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BACHELOR OF EDUCATION DEGREE IN COMPUTER SCIENCE

AN AUTOMATED RECORD MANAGEMENT SYSTEM FOR A MODERN-DAY CLASS TEACHER AT SUTTON MINE PRIMARY SCHOOL.

BY

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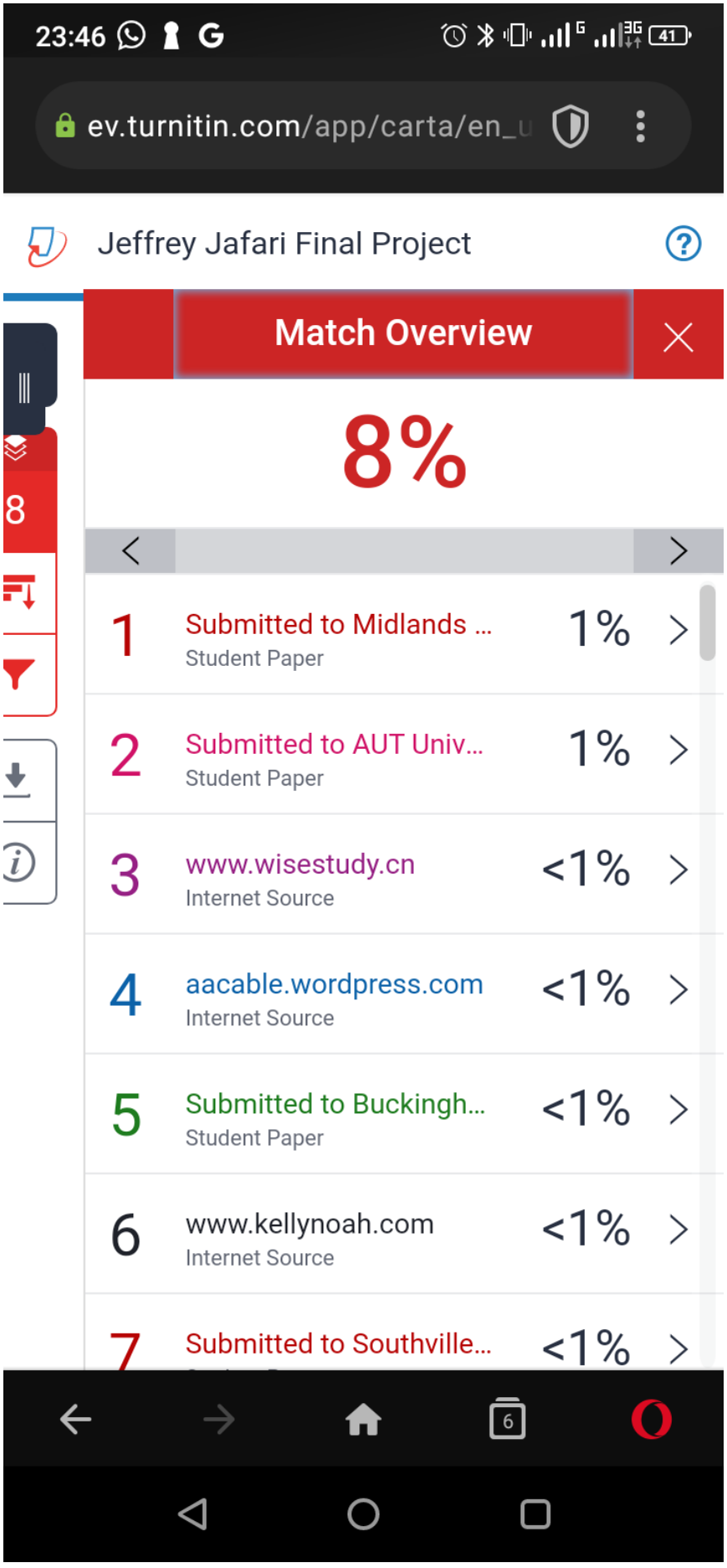
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Abstract

Since time immemorial the teacher has been burdened with too many activities yet expected to perform optimally. The effect of burden on the classroom teacher is drastic reduction in teacher-leaner contact time. The manual design and maintenance of class record books by the teacher has always been a taxing and time intensive process. The manual system of collecting and processing information has been largely ununiform and of less meaningful consequences to the teaching process. The process has been riddled with inconsistencies, data redundance, exposure to confidentiality violations, fragmentation of records and numerous other ills associated with the manual information systems. However, albeit the importance of data in this day and age, there has never been any initiative to transform the class record books processing. At Sutton Mine Primary School, there are 12 qualified teachers who are also not spared by the scourge of record books generating and maintenance. It was found out that on average, a teacher spends at least a week developing class record books for each new year. This amount of time multiplied by 12 will be 24 weeks of wasted valuable teaching time or 400 learners deprived of two weeks of uninterrupted

learning. Realising this injustice, the purpose for this study therefore is to offer a modern way to revolutionise the class record system by leveraging on technological advancements to computerise the process. An integrated class records system which is electronic in nature is being suggested as the solution to problems associated with manual class records keeping. This system is specifically for the teacher and may be describe as transaction processing system for the operational level of the school system. Thus, the project takes the form of an action research because it basically involves identifying a problem and attempting to offer a solution for it. The Sutton Mine Primary School has a stuff compliment of 12 from which a sample of 8 teachers was taken for the data creation or acquisition process. At data aggregation level the data collected was consolidate before it was analysed in the requirements specification phase of the project. The data analysis then paved the way for the design phase before the actual development took place. The solution, termed Integrated Class Records System (InClaRS) was finally developed and put to different test scenarios. After passing the software acid test, the system was finally deployed pending maintenance and further development. It was sufficiently conclusive that the solution offered did achieved its intended purpose.

Declaration

I, Jafari Jeffrey, do hereby solemnly declare that I have personally done this research and investigation of this project, with minor referencing to the extent of this revealed in the references and comments included within the body of this report, and that the work is original and has not been submitted in part or full for any other degree at any other university.

……Student signature Date …….
Jafari Jeffrey

……Supervisor's signature Date …….
Mr F. Gudo

……Chairperson's signature Date …….

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Chapter 1

This chapter shall form the platform upon which the project stets off. Here, the research shall introduce the problem and attempt to describe it. The solution that is being proffered shall also be explained giving a framework of how the researcher-cum developer shall solve the problem identified. The closing section of this chapter will be an important narrative reviewing the related literature of this project.

1.0 Introduction

The Integrated Class Record System (InClaRS) is a computer-based application that provides an interface for the storage, processing and management of student information for a modern-day class teacher. The proposed system is a direct and adequate solution to the Ministry of Primary and Secondary Education's (MOPSE) commitments as highlighted in the ministry's ICT Policy for Primary and Secondary Education in Zimbabwe (2016). Commitments are made by the MOPSE to the effect that "Every school shall be provided with an appropriate set of digitally-based assessment tools, including, but not limited to tools to support: teacher-designed classroom-based learner assessments…monitoring and evaluation and comparison of school results", and that "Every school and MOPSE offices shall be provided with access to a comprehensive, integrated, digitally-based education management information system (EMIS)" ICT Policy for Primary and Secondary Education in Zimbabwe (2016:18 part(f) and (g)). The Integrated Class Record System fits the description of the requirements by the MOPSE in that it is digitally-based, integrated, teacher-designed and seeks to achieve the set goals.

