − In Agile development, self-organization and motivation are important, as are interactions like co-location and pair programming.
* **Working software** − Demo working software is considered the best means of communication with the customers to understand their requirements, instead of just depending on documentation.
* **Customer collaboration** − As the requirements cannot be gathered completely in the beginning of the project due to various factors, continuous customer interaction is very important to get proper product requirements.
* **Responding to change** − Agile Development is focused on quick responses to change and continuous development.

### **3.1.8 Agile Vs. Traditional SDLC Models**

According to Boehm, B; R (2004). Guide for the Perplexed. Boston, MA: Addison-Wesley. ISBN O-321-18612-5. Appendix A, PAGES 165-194, agile method lie on the **adaptive software development methods**, whereas the traditional SDLC models like the waterfall model is based on a predictive approach. Predictive teams in the traditional SDLC models usually work with detailed planning and have a complete forecast of the exact tasks and features to be delivered in the next few months or during the product life cycle.

Predictive methods entirely depend on the **requirement analysis and planning** done in the beginning of cycle. Any changes to be incorporated go through a strict change control management and prioritization.

Agile uses an **adaptive approach** where there is no detailed planning and there is clarity on future tasks only in respect of what features need to be developed. There is feature driven development and the team adapts to the changing product requirements dynamically. The product is tested very frequently, through the release iterations, minimizing the risk of any major failures in future.

**Customer Interaction** is the backbone of this agile methodology, and open communication with minimum documentation are the typical features of agile development environment. The agile teams work in close collaboration with each other and are most often located in the same geographical location.

### **3.1.9 Agile Model - Pros and Cons**

Agile methods are being widely accepted in the software world recently. However, this method may not always be suitable for all products. Here are some pros and cons of the agile model.

#### **3.1.9.1 Advantages of the Agile Model**

* Agile methodology allows for changes to be made after the initial planning. Re-writes to the program, as the users decides to make changes, are expected.
* Because the Agile methodology allows users to make changes, it is easier to add features that will help the project team to keep up to date with the latest developments.
* At the end of each sprint, project priorities are evaluated. This allows users to add their feedbacks so that they ultimately get the product they desire.
* The testing at the end of each sprint ensures that the bugs are caught and taken care of in the development cycle. They will not be found at the end.
* Promotes teamwork and collaboration. Agile highlight on the importance of frequent communication and face-to-face interactions. Teams working together, and users can take responsibility and own part of the project.

#### **3.1.9.2 Disadvantages of the Agile Model**

* While the level of flexibility in Agile is usually an acknowledged positive, it also comes with some trade-offs. It can be hard to establish a solid delivery date, documentation can be neglected, or final product can be very different than originally intended.

## 3.2 Requirement Specification

Performance is measured in terms of the output provided by the application. Requirement specification plays an important part in the analysis of a system. Only when the requirement specifications are properly given, it is possible to design a system, which will fit into the required environment.

### **Functional Requirement**

Functional requirements capture the intended behaviour of the system. This behaviour may be expressed as services, tasks or functions the system is required to perform. In product development, it is useful to distinguish between the baseline functionality necessary for any system to compete in that product domain, and features that differentiate the system from competitors’ products. Features may be additional functionality or differ from the basic functionality along some quality attribute (such as performance or memory utilization). The Functional requirements that serve as the basis for the new system include the following:

* The system should allow the addition of new users and their conplaints.
* The system should allow the modification and deletion of existing user information.
* The system should be able to authenticate and restrict user’s access to system resources.
* The system shall present an error message if the user enters invalid login information and allow the user to attempt a login again.
* The system should allow users to change their password
* The system should allow users to receive electronic notifications about crimes reported, status and wanted criminals.
* The system should be able to validate information entered into the system.
* The system should be able to store data entered into the system. Citizens and police officers should be able to view information about complaints and crimes reported.
* The system should provide a form interface to capture information from citizens about their complaint or crime.

