

Aeronautical Publications and Flight Permits Processing System



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Aeronautical Publications and Flight Permits Processing System

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ABSTRACT

Aeronautical Publications and Flight Permits Processing System is a web-based computer system that automates all the processes that are involved in issuing flight permits, as well as recording and management of publications. Its major thrust is to provide a secure platform to issue flight permits for over flight and landing, and to conduct Airport surveillances online. The system deals with the creation and management of applicants or operators' accounts since some Aircraft operators have prepaid accounts managed by the AIS permits office. Usually at the end of every month statements are sent to the prepaid account holders as a breakdown of permits issued that month and the remaining balance. The system was developed to address the weaknesses of the old system. MYSQL, WampServer, php and java scripts are the tools that were used in the development of the new system.

DECLARATION

I, **Aluis Mukwembi**, hereby declare that I am the owner and author of this dissertation. I give permission to the Midlands State University to grant this dissertation to individuals or other institutions for the purpose of academic research.

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APPROVAL

This dissertation entitled “**Aeronautical Publications and Flight Permits Processing System**” by **Aluis Mukwembi** conforms to the regulations governing the award of the **BSc Information Systems Honours Degree** of Midlands State University, and is approved for its contribution to the knowledge and literary presentation.

Supervisor

Date

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DEDICATION

I dedicate this project to Mr and Mrs Mukwembi for their unwavering support, love and guidance in my life. Lastly I would like to dedicate this dissertation to CAAZ ICT team.

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ACRONYMS AND ABBREVIATIONS

ICAO -	International Civil Aviation Organization
CAAZ -	Civil Aviation Authority of Zimbabwe
ATC -	Air Traffic Control
AIC	Aeronautical Information Circulars
AIP	Aeronautical Information Publications
AIS	Aeronautical Information Services
DCA	Department of Civil Aviation
DFSS	Directorate of Flight Safety and Standards

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CHAPTER ONE: INTRODUCTION

1.1: INTRODUCTION

Aeronautical Publications and Flight Permits Processing System is a web-based computer system that automates all the processes that are involved in issuing flight permits, as well as recording and management of publications. Its major thrust is to provide a secure platform to issue flight permits for over flight and landing, and to conduct Airport surveillances online. The system deals with the creation and management of applicants or operators' accounts since some Aircraft operators have prepaid accounts managed by the AIS permits office. Usually at the end of every month statements are sent to the prepaid account holders as feedback, showing all permits issued that month and the remaining balance.

The system enabled stakeholders to subscribe and receive their Aeronautical Information Publications (AIPs).

1.2 BACKGROUND

This section gives a brief description of the organisation stating its origins, their line of business and other details pertaining to the organisation.

1.2.1 Background of organization

The Civil Aviation Authority of Zimbabwe (CAAZ) was launched on January 1st 1999 as a statutory body to take place of the former Department of Civil Aviation (DCA) and started to operate on for profit and under Chapter [13:16] of the Civil Aviation Act, with its objectives being:

- To promote efficient, regular and secure use and improvement of aviation within and outside Zimbabwe.
- To give advice to the Government of Zimbabwe on all issues relating to domestic as well as international aviation.

The Authority's core business is airport and airspace management, air service development and industry regulation as well as providing advisory services. The mandate to regulate the aviation industry falls under the ambit of the Directorate of Flight Safety and Standards (DFSS). The DFSS has under it five departments which are Aerodromes, and Licensing and Examinations, Airworthiness, Aeronautical Information Services(AIS) and Flight Operations. The project computerized the key areas involved in the Aeronautical Information Services section with regard to flight permit issuance.

1.2.2 Vision

To be among the prominent providers of airport, air navigation and regulator services in the world.

1.2.3 Mission statement

To provide customer driven, safe and secure airports, air navigation and regulatory services through a highly motivated workforce.

1.2.4 Organizational structure

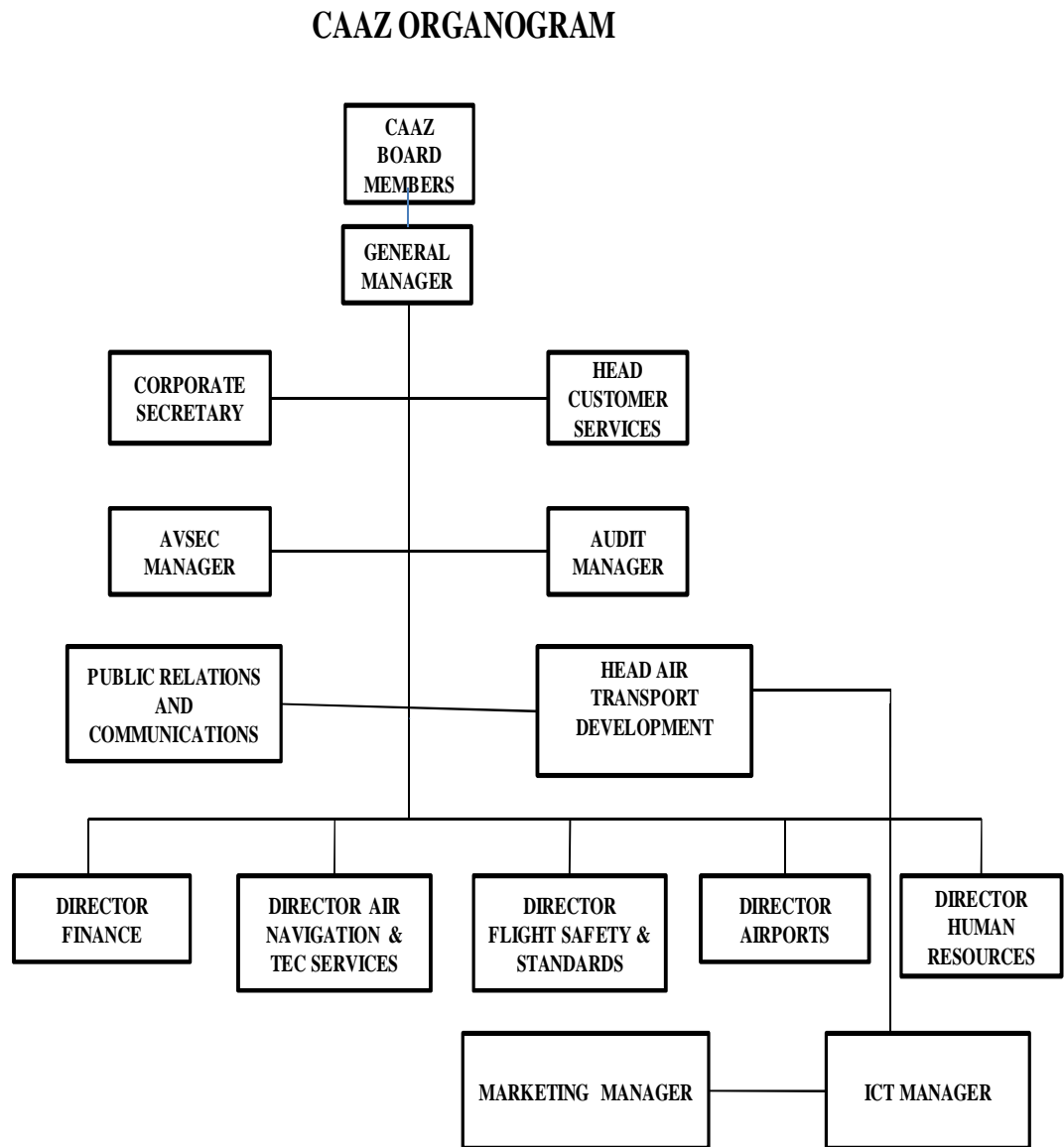


Fig 1.1 CAAZ organogram

1.3 PROBLEM DEFINITION

The Aeronautical Information Services is responsible for the issuance of flight permits to Aircraft operators. The section works hand in hand with other sections namely Flight operations, Airworthiness, Air Traffic Control and Aerodromes. Problems were being encountered in the old system were as follows:

- a. Due to the use of the manual system the AIS Officers had to travel to different Aerodromes with hard copy forms that they filled in with survey details, and then return them to the Harare International Airport for compilation and filing. This exposed the documents to high risk of being lost, and insecurity of confidential information.
- b. The permits and permits enquiry papers were recorded in a book then sent for filing. This means more storage space was required and it took some time to search for a record, even when there was need to produce reports the compilation of the data took long.
- c. Aircraft operators had prepaid accounts managed by the AIS permits office and their balances and transactions were recorded in a book awaiting compilation after three weeks or at the end of the month. Usually at the end of every month statements were sent to the prepaid account holders as feedback of the transactions conducted that month and their current balance status. The number of these prepaid account holders was increasing at a faster rate such that it became difficult for them to manage these accounts using the method of recording transactions or charges in a book.
- d. AIS officers used the same CAAZ webmail account when issuing flight permits, this made it difficult for access control to be enforced and since they used the same account there was a possibility that one could login even if they were off duty without being tracked
- e. Aeronautical information publications (AIP) were being issued as hard copies to other airports and to CAAZ stakeholders. This resulted in exorbitant printing and binding costs.

1.4 AIM

Technology advancement brought new ways of doing things, so for an organisation to remain competitive and survive it must take advantage of available technologies. The major purpose of this piece of research was to design a system that automated the process carried out in the Aeronautical Information Services section to improve its performance, optimize speed of retrieval of permit records and eliminate paper where possible.

1.4.1 Objectives

- Issue flight permits for over flight and landing and automatically randomizing permit numbers so as to conduct an online surveillance.
- To view audit trail of user login time and date and activating and deactivating user accounts
- To build a centralised database for all permits records and Operators' accounts to provide a central data source for analysis and reporting.
- To create and manage operators' accounts debiting them for every permit issued.
- To provide the Air Traffic Control (ATC) section with a view where they can see a list of all the Aircrafts that have been issued flight permits.
- To enable stakeholders to subscribe and receive their Aeronautical Information Publications (AIPs) online.

1.5 INSTRUMENTS

In developing the Aeronautical Publications and Flight Permits Processing System a number of tools were required

- **Macromedia Dreamweaver** – an adaptable and user friendly Rapid Application Development tool used in designing Web Interfaces.
- **PHP** – a loosely typed programming language used for designing applications that run on a web browser.
- **MySQL Database** – a vigorous Database System that operates well with web based applications.
- **C++**
- **JavaScript**

1.6 JUSTIFICATION

Software systems performance can be measured in terms of reducing cost, and supporting business processes to achieve organisational goals efficiently. The new system effectively supported CAAZ in its business strategies by reducing costs (For example, cost of printing), and improved the day to day operations of the business thereby giving the organisation a competitive advantage.

The new system provided an easier and efficient way of conducting all the processes done by the Aeronautical Information Services section. Additionally, it reduced AIS officers' workload and chances of working overtime. It became easy to search for a record through the use of ad hoc queries.

The development of such a computerised system helped in eliminating and curbing the above mentioned problems faced by the Aeronautical Information Services section. The merits below justified the need for automating all the processes manually done in the old system;

- Access control and data security was improved.
- Lessening salary costs because it reduced the time taken in every process that was being done manually, getting rid of unnecessary overtime at the work place.
- The use of a computerized Database system for data storage reduced paperwork and data redundancy, which resulted in reduction of stationary and storage costs.
- Backup of data was facilitated thus reducing the potential risk of losing essential data
- Data in the database can be accessed concurrently.
- Data integrity: data in the database is protected from improper modifications, either intentional or accidental, to maintain database integrity. Only the kind of operations that need to be carried out by the user should be allowed to them. For instance, an employee who works in any department other than the Aeronautical Information Services section should not be allowed to make any changes to Aeronautical records.

1.7 CONSTRAINTS

a. Limited Money Resources: The funds to finance the project were limited, financial resources were scarce. The benefits of using the new system were made known to the finance department so they realized its importance and set aside funds to finance the project.

b. Acceptance: Generally users may not fully participate or air their views because of suspicion and resistance to change. Therefore users were educated on the benefits of the new system in order encourage them to cooperate.

c. Power Cuts: The occurrence of load shedding was an additional constraint in this project; this impacted the progress of the project negatively. This challenge was addressed by having a generator on standby as an alternative power source.

d. Internet access: The internet systems were sometimes down or unavailable so a modem was used as an alternative, which increased the cost budget.

e. Time constraint: The project was designed and developed within a period of three to four months. This time frame was not enough for one to produce a fully running system with all modules required, so because the time was limited the developer had to just focus on those modules concerned with the above mentioned objectives.

1.8 CONCLUSION

This chapter has elaborated quite a number of aspects concerning this project which includes the background and the structure of the Civil Aviation Authority of Zimbabwe, the organisation for which the system was designed. The problems faced were also highlighted and the proposed solution to those problems was given outlining the instruments that were used. Most importantly identifying the objectives of the project and possible limitations have also been disclosed. At this juncture the project proceeded to the next chapter that is the planning phase.

CHAPTER TWO: PLANNING PHASE

2.1 INTRODUCTION

The planning phase looks at all the aspects that determine the viability of the new system (Dawn, 2002). These include technical feasibility, operational feasibility, economic feasibility and all kinds of risk analysis. The feasibility study being conducted is to determine whether the project is economically, technically and operationally feasible. Risk analysis also carried out to identify risks and plan countermeasures to taken to address those risks.

2.2 BUSINESS VALUE

Business value looked at what benefit the proposed computer system would bring to the organization if it puts it into operation. It is crucial to take into consideration the business needs before embarking on the evaluation of the benefits derived from the implementation of the system.

2.2.1 Business needs

- Cut costs, so that the funds that were used for stationery could be used for something else.
- Lessen or minimise the workload on employee so as to increase their morale.
- Increase productivity
- Improve service delivery to customers

2.2.2 System Functionality

This portion outlines what the proposed system was expected do. The Online Aeronautical Permits and Publications Processing System was expected do the following:

- Prepare summaries of transactions conducted through different kinds of reports.
- Generate permit numbers
- Credit and debit operator accounts
- Validating user input
- Grant different privileges to users

2.3 FEASIBILITY STUDY

Kendall (2005) pointed out that this particular study helps an organisation to make a judgement on whether continuation with the project is worthwhile or not. The intention of conducting this study being the determination of difficulties being faced and try to come up with appropriate solutions to the identified problems.

In this analysis the business identified what resources were available to them, the risks involved and their position on whether they can afford to finance the project or not. The study was broken down into three categories of study namely:

- Technical
- Operational
- economic

2.3.1 Technical feasibility

The study ascertains whether the resources at the organisation’s disposal or available could execute the project successfully and to completion, by paying particular attention on the hardware and software instruments required and also the ones that are available (Dawn, 2002). The consideration of the skills and expertise of available personnel was also of paramount importance.

2.3.1.1 Technical expertise

It is of paramount importance to ascertain the abilities of personnel at this stage so as to determine whether they can technically handle the software project or not. That is to find out if the available team or staff possesses required and necessary technical skills that were needed to execute the project. The organisation had a team fully equipped with the knowledge of programming and was willing to fund additional training of the team and users.

2.3.1.2 Hardware and software requirements

The following were the hardware required:

Table 2.1: Hardware Requirements

Quantity	Component/item	Specifications	Available
4	HP PRO 3500 SERIES MT	500GB HDD 4GB RAM 3.20GHz Processor Speed Intel Pentium G2020	3
2	SERVERS	1TB HDD 8GB RAM 3.20GHz Processor Speed Intel Xeon	1

1	HP PRO 300 PRINTER	Colour printer Network port	1
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2.3.1.1.1 Software Requirements

The project requires the following software applications:

- Adobe Dreamweaver CS5
- WampServer
- Adobe Photoshop

Technically, with facts so far presented or resources needed and those available a conclusion was drawn that the proposed system was technically feasible, since some of the hardware needed was already available and also some of the software could be downloaded freely from the internet.

2.3.2 Operational feasibility

Kendall (2005) states that operational feasibility is a study that shows whether internal stakeholders are in support of the proposed software project. The management was wholly behind the idea of having a new system to replace the old system. End users were also supporting the project since it would lessen their workload but were also partially feeling insecure because they fear losing their jobs. This feasibility study relied on the support of end users and the management.

Considering the above mentioned situation it was concluded that the new system was operationally viable since the internal stakeholders were in full support of its development.

2.3.3 Economic feasibility

Lucey (2002) defines economic feasibility as a study conducted in order to assess if the project is financially viable. Thus it is done to compare the costs and benefits incurred to see if the benefits to be derived are more than the costs anticipated. In other words a project is said to be economically viable if its benefits outweighs the costs.

2.3.3.1 Cost- Benefit analysis

Cost plays a crucial role when giving a judgement on the new system, so it is of paramount importance to identify and estimate it with accuracy such that the conclusion is not misleading. Both costs and benefits differ by type and consist of diverse elements. Benefits of the system can be divided into four types which are:

- Cost Savings
- Cost Avoidance
- Improved service

➤ Improved Information

Cost Saving benefits –are those that lead to the reduction in costs of operation and administration. For example, a reduction in the number of staff employed to support the administrative activities.

Cost Avoidance benefits-leads to the elimination of future operational and administrative costs. As highlighted in the example above, there will be no need to employ more clerical staff to deal with administrative activity.

Improved service benefits-this deals with the betterment of the performance of the existing system through computerisation. For example, being able to issue a flight permit in a minute rather than five minutes.

Improved information benefits-These are benefits derived from using a computer-based system. For instance, the system reports are summarized and this may result in a better data representation easy to comprehend thereby improving decision making.

Cost and Benefits will be categorized as follows:

- Tangible or intangible
- Fixed or variable
- Direct or indirect

2.3.3.1.1 Tangible

These are costs or benefits which are ease to define and measure. For example, an expenditure of money for a computer to be used in the development of the system can be referred to as a tangible cost. These benefits and costs can be approximated or calculated accurately.

2.3.3.1.2 Intangible

Intangible costs or benefits refers to those costs or benefits which are incurred but their exact monetary value is difficult to measure or quantify. Especially benefits in many instances are complex to estimate the actual value than costs. For instance, benefits like improved customer satisfaction as a result of using the new system.

2.3.3.1.3 Direct or Indirect

Direct costs refer to those costs which are directly identified with particular task or item (Lucey, 2002). Direct benefits are those benefits that are directly attributed to the system or project. For instance, being able issue 20 more permits an hour as a result of using the new computerised system can be referred to as a direct benefit derived from the system.

Indirect costs or benefits cannot be directly attributed to a particular task or activity. In terms of costs they can also be termed overhead expenses. Examples of indirect costs are lighting, administration, heating costs etcetera.

2.3.3.1.4 Variable and Fixed

There are some costs and benefits that do not vary despite how the system is being used. In this case, costs that remain constant are known as fixed or sunk costs because whether one uses the system or not these costs are incurred. For example, the cost of purchasing a software package falls under fixed costs since it remains unchanged whether the package is being fully utilized or not.

Variable costs and benefits are those that directly vary with the work volume. That is as the system is used more and more their value or size also grow in proportion to the use.

However, regardless of different categories costs and benefits may fall under they have to be expressed in monetary terms (or common unit) for them to be comparable. Then aggregate them respectively, tangible and intangible costs to get the total cost and the same for benefits. If the total benefit exceeds total cost then the project is a desirable investment and qualifies for further consideration.