The Integrated Class Records System is also part of manifestation of the government of Zimbabwe's thrust to integrate ICTs in all sectors of the economy as enunciated by his excellence cde ED Munangagwa in his vision 2030 endeavour. In line with the National Development Strategy 1 (NDS1), the Integrated Class Records System is aimed at revolutionizing the education sector by modernising the teacher's professional tools of trade. Focus is shifting from agonising the classroom practitioner with too much manual clerical work to converting as much time as possible to teacher-pupil contact time.

The proposed system seeks to significantly cut back on the time and labour used by the classroom practitioner in designing, generating, and maintaining the requisite classroom record books and files. Particularly at primary schools in Zimbabwe, the teacher is required to

create and periodically update record books that include, but not limited to:- (1) Social/ Individual Record, (2) Progress/ Continuous Assessment Record, (3) Remedial Record, (4) Extension Work Record, (5) Performance Lag Address Program (PLAP) Record, (6) Reading Record, (7) Fees and other payments Record, (8) Classroom Inventory and other institution or class-specific records. These records are traditionally done manually by the teacher and at a time which is neither specified on the timetable or anywhere else. The integrated Class record System aims at computerising the design, generating and maintenance of the teacher's records. The system accepts input by the classroom teacher, stores the data, processes it and generate professional reports and records. This will then allow tracking of the learner's attendance, assessment and evaluation of academic progress, evaluation of effectiveness of teacher's mediation programs such as Performance Lag Address Program (PLAP) and remedial work.

Key Words: Integrated Class Record System (InClaRS), Database, C#, SQL

1.1 Background Study

A record in the context of teaching and learning is defined by Cohen and Manion (1989) as a written account of statement prepared by an individual for attestation or provision of information. Thus, record books are essentially professional documentation of important information and activities of the teaching and learning process. Farrant (1991) posits that class record books act as professional instruments drawn and used by the teacher to build understanding on his or her class and determine the degree to which the teaching and learning processes is effective. Lincoln and Guba (1981) summaries the rationale for class records in stating that class records: -

- ✓ Provide personal and background information about the learner. Information provided include the child's social background, medical history, parent or guardian information and other related details.
- ✓ Provide the teacher with information on the success of failure of the teaching methods and failure.
- ✓ Ensure the success and continuity of educational programmes throughout the teaching and learning process.

- ✓ Keep track of the learner's progress in different faculties of his or her educational experience.
- ✓ Acts as a professional medium of communication between teachers, parents, school administration, other school authorities as well as stakeholders and donors interested in the field of education.
- ✓ Serve as testimony or proof as to how much the teacher is committing to his duties and professional obligations.

Therefore, class record keeping appear to be a very important role a teacher is supposed to take up. However, the definitions of what a class record is as given by the authors quoted above reflect an important deficit. The assumption portrayed is that records are, naturally, written. This reflects the scenario that class records are being done manually, an idea which was the only option then but an indictment on the countries education ICT policy of today.

The approach implemented in the development of an Integrated Class Record System is a departure from the traditional manual and paper-based record generating and keeping system. Today's teacher is evidently overwhelmed by the duties and obligations that are to be done in a time-deficient school programme. In Zimbabwe, the updated curriculum introduced in 2015 did not make things any easier for the classroom practitioner, more new things where refined none of which had an effect of reducing the professional load carried by the teacher. The teacher's time for actual contact with the learners is largely consumed by other extra-classroom activities and obligations. For instance, while it is policy that a primary school teacher should maintain classroom records that include (1) Social/ Individual Record, (2) Progress/ Continuous Assessment Record, (3) Remedial Record, (4) Extension Work Record, (5) Performance Lag Address Program (PLAP) Record, (6) Reading Record, (7) Fees and other payments Record and other institution or class-specific records, the time for doing so in neither specified no implied on the official timetable. The imbalance identified above is evidenced by the Secretary's Circular number 2 of 2017(Implementation of the Curriculum Framework 2015-2022) which directs on the number of learning areas done at primary (and secondary) school level. Thus, teachers are left with no option than to borrow, with no chances of replacing, some teaching time to design, generate and maintain the required classroom record books. This has an obvious effect of discounting the teacher's contact hours with the learners.

The Integrated Class Record System introduces a new user-friendly approach where workload on the part of the teacher is significantly reduced. Ngwenya (2015: 10) states that "teachers are demotivated by poor working conditions …and lack of teaching and learning resources". The InClaRS is one such resource which is designed to inculcate motivation in teachers. The system is an answer to the call made by the Ministry of Primary and Secondary Education (MOPSE) through ICT Policy for Primary and Secondary Education in Zimbabwe (2016). The stated policy gives a road map of how ICT are to be used and developed for the improvement of the teaching and learning in Zimbabwean schools. ICT Policy for Primary and Secondary Education (2016:8-9) states that "The policy is intended to cover the use of ICTs to improve: … (b) Summative and formative learner assessment (c) Monitoring and evaluation at all levels (d) Education Management Information Systems (EMIS)". One of the key aims pronounced by the ICT Policy for Primary and Secondary Education (2016:11) is ensure that "All teachers and school administrators are proficient in the use of ICT and using them daily in their work." The preceding statement hints on a near future where the use of ICTs in the day to day work of a modern-day teacher will be a requirement.

The In ClaRS automates the processing of the data which would have been input by the teacher. The system is to be further developed so that it can be ported to run on other devices such as smart phones. The system provides graphical user interfaces which are easy to learn and navigate. Here the seriousness and care with which learner information is to be handled is underscored. Each windows form of the system holds specific information of a specific record, thus fostering neat and professional organisation of the class records. Only authenticated users are allowed to view, edit, copy or add information depending with privileges commensurate with their assigned login status. In essence, the Integrated Class Record System provides database services for the classroom teacher. The database is developed using the Structured Query Language (SQL) while the main project is developed using the C# programming language. As defined by the ICT Policy for Primary and Secondary Education in Zimbabwe (2016:16) "e-Resource are intangible software-related components of ICT systems", thus by extension, the Integrated Class Record (In ClaRS) is an e-resource tool that is intended to support the teacher for learner details documentation.

Currently the Zimbabwean education society has seen the emergence of institution management systems at different learning institutions. However, the student/ institution management systems are built to service the entire institution. As an example, a school management system is administered and maintained outside the classroom. The system

directly services and benefits the institution's administration and only remotely and indirectly service the classroom-bound teacher. Such records that are directly generated for the learners by the teacher, for example the remedial record, are not commonly integrated into institution-size systems. As such, the current solution to student information management leaves out one very important aspect to the teaching and learning matrix -the teacher. This means that even with a functional school management system the teacher still has to design and generate his or her own class-based student information system. It is this gap that is left by institution-size systems that is being filled by the Integrated Class Records System. Other integrated learning systems such as Google Class and Black Board Learn also fail to address the problem explained above. The said ILSs have their primary focus on lesson delivery and assessment thus oversimplifying the complex and intricate nature of the physical classroom. The teacher also depends on the information about the learner and his or her background which may not be accessible or properly stored on such interventions as the Google Class. Such details as the child's personal information, parent or guardian information, home setup, medical history and any other such records shapes the teacher's decision making processes.