### **3.2.2 Non-Functional Requirements**

The non-functional requirements are not the functions of the system rather they are Standards that the system must comply with instead of its specific behaviours. They are the systems qualities;

* Reliability: The system shall be accessible at any time, except for technology infrastructure failure. This requirement shall be provided for by the Ghana Police who is the primary beneficiary of this system.
* Usability: The system will be designed to promote clarity and interface consistency that will ensure ease of use. The system will be intuitive and self-explanatory since it will be mainly used by people who may have little knowledge in computers.
* Interoperability: The system shall allow for easy integration with other diverse systems.
* User friendliness: The system should be user friendly. The user interface should be easy to navigate, and the colour schemes should be moderate.
* Flexibility: While insufficient flexibility of an information system to support a business process precludes the use of the system in certain cases, excessive flexibility of an information system can limit the usability of the system (Silver 1991), in addition to presenting an unnecessary investment. The system will be flexible so that it can respond to potential internal or external changes affecting its value delivery, in a timely and cost-effective manner.
* Extensibility: The system shall be extensible using JS libraries. Code may be modified, styles may be changed, and content may be added all using the Visual Studio Code interface.
* Resource Utilization: The system shall be accessible from any device through the web with an active internet connection. The system’s database can be accessed from any internet enabled device since it’s primarily online.

## 3.3 System Functional Design

### **3.3.1 System Architecture**

System architecture is a response to the conceptual and practical difficulties of the description and design of complex systems. It is a visual model of a system, its components and their interactions. The drive of a model is to reduce the ambiguities that occur in the descriptions and to visualize its design. The system architecture for this project is shown below.

The system architecture has a computer device be it a smartphone, laptop and or tablet just to mention a few devices, a web service and browser, a database server and the user as its components. The computer device must use network for internet connectivity to ensure better performance however 2G should also satisfy the user request with added disadvantage of time lag. The user will login to the application through any smart device or computer with a browser. The user-type is verified with the database server and access is given to the appropriate user. The website accesses data from the mongo DB cloud server through the internet.

1. **User Module:** In this module, users will be authenticated by providing Ghana card id and password. If Ghana card id and password is valid then they will be taken to their screens. To identify the user, the unique card ID of the user with their password would be stored automatically on the server. When they get matched with each other browser checks the status of that device and transfer the control to respective user-interface.
2. **Database Module:** The proposed system used Mongo Database as its database because of their simplicity and flexibility. This module stores every single information about citizens, police station, reports etc. and model their data on specified operations.
3. **Admin Module:** This module is also designed for the administrator, who will use their device to post feeds on validated crimes, wanted criminals and missing person reports. The entered admin details are encrypted and sent to server for verification. Only after successful authentication are the operations performed.

### **3.4.1 Structural Design**

The Structural Design of the crime reporting and information system shows a bird’s eye view of the entire system. Generally, it allows easy accessibility to obtain information. Citizens can browse the web application to obtain various types of information such as wanted criminals, missing person’s report, latest news in the world of crime and a feedback platform. On the other hand, the Administrator would be able to assess the system to update the crime events information, complains status, latest news, and feedback.

A structure diagram has been created for the crime reporting and information. The main system is divided into 2 major sections, Administrator section and Users section as shown in Figure 3.3.

Crime Reporting System

Authority

Citizen Accounts/Information Administration

Citizen Section

Admin Section

**Figure 3.3 Structural Design of Crime Reporting and Information System**

**Source; Authors’ Design**

### **3.4.2 Use case diagram**

A use case diagram is a dynamic or behaviour diagram in UML. Use case diagrams model the functionality of a system using the actors and use cases. Use cases are a set of actions, services, ad functions that the system needs to perform. In this context, a system is something being developed or operated, such as a website. The actors are people or entities operating under defined roles within the system. Use case diagrams are valuable for visualizing the functional requirements of a system that will translate into design choices and development priorities. Figure 3.4 clearly depicts the use-case diagram of the Crime reporting and Information System.