Table 2.2: Development Costs

Development Costs	Year 1	Year 2	Year 3	Year 4
computers	1750	0	0	0
Printer	150	0	0	0
Ethernet cables And RJ45 sockets	250	0	0	0
Servers	2100	0	0	0
Total	3750	0	0	0

Table 2.3: Operating Costs

Operating Costs	Year 1	Year 2	Year 3	Year 4
Hardware Maintenances	0	300	300	250
Software Maintenances	0	150	150	200
Training Costs	450	0	0	0
Total	450	450	450	450

Table 2.4: Cost/Benefit Analysis

Cost/Benefits	Year 1	Year 2	Year 3	Year 4
Tangible Benefits				
Reduced clerical or paper work	400	430	445	490
Reduced operating costs	415	456	470	470
Reduced Clerical staff	3600	3600	3600	3600
Computation Accuracy	400	500	700	765
Intangible Benefits				
Increase in staff morale	300	305	340	350
Improved service level	200	243	260	260
Speedy and improved report generation	180	210	242	250
Security Enhancement	120	200	250	300
Corporate image or goodwill	100	130	170	340
Total Benefits	5715	5831	6477	6825

Costs				
Operational	450	450	450	450
Development	3750	0	0	0
Total	4200	450	450	450
Net Benefit or cost	1515	5381	6027	6375

2.3.3.2 Net Present Value (NPV)

Randall (2001) defined NPV as the value of money in relation to the present day. It takes into account the time value for money. To compute NPV it is important to firstly estimate the discounting rate to use. In the determination of the discount rate the following ways are used:

- Use a standard discount rate recommended by the firm
- Use the current rate of interest plus premium
- Use the targeted rate of return

The equation for calculating NPV is as follows:

$$\begin{aligned} \text{Net Present value} &= \sum \frac{\text{Value in year } n}{(1+r)^n} \quad \text{where } n = \text{the number of years and } r = \text{discount rate} \\ &= (1515/1.15) + (5381/1.3225) + (6027/1.520875) + (6375/1.74900625) \\ &= \underline{\underline{12993.978}} \text{ (3 d.p)} \end{aligned}$$

A positive outcome indicates that the project can be considered.

2.3.3.3 Return on Investment (ROI)

Computes the average profit per annum as a percentage of average capital invested (Randall, 2001). Average capital calculated by dividing the total capital outlay by two. It also known as Average rate of Return (ARR). The equation formula for computing ROI is as shown below:

$$\begin{aligned} \text{Return on Investment} &= \frac{\text{Average profit per Annum}}{\text{Total investment}} \times 100\% \\ &= \frac{4824.5}{5550} \times 100\% \\ &= \underline{\underline{86.928\%}} \text{ (3 d.p)} \end{aligned}$$

A positive and high percentage figure shown the project was profitable and worthwhile.

2.3.3.4 Overview of feasibility study

At this juncture an overall conclusion was made pertaining to the viability of the proposed system, having conducted technical, operational and economic feasibility of the proposed system it showed that the system was technically, operationally and economically viable since it was financially profitable and some of the technical resources needed were available also the management and users were in full support of the project therefore the system was viable.

2.4 RISK ANALYSIS

Risk analysis refers to the scrutiny done on the risks that may hinder the smooth flow of the project during development and the precaution to be taken in order to curb the impact of the risks identified on the project (Pressman, 2005). That is by taking the basic and fundamental steps of managing risk which are:

- identify the possible risks
- Analyze them
- Develop a risk mitigation plan
- Control the risks

2.4.1 Technical Risks

- The internet systems are sometimes down or unavailable so a modem was used as an alternative.
- There is a tendency of changing requirements by users and a countermeasure for this was to involve users.
- Users lacked necessary skills to use the system so training sessions were conducted to deal with that.

2.4.2 Economic Risks

- Due to lack of enough electricity in Zimbabwe, there was an increase in load shedding and power cuts which affected the smooth progress of the project thus generators were needed to supplement as a source of power.

2.4.3 Other Risks

- The vulnerability of the machines that were used in the development of system to viruses might have affected the system. Therefore to counter for that risk an effective Anti-Virus was installed and updated frequently.

2.5 PROJECT WORKPLAN AND TIMING

2.5.1 Project Schedule

Walter (2004) defines project schedule as the study conducted to determine whether set duration dates can be achieved without affecting the organisation's day to day activities. It involves the assessment and estimation of time needed to complete the project

Table 2.5 Project Schedule

TASK	START DATE	END DATE	WEEKS
System proposal	28/07/14	05/08/14	1
Planning period	05/08/14	18/08/14	2
Analysis period	18/08/14	02/09/14	2
Design period	02/09/14	16/09/14	3
Implementation	16/09/14	30/09/14	2
Maintenance	30/09/14	Progressing	1
Documentation	28/07/14	Progressing	11

2.5.2 Gantt chart

A Gantt chart is a bar chart showing activities, their scheduled dates and estimated durations (Encranta Dictionary).

Week	1	2	3	4	5	6	7	8	9	10	11
System proposal											
Planning Period											
Analysis Period											
Design period											
Implementation											
Maintenance											
Project Documentation											

Key:

1 Week



Fig 2.1: Gantt Chart

2.5.1 Analysis of Work Plan

The time frames above shown by the work plan and Gantt chart were just estimates the software project took approximately four months because of the available resources, complexity and number of modules in the project.

2.6 CONCLUSION

The outcomes of this phase confirmed the project as practicable and feasible. The results from the above assessment showed clearly that the proposed software project was of benefit to the organisation and the risks expected to be faced were bearable and their impact could be reduced if corrective actions were taken in advance. The success and results of this planning phase qualifies the project to continue to the analysis phase.

CHAPTER THREE: ANALYSIS PHASE

3.1 INTRODUCTION

In this phase there was a detailed examination of all aspects of the old system such as the flow of data which was illustrated through the use of dataflow diagrams and context diagram. The phase outlines the methodologies to be used to obtain information that will be used in analyzing the weak points of the existing system (Cliff, 1994). User requirements are also looked at in the analysis phase so that the extracted requirements are used as the basis for designing the proposed software project.

3.2 INFORMATION COLLECTION METHODS

Mathers (2000) states that information gathering allows the developer identify the weaknesses of the old system and provide appropriate solutions in the proposed system as desired by the users. The following instruments were used to collect information used in scrutinizing the weak areas in the old manual system:

- Interviews
- Observations
- Questionnaires

3.2.1 Interviews

O'Brien (2011) defined an interview as a conversation between two or more people with a common purpose. The stakeholders of the system were interviewed especially the users so as to get greater detail of the problems that they were facing and their requirements pertaining to the new system.

3.2.1.1 Advantages

- Direct communication.
- It takes less time than observations and questionnaires.
- Immediate response to questions

3.2.1.2 Disadvantages

- It requires more time.

3.2.1.3 Findings from interviews

- Interviews enabled direct communications with the management and users. All the challenges faced in the manual system were mentioned.
- Interviews saved a lot of time since the response was instant. Another advantage of this is that even non-verbal language could be seen.

- The research was confidential and private. All the interviewees were free to give the information needed. The majority of the individuals that were interviewed supported the idea of having a computerised system.

3.2.2 Observations

The collection of information was done through observation that is watching the users of the manual system doing their job and assessing the procedure and processes involved (Cliff, 1994).

3.2.2.1 Advantages

- Allows easy understanding of the processes involved and also other facts that may never be mentioned interviews and questionnaires.
- First hand information is gathered.

3.2.2.2 Disadvantages

- It requires more resources and time.
- The information collected depends on what the observer perceives as useful to the system development.

3.2.2.3 Findings from observations

There was information insecurity-there was no stringent security measures being used to prevent unauthorized users from getting access to the private information. Permit numbers were manually generated exposing the permit numbers to forging. Records were also manually recorded, stored, updated and retrieved which was a tiresome process. Thereby making the compilation of data time consuming.

3.2.3 Questionnaires

Questionnaires were designed to make users air their views without necessarily disturbing them when they were doing their daily work since the questionnaires were filled out on their spare time.

3.2.3.1 Merits

- Is a much easier method to collect information than interviews and observations
- Information can be gathered from numerous people in a short time.

3.2.3.2 Demerits

- Sometimes responses may be vague.
- The questions may be misinterpreted

3.2.3.3 Findings from questionnaires

This method research was convenient for recipients since it did not disturb them from doing their jobs. It enabled the respondent to write down answers at their own pace and the research shown that the respondent corresponds exactly to what needed to be known, many complained about the existing system.

3.3 ANALYSIS OF THE CURRENT SYSTEM

The old system was a manual based system in which permit numbers were generated manually. Also records were searched manually because they were stored as hard copies. Inputs, processes, output were as follows:

A. Inputs:

- i. Permit Number
- ii. Flight date
- iii. Flight and Operator/Applicant Details

B. Processes:

- i. Verification of permits
- ii. Production of reports and financial statements

C. Output:

- i. Flight permit
- ii. Financial and permit Reports

3.4 DATA ANALYSIS

This is a process or logical technique used to describe inputs, processes and output, evaluate data and also illustrating how it flow (Yeates and Wakefield, 2004).

3.4.1 Context Diagram of the current System

A context diagram is a diagram that represents the flow of data through an information system, describing its process to be considered (Denis and Wixom, 1999). That is the context diagram of the existing system is a sketch of the system, it reflects how data flows in the current system.

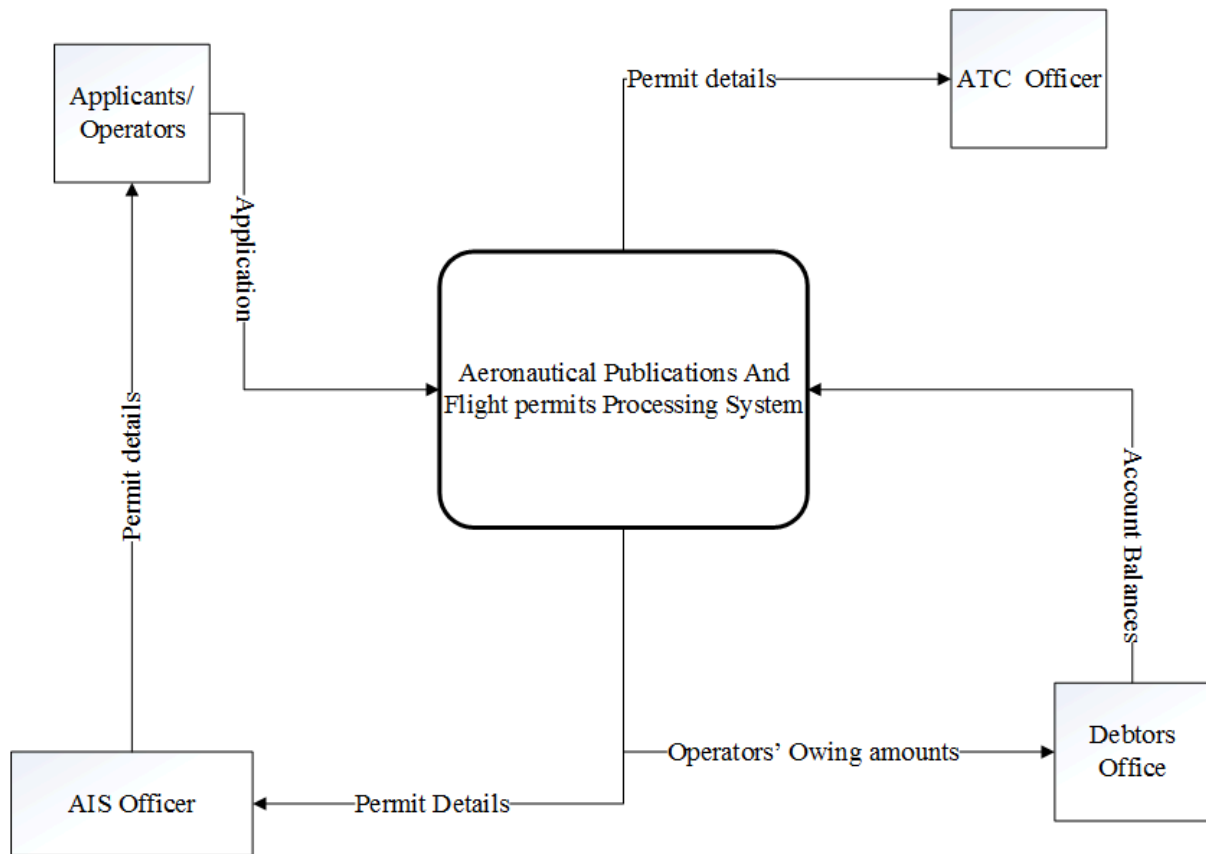


Fig 3.1: Current system context diagram

3.4.2 Data Flow diagram of the current System

Denis and Wixom (1999) a data flow diagram is a graphic representation of the information system entity, processes and the flow of data. It shows how data flows between different entities, processes and stored.

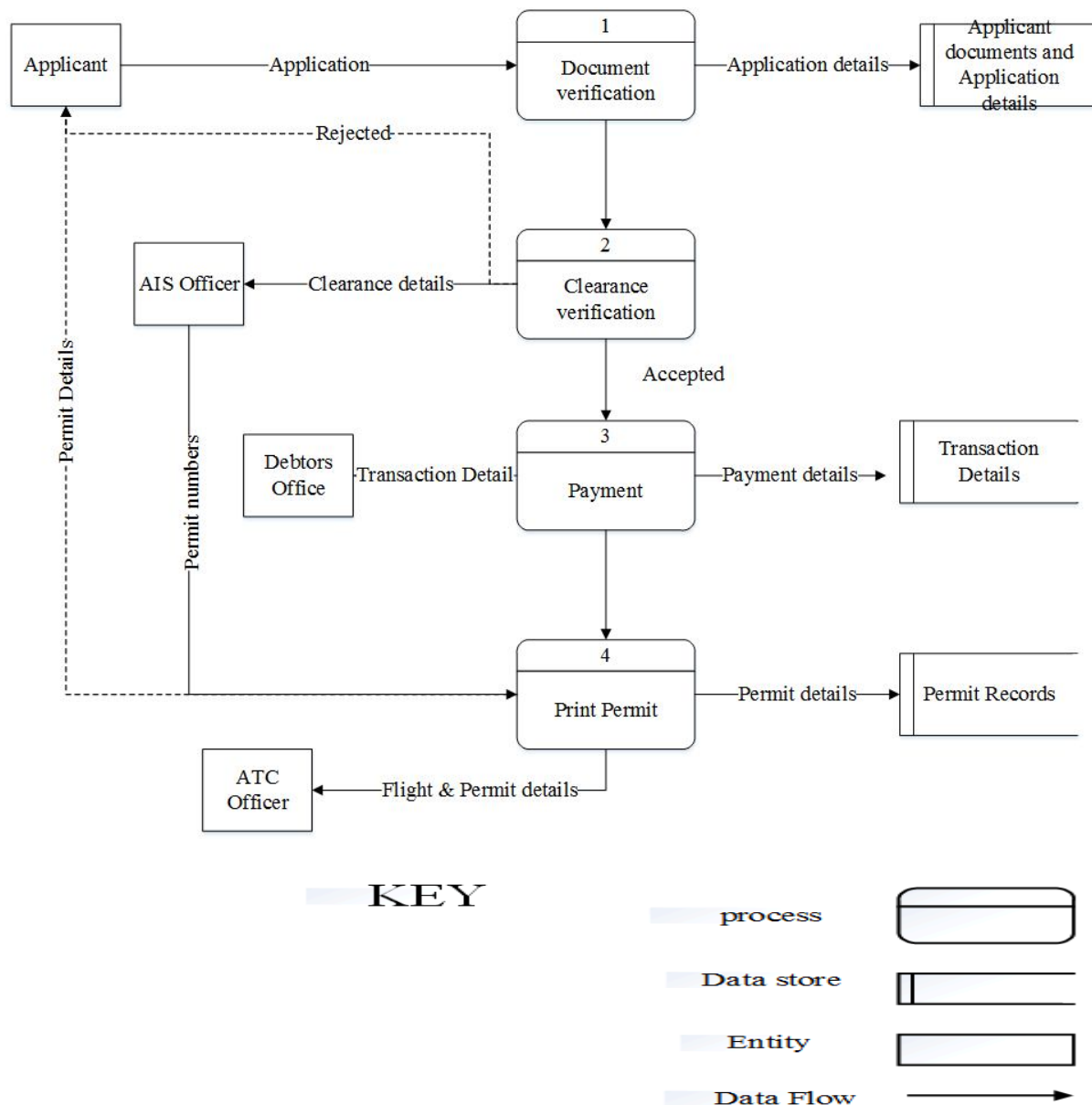


Fig 3.2: Current System Data Flow Diagram

3.4.3 Description of the current system

The Aeronautical Information Services is responsible for the issuance of flight permits to Aircraft operators. The applicants send their application letter together with all the required details about the aircraft and a clearance letter from the Air force of Zimbabwe. Upon receiving the application the AIS officer checks for missing details, if there are no missing details and the applicant has account with them a permit number will be generated and send back to the applicant. If they do not an account with CAAZ they will required to make payments first before being issued a permit except if it is a landing permit because they will pay upon arrival. Copies of the record of issued permits will be sent to the assistant accountant to enable follow up of debtors.

3.5 WEAKNESSES OF THE EXISTING SYSTEM

- a. Due to the use of the current system the AIS Officers had to travel to different Aerodromes with hard copy forms that they will fill in with survey details, and then return with them back to the Harare International Airport for compilation and filing. This exposes the documents to a high risk of being lost, and insecurity of confidential information.
- b. The permits and permits enquiry papers were printed and recorded in a book before being sent for filing. This meant more storage space was required and it took some time to search for a record, even when there was need to produce reports the compilation of the data took long.
- c. Some Aircraft operators had prepaid accounts managed by AIS permits office, their balances and transactions were recorded in a book awaiting compilation after three weeks or at the end of the month. The number of these prepaid account holders was increasing at a faster rate since many airlines were resuming their routes after the introduction of a multi-currency system. It became difficult for them to manage these accounts using the method of recording transactions or charges in a book.
- d. Currently AIS officers use the same CAAZ webmail account when issuing flight permits, which makes it difficult to enforce access control and since they use the same account there was a possibility that one could login even if they were off duty without being tracked. Permit numbers were also manually generated, this meant the system was not secure and was prone to forging of permit numbers
- e. Aeronautical information publications (AIP) were being issued as hard copies to other airports and to CAAZ stakeholders. This resulted in exorbitant printing and binding costs.

3.6 EVALUATION OF ALTERNATIVES

In the previous chapter, the feasibility study conducted indicated that the Aeronautical Publications and Flight Permit Processing System was viable and economic. Therefore there were several ways in which the organisation could have addressed the problems of the current system which included:

- i. Improvement of the current system
- ii. Off-the Shelf packages
- iii. Outsourcing
- iv. In-house development

3.6.1 Improvement of the current system

The alternative of improving the current was cheaper since less operational and developmental costs incurred were going to be less. However, the alternative had the following disadvantages:

- Required a lot of research than buying an off-the shelf package.
- The organisation would not have benefited fully to the extent it would have done if the whole system had been computerised.