The integrated learning systems dominating the education fraternity are largely online and inaccessible to the learner and/or the teacher in the peripheries of today's civilisation. Internet connectivity remains an elusive dream to the better fraction of the general populace. Internet and networking infrastructure is yet to be developed in sufficient proportions in many of the Zimbabwean communities. The cost of bandwidth is also beyond the reach of the better part of the general populace. These and other related factors are thus persistent impediments to the effective use of integrated learning systems such as Google Class and Black Board Learn. While effort is being directed to address the challenges addressed above the InClaRS presents workable solutions for transitioning from the archaic educational system to a fully modernised one.

1.1.1 Context of the Study

Sutton Mine Primary School is a P3 type school located in the Zvimba South Constituency of the Zvimba District in Mashonaland West. The School, being one of the six schools in the rural ward 32, is conveniently situated along the Mapinga -Mutorashanga road (GPS Coodinates:). Having been founded in 1955 by, and run under the responsible authority of, the ZimAlloys Limited mining company the institution was registered under the purview of the then Ministry of Education.

The Sutton Mine Primary School is designated P3 status type denoting that it is a Primary (P) school in the rural areas. The school was initially an initiative by the ZimAlloys Ltd operating Sutton Mine to accord children of mine workers accessibility to basic education. Before the school learners had to travel for 45 km all the way to Mutorashanga for their education, a feat that was taxing both financially and mentally.

Many a generation has come and left the confines of the Sutton Mine Primary School. The initial objective for building the school was clearly achieved, with school records indicating that the school enrolled over 500 learners the very year it was opened. The enrolment would continue to swell in the coming years as the mine continued its operations. At some point, as is indicated by school record, the enrolment went up to as high as 1500 learners under the stewardship of a 45 strong, women and men, staff.

With the passage of time, however, the ZimAlloys Ltd was placed under judicial management about the early 2000 thus implying its insolvency and by extension pitting the school to self-funding. The closure of the mine at Sutton Mine also saw the mass exodus of former mine workers, perhaps in search of livelihood elsewhere.

To date (2020) Sutton Mine Primary School thrives with a modest enrolment of 450 learners classed from Early Childhood Development level A to grade 7. There are 12 trained teachers, including administration, all on government pay roll. The Sutton Mine Primary School, though still under the responsible authority of ZimAlloys Ltd, is virtually run by a School Development Committee (SDC).

1.2.1 The Problem Statement

The Ministry of Primary and Secondary Education directs and dictates the trajectory of teaching and learning activities at the primary and secondary school levels. Though teachers are under the employment of a different ministry, the Ministry of Public Service and Social Welfare, their classroom duties and obligations are largely defined and assigned by the Ministry of Primary and Secondary Education. It is policy, as instructed by the Ministry of Primary and Secondary Education, that a class teacher, apart from the core duties of lesson delivery, assessment and evaluation, should also maintain certain records that keep salient learner's information. Albeit lack of clarity as to when to do the time gobbling record keeping activity, the teacher maybe charged with dereliction of duty along with other offspring

charges if he or she does not produce the required records. This points to the seriousness with which the class record books are associated. These books have almost always been done manually and eating quite a fraction of time that the teacher could have been in professional contact with the learners. This system is outdated and does not resonate with the technological advancements that have changed and simplified how things are done in the 21st century. A teacher must have, at his or her disposal, certain teaching resources the most important and indispensable being time. The less time the teacher has with her or his learners the less effective the whole process of teaching and learning. The manual record keeping system has been identified as a time intensive thus robbing the learners and the teachers of valuable contact time.

Record books maintained by the teacher include, but not limited to:-

(1) Social/ Individual Record

(2) Progress/ Continuous Assessment Record

(3) Remedial Record

(4) Extension Work Record

(5) Performance Lag Address Program (PLAP) Record

(6) Reading Record

(7) Fees and other payments Record

(8) Classroom Inventory and other institution or class-specific records.

All these record books require weekly, some daily, updating taking so much of the teacher's teaching time.

Now the problems arising from the situation include, but not limited to:-

- **Data Loss:** The entire work is done in physical books and written manually by pen. This scenario points to complete and unrecoverable data loss once the book gets destroyed or lost.

- **Time Consuming:** The design and maintenance of the record books is time consuming. This actually take so much time the teacher could have productively used for the actual teaching and marking.
- **Rigidity of the System:** Once an entry of a record has been generated, by pen. The entry cannot be changed in the same place as it was entered the first time. Entries are virtually permanent.
  - Also adding new entries may upset the initial order of the entries.
  -Unwanted entries will remain in the document blotted or redacted.
- **Data Duplication:** Since records are kept separately such entries like names of learners and other details may be duplicated in each record where such information may be required.
- **Data Redundancy:** As learners change classes moving from the hands of one teacher to another. The receiving teacher is required to generate new class records for the new class. However, the records from the previous class are left redundant and may never be used again.
- **Poor Presentation:** The records are manually produced such that presentation of the records largely depends on the writing skills of the teacher. The records may be poorly produced such that no other person may meaningfully use them other than the producer.
- **Lack of Uniformity:** As teachers produce their records, they may take any form or shape because there are no set criteria as to how the records may be produced uniformly.

The Ministry of Primary and Secondary Education made bold commitments intended to lessen work and revolutionise student information management by promoting the use of ICTs. The ICT Policy for Primary and Secondary Education in Zimbabwe (2016:17) under the sub topic Policy Commitments Related to e-Resources: states at part (f) that "Every school shall be provided with an appropriate set of digitally-based assessment tools, including, but not limited to tools to support: teacher-designed classroom-based learner assessments…monitoring and evaluation and comparison of school results", part (g) reads "Every school and MOPSE offices shall be provided with access to a comprehensive, integrated, digitally-based education management information system (EMIS)". The commitments quoted above are a true testimony by the Ministry of Primary and Secondary

Education that there is an existing gap in the management of classroom-based information management.

1.3.0 Current System

In Zimbabwe and in the primary schools, all record books that teachers are required to generate and maintain are done manually. This is a traditional way of doing things that has persisted since the inception of formal education in the country. The class databases are paper-based and outdated this is probably because the government has not invested significantly towards improving the teacher's tools of trade except for those that directly benefit the learner. The records are all written in ink by pen. The records are generated and maintained by the teacher presumably at her or his own time because, apparently, there no such slot on the daily time table to do the work. Basic record books include: (1) Social/ Individual Record, (2) Progress/ Continuous Assessment Record, (3) Remedial Record, (4) Extension Work Record, (5) Performance Lag Address Program (PLAP) Record, (6) Reading Record, (7) Fees and other payments Record, (8) Classroom Inventory and other records which maybe specified and required in specific institutions. The performance report book is another record that is utilised every term ending to record the progress, or lack of which thereof, by the learner. This is another record that is also done manually.

The records are usually kept in separate books which the teacher is supposed to secure in case they get lost. However, there is always persistent talk of a teacher's record books being missing or having been damaged at home while the teacher was updating them. The record books are supposed to be submitted to the administration who check whether they are up to date. When recording learners' information, the teacher relies, mostly, on the information given by learner. Learners being learners and not adults sometimes provide incorrect information during interviews which the teacher may later need to change. This means that entries are not easy to edit or update when there are changes or adjustments to the initially entered record.