LOGIN

CITIZEN

ADD, EDIT, DELETE

VIEW INFORMATION

AVAILABLE INFORMATION

ADD, EDIT, DELTE

USER

REGISTER

CANCEL INFORMATION

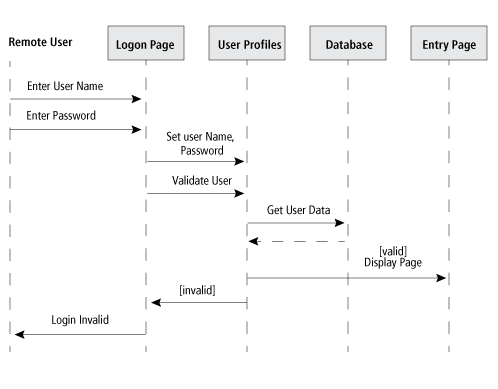
LOG OUT

ADMIN

**Figure 3.4** **Use Case Diagram for Crime Reporting and Information System Source: Author’s Design (2022)**

### **3.4.3 Sequence Diagram**

A sequence diagram shows object interactions arranged in time sequence. It depicts the objects and classes involved in the scenario and the sequence of messages exchanged between the objects needed to carry out the functionality of the scenario. Sequence diagrams are typically associated with use case realizations in the Logical View of the system under development. Sequence Diagrams are sometimes called event diagrams or event scenarios.



**FIGURE 3.5**

**Sequence Diagram for Crime Reporting and Information System Source: Author’s Design (2018)**

## 3.6 Tools and Methodology used

In this section the Tools and Methodology used in the development of the prototype system is introduced.

### **3.6.1 Software Package Used**

To develop the prototype of the proposed system an appropriate software package needs to be selected. To determine suitable software, it can be identified by addressing several questions:

1. **Familiarity: Is it familiar and easy to learn?**

This aspect concerns the Administrator and the User. It is best to choose a software that is familiar to the Administrator and User so that both parties are more comfortable using the system and find it easy to learn.

1. **Flexibility: Can the system be changed or is it easy to modify the program?**

The system needs to be changed or enhanced from time to time, as the Administrator may want to alter or modify some functions. This can be achieved depending on the type of software package and the degree of flexibility allowed.

1. **Maintainability: Can the system be maintained easily?**

The system should be able to be maintained easily by the Administrator. Maintainability will also reduce time and cost if the software package allows maintainability and this would mean that the software is more reliable and efficient to us.

Thus, in choosing the tools to develop the prototype system, the above criteria are checked to ensure it is met.

### **3.6.2 Tools Used**

The tools used for the development of the prototype system are important, as it would affect the effectiveness and efficiency of the system. Thus, careful consideration has been taken in choosing the appropriate tool.

### **3.6.2.1 Software Requirement**

Javascript is an open-source language that is widely used to build web applications it comes with libraries and frameworks such as React and NodeJS respectively. And it will be used as the primary language alongside HTML and CSS to build the web application.

### **3.6.2.2 User-Interface Design**

To build a beautiful UI to be appealing yet efficient to the user, HTML, CSS and React which are all open-source languages and libraries that anyone can use without purchasing a license.

### **3.6.2.3 Database Management**

Mongo DB is a mobile and web application development platform developed by mongo, Inc. in 2011. Mongo DB provides a real-time database and backend service. The service provides application developers an API that allows application data to be synchronized across clients and stored on Mongo DB cloud. The company provides client libraries that enable integration with web applications. This real-time database will be used to secure data by using server-side enforced security rules.

### **3.6.2.5 Operating System**

For this project, the latest version of Windows 11 is used as the development platform since it has easy to use interface and more improved user management compared to other Windows platforms.

## 3.7 Hardware, Software and Human Computer Interaction (HCI) Requirements

The choosing of Hardware and Software is very important for developing a system as it has a profound impact on the quality and productivity of the system.

### **3.7.1 Requirement for System Development**

The basic software and hardware used to develop the system are as follows:

1. Intel(R) Core (TM) i5-6200 CPU @2.30GHz
2. 8GB of RAM
3. Hard disk space – 1TB
4. Windows 11 (Professional)
5. Google Chrome
6. Visual Studio Code
7. HTML
8. CSS
9. React
10. Mongo DB
11. Node JS
12. Express

**3.7.2 Human Computer Interaction (HCI) Factors**

The design is created based on Human Computer Interaction factors such as user, productivity factors, organizational factors, and user interface factors. They include:

1. **The user**

In designing the site, the experience and educational background of the users have been taken into consideration.

1. **Productivity factors**

The design must have good quality and at the same time have increased output and minimal error.

1. **Organizational factors**

There is no need to provide training for the system, as the design is easy to use.

1. **User Interface**

The use of colours, icons and command buttons, graphic and output display is important when designing the interface. All these have been included when designing the android application.