3.6.2 Off-the Shelf packages

Another alternative is for the organisation to buy a readymade software package. This option will have the following merits and demerits:

3.6.2.1 Advantages

- It takes less time for the organisation to have the new system.

3.6.2.2 Disadvantages

- The software is usually designed to meet generalized requirements
- The system documentation is obtained through developer contact.

3.6.3 Outsourcing

Involves contracting an external individual or company to develop the new system for the organisation.

3.6.3.1 Merits

- Implementation time required is less.
- Improvements on the system can be done as per user request since the organisation would be paying maintenance and license fees.

3.6.3.2 Demerits

- There were high chances that the end product will not meet user requirements and expectations because of lack of organisational background knowledge and understanding of the existing systems.
- Outsourcing is usually quite expensive on both development and maintenance charges.
- High training costs as a result of continuous reference to the developers for assistance or training.
- Lack of ownership of source code

3.6.4 In-house Development

The system was developed by the internal team or staff.

3.6.4.1 Advantages

- The cost were reasonable.
- Reduced training, hired labour and consulting costs.
- User requirements were met because the internal team had a clear overview of the problem faced and the possible ways of addressing the problem.
- The new system was fully tested across the entire spectrum before implementation.
- Easier maintenance since the system was built by the internal staff. The team would always be available if anything happens.
- Serves as a platform for staff training and development

3.6.4.2 Disadvantages

- The daily work activities of the staff in the development team may be compromised.
- The internal team may lack the required expertise.
- More implementation time was needed.

3.6.5 Recommended Alternative

Assessing all the above alternatives and weighing their advantages and disadvantages it was seen that the option of in-house development was of more benefit to the organisation. Therefore in-house development was the recommended alternative to address the faced problems and also kept private information secure.

3.7 REQUIREMENTS ANALYSIS

This type of analysis was conducted to check if the user requirements were met in the new system. Requirements analysis was split into two:

- a) Functional Requirements:-These are the fundamental functions to be provided by the new system (Sommerville, 2008).
- b) Non-Functional Requirements:-pays attention on the constraints we may face when developing the new system (Sommerville, 2008).

3.7.1 Functional Requirements

- The new system provided an interactive and user friendly interface.
- The system generates reports and random numbers used as permit numbers.

- It validates and verifies user input to ensure correct data is captured in the system.
- The system provides a central data storage or database to enable easier querying, data analysis and reporting.
- The new system allows concurrent access to shared files, share resources and information over the network.

3.7.1.1 Use case diagram for Online Flight Permits and Publication Processing System

Use case is a diagram that shows up the relationship between the system users (for example ATC Officer, AIS Officer, Accounts e.t.c) and the system itself (John and Wald, 2004). This diagram shows different ways in which the users can use the Online Flight Permits and Publication Processing System.

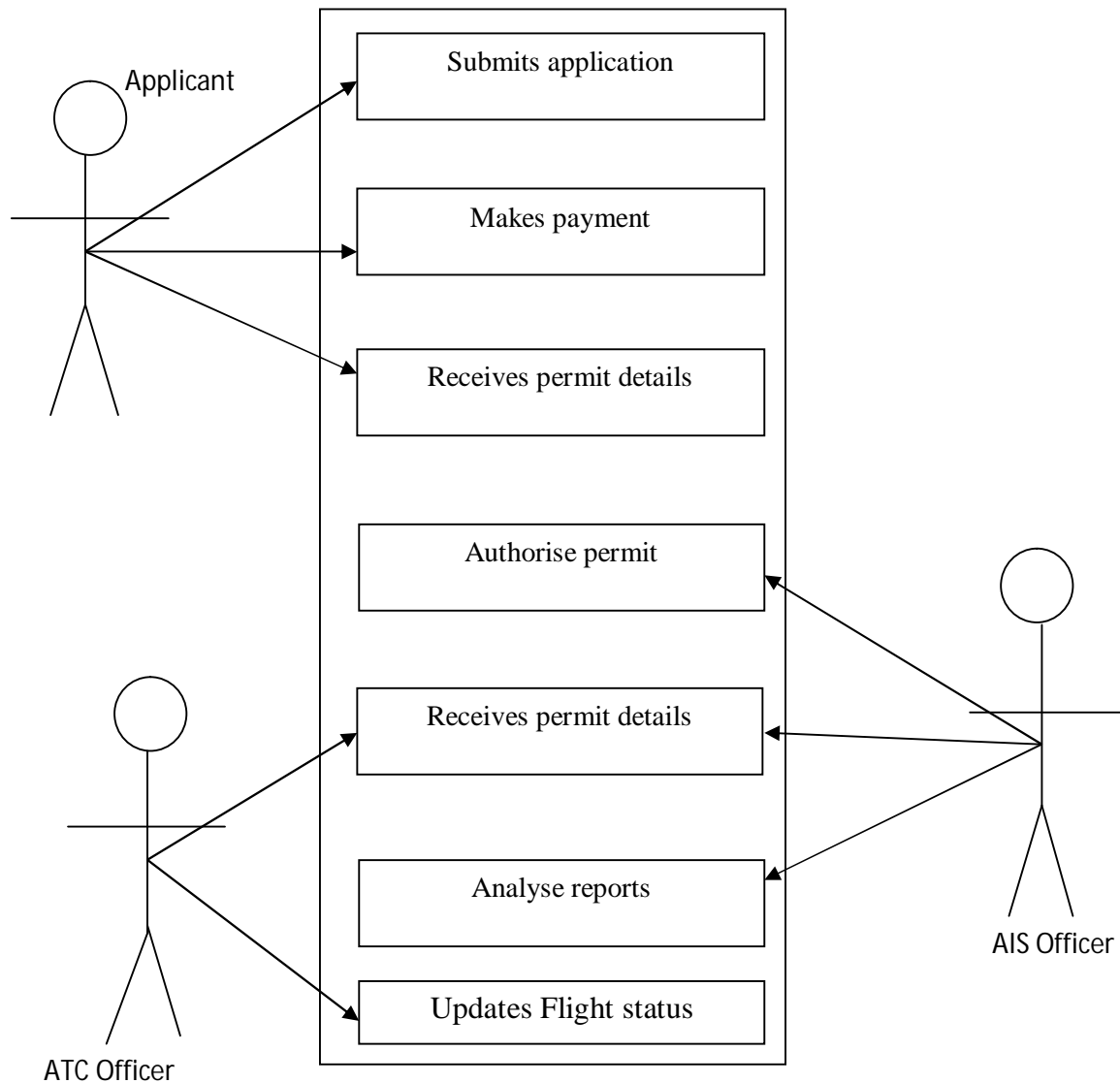


Fig 3.3: Use Case Diagram-Online Flight Permits and Publications Processing System

3.7.2 Non-Functional Requirements

- The old system was slow and not secure since permit numbers were generated manually.
- The system had to have some form of validation of user input and error checking so as to determine if data entered is valid.
- Quality of service offered was also a crucial factor worth consideration in an organisation. The new system ensured improvement in the quality of service delivery.
- Security levels were enhanced through the use of passwords and granting of different levels of privileges to users.

3.8 CONCLUSION

At this juncture having analyzed the weak spots of the current system using information gathered using the above mentioned methodologies and alternatives have been evaluated to map the way forward. The outcome of the evaluation of alternatives have highlighted in section 3.6.5 that in-house development was the best alternative which allowed the project to go to the next phase which was the design phase.

CHAPTER FOUR: SYSTEM DESIGN PHASE

4.1 INTRODUCTION

The design phase is mainly concerned with the actual design of the proposed system. It looks at the aspect of how the new system was designed, how it would work, how its database was designed, the security measures and the network infrastructure in place (Heathcotte, 1997).

4.2 SYSTEM DESIGN

System design has everything to do with how the Aeronautical Publications and Flight Permits Processing System was designed and the functionalities that were incorporated. The proposed computerised system was mainly concerned with applicants or operators' prepaid accounts management, generating permit numbers and also producing permits. The design stressed on the following aspects:

- **Productivity and Efficiency**-The system was designed to meet user requirements since its development was going to be executed after a detailed analysis of the current system. The proposed system was both productive and efficient as it was witnessed in the amount of energy and time that it needed to do the work.
- **Performance**-The new system has high performance since it is a computerised system it serves many applicants, clients and administrators concurrently. Having the ability to process many queries at the same time.
- **Extendibility**-The system was designed in a way that allows future modifications to ensure it is adaptable to the constantly changing business environment and business needs.
- **Usability**-The system and its interface was designed in a user friendly manner having some descriptive texts to hint and cater for different users with different IT understandings.
- **Functionality**-The new system provided users with the needed functionality and is amendable to meet some changes that may not be currently noted.
- **Security**-This was the major area of weakness in the old system therefore it was crucial that the new system took this into consideration. The system requires username and password in order to protect data from unauthorised users and also provides each user relevant data manipulation privileges. To avoid abuse of the system it was equipped with an audit trail that means the system records each and every user who login into the system for tracking purposes.

4.2.1 Proposed System Context diagram

A context diagram is a diagram that represents the flow of data through an information system, describing its process to be considered (Denis and Wixom, 1999). That is the context diagram of the proposed system is a sketch of the system, it reflects how data will flow in the new system.

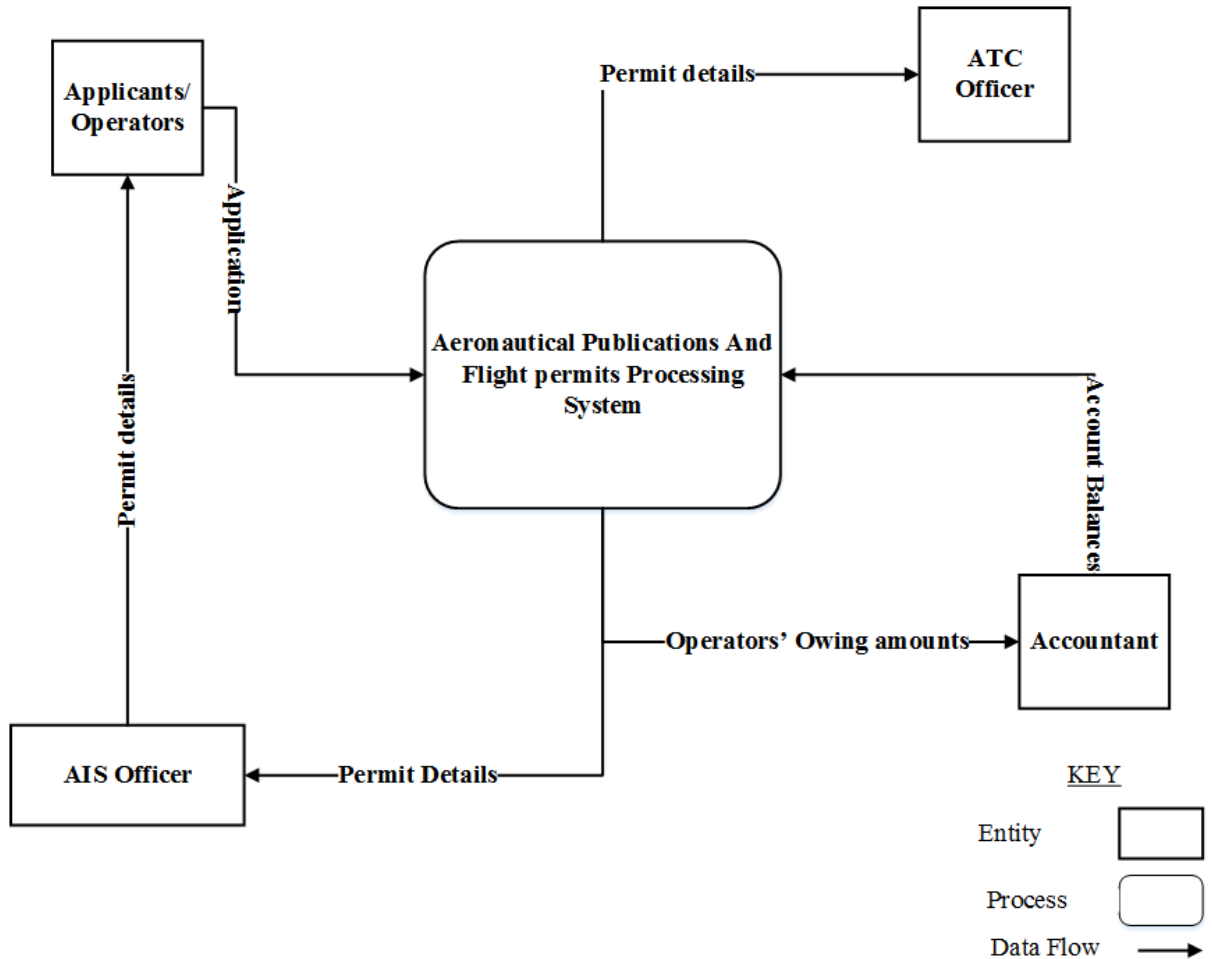


Fig 4.1: Proposed System Context diagram

4.2.2 Proposed System Data Flow diagram

Denis and Wixom (1999) a data flow diagram is a graphic representation of the information system entity, processes and the flow of data. It shows how data will flow between different entities, processes and stored.

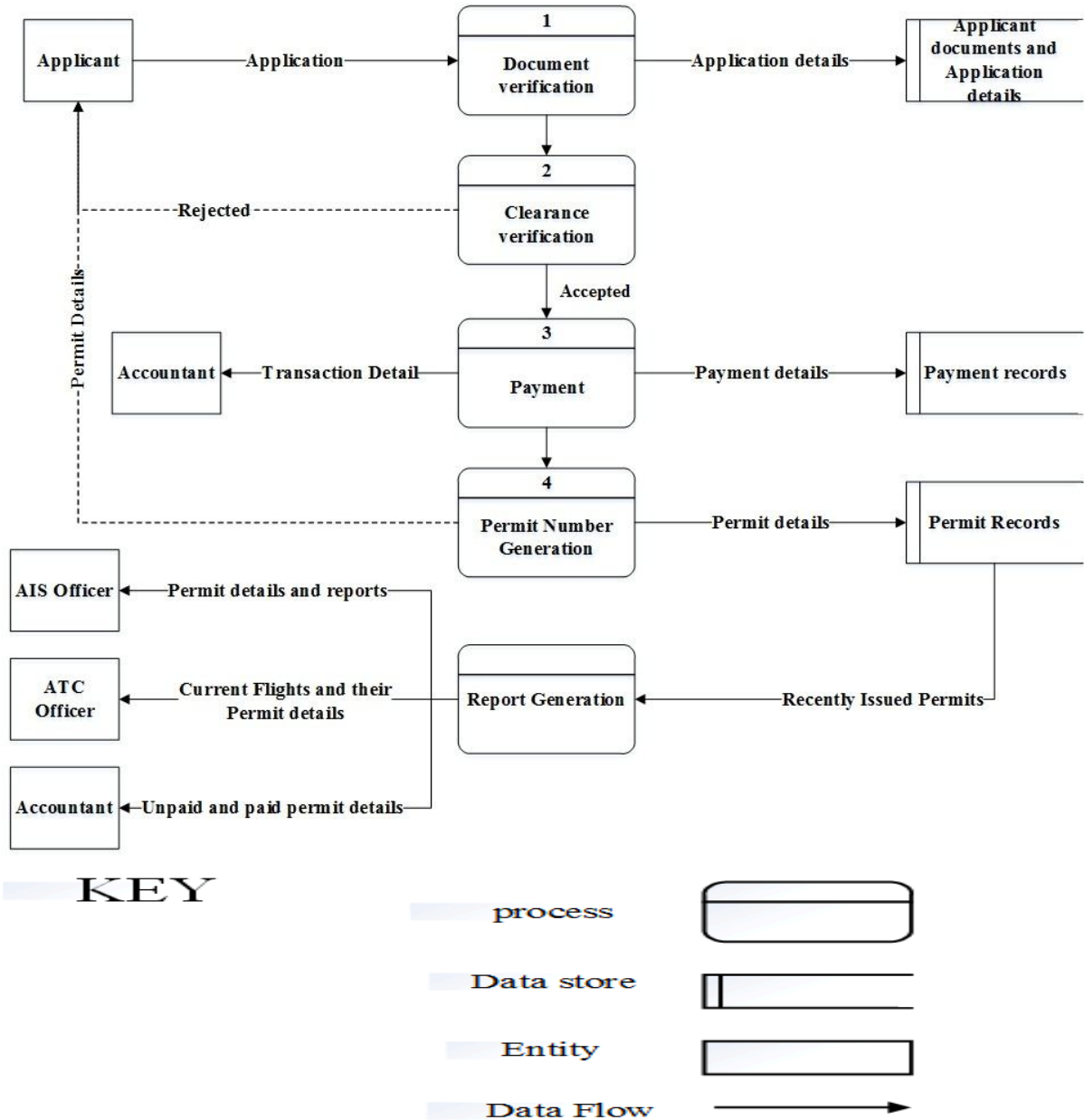


Fig 4.2: Proposed System Data Flow diagram

4.3 ARCHITECTURAL DESIGN

According to Sommerville (2008) this is the description of the technical environment which includes software, hardware, procedures and users. Architectural design paid attention on hardware, software and network platforms on which the new system was running on so that it can be utilised to the maximum of its capabilities. This section considers the following:

4.3.1 Hardware Required

- Servers
- Client machines
- Printer
- Ethernet cables
- A Router

4.3.2 Software required

- WampServer
- Adobe Dreamweaver CS5
- MySQL

4.4 PHYSICAL DESIGN

According to French (1994) the physical design indicates how different hardware and physical components of the new computerised system was arranged or setup to ensure effective communication. The database was centralised for easy access from other aerodromes via the network. The pictorial diagram looked as follows:

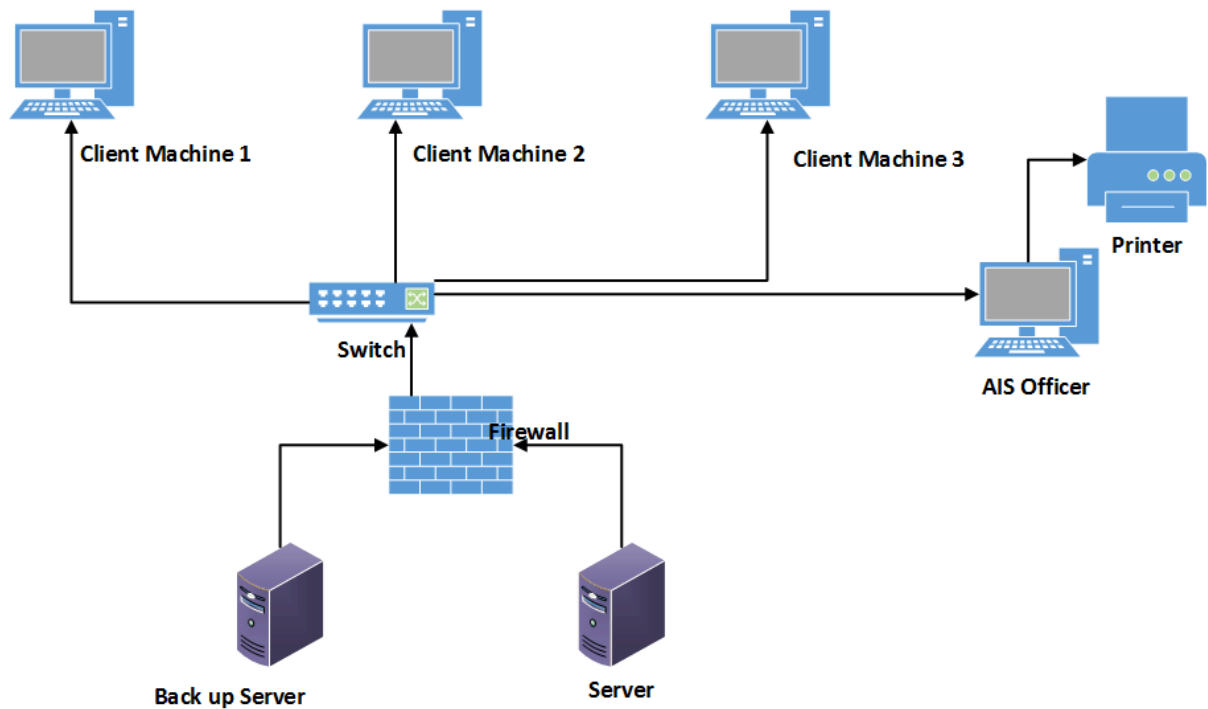


Fig 4.3: Physical Design

4.5 DATABASE DESIGN

A database refers to a collection of records or interrelated data meant to meet the information requirements of organization (Coronel, 2010). The database design is primarily concerned with a full description of the database and its entities. From the definition above it suggest there is sharing of interrelated data which raises issues concerning data security. When data is shared security measures are needed to ensure that users only view and manipulate the information they are permitted to so as to avoid data loss and inconsistency. Therefore there was need for data to be normalised to eliminate data redundancy. The ANSI SPARC architecture demonstrates the database is viewed. The architecture looks as follows:

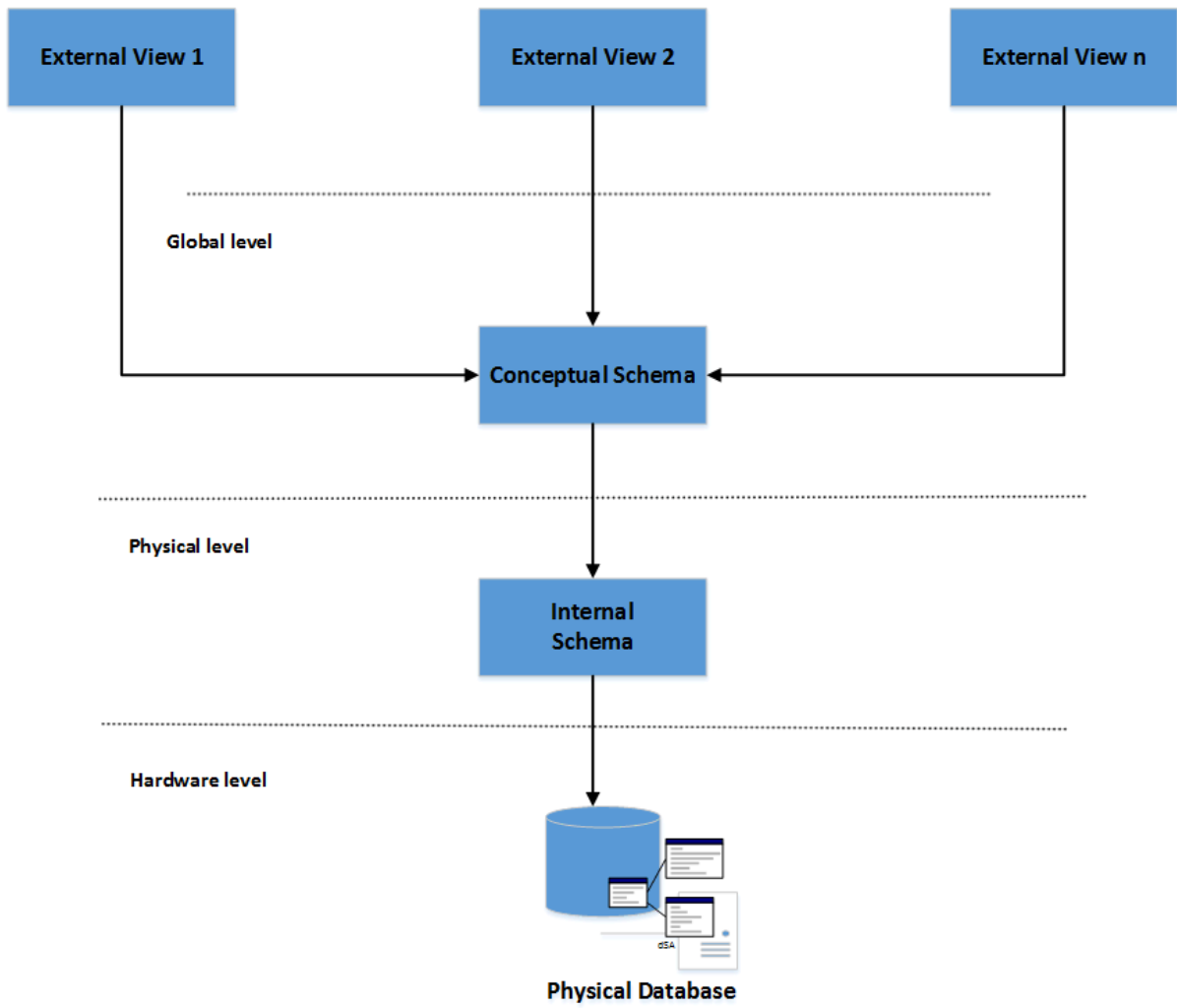


Fig 4.4: Database architecture
(Source: Barry Eaglestone, 2000)

4.5.1 Enhanced Entity Relationship Diagram (EER)

EER can simply be defined as a diagram that has been designed for special purpose to illustrate how two or more entities in a database communicate (Jacob, 2006). In other words it is a specialized diagram that shows interrelationships between entities that belong to the same database.

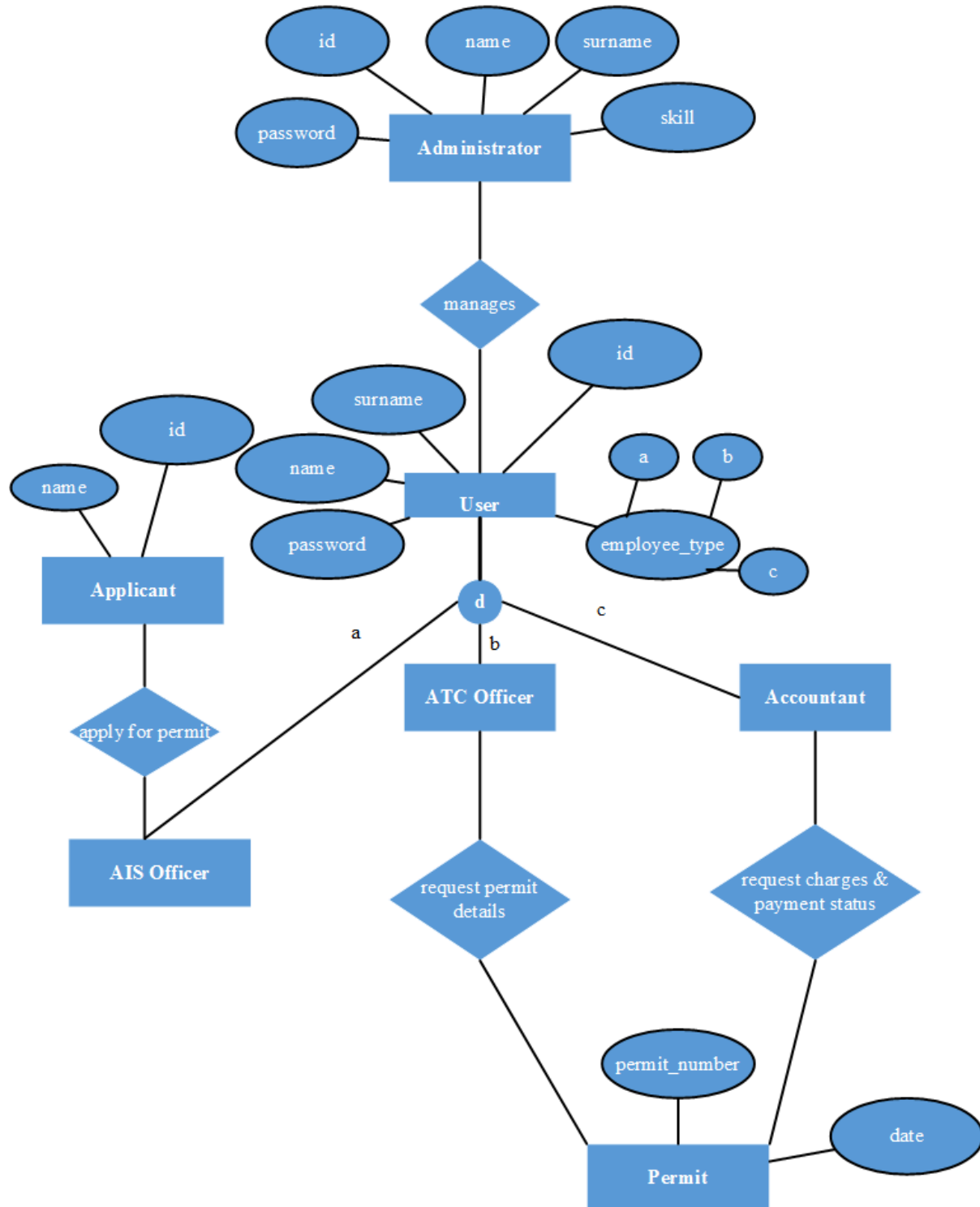


Fig 4.5: Enhanced Entity relationship diagram

4.5.2 Sequence Diagrams of the proposed System

A sequence diagram is a diagram that shows reciprocated action and gives detail on the manner in which things are done or procedures (Amihan and Berhim, 1996). Sequence diagrams are a collection of diagrams organized in orderly manner according to the logical order in which activities are carried out. A sequence diagram represents all the stages or procedures in the system.

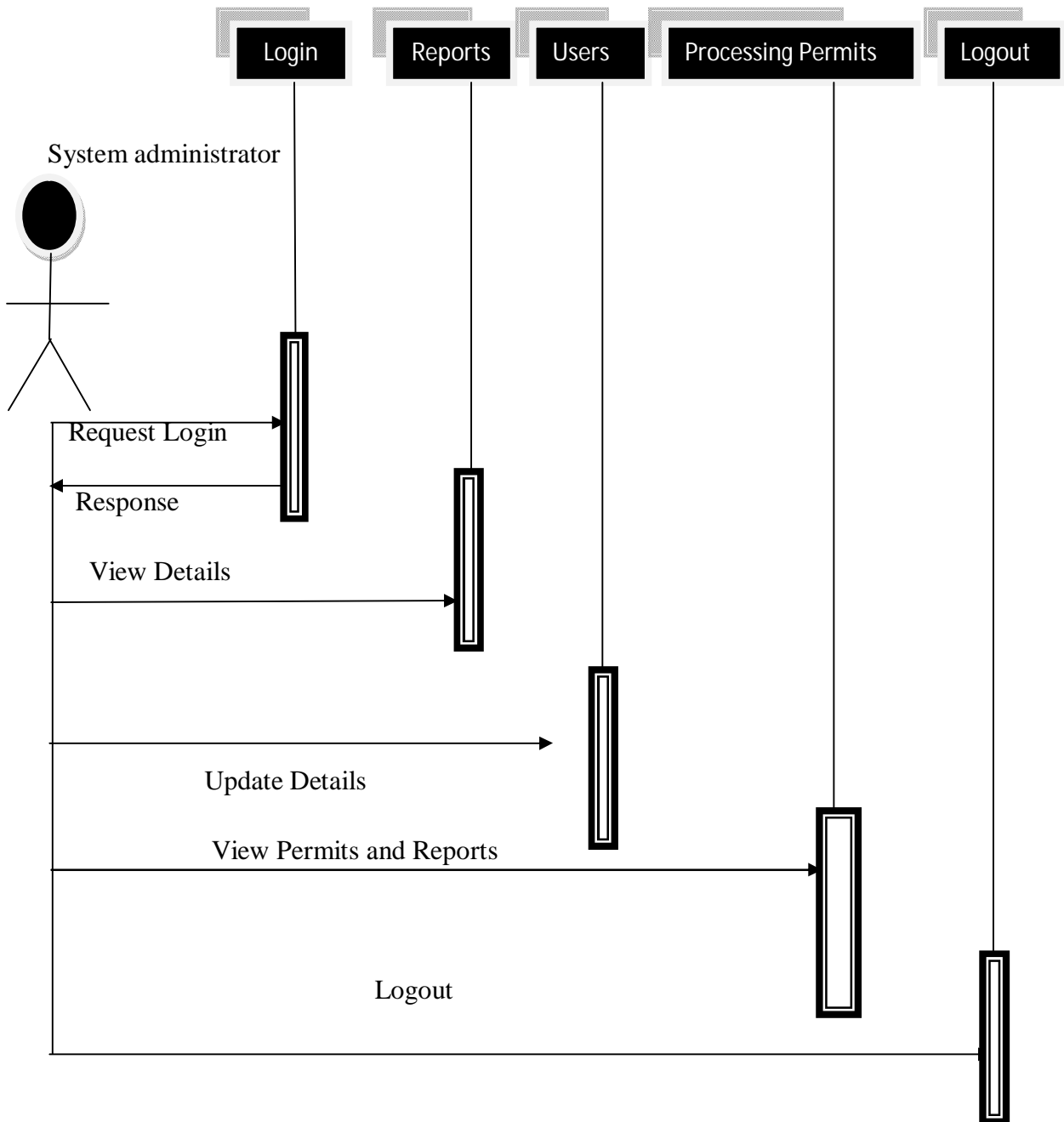


Fig 4.6: Sequence Diagram for the System Administrator

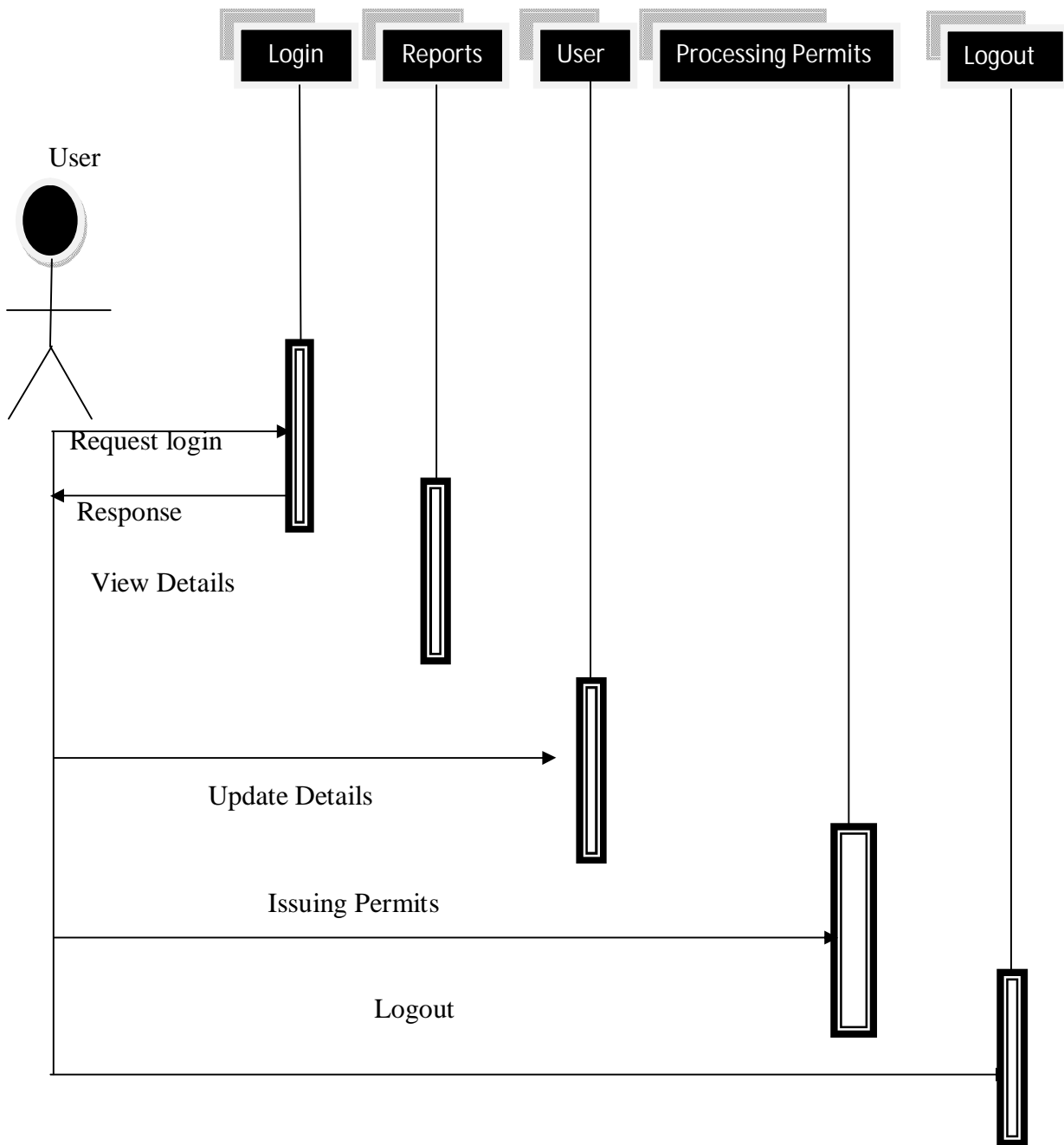
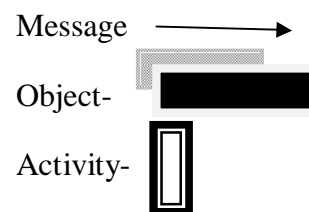


Fig 4.7: Sequence Diagram for the User

KEY



4.5.3 Class Diagram

A class diagram describes objects of the system and their relationships (Collins, 2011). It can also be referred to as a static composition diagram that show the manner in which the system was developed by illustrating the classes involved in the system, their behaviour and relationships. It also shows attributes or properties and operations of each class.