Any electronic or computer-based systems utilised at schools, particularly primary schools, is designed for the whole school and not easily accessible to the classroom teacher. Even where student information management schools are developed, the idea of implementing such systems at schools is still foreign. This is basically because system developers in Zimbabwe are evidently less interested in the Secondary and Primary Education sector.

1.3.1 Analysis of the current System at Sutton Mine Primary School.

At Sutton Mine Primary School and, particularly interesting, all other public schools every teacher is required to keep class specific records. The records are all done manually by pen. The records are generated and maintained by the teacher presumably at her or his own time because, apparently, there no is such slot on the daily time table to do the work. Basic record books include: 1) Social/ Individual Record, 2) Progress/ Continuous Assessment Record, 3) Remedial Record, 4) Extension Work Record, 5) Performance Lag Address Program (PLAP) Record, 6) Reading Record and other institution or class-specific records. The performance report book is another record that is utilised every term ending to record the progress, or lack of which thereof, by the learner. This is another record that is also done manually.

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1.3.2 Description of the current system

- ✓ Paper based
- ✓ Manually maintained
- ✓ Disintegrated, the records are in separate books
- ✓ Has too much redundancy
- ✓ Is rigid
- ✓ Is fault intolerant. An entry error cannot be correct in the same place the error was made.

1.4.0 The Proposed System

An Integrated Class Records System is being proposed. This system is a clear shift of focus from the manual system to one done electronically. The Integrated Class Record System also seeks to integrate the many defragmented records into one flexible easy to use electronic system. The proposed system is basically addressing the tedious manual way of doing things

and significantly saving time by cutting on the time the teacher spends when physically designing, generating and maintaining the record books. The Proposed system is meant to be portable such that the teacher can carry all his work in one place. Of particular interest is also the proposed system's capability to back up data to prevent data loss in case of a damage or loss of the machine. The Integrated Class Record System is new in implementation but not purely new in principle. There are other information management systems utilised at other learning institutions but the implementation of one that is directly administered and benefiting the classroom teacher is a purely new idea in the Zimbabwean context. The In ClaRS (pronounced '*In Class*') is a graphical user interface application which is secure, effective, user friendly class information management system. It houses all the general class records properly organised and with the capability to process information and generate professional reports.

The proposed system is also intended to make work presentable and fun by implementation of psychology in computers principles. The Systems is to make the work as presentable and fun to work with as possible. An electronic system will also have an effect of fostering uniformity and neatness.

The proposed system shall basically be a desktop system with potential to be ported to run on other devices such as the smart phone. Noteworthy is the perspective that the system is class based as opposed to institution based. This is specifically to fill the void or gap that is left with institution size systems that are already in use. The proposed system, Integrated Class Records System (InClaRS), is basically operated by the teacher for the teacher. This solution is particularly a new approach in Zimbabwean primary schools.

1.5.0 Project Objectives

This project is intended to:

- Create an offline class-based student information management system.
- Provide an offline electronic classroom record keeping systems for the modern-day classroom teacher.
- Provide security to the classroom records and foster confidentiality of student information.
- Create a professional class-based database for use by the modern-day classroom practitioner.

- Give means to process data entries to provide the teacher with professional analysis of students
- Provide the classroom teacher with the tools useful tools to generate professional class-based reports
- Store all event data and make summary information available in a variety of formats
- Track students' academic progress and progress in other cocurricular activities
- Provide a flexible record keeping system where data can be added, edited, updated, organized and securely erased.
- Provide the means to mitigate data loss (fees payment records, expenditure records) as a result of virus attacks on the electronic system.
- Provide the MOPSE with solutions to their commitment to develop e-resources for use by classroom teachers in information management.

However, some of the objectives may demand an enormous amount of time to achieve, thus the researcher shall only focus on basic objectives that will ensure the release of a minimum viable product (mvp). The first four objectives are essential to this project and shall be the reference point for the success of the project while the rest are collateral achievements of the finished product. The rest are collateral achievements in the sense that once the core objectives are achieved, they will form the basis upon which the 'extended' objectives are achieved. As an example, achieving the first objective: Create an offline class-based student information management system, will ensure achievement of the last objective: Provide the MOPSE with solutions to their commitment to develop e-resources for use by classroom teachers in information management.

1.6.0 Scope of the Project

The scope of this project shall merge two facets that are salient to this project. Ideally the culmination of this endeavour shall be marked by the production of a fully functional computer application for use by a modern-day primary school teacher. This part is the practical and also the application side of this project. Here the project takes the form and shape of an action research. Hult and Lennung (1980) cited in Cohen et al (19) state that action research makes for practical problem-solving as well as expanding scientific knowledge and also focuses on those problems that are of immediate concern to the

practitioner. To back the application, this project shall also bring to light the theoretical justification for maintaining records. This theoretical part of the project, forming the foundation for the whole project, shall mainly focus on highlighting and illuminating the need to computerise class records generating and maintenance.

For the purposes of this discourse, only record keeping for a modern-day primary school teacher in the context of the Zimbabwean Education sector shall be discussed. The project shall be narrowed to the narrative highlighted above because it is in the researcher's view that the primary school teacher is most adversely affected by the problem of a congested timetable. This is so because the primary school teacher is bound by a timetable that has no such thing as a 'free period' which the teacher may utilise for record maintenance. This means that the primary school teacher is expected to be in contact with the learners at all material times as indicated on the timetable. The afternoons are reserved for sporting activities which the teachers are also supposed to supervise.

Record books of a modern-day primary school classroom practitioner come in many forms and types but there are general record books that are common to every primary school teacher. This project shall be focusing on the generic record books as listed below:

(1) Social/ Individual Record

(2) Progress/ Continuous Assessment Record

(3) Remedial Record

(4) Extension Work Record

(5) Performance Lag Address Program (PLAP) Record

(6) Reading Record

(7) Fees and other payments Record

(8) Class Inventory

Within the bounds of this projects, policy dictating the need to generate record books shall be discussed. Also, literature giving rationale for class record books shall also be reviewed.

The practical part of the project can further be divided into two disciplines which are; 1. the paper work supporting the development of the application and 2. The actual development of

the application. The paper work shall focus on the System Analysis and Design. Here different models for System Architecture, Software Engineering Paradigms, Cyclomatic Complexity and Requirements Engineering shall be reviewed and considered.

Data Flow Diagrams (DFDs) and the Unified Modelling Language UML for designing the intended application software shall also be under discussion. The actual diagrams for the *In ClaRS* shall be also be drawn and adhered to during application design and development. Software Development and Life Cycle (SDLC) models shall be used to guide the development, maintenance and eventual termination of the system application.

The Development phase of the application will see the coding of the application using any of the chosen Integrated Development Environments (IDEs). Other CASE tools will also be put to use to support the development stage of the application. Coding shall be done in C# for the backend and SQL for the databases which are to be part of the system. White box testing shall be done in consultation with the supervisor while black box testing shall be done by primary school teachers in the Maquadzi Cluster of the Zvimba District in Mashonaland West.

Data shall be processed and evaluated to ascertain the extent to which the application is useful and acceptable in the education system.