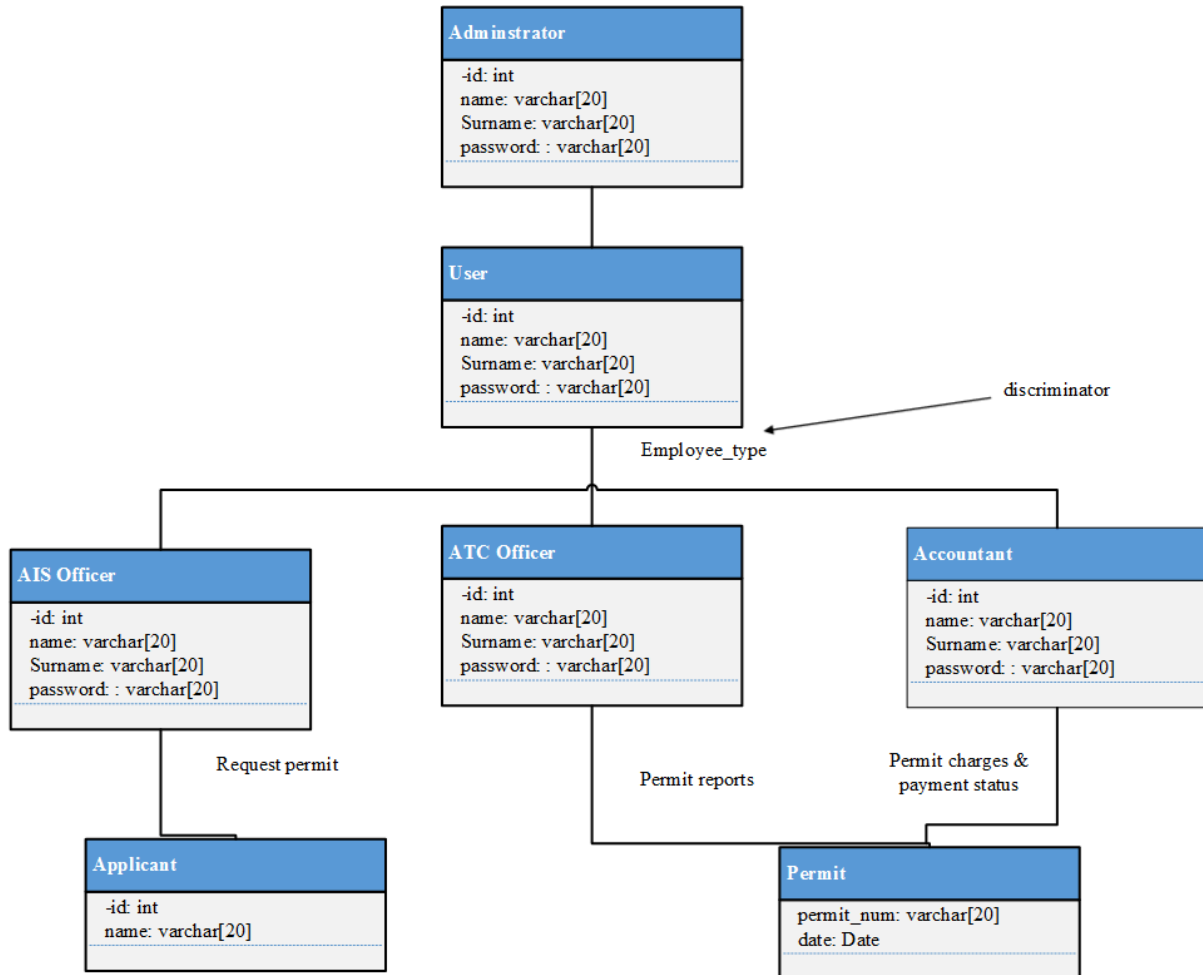


Fig 4.8: Class Diagram

4.6 INTERFACE DESIGN

Interface design is the process of creating a method for two or more modules in a system to connect and interact (French, C. S, 1994). It outlines the design of menus and linked forms for data input into the new system. Before the users test the functionality of the system they consider the interface first whether its user friendly or not.

4.6.1 Menu Design

A menu refers to the computing list of options displayed on a video display unit (Joanne, 2006). The menu was designed in order to allow users to use input devices such as a mouse and the keyboard for navigation.

Before the user is given access to the main menu they have to login with valid credentials first. The figure below shows the structure of the interface design that lead to the main menu design.

4.6.1.1 Main Menu

The fig below shows the main menu that the user will see after a log in. This helps the user to navigate through the whole system.

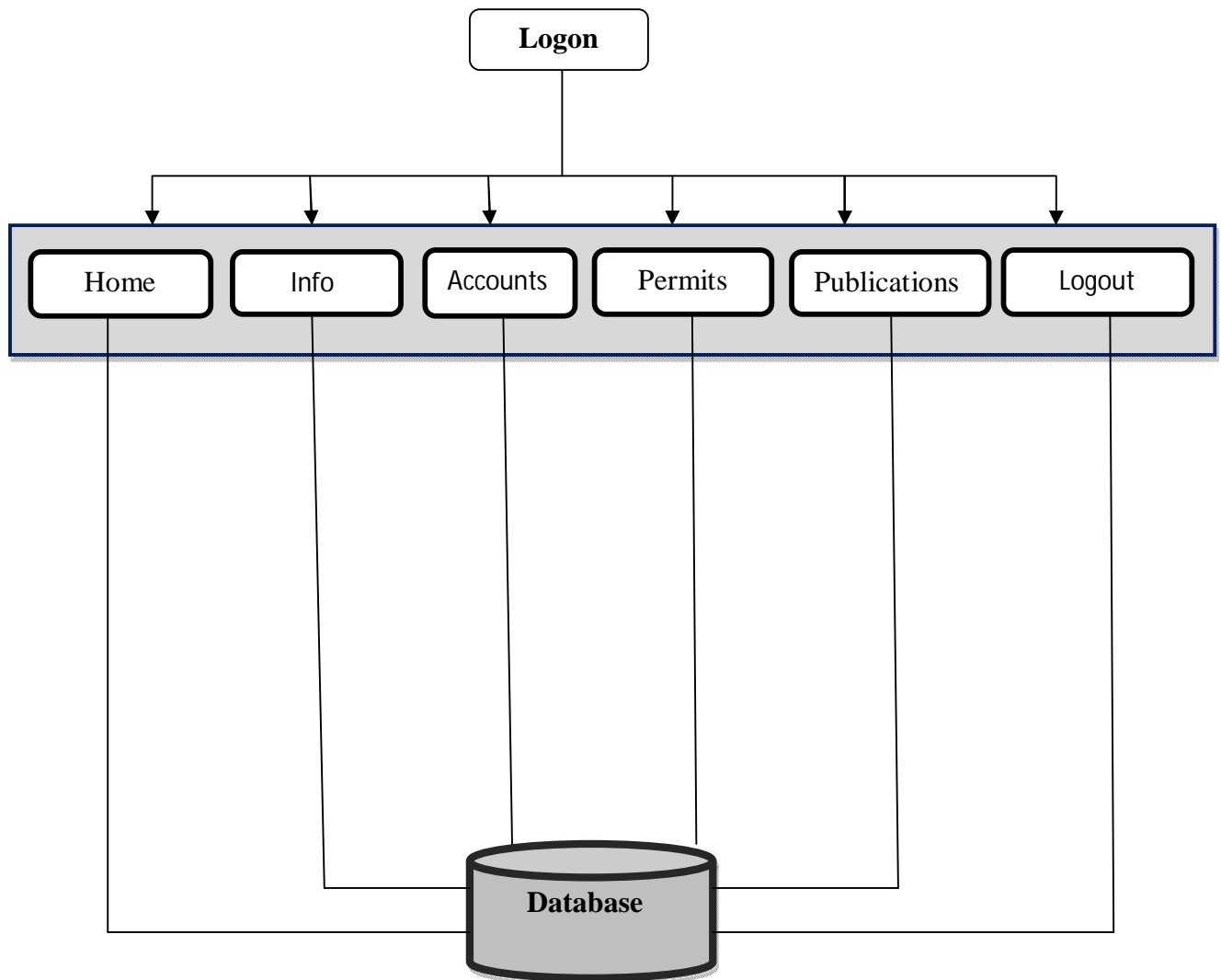


Fig 4.9: Main Menu

4.6.1.2 Submenus

The fig below shows the submenus that the user will see on clicking main menu buttons. This makes the system organised and easier to navigate through.

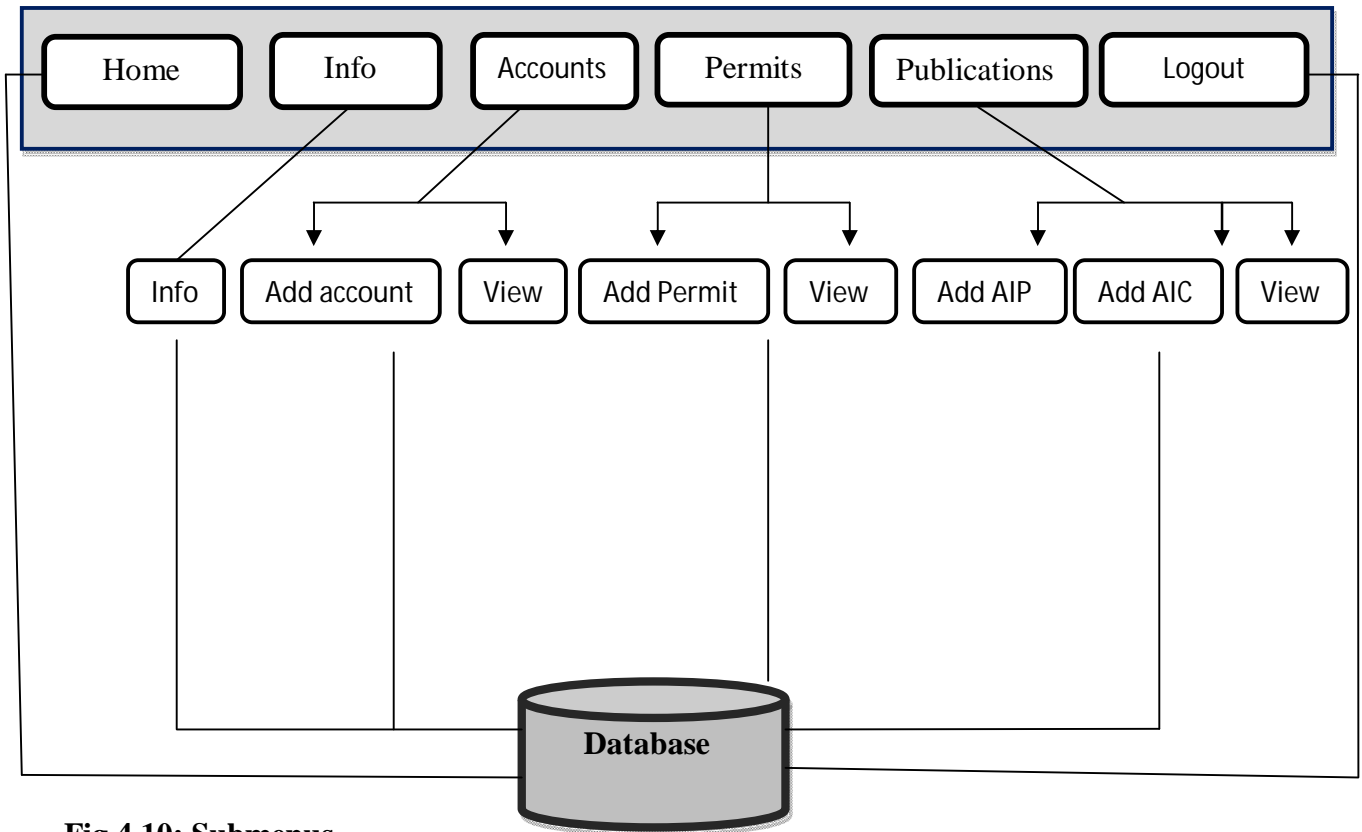


Fig 4.10: Submenus

4.6.2 Input Design

According to Joanne (2006) this is the design of various input forms of the system. It facilitates the entry of data in the system by using different input forms. The users add new data and enter it through forms

4.6.2.1 Login form

The login form is the entry point of the system. This is where user authentication takes place, those who supply valid username and password are given access and vice versa is true for invalid username and password.

Logo and System title	
Username	<input type="text"/>
Password	<input type="password"/>
<input type="button" value="Login"/>	

Fig 4.11: Login form

4.6.2.2 Create user account

After being issued with an id the user will fill in the following form with their credentials to create their account.

Logo and System Title	
Username	<input type="text"/>
New Password	<input type="text"/>
Confirm Password	<input type="text"/>
ID	<input type="text"/>
<input type="button" value="Submit"/>	

Fig 4.12: Create user account

4.6.2.3 Issue Permit

To issue the permit an AIS officer will fill in the form below with appropriate details. The permit number will be generated randomly and date issued will be captured from the system.

Logo					
					Menu
Applicant	<input type="text"/>	Operator name	<input type="text"/>	Aircraft Type	<input type="text"/>
Aircraft Reg	<input type="text"/>	From	<input type="text"/>	To	<input type="text"/>
Permit number	<input type="text"/>	Permit Type	<input type="text"/>	Flight date	<input type="text"/>
MET fees	<input type="text"/>	Enroute - Nav fees	<input type="text"/>	Payment Status	<input type="text"/>
<input type="button" value="Submit"/>					

Fig 4.13: Issue permit form

4.6.2.4 Financial statement

For the user to generate a financial break down for an operator or applicant who have a prepaid account they enter the applicant name and the range of dates.

Logo					
Operator /Applicant	<input type="text"/>	Start date	<input type="text"/>	End date	<input type="text"/>
<input type="button" value="Generate Statement"/>					

Fig 4.14: Generate Statement

4.6.2.5 Create Operator/Applicant account

To add a new operator/applicant account or update balance of an existing account the form below will be used.

Logo	
Operator/ Applicant	<input type="text"/>
Amount	<input type="text"/>
<input type="button" value="Submit"/>	

Fig 4.15: Create Operator/Applicant account

4.6.2.5 Add AIP

The form below will be used to insert a new AIP item and standard to be used in publications inspection to be conducted on each aerodrome.

Logo	
Item	<input type="text"/>
Standard	<input type="text"/>
<input type="button" value="Submit"/>	

Fig 4.16: Add AIP

4.6.2.6 Add AIC

The form below will be used to insert a new aeronautical information circulars item and standard to be used in publications inspection to be conducted on each aerodrome.

Logo	
Item	<input type="text"/>
Standard	<input type="text"/>
<input type="submit" value="Submit"/>	

Fig 4.17: Add AIC

4.6.2.7 Add Annexes

The form below will be used to insert a new annex and its edition so that it will be considered when publications inspection will be conducted on each aerodrome.

Logo	
Annex	<input type="text"/>
Edition	<input type="text"/>
<input type="submit" value="Submit"/>	

Fig 4.18: Add Annexes

4.6.3 OUTPUT DESIGN

Whenever input is put output is expected to be delivered (Joanne, 2006). Output design shows the manner in which output will displayed. The output of this system will take two forms:

- Soft copy reports
- Print out(a printer will be required)

Output forms

These are the forms that will be used to produce reports.

4.6.3.1 View permits

This view reports displays all the permits issued, flight details, date and the type of flight permit issued whether landing or over flight.

Table 4.1: View Permits

Name	Permit_no	Date Issued	From	To	Flight date	Type
Zim Aviation	MN142	14/08/14	Durban	Harare	23/11/14	Landing
Global Aviation	MM423	17/08/19	Egypt	Johannesburg	12/9/14	Over flight
Avient Aviation	AM678	19/08/14	Lusaka	Harare	30/08/14	Landing

4.6.3.2 View permits charges

This view reports displays all the permits issued, flight details, date issued and the fees charged for that flight permit and the payment status so as to allow the debtors office to do follow up on debtors.

Table 4.2: View Permit charges

name	Permit_no	Date issued	type	MET fees	Enrt-Nav fees	Landing fees	Bussing fees	Total	status
Zim Aviation	MN142	14/08/14	landing	\$20	\$70	--	--	US\$90	Not paid
Global Aviation	MM423	17/08/19	Over flight	\$13	\$80	--	---	US\$93	Paid

4.6.3.3 View Statement

This view is an excel generated financial statement giving a report of permits issued within a certain period and give the operator their current balance as far as their prepaid account is concerned.

Table 4.3: View Statement

Zim Aviation Statement								
Date	Permit_no	Registration	Opening	MET	NAV	Total	Deposit	Credit remaining
11/07/14	MN1123	ZS-ASD	US\$100	US\$10	US\$20	US\$30	-	US\$70

4.6.3.4 View AIP

The table below will be used to show a list of AIP items and standards to be used in publications inspection to be conducted on each aerodrome.

Table 4.4: View AIP

Item	Standard
AIP Binder	Condition
AIP Divider	Availabilty

4.6.3.5 View Operator Accounts

This view displays the operator's current balance as far as their prepaid account is concerned.

Table 4.5: View Operator Account

Applicant/Operator name	Balance
Global Aviation	US\$1234
Zim Aviation	US\$567

4.6.3.6 View Users

The table below will be used to show a list of users added into the system and gives the administrator option to reset passwords or delete users.

Table 4.6: View Users

Name	Level	Action	Action	Status
Aluis Mukwembi	Admin	Reset password	Delete user	Active
John John	User	Reset password	Delete user	Deactivated

4.6.3.7 View settings

The view displays the settings are governing password length, allowable number of attempts before the user account is deactivated and session timeout.

Table 4.7: View settings

Setting	Setting value	User may edit
Auto-disable account after # failed login attempts	3	No
Minimum password length	8	
Default session timeout	30 minutes	

4.6.3.8 View AIC

The view below will be used to show a list of AICs and their standards and it gives the administrator option to update or delete items and standards

Table 4.8 View AIC

Item	Standard
A Series	Availability and currency
B Series	Availability and currency

4.6.3.9 View Annexes

The view below was used to show a list of annexes and their editions and it gives the administrator option to update or delete annexes and editions

Table 4.9 View Annexes

Annex	Edition	Action	Action
Annex 1	5 th edition	Update	Delete
Annex 2	3 rd edition	Update	Delete

4.7 SECURITY DESIGN

Security means protecting the system data against accidental or intentional modification or use by unauthorized users (Coronel, 2010). This section outlines the measures that were put in place to ensure the security of the proposed system.

4.7.1 Physical security

Both hardware and software was installed in a closed place with restricted access, as well as prepare the computer sites to provide air conditioning, backup power and fire protection.

4.7.2 Functional/software Security

Multilevel passwords and privileges and hardware and software were used to properly identify authorized users of the system. This ensured the system was secure and still remained functional to the users.

4.7.3 Database Security

The database is the central repository of all the records of the organization hence was secured by a password that only the database administrators know. So as to ensure data integrity and information security since only the administrator can modify the data in the database. The database password will be changed frequently.

4.8 CONCLUSION

The design phase gave an abstract of how the Aeronautical Publications and Flight Permits Processing system appears like. The inputs, processes and output of the new system were designed accompanied by the data flow and entity relationships in the system. Having designed everything that was included in the system it was now time to move to the next chapter.

CHAPTER FIVE: IMPLEMENTATION PHASE

5.1 INTRODUCTION

This chapter looked at the coding aspect of the system, testing of the developed system and the installation to see if it met the specified user requirements. This phase looks at coding, installation, training of the users and the maintenance of the new computerised system (Joanne, 2006). It also considered the strategy that was used in the implementation of the system whether direct changeover or parallel running of both systems during the introduction of the new system.

5.2 CODING

Pressman (2005) coding shows the logical methods of a computer program and the actual commands that will be executed. In the coding the system three tools were used, php is the language to be used in the development, MySQL and WampServer for the database. System functionality was subdivided into modules which were integrated in the end.

5.2.1 Pseudo Code

This is an English phrased code that summarizes a computer program and used to indicate the tasks and procedures found in the computer program (Pressman, 2005). This type of code was achieved by writing the system functionality or behaviour through the use of the key words IF...THEN...ELSE and or IF...ELSE.

Connecting to the database

Check if connection has been made

If not yet set then

{

Set the connection

}Else

{

Ignore

End if

}

Logging on

enter username

enter password

```
If username and password are correct then
{
  Show the home page applicable to their access level
}
else{
  Show an error message dialog and repeat trial
  End
}
```

Main Menu

```
If the user belong to AIS then
{
  Show the system home page menu with an option to issue permits
} Else if user is from ATC
{
  Show the system main menu page with an option to view flights for that day
}Else if user is from Accounts
{
  Show the system main menu page with an option to view permits charges and operators who
  paid
}Else if administrator
{
  Show the system main menu page with an option to view permits charges, operators who
  paid and update database, user accounts management
}
Else
{
  Try again
}
```


If number of tries=3 and login is failure then

User account deactivated

end

}

Change user password

Login first

If credentials are correct then

{

Fill in old password

Fill in the new one

}

Else {

error incorrect old password

End

}

Generate Statement online

enter applicant or operator name

enter start date

enter end date

If correct then

{

Generates an excel document

}Else

{

Enter valid dates or operator/applicant

End if

}

Add/Update a Record

Updating the database

If add then

{

Insert into table the new record

}

If edit then

{

Update table where primary key=value

}

If remove then

{

Delete record from table where primary key=value

End if

}

Searching for a record

Get the record ID

Using the established connection, retrieve data

If data has not been found then

{

Display error message

} Else

{

Display data

}

Data reporting

insert a valid query

If that query is application to the database then {

produce results

} Else {

Display a feedback message

end if

}

5.3 TESTING

The fundamental principles in software development were implemented in the system testing. System testing took into account various ways in which the system testing was conducted to check if the system had met the expectation of the users (Graves, 2007). The aeronautical flight permits and publications processing system was tested using:

- Unit testing
- Module testing
- System testing
- Acceptance testing

5.3.1 Unit testing

Unit testing is done on each of the developed system units which are generally small and simple components of the system (Beizer, 1984). The objective being observing whether each of the units performs its intended task. The testing is mainly done independently of all the other system units. For example a form was viewed as a separate component and focusing on an operation like adding information into the system using the form and then checking whether the system unit is working properly.

5.3.2 Module testing

A properly running system should have modules that are not viewed during system run time. A module is a collection of dependent components that is a collection of procedures and methods or functions (Boehm, 1981). By module testing the developer whether the set commands that carry out particular procedures are properly running. Module testing was done using set objectives. The objective was to measure the functionality and reliability of modules.

5.3.3 Sub system testing

It tests a collection of modules that have been integrated to form subsystems. During this stage the developer tested interfaces to detect interface mismatches. Subsystem testing serves to check the functionality of certain components of the system as standalone items (Beizer, 2003).

5.3.4 System testing

The subsystems were integrated to make up the entire system. During system testing the developer was concerned with finding errors, which resulted from the interactions of the system, whether the forms are communicating well with each other and with the database and checking whether the system was running properly (Graves, 2007).

5.3.5 Acceptance testing

This was the final stage during testing before the system was accepted for operational use. The main aim was to test the acceptance of the system by the system stakeholders (Beizer, 2003).. This test determined the success or failure of the system.

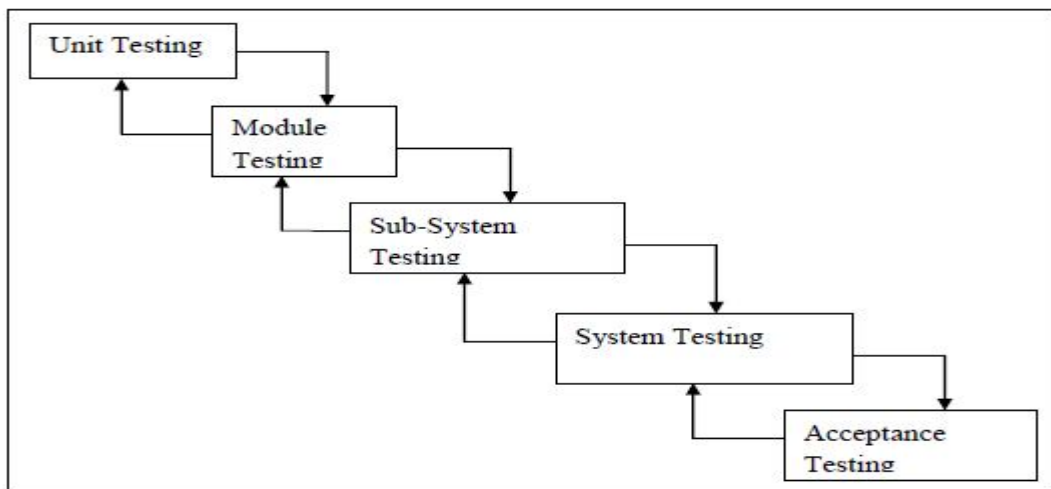


Fig 5.1: General testing process

5.3.6 Verification

Verification is the process of making sure that the application conforms to the predetermined specifications that were derived from the objectives (Jiantao, 2005). This was important as it helped us to ensure all the functions of the computer program were working correctly and properly.

5.3.7 Validation

Validation is concerned with answering the question “Are we building the right software?” (Tannenbaum, 1990). It also includes checking user input is of the required type. The system alerts the user if they enter wrong data type for example if they enter numbers where letters are required an error message will appear informing the user the correct type they must input.

5.3.7.1 Verifying Login details

- Login testing looks at whether the entered username and password can give access into system.

If a wrong username or password is entered the following error message will be displayed.

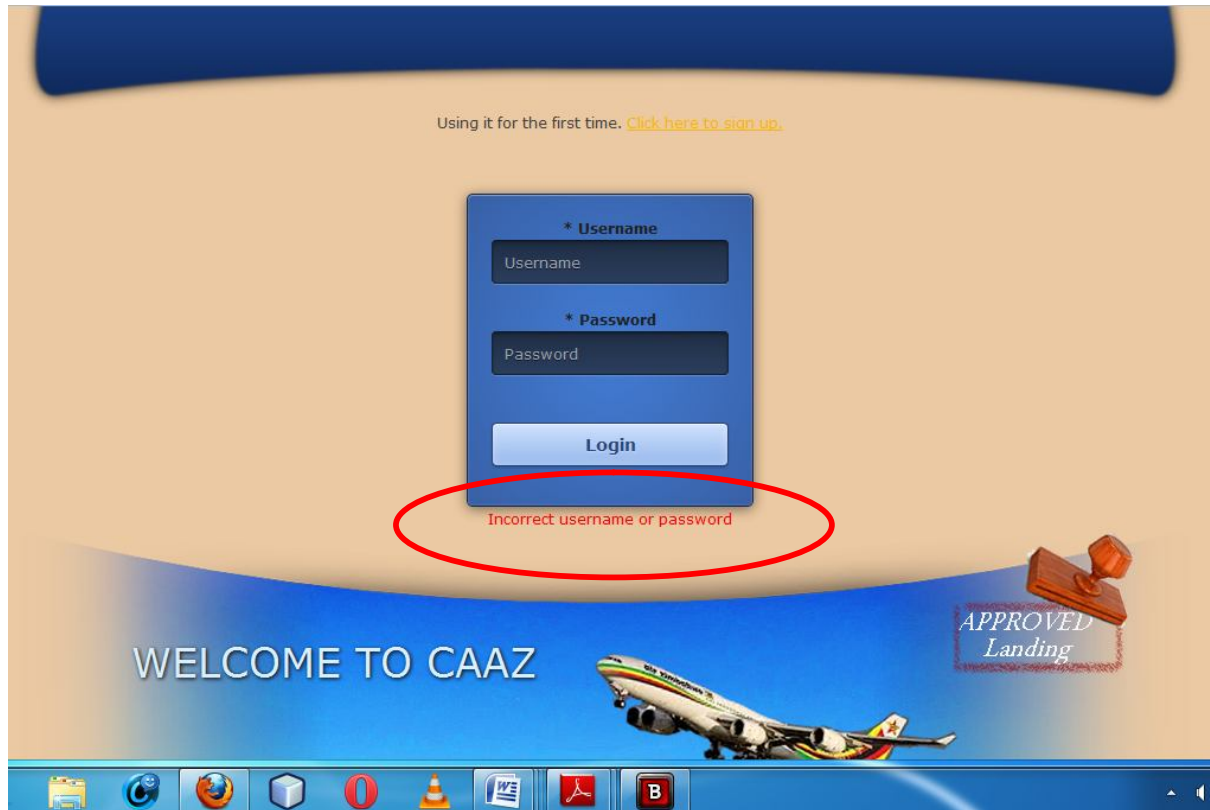


Fig 5.2: Invalid login

5.3.7.2 Validation of null fields

If the user leaves some fields empty the system will notify them with an error message as follows:

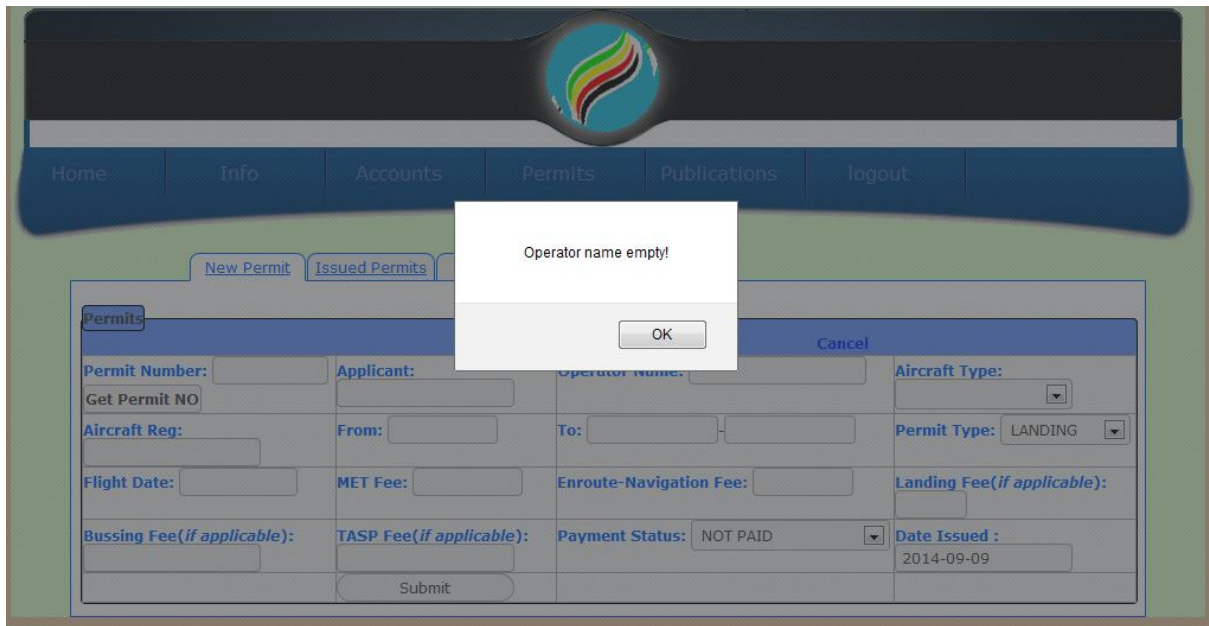


Fig 5.3: Validation of null fields

5.3.7.3 Validation of correct data type input

The system will alert the user if they enter wrong data type for example if they enter numbers where letters are required an error message will appear informing the user the correct type they must input.

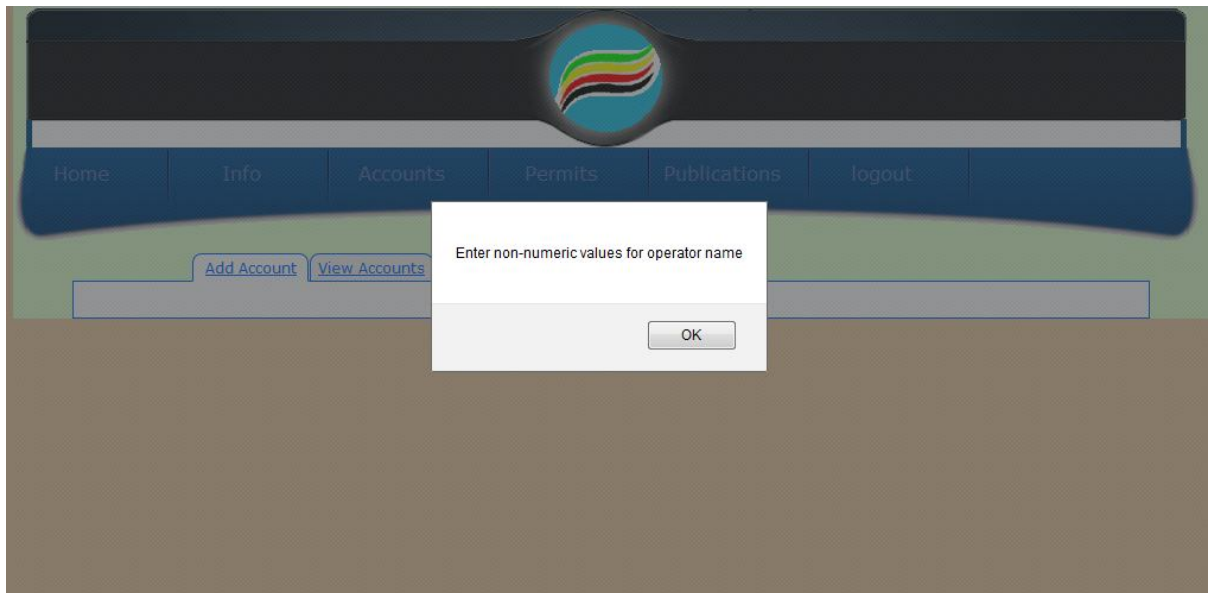


Fig 5.4: Validation of correct data type input

5.4 INSTALLATION

This section looked at various methods that were used to implement the new system.

5.4.1 Installation Procedure of the Aeronautical Publications and Flight Permits Processing System

1. Check if MySQL is on the server, if not check for softwares that may conflict with WampServer.
2. Install WampServer
3. Run WampServer , create the database for System and import database tables
4. Copy the site root folder and paste it into the www folder in the C drive in the wamp directory .At this point installation is complete and what is left the running and testing of the system.
5. To enter into the system valid login credentials will be required with those of the administrator having all the privileges. If the system runs well then do the next stage otherwise fix it.
6. Create a back up for both the site and the database

5.4.2 Parallel changeover (Recommended method)

According to French (1997) the parallel changeover is when the two systems (the old and the new) are run concurrently, using similar inputs. The outputs of the two systems were compared and any differences observed were resolved. The outputs from the old system carried on to be distributed up to a point when the new system proved to be satisfactory. At this juncture the old system was discontinued and the new system replaced it.

5.4.2.1 Advantages

- Its use gave management an opportunity to fully test the new system whilst still retaining the old system.

5.4.2.2 Disadvantages

- It was expensive since there was duplication involved.
- It is only possible when the outputs from the two systems can be easily compared and where the systems are identical.
- The method would require extra labour or overtime working for the existing staff over the period of changeover

5.4.3 Pilot changeover

The “Pilot” changeover method would involve changing part of the old system, either parallel or directly. The major disadvantage of this method is:

- The use of the variation of parallel and direct changeover is possible when part of the old system can be treated as a separate entity.

5.4.4 Direct changeover

This method discontinues the old system immediately when the new system becomes operational. There must be complete confidence in the new system's accuracy and reliability before being implemented.

5.4.4.1 Advantages

- Costs incurred were generally low since one system was in operation

5.4.4.2 Disadvantages

- Highly risk especially when there is no backup option

5.5 MAINTENANCE

Now that the new system is operational it needs to be continuously examined to ensure it continues to meet its objectives. The system also requires reviews and maintenance periodically for the following reasons:

- To deal with unanticipated problems that may arise during operation.
- To ensure that the system is able to cope with changing needs of the organization.
- To develop performance or familiarize system to a new environment. Software must be updated to run on improved hardware or with improved software.

Therefore, for the system to continue to run efficiently it must be constantly monitored and maintained. This maintenance is bound to be done sooner or later and should be planned for. The maintenance processes can be categorised into three categories namely:

- ✓ Adaptive maintenance
- ✓ Corrective maintenance
- ✓ Perfective maintenance

5.5.1 Adaptive maintenance

Adaptive maintenance involves changing some of the functionality of the system so that the system performs the functional requirement and satisfies the system users (French, 1997). This kind of maintenance is inevitable since it is brought about by the changes that may happen in the aeronautical information systems department which includes the following:

- Change in information needs in the AIS or other departments.
- Change in security needs.
- Changes in forms

These above mentioned events would result in the system adapting to additional operations, and evolving new hardware and or software. Making the system to be able to be integrated

with a new interface or to be run on a different operating system are also other forms of adaptive maintenance. The decision to conduct this kind of maintenance is usually driven by the coming of new technologies. This type of maintenance is usually conducted frequently because of swift changes in technology and its environment.

5.5.2 Corrective maintenance

French (1997), Corrective maintenance is the reactive modification of the system conducted after delivery to correct noticed faults. Corrective maintenance is usually done whenever a user reports a fault which would have taken place. In other words it is mainly associated with the modifications done to the system so as to address the defects made throughout system development. These errors normally happen not long after implementation and the maintenance's main aim being the elimination of defects from the system without necessarily adding new features or affect the system. Corrective maintenance should be conducted as soon as a bug is discovered to reduce chances of disturbing the perfect running of the daily business activities.

5.5.3 Perfective maintenance

Perfective maintenance involves getting user requests, and or suggestions for the system enhancements or changes, conducting analysis of their outcomes and implementing those (French, 1997). Even if system has been successfully delivered and perfectly working having not even one bug it does not necessarily mean that users are satisfied they can request for new or more advanced features. In other scenarios users are the ones that may push for alterations of some components of the system even its interface. Perfective maintenance usually is user initiated. That is, if any alteration is needed as a result of user suggestions or complaints, perfective maintenance then comes into play.

5.5.4 An overview of maintenance

Having conducted comprehensive analysis of different maintenance methods, perfective maintenance outweighed other maintenance techniques. It was discovered that it is the most effective and efficient especially when the system is being developed in-house. The system maintenance and upgrade could be done by the system administrator being assisted by the system developer.

5.5.5 Recommendation

From the currently prevailing situation, it was recommended that the adaptive maintenance be adopted because of rapid changes in the technological environment. This gave room for backups to be conducted and data was stored in a secure place for later use.

5.6 SYSTEM SECURITY

In case an illegitimate user manages to bypass physical security measures, therefore as a counter measure software measures were implemented.

- Operating System-based measures :- The database of the system was run on the MS Windows server which makes use of passwords to prevent unauthorised access of the system data.
- Program-based access control :- The Aeronautical Publications and Flight Permit System makes use of usernames, passwords and different user access level in order to give access only to legitimate users
- Measures like the use of antivirus, creating system data backups, having a backup generator among others were used as counter measures for threats like virus attacks, hacking, power cuts, natural disasters, equipment failure and so on.