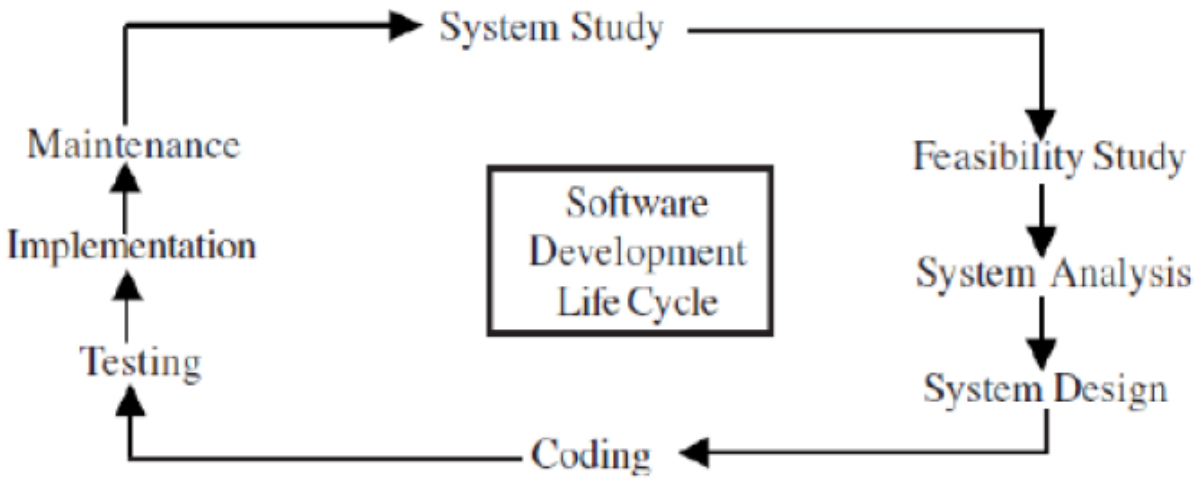
The system, among other things, shall not:

- Be usable at the secondary school level
- Be used for the administration of the whole institution but for the teacher in the classroom
- Be used for as a web based or online system, to cater for the plight of the rural teacher

1.7.0 Life Cycle Model

System Development Life Cycle (SDLC) is an essential component of software engineering. The life cycle of a software is a conceptual framework that outlines the stages or phases the system will go through from the inception of the idea under the system has outlived it process. Cusumano and Smith (1995) state that a life cycle model represents all the activities required to make a software product transit through its life cycle phases.

Figure 1.0 System Life Cycle Model

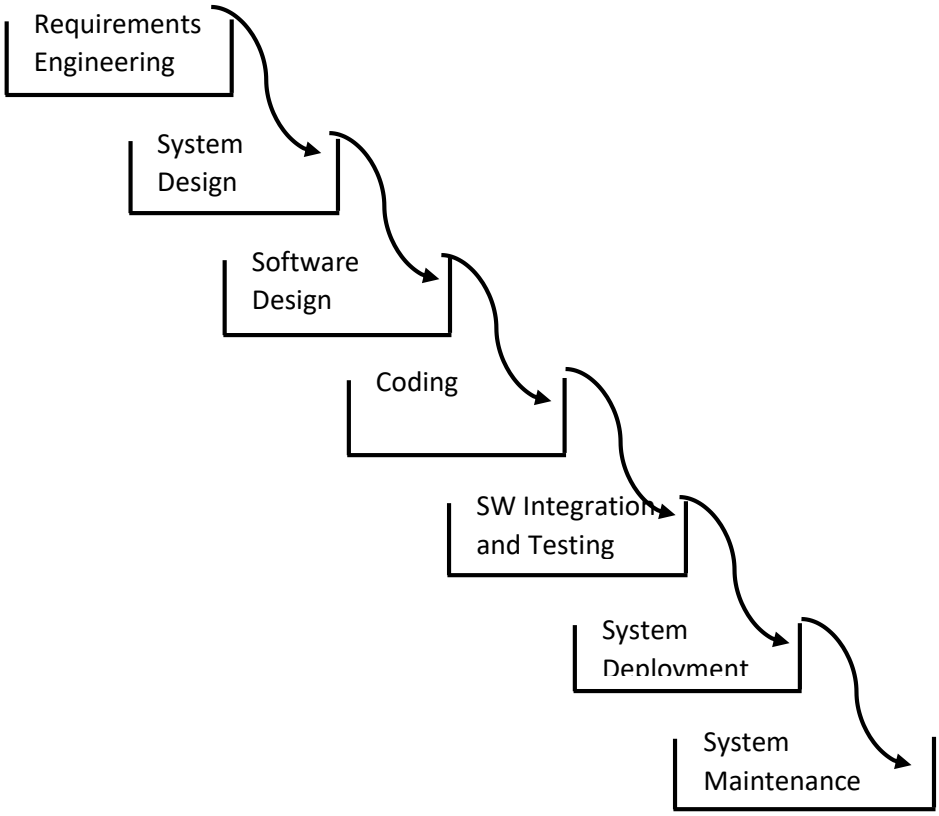


The project shall follow an Object-Oriented Design (OOD) thus an Object-Oriented Life Cycle model will be of better choice. The system shall be built following the Waterfall model which is best when the requirements of the system are well understood. Since the researcher and developer of the *In ClaRS* has adequate experience in teaching at primary school, the requirements for the systems are well understood and clear.

1.7.1 The Waterfall Model

Cusumano and Smith (1995:2) state that "The classic waterfall model views the optimal process for software development as a linear or sequential series of phases that take developers from initial high-level requirements through system testing and product shipment". The operational process of the waterfall model is explicitly outlined by Cusumano and Smith (1995: 2) in stating that "Designers begin by trying to write a specification that is as complete as possible. Next, they divide the specification into pieces or modules in a more detailed design phase, and then assign different individuals or teams to build these pieces in parallel. Each team tests and debugs (finds and fixes errors) in its pieces."

Figure 1.0 The Waterfall Model.



1.7.2 Weaknesses of the Waterfall Model

- Inadequacies in requirements mean that subsequent phases will suffer
- Solutions from the previous phases are shifted to the lower stages, which is bad for system development
- Inheritance of problems from upper phases will end up piling problems for the last phase which is the maintenance phase.

The waterfall model has been preferred because it is useful in developing a system for which the domain is sufficiently understood. It has been noted earlier that this research shall take the form of an action research, thus it involves identifying a problem and understating its nucleus so as to provide a working solution for the problem. This researcher, being in the education system and at a vantage point to identify a problem in the class record keeping processes, has developed substantial understanding of the problem and synthesised a workable solution

which he intends solve the problem with. For this and other reasons the researcher-cum developer has chosen the waterfall model for the development of the Integrated Class Records System (InClaRS).

1.8 Review of Related Literature

1.5.0 Introduction

The idea of record books maintenance by the primary school teacher is by no means a new phenomenon. As far back as 1981 when Zimbabwe was just a new born nation, Lincoln and Guba (1981) were already justifying class records in stating that they give the teacher enough basis upon which he or she makes his or her teaching and learning decisions. This chapter is an examination of work done by other scholars in relation to the narrative this researcher is proffering as an alternative solution.

This section shall consist of two aspects that characterises the design-based research type of a project. The first part shall be concerned with class record keeping as an indispensable part of the education process. This first part shall be oblivious of the distinction between manual and computer-based record books, rather, focus is simply on justifying class record keeping and maintenance. Wang and Hannafin (2005) point out that design-based research has five basic characteristics: pragmatic, grounded, interactive, integrative and contextual. The second part relates to the design-based approach and shall focus on the technical aspect of the project. Here the researcher reviews work to do with the advantages associated with the computer-based class record keeping and how these advantages may be leveraged to revolutionise class record keeping by a primary school class teacher. This part shall also review work on software engineering theories that are critical to the actual development of the system being proposed.

1.8.1 Rationale for Maintaining Class Records

This section attention shall be drawn to the justification for maintaining class records by the primary school classroom practitioner. Within the context of teaching as a profession, class record books may also be referred to as the teacher's professional books or documents. Though the list of the teacher's professional books may not be directly exhaustive depending

with different school policy, this narrative shall discuss the generic record books a teacher is supposed to maintain. Chivore (1995) list some of the important record books that include progress record, attainment record, test record, reading record, remedial record, extension record, plans, and schemes. However, the list reflects the trends of the 1990s and many other important records have been considered and introduced which include the individual/social record, performance lag address programme record, inventory, payments record and many other institution specific records.

One unknown author once opined that "If it is not written then it did not happen". The statement here quoted is not literal and does not imply the author's objection to the fact that an event can precede subsequent documentation. The author is simply highlighting the difficulty of proving the occurrence of an event whose occurrence was not recorded. The logic applied here seem to resonate perfectly with education sector particularly in teaching and learning. Tunner (1980: 13) defines the school curriculum as a "planned and guided experiences and intended outcomes formulated through systematic reconstruction of knowledge and experience under the auspices of the school for the learner's continuous growth and social competence". The above proposition seems to be in sync with McKernan's (2008: 3) definition of the same concept in saying that "A curriculum embodies the planning and implantation of educational experience through carefully orchestrated procedures made from judicious selection from the culture". It may be safely inferred from the definitions given above that a curriculum is a prescription of experiences and content the learner is supposed to be subjected to in pursuit of set goals. Therefore, following the logic the "if not written then not happened" logic expressed above, a curriculum would be a huge non-event if record books are not maintained by its implementers- the teacher.

Class record books are drawn and maintained for than just a single reason. Anderson cited by Chivore (1997: 26) "…regards effective teachers as the teachers who achieve the goals set for them by the school administration and ministries of education. This means goals imposed on teachers, as well as goals teachers set for themselves". For a teacher to be able to achieve the said goals, which is pretty much the entirety of his or her role in education, Medley, cited by Chiwore (1997), suggests that a teacher should possess two of the most important teacher attributes- competence and performance. Medley in Chiwore (ibid) states that "the possession of knowledge and skills by the teachers is called teacher competence while the use of that knowledge and skills in the classroom is referred to as teacher performance." This means that a teacher who is has mastery of his or her subject matter but not able to perform his assigned

duties, which include record keeping, finds it impossible to achieve both the institutions' and his or her own goals. Record keeping is, thus, one of the duties performed by the teacher to augment his competence so a as to achieve set goals. As rightly put by Anderson (1991) a teacher competent teacher is not effective unless if he or she performs.

Chivore (1995: 28) avers that "Maintenance of various records by the teacher helps him/her in the implementation of the curriculum". Record books contain important information that acts as the teacher's guide and reference in discharging his or her duties. Such information as is contained in the Individual/Social record books gives the teacher information on the learner's background thus informing his conduct of each individual learner. Record books also are also among the tools that used to measure the extent to which set goals of the curriculum have been achieved. In the progress record where the teacher records the marks of the different tests and exercises that the teacher administers, the teacher may obtain essential analysis on the success of his contact with the leaners. Regardless of the school having a school administration system the primary school classroom teacher still has to maintain his or her records. This just goes to confirm that some of the teacher's duties cannot be outsourced and are not going anywhere. The teacher will always be required to maintain class records because they are particularly indispensable in the equation of successful teaching and learning.

Documentation also helps the teacher to make informed decisions. The various record books inform the teachers course of action in many aspects of teaching. This is confirmed by Farrant (1991) in asserting that class record books lent the teacher professional analysis tools and material that enable him or her to make judgments and decisions on his or her teaching and learning trajectory. As an example, the inventory informs the teacher as to how resources may be distributed among learners in the class. The teacher may or may not proceed to introducing a new topic depending on a test whose outcome is recorded in the progress record book. The reading record may also identify learners who may need extra assistance or resources.

It may be concluded therefore that without class record books the teacher may not be able to convincingly prove that his or her role in curriculum implementation was executed to the satisfaction of his or her supervisors. It has also been established that the nature of teaching and learning makes class records keeping unavoidable and a concept which will endure in the education system forever.

1.8.2 Record Keeping as an important Part of the School System

It may be readily apparent from the section above that class record keeping is basically concerned with the gathering, storage and processing of information related to learners within a particular class. It has been established that the maintenance of class records is salient to the achievement of the goals defined by the curriculum thus making class record books an imperative component of the school system. This section shall, therefore, seek to establish the relationship that exists between the concept of class record keeping and the whole matrix of the school system. The importance and relevance of integrating information technology in class record keeping shall also be subject to this discourse.

O'Brien and Marakas (2011:) intimate that "a system is a set of interrelated components, with a clearly defined boundary, working together to achieve a common set of objectives." thus being the perfect description of a typical school. Components of a school include its human resources, records, infrastructure, stakeholders, the curriculum, the learners and other various components that are essential for the achievement of the goals set by the curriculum. One common saying state that "A chain is only as strong as its weakest link", this implies that within a system the less effective component will ultimately determine the overall efficiency of the whole system. If follows therefore that while there may be improvements in other components of the school system, the archaic way of maintaining class records will deter the modernisation process of the school system. This lag will be much more reflected in the classroom where the records are supposed to be maintained.

O'Brien and Marakas (ibid.) aver that "An information system (IS) can be any organized combination of people, hardware, software, communications networks, data resources, and policies and procedures that stores, retrieves, transforms, and disseminates information in an organization". Here, the authors make it clear that information retrieval, storage and processing also form an information system. Class record books maintained by the classroom teacher also involve input, retrieval, storage and processing of information thus fitting the description and definition of an information system. However, as has been already pointed out, the processes involved in the maintenance of class records is largely manual ana paper based. It is important to note here that the manual processes of maintaining record keeping does not disqualify class record keeping as an information system, rather it only betrays the outdatedness of the processes.

In Zimbabwe, various factors are associated with the lack of improvement and innovation in the area of class record keeping in particular and teaching in general. Chief among these factors is the lack of financial support and stimulus for teaching innovations. The researcher, in his eleven years of service, noticed that, though a cocktail of innovative initiatives is being introduced to enhance the learning experience very little or no attention is put on the human resource-the teacher. Inaccessibility of technological resources such as computer, printers and network connectivity also hinder innovation in teaching and the education system at large. The ugliest and most brutal of the impediments to teacher innovation is particularism which is defined by Loudon and Loudon (2006) as the tendence of basing judgement on narrow or personal characteristics. This tendence is still a reality where some office holders prefer only the way they used to do things and thus unobjectively dismissing and suffocating new ideas. There are people who holds the belief that technological innovations in teaching takes too much responsibility off the teacher and breed laziness among members. This may be evidenced by the disdain with which typed scheme books are associated. The difficulty encountered by the researcher in locating literature on class record book keeping also revealed the deficiency in research and work in the area. This also has been a major factor that perpetuated the manual or traditional information system.

1.8.3 Importance of Information Technology (IT) to Class Record keeping

A review on research work done on the classroom practitioners' records exudes an element of obsoleteness. Work done is primarily on justification for producing such records but little technological innovation of today is exhibited in the researches. Authors such as Farrand J.S, Cohen, Manion and Guva and Lincoln are quiet on how advances in technology can be leveraged to lessen and improve work on the design and maintenance of class records. The present records as being manually written, thus reflecting the technological deficiencies of the past. Some innovations such as the Google Class seek to address the lack of innovation in the area of teaching and learning but also falter in the regard of comprehensive record keeping. Wisemen and Hunt (2008) in Sieberer-nagler (2016:165) state that "…there are three important questions to teach successfully: Who are our students? What do we want them to learn? What do we want them to do when they don't learn to learn?". The first question is very important yet seemingly ignored by trending integrated learning systems the likes of Google Class. Records that seek to answer the 'who' question above are important to teaching and learning processes. Such aspects as profiling and personal information compilation are not present within the solutions on the market.

Laudon and Laudon (2006:1) "…information technologies and systems are revolutionizing the operation of firms, industries, and markets". Information technologies (IT) have scored huge in all aspects of business as it has brought with it ease of operating and efficiency of operations. Loudon and Loudon (2006:3) observe that "There is a growing interdependence between a firm's ability to use information technology and its ability to implement corporate strategies and achieve corporate goals". This observation is not applicable to profit making entities but is also a reality in any institution aiming at achieving set goals. The teacher is hugely guided by aims and objectives of the curriculum and this is the official function of the school- to achieve the curriculum goals that is. It goes without saying that the teacher's ability and efficiency in gathering and using information dramatically improves the teacher's odds of achieving goals defined by the curriculum or the institution.

O'Brien and Marakas (2011) ague that IT reduces the cost of doing business by cutting on the number of resources that are required to do the business. Albeit, lacking the complete shape and form of a business, the teaching profession also requires various resources that are useful in the discharge of the teacher's duties and the thrust to achieve some form of some gain. The school carries the burden of providing resources that are needed by the teacher. While the amount of money required to buy books and pens for record books for each teacher in each year is generally little, the amount tents to rise with the number of teachers and over many years. Paper based class record books, in most cases, become redundant once the learners move to the next level. This means another set of record books are generated for the same group of learners by another teacher, or in some cases the very same teacher. This scenario, where record books are generated on yearly basis, means that the school will always carry the burden of procuring the books and pens used in the process of generating the record books. The use of IT will effectively help alleviate the problem of 'stalemate' costs by providing means to recycle records that have already been generated. Such is the essence of the Integrated Class Records System which is designed to permanently store information which maybe reused in the future by teachers within the same system.

Cankaya and Kuzu (2010:1) state that "For a lot of people, teaching and learning activities are boring and effortful as mentioned in an English proverb: no pain no gain." The use of information technologies, however, has been proven to stimulate "gain" even with minimal amount or the absents of "pain". This may be proven by the ease with which certain tasks may be effectively performed effortlessly using IT tools. The use of computer-based applications such as the InClaRS minimises the pain associated with class records

maintenance while ensuring accuracy and efficiency. The principles of management of information systems give a highlight what is considered to be a good information system. O'Brien and Marakas (2011) state that a good information system must the reflect the following characteristics: accurate, timely, relevant, just sufficient and worth its cost. The use of technological systems improves accuracy by minimising human error. A well-developed system must be able to detect such errors as duplicate entries, redundancy and many others. The time it takes to manually generate and maintain class records hinders the timeliness of the manual system. It is often said that the world is now going through the information age, it means sometimes there is too much information than is necessary for specific business systems. The use of technology minimises the risk of overloading information. Manual systems are often maintained within separate record books which leads to some elements of data being repeated over and over again. Manual systems also present the temptation of excluding some important information in a bid to reduce workload. Computer-based information systems allows storage of sufficient information and avoids unnecessary redundancy and duplicates. It has been argued that information about students is crucial in making decisions by the teacher, thus having accurate information as presented by the computer-based systems makes it easy for the teacher to make correct decisions. This means that the computer-based information systems are worth their cost.

1.9 Conclusion

The discourse above has illuminated the problem with which manual record keeping is associated with. This has been explored within the context of the primary education system in general and of Sutton Mine Primary school in particular. The researcher has established and concretised the idea behind the solution for the problem that has been identified. Related academic work has been reviewed to find parallels and departing point with the automated record management system which is being suggested here as the solution to the inadequacies of the manual record keeping system.

Chapter 2

Project Plan and Feasibility Study

2.0 Introduction

This chapter shall comprise four salient elements. The first part of this chapter shall give an over view of what planning is all about. This phase shall give graphical presentation of how the project shall be structured. The second part shall mainly focus on what a feasibility study is and its importance to project development. This shall thus form the basis upon which the actual feasibility study shall be done. The third part shall therefore be the actual feasibility study being undertaken using the highlights and guidelines drawn from the background of this chapter. The fourth and final step shall be the presentation of a feasibility study undertaken by the researcher. Feasibility, being the key term of his chapter, is defined as task's measure of being practical or doable. Feasibility study is thus a systematic assessment for establishing the 'doability' or practicality of achieving a specific plan or method. This chapter is therefore very important in determining the possibility for materialising the solution this researcher has suggested. The report to be produced at the end of this chapter shall, particularly, form the basis upon which the decision to continue, adjust or discontinue the Integrated Class Record System Record (InClaRS) project is ultimately made.

2.1 Project Plan

"Failing to plan is planning to fail" so goes the old adage. This section puts attention on how the project shall be undertaken giving special focus on the resources, time frame, risks and methods of execution.

- Resources: these are the material and non-material equipment useful for the engagement by the developers. These resources include hardware and software equipment which are useful for the development of the project.
- Time Frame: Here the researcher-cum-developer shall give time frames and bench marks for the process of developing the system. Deadlines may also be included to guide the developer and manage the time within which the minimum viable product may be produced. Workplans shall be drawn which are detailed representation of the time frames.
- Risk analysis—will be looking at all possible risks and setbacks to the development of the project itself, the impact of these risks on the whole project and the preventive measures to avoid these risks and also try to come up with counter measures for the risks if they do occur. The impact on the project will be estimated.
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2.2.0 Feasibility Study

Shaw (2003) defines feasibility study as a document that mainly aims at identifying, exploring, and evaluating the solution of the project to save money and time. This document is pivotal in mapping the course and direction for a project in business and technical environments. When conducting a feasibility study all the possible variables that has an impact on the project and its environment are evaluated. A feasibility study is important both at the beginning of a project and during its development. At the foundation stage of a project it is necessary to establish the trajectory of a project and the constraints associated with the whole endeavour. Arain et al (2010) state that mistakes that are made and unnoticed at the beginning of a project are much more difficult to correct later. It follows therefore that the success or failure of a solution being embodied by a project has to be forecast early enough to allow timely correction of mistakes thus avoiding wastage of time and resources on a wild goose chase. The feasibility study therefore helps to make decisions on the viability of a project before the project is developed.

Orsmond and Cohn (2015) intimates that institutional goals, demands and environment are, to a considerable degree, dynamic. This points to the non-static nature of most operating and implementing environments. Feasibility study during the development phase will allow the developers to take note and implement any changes within the domain of the intended project.

It is also important to view system design and development as a purely economic process. It is apparent that resources, effort and time necessary for the success of a project attract some unavoidable costs. The finished product is essentially built for a certain amount of return. The cost for development and the return on investment must be balanced so as to ensure viability of the project. Issa et al (2017:1) postulate that "The main purpose of software cost estimation at the early stages is to investigate the economic feasibility of the software project". This so-mentioned viability cannot be ascertained in the absence of a deliberate process to study the possible trajectory of a project. A feasibility study is thus very important as a tool used to measure the balance between the project cost and the expected return on investment.

Arian et al (2010) explains that a feasibility study is also supposed to give quantitative and qualitative proof of the economic feasibility of positively adjusting the status quo within an organisation. Also, proof must be presented that the solution being suggested will improve the effectiveness of the organisation thus initiating the achievement of the institution's goals.

Thus, the goal of a feasibility study is to produce a feasibility report that gives information on the economic, technical and operational feasibility of the solution being proposed.

2.2.1 Project Description

This section seeks to highlight explicitly the description of the Integrated Class Records System. The background of the project is also to be put under the spot light.

Conclusively, a feasibility report should draw from the finding of the feasibility study. A report is given to in detail but short enough as to encourage the targeted readers to read it. The report should culminate into a decision to proceed, adjust or halt the project. Shaw (2003) state that a feasibility report must be short so that everyone is encouraged to read but long enough as to include all the important details.

2.2.2 Project Background

The prevailing situation is that teachers are supposed to generate and maintain record books with student information. The system is largely manual and ununiform, teachers produce their class documents based on personal preference and style. Though some elements of the record books are common, there is no standard prescription as to how the class records are to be developed.

This project development is a new innovative information management system to enhance efficiency, accuracy and usability of the teacher's class record books by automating or, rather, computerising the processes of capturing, storage and processing of learners' information at class level. The new system cuts back on the time taken by the teacher in the production and maintenance of the class records, saving the teacher-learner contact time and improving the teacher's decision-making process. Ultimately the institution's and the teacher's goals are achieved with minimum hustle.

2.2.3 The Decision Maker's Viewpoint

The section shall attend to the senior members of the Sutton Mine Primary school. The research shall try to reveal information on the domain of the project and how it is supposed to be a solution.

Client: The project is for Sutton Mine Primary school

Scope: The project is designed for the primary school teacher. This means the project shall have features that are most applicable to a primary school teacher. The project is supposed to be useful for the classroom teacher. The system may not be generalised to the whole institution. It is important to note that at deployment the software is only but the minimum viable product, this means that the basic functionality of the project is guaranteed but some tasks and functions may be included in the subsequent versions of the software.

Benefits: The System seeks to improve the teacher's efficiency in record keeping. Ease of operating shall save the teacher time which he may use for other important activities. The project also helps to generate professional reports which may be used for decision making.

Technical: The project is a graphical system which combines the main application, which is the interface and the database which would be used for storage and some processing of data. This project is, apparently, not the first of its kind. Though the premise is purely a new perspective some applications have been developed which have the same architecture and technical character. It follows therefore that developing the project is perfectly practical.

Resources: (1) Resources needed by the client will include computers. (2) Windows operating system

Alternative: Since this is purely a new alternative known at the school and surrounding areas, if the project is not done the only option that exists is to do the class record keeping manually.

2.2.4 General Information

Sutton Mine Primary School is a P3 school, in the Zvimba district of the Mashonaland West Province. P3 means Primary classification 3, this is a classification of groups of primary schools that are considered to be rural schools. The school is under the responsible authority of the Zimalloys ltd mining company. However, Sutton Mine Primary School is far form being a private institution and is pretty much under the direct administration and control of the Ministry of Primary and Secondary Education.

The education industry is somewhat public though funding is largely by the parents and guardians of children through school fees payment. The curriculum is designed by the government through the ministry of primary and secondary education. The Public Service Commission (PSC) does the recruitment and employment of the teachers for all public schools. The commission is mandated to play oversight role on the performance of all the

civil servants under its purview. The ministry of education also defines its expectations and demands on the teacher on professional matters and standards.

2.2.5 Past Experience

Sutton Mine Primary School was initially the Zimalloys Ltd's baby gaining important financial and material support for the development of the school. It was when the mine was still functional and recording profits. This changed around 2008 when the mine officially folded and leaving the school in the hands of the parents and guardians whose children attended school at Sutton Mine Primary School. Though responsibility was transferred to the parents and guardians the school remained, officially, under the authority of Zimalloys Ltd.

2.2.6 Risk and Prospects about the industry.

The education industry continues to be relevant especially in this information age. The school enrolments continue to swell as the general populace's attitude and perception on education improves. At Sutton Mine at least 60 new learners are enrolled into the Early Childhood Development every year. This number is only the average and with housing units in the excess of 200 at the Sutton Mine Compound, the enrolment is expected to improve. In March of 2021 the president of Zimbabwe, His excellence ED Mnangagwa, announced that the school where to be provided with computers for teaching and learning purposes. This shows that the prospects of the education system in Zimbabwe are very positive.

The risks that exists within the education sector are mostly initiated by poor performance in the economy. Since schools are mainly supported by the parents of learners at a school, failure by these parents to meet their obligations means the demise of or operational difficulties in the school. At Sutton Mine Primary school, the income and expenditure report of 2014, the period of which the economy of the country was generally good, shows that about 70% of parents where able to meet their school fees obligations. The income and expenditure report of 2019, which was not the best year economically, registered a drop in fees payment with only 40% of parents being able to pay for their children's education. This shows that the will or ability to pay dwindles with the decline of the economy.

2.2.7 Objectives of the School

The Sutton Mine Primary school was established to provide education to the children, and sometimes adults, of people at Sutton Mine and surrounding areas. Learners are taught from ECD (A) up to grade seven. Special class services are also provided at the school with a

teacher deliberately dedicated for the class. The objectives of the school are encapsulated within the ministerial goals and objectives.

2.2.8 Demand

Currently, as at March of 2021, the school has an enrolment exceeding 400 learners. Leaners from the mine compound are more than 50% of all the total enrolment while the rest come from the surrounding areas. The school boast of a 12 strong staff compliment.

2.2.9 Strategies for Achieving the Institution's Objectives

Servant leadership by the administration

Innovation in the teaching and learning processes

Acquisition of the requisite resources for the running of the school

Employing business intelligence principles to gain competitive advantage over other institutions in the area

2.2.10 Assumptions and Risks

2.2.11 Assumptions

It is assumed that the services of the school will continue to be relevant and on demand as long as the importance of education remains relevant.

It is assumed that the catchment area of the school will continue to thrive thus providing the school with learners. The existence of the school will be ensured by the continued uptake of new learners in the education system. It is also the assumption of the researcher that, being trained, the teachers at Sutton Mine Primary school possess the basic knowledge and skills to navigate through a simple computer application.

2.2.12 Risks

Near the school there are two smaller schools, Tramore Primary School and Templeton Primary School, which may threaten the enrolment at Sutton Mine Primary school. The school runs the risk of losing learners if nearby schools expand and improve their operations. At the moment the Sutton Mine Primary School has an advantage of better infrastructure