5.7 CONCLUSION

Thorough tests were conducted in this chapter using various ways of testing so as to determine or assess if the finished system met user requirements derived from or represented by the highlighted objectives. This chapter marked the end point of the documentation on the Aeronautical Publications and Flight Permit System.

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APPENDICES

Appendix A: User Manual

In this appendix, an insight was given of full system to the system users with the intention of making them understand how the system works.

How to log in the System?

The user have to enter their username and password, after this input the user will click LOGIN button to login and the system will take the user to the platform they should go depending on their access level. If one has forgotten their password, they should contact the administrator so that their password may be reset.

Login page

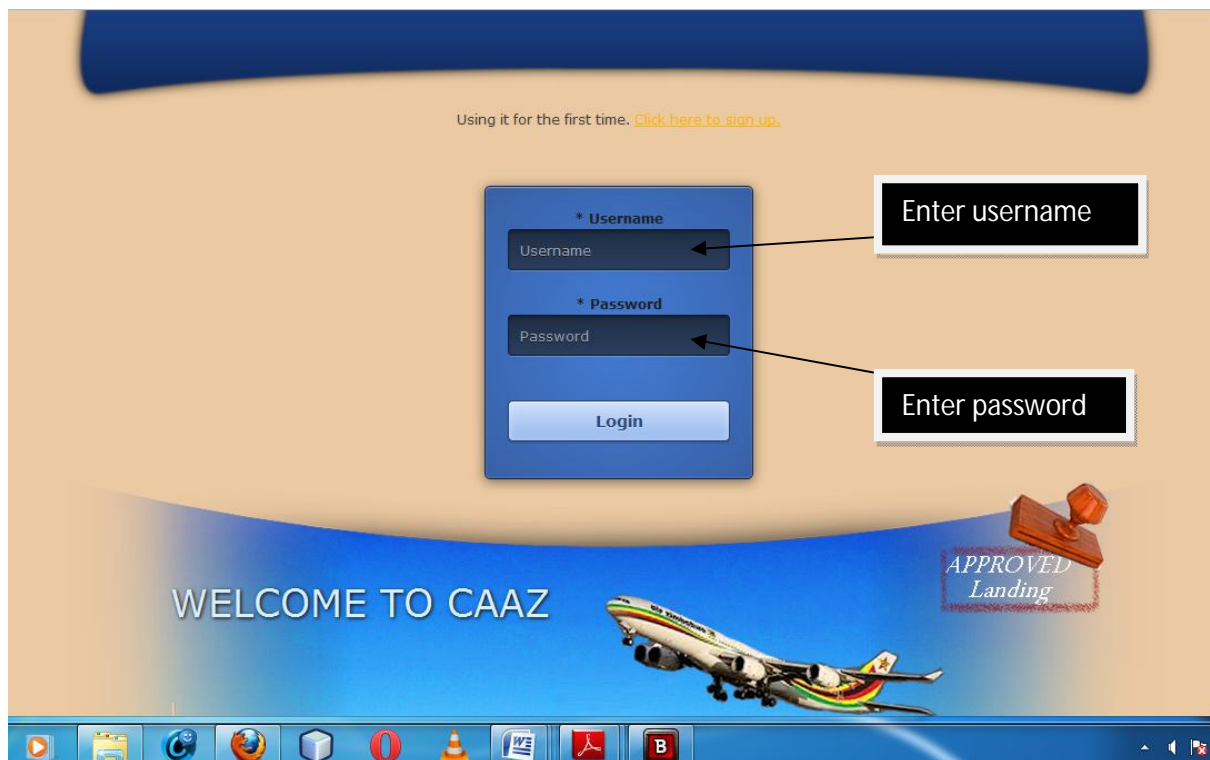


Fig A1: User login form

Wrong username and password on log in

Upon entering wrong details on log in, an error message will pop up informing the user that they have entered a wrong username and or password. The message shown below appears when one enters wrong credentials.

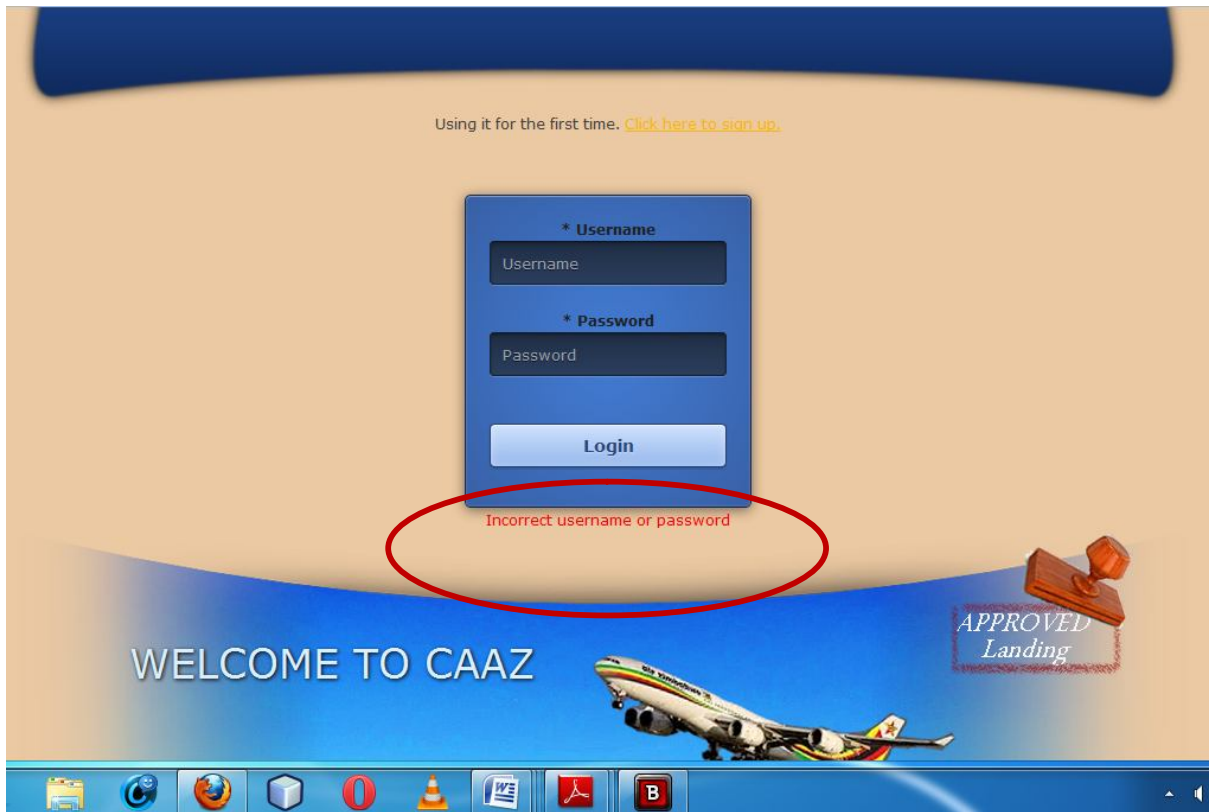


Fig A2: User Login error message

Administrator's Main Menu

The administrator's main menu shows the functions that the system administrator has to do and is supported by the system, which takes into account adding new users and managing the existing ones among others.

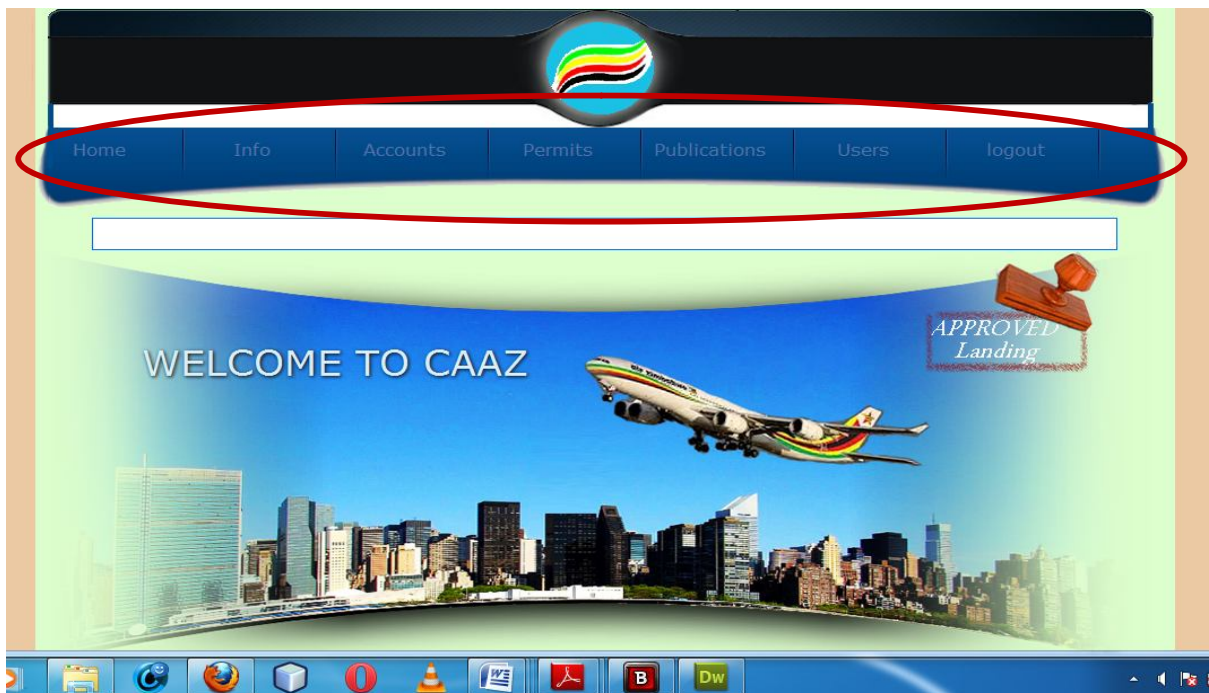


Fig A3: Administrator's Main Menu

Adding and managing existing users

The administrator clicks on USERS under the administrator main menu and a form with a list of users and their account status will appear. From which the administrator can reset user passwords, delete users and update user account status. Below the list of users there is a form to add a new user. After adding the details the system administrator will submit and a message will pop up notifying that the process has successfully done.

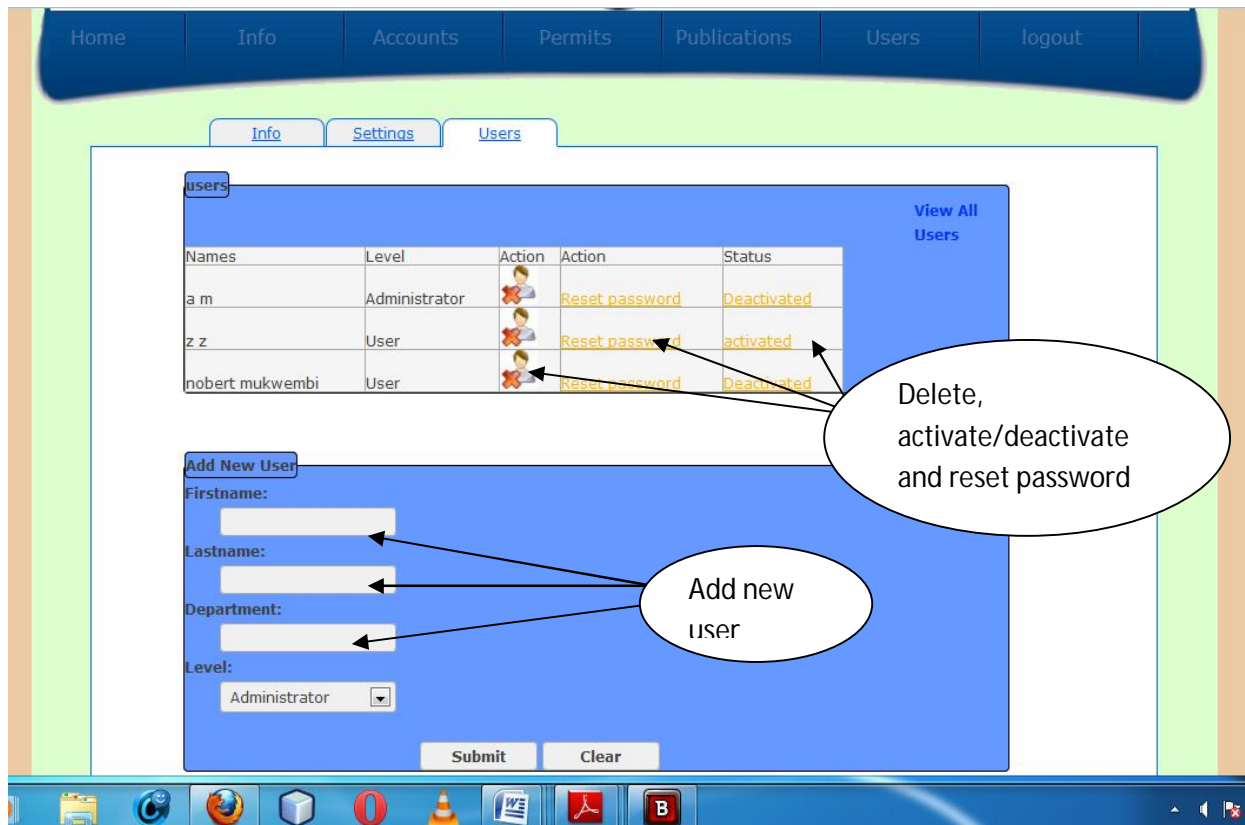


Fig A4: Adding and managing existing users

Issue a new permit

To issue a permit the user should go to the main menu and click PERMITS. From there they click NEW PERMIT on the sub menu that appears then click GET PERMIT NO to generate a permit number and fill in all required details.

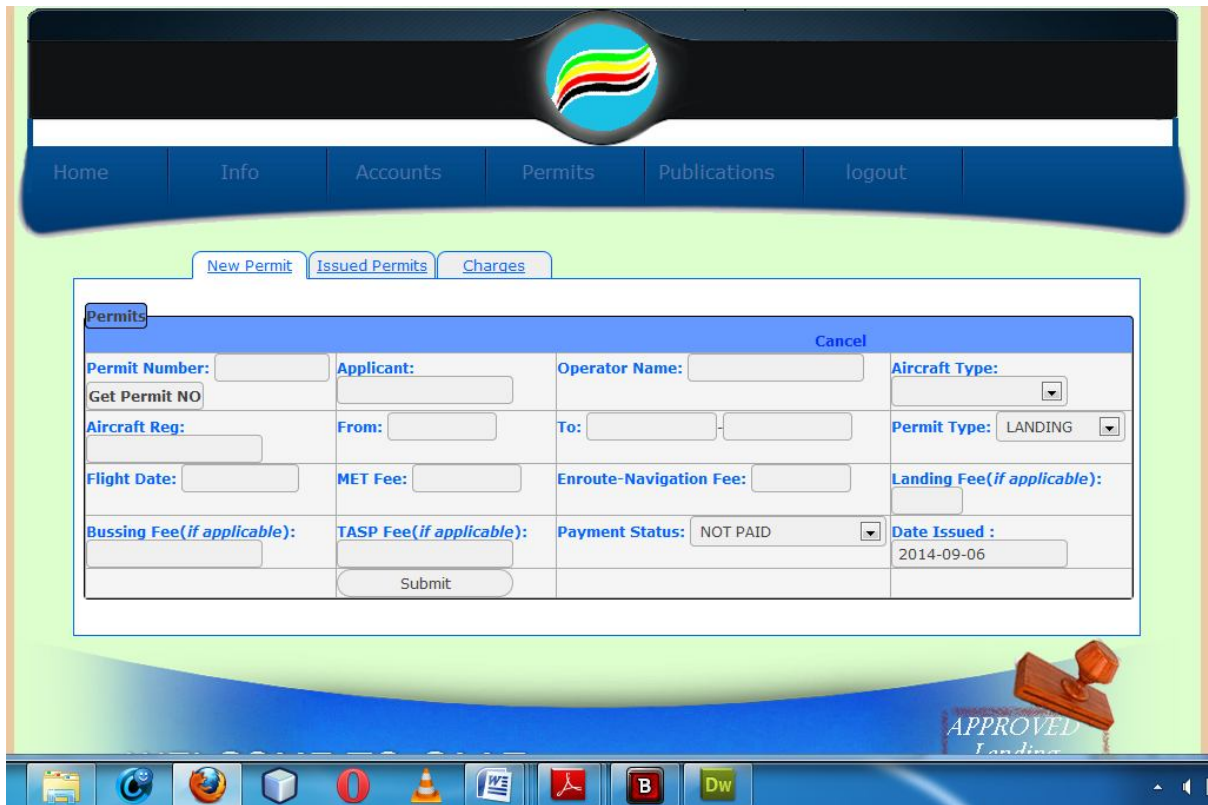


Fig A5: Issue new permit

Change password

To change password the user should go to the main menu and click INFO. From there they click RESET PASSWORD in the form that appears then fill in their old and new password details.

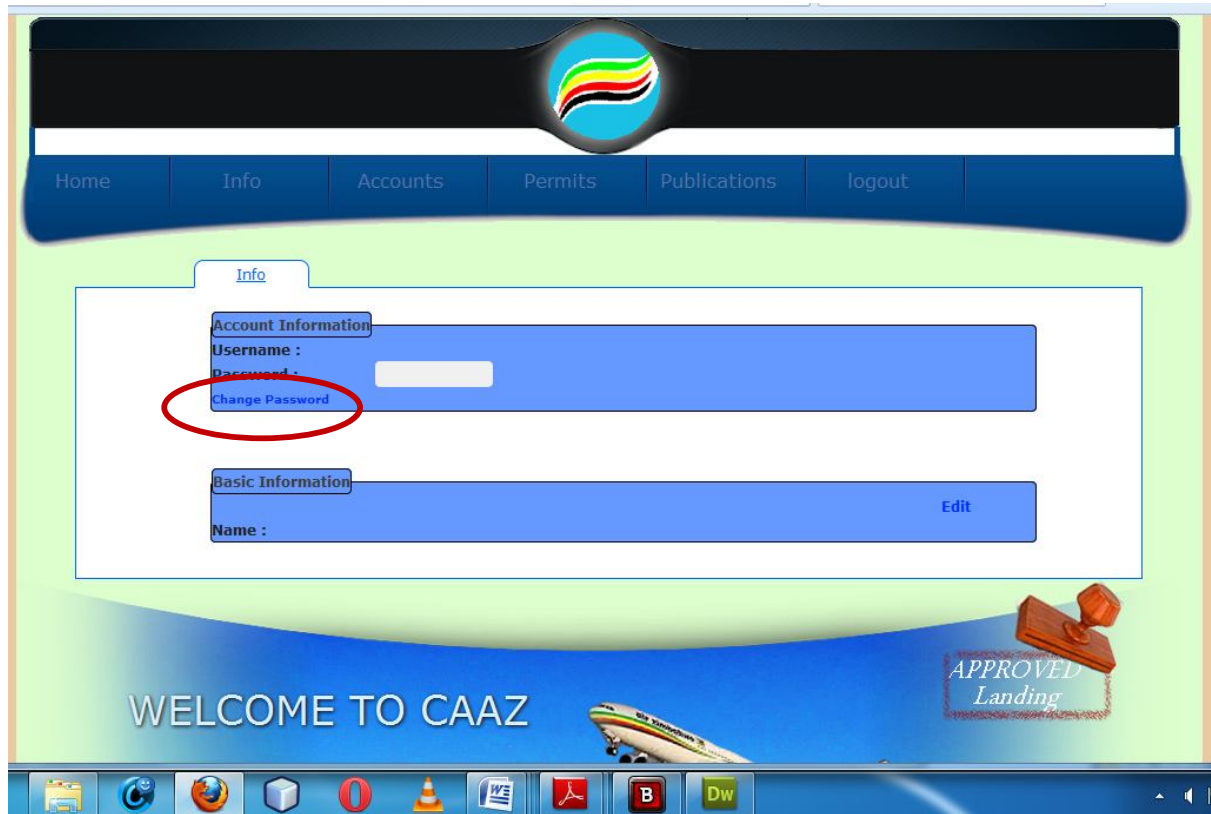


Fig A6: change password

Add operator/applicant account

To add operator/applicant account the user should go to the main menu and click ACCOUNTS then fill in the required details in the form that appears. The same form is used to update the balances for the existing accounts if they deposit money.

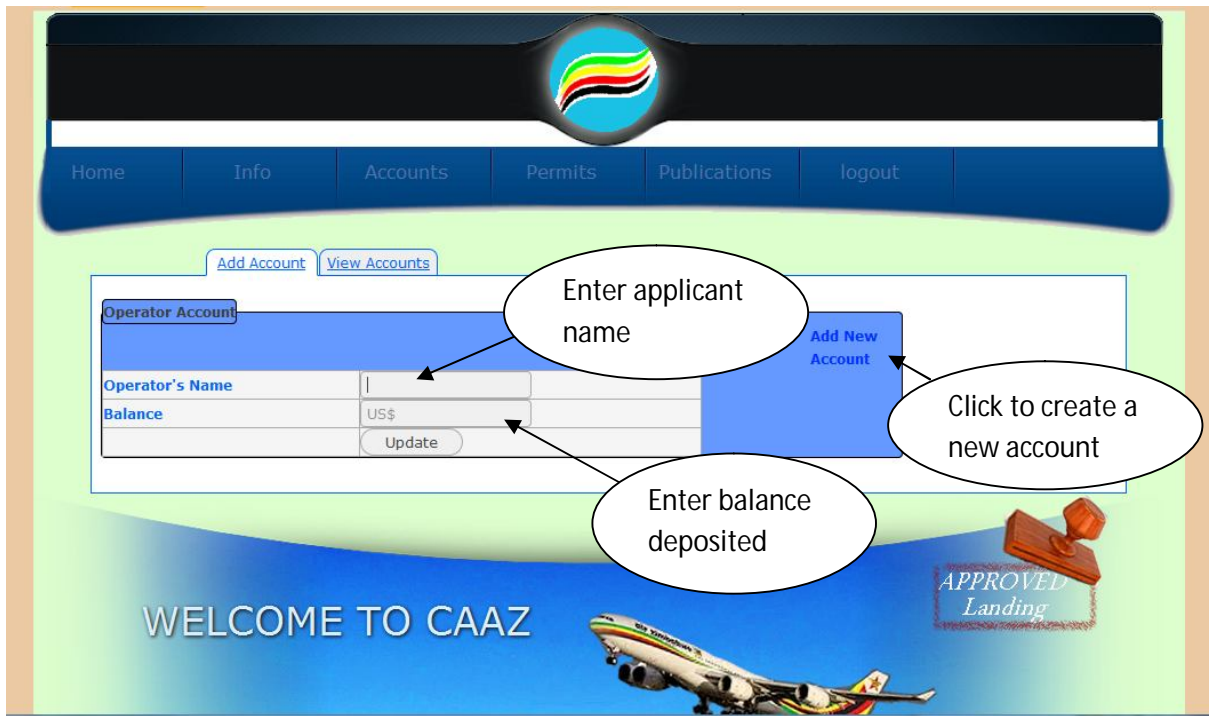


Fig A7: Add operator/applicant account

Add/Update/Delete Publications

To issue a permit the user should go to the main menu and click PUBLICATIONS. From there they click on the publication that they want on the sub menu that appears then choose their action (delete, edit or add a new record).

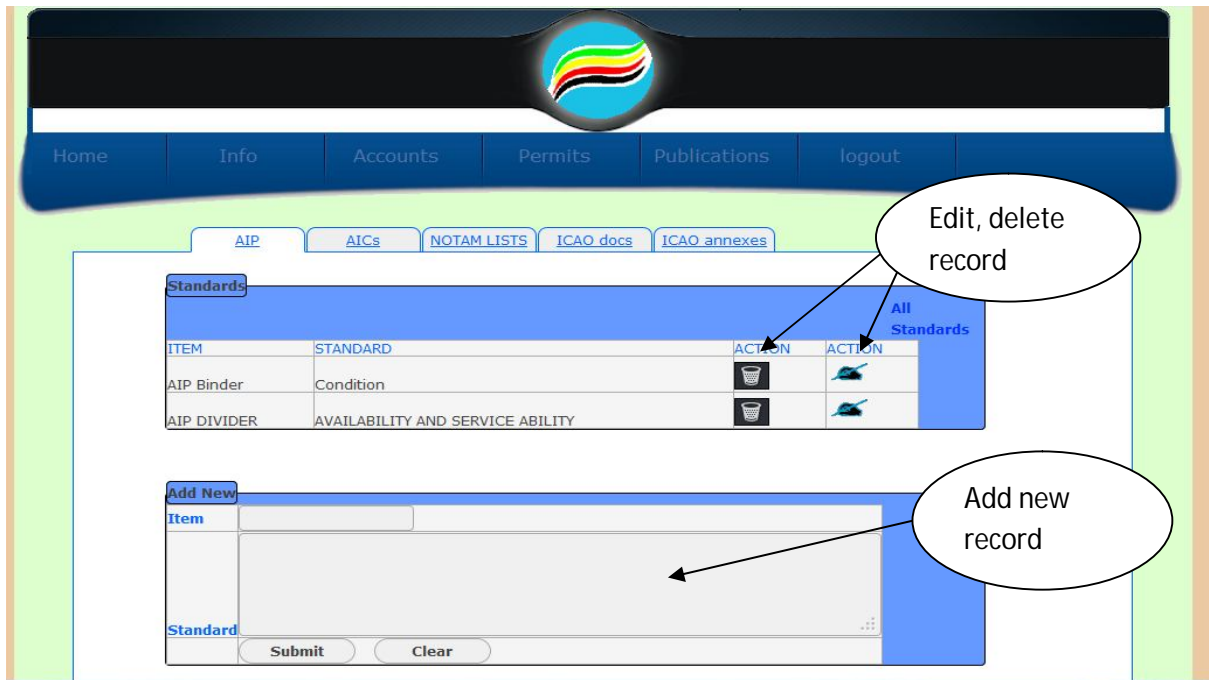


Fig A8: Add Publications

Sign out

To logout the administrator will go to the main menu and click LOGOUT .Once the administrator logs out of the system, he or she will to login again for him or her to view, manage accounts and generate reports.

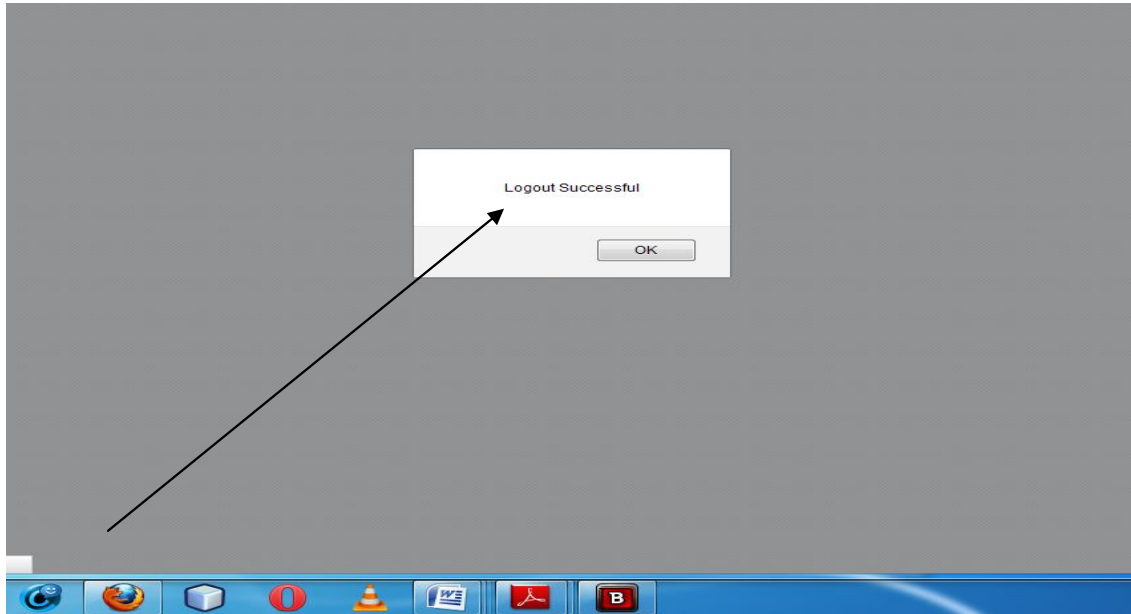


Fig A9: logout

APPENDIX B: Questionnaires

ADMIN/MANAGEMENT

1. How do you rate the existing system in terms of security?

Excellent Good Fair Poor

2. How do you rate the existing system in terms of generation of flight permit reports?

Excellent Good Fair Poor

3. Do you vote for computerisation if it is considered a candidate for transferring from the current system of issuing flight permits?

Yes No

If **No**, what could be the reason?

4. How often do you experience very busy days and huge workloads during your operations?

Very Often Sometimes All the time

5. Have some of the employees complained about the current system's performance?

Yes No

If **YES** what were the complaints?-----

6. What problems are you facing with the current system?

USERS

1. Are you satisfied with the current manual system?

Yes

Sometimes

No

If **YES**, give the reason

2. How do you rate the current system?

Excellent

Good

Fair

Poor

3. Are you pleased with the processing speed of the current manual system?

Yes

No

If No what are your suggestions?

4. What do you think should be done to the current system?

APPENDIX C: Interview Questions

MANAGEMENT/ADMINISTRATION

1. How the current system work and what does are the processes involved in issuing a flight permit?
2. What kind of data do you capture and or retrieve from the system and how often?
3. Are there any problems that you face in the existing system? If YES identify them and point out what you think should be done to deal with them?
4. How do you rate the performance of current system?
5. Are there any measures in place to safeguard your information against unauthorized access?
6. How do you generate reports and who can access them and when?
7. What are your views or opinions about changing the current system to a fully computerised system?

USERS

1. What are your major tasks when you issue flight permits?
2. Do you enjoy working with the current manual system and if so what are its strengths?
3. What are your views or opinions about changing from the existing system to a fully computerised system?
4. What are the things you would expect to see if a computerised system was to be introduced?

APPENDIX D: Observation Score sheet

Observation guide schedule

Schematic of observation recording sheet

Date/...../2012

Time

Area under Observation

Observations

.....
.....
.....
.....
.....
.....
.....
.....

Recommendations

.....
.....
.....
.....
.....
.....
.....

Conclusion

.....
.....
.....
.....
.....
.....

APPENDIX E: Code snippet

Database connection

```
<?php  
mysql_connect("localhost","root","") or die(mysql_error());  
mysql_select_db("ais");  
?>
```

Login code

```
<?php  
session_start();  
include "db/tdb.php";  
include("l_functions.php");  
$query=mysql_query("SELECT * FROM users WHERE username='$_POST[username]' and  
password='$_POST[password]'" ) or die(mysql_error());  
$count= mysql_num_rows($query);  
/* if($count==0){  
message("Username does not exist!");  
}*/  
while($fetch=mysql_fetch_array($query)){  
if($fetch['level']=='Administrator'){  
$username=$fetch["username"];  
$_SESSION['username']=$username;  
$_SESSION['id']=$fetch["id"];  
$_SESSION['logged']=true;  
redirectto("Adminhome.php");  
}  
if($fetch['level']=='User' && $fetch['department']=='ais'){  
$username=$fetch["username"];
```



```

$_SESSION['username']=$username;
$_SESSION['id']=$fetch["id"];
$_SESSION['logged']=true;
redirectto("AIshome.php");
}
if($fetch['department']=='accounts'){
$username=$fetch["username"];
$_SESSION['username']=$username;
$_SESSION['id']=$fetch["id"];
$_SESSION['logged']=true;
redirectto("Accountshome.php");
}
if($fetch['department']=='ATC'){
$username=$fetch["username"];
$_SESSION['username']=$username;
$_SESSION['id']=$fetch["id"];
$_SESSION['logged']=true;
redirectto("ATChome.php")
}
if($fetch["username"]!=$_POST[username] || $fetch["password"]!=$_POST[password]){
$rs1= mysql_query("SELECT * FROM users WHERE username=$_POST[username]");
$row1=mysql_fetch_array($rs1);
lockout($row1["id"]);
message_redrct("Wrong Username or Password!");
}??>

```

Add user

```
<?php
include ("db/tdb.php");
if(isset($_POST["submit"])){
$firstname = $_POST["firstname"];
$lastname = $_POST["lastname"];
$dpt = $_POST["department"];
$lvl = $_POST["level"];
$n_a="";
$status="Deactivated";

mysql_query("INSERT INTO users
VALUES(NULL, '$firstname', '$lastname', '$n_a', '$n_a', '$n_a', '$n_a', '$n_a', '$status', '$dpt', '$lvl')
") or die(mysql_error());
?>

<script language="javascript">
alert("User Added successfully");
window.location="users.php";
</script>

<?php
exit();
}
?>
```

Issue permit

```
<?php
include("db/tdb.php");
if(isset($_POST['cod'])){
```

```

die('<script
language=javascript>document.form1.permitno.value=Math.floor(Math.random()*1000024
+ 10000); </script>');

}

if(isset($_POST["submit"])){

$n_date=$_POST["to1"];

$l_fee=$_POST["landing_fee"];

$b_fee=$_POST["bussing_fee"];

$t_fee=$_POST["tasp_fee"];

$rs1=mysql_query("SELECT balance FROM prepaid_accounts WHERE
operatorname='".$_POST[operatorname]'") or die(mysql_error());

$row1=mysql_fetch_array($rs1);

$count1=mysql_num_rows($rs1);

if($_POST["operatorname"]==""){

?>

<script language="javascript">

alert("Operator name empty!");

window.location=("adprmt.php");

</script>

<?php

exit();

}

if($_POST["to"]==""){

?>

<script language="javascript" >

alert("To field is empty!");

window.location=("adprmt.php");

</script>

```

```
<?php
exit();
}
if($_POST["from"]==""){
?>
<script language="javascript" >
alert("From field is empty!");
window.location=("adprmt.php");
</script>
<?php
exit();
}
if($_POST["to1"]==""){
$n_date="N/A";
}
if($_POST["landing_fee"]==""){
$l_fee="N/A";
}
if($_POST["bussing_fee"]==""){
$b_fee="N/A";
}
if($_POST["tasp_fee"]==""){
$t_fee="N/A";
}
if($count1==0){
$opening_crdt="N/A";
```

```

$balance="N/A";

}

if($count1==1){

$opening_crdt=$row1["balance"];

$balance=$row1["balance"]-($_POST["met_fee"]+$_POST["nav_fee"]);

    if($balance<0){

?>

        <script language="javascript" >

alert("Credit Remaining is now insufficient!");

window.location=("adprmt.php");

</script>

        <?php

exit();

}

}

$stts="EXPECTED";

mysql_query("INSERT INTO permits VALUES
(NULL,'$_POST[applicant]','$_POST[operatorname]','$_POST[aircraft_type]','$_POST[reg]'
,'$_POST[permitno]','$_POST[date_issued]','$_POST[from]','$_POST[to]','$n_date','$_POST
[permittype]','$_POST[flightdate]','$stts)") or die(mysql_error());

mysql_query("INSERT INTO account_trans VALUES
(NULL,'$_POST[operatorname]','$_POST[permitno]','$_POST[date_issued]','$_POST[permi
ttype]','$_POST[met_fee]','$_POST[nav_fee]','$l_fee','$b_fee','$t_fee','$_POST[status]','$ope
ning_crdt','$balance)") or die(mysql_error());

if($count1==1){

mysql_query("UPDATE prepaid_accounts SET balance=$balance WHERE
operatorname='$_POST[operatorname]') or die(mysql_error());

}?>

<script language="javascript">

```

```

alert("Permit added successfully");
window.location=("prmt.php");
</script>
<?php
exit();
}
?>

```

Inspection report

```

<?php
$svyid=$_POST["surveyid"];
if(isset($_POST["submit"])){
$rsA=mysql_query("SELECT * FROM aip") or die(mysql_error());
while($rowA=mysql_fetch_array($rsA))
{
$aip=$_POST[$rowA["id"]];
$resultA = mysql_query("INSERT INTO results_aip VALUES
(NULL,$svyid,$rowA[id],$aip)")or die(mysql_error());
}
$rsB=mysql_query("SELECT * FROM aeronautical_information_circulars") or
die(mysql_error());
while($rowB=mysql_fetch_array($rsB))
{
$aic=$_POST[$rowB["id"]];
$resultB = mysql_query("INSERT INTO results_aic VALUES
(NULL,$svyid,$rowB[id],$aic)")or die(mysql_error());
}
}

```

```

$rsC=mysql_query("SELECT * FROM notam_list") or die(mysql_error());

while($rowC=mysql_fetch_array($rsC))
{
$NOTAM=$_POST[$rowC["id"]];

$resultC      =      mysql_query("INSERT      INTO      results_notam      VALUES
(NULL,'$svyid','$rowC[id]','$NOTAM')")or die(mysql_error());

}

$rsD=mysql_query("SELECT * FROM icao_documents") or die(mysql_error());

while($rowD=mysql_fetch_array($rsD))
{
$doc1=$_POST[$rowD["id"]];
$doc2=$_POST[$rowD["id"]-2];

$resultD      =      mysql_query("INSERT      INTO      results_docs      VALUES
(NULL,'$svyid','$rowD[id]','$doc1','$doc2')")or die(mysql_error());

}

$rsE=mysql_query("SELECT * FROM icao_annexes") or die(mysql_error());

while($rowE=mysql_fetch_array($rsE))
{
$annex1=$_POST[$rowE["id"]];
$annex2=$_POST[$rowE["id"]+1];

$resultE      =      mysql_query("INSERT      INTO      results_annex      VALUES
(NULL,'$svyid','$rowE[id]','$annex1','$annex2')")or die(mysql_error());

}

mysql_query("INSERT      INTO      surveillance      VALUES
(NULL,'$_POST[aerodrome]','$svyid','$_POST[date_inspected]','Awaiting
Approval','$_POST[inspector]','$_POST[atc_officer]')")or die(mysql_error());

?>

```

```
<script language="javascript" type="text/javascript" >  
alert("AIS Inspection report has been sent for approval!");  
window.location="inspection_report.php";  
</script>  
<?php  
}  
?>
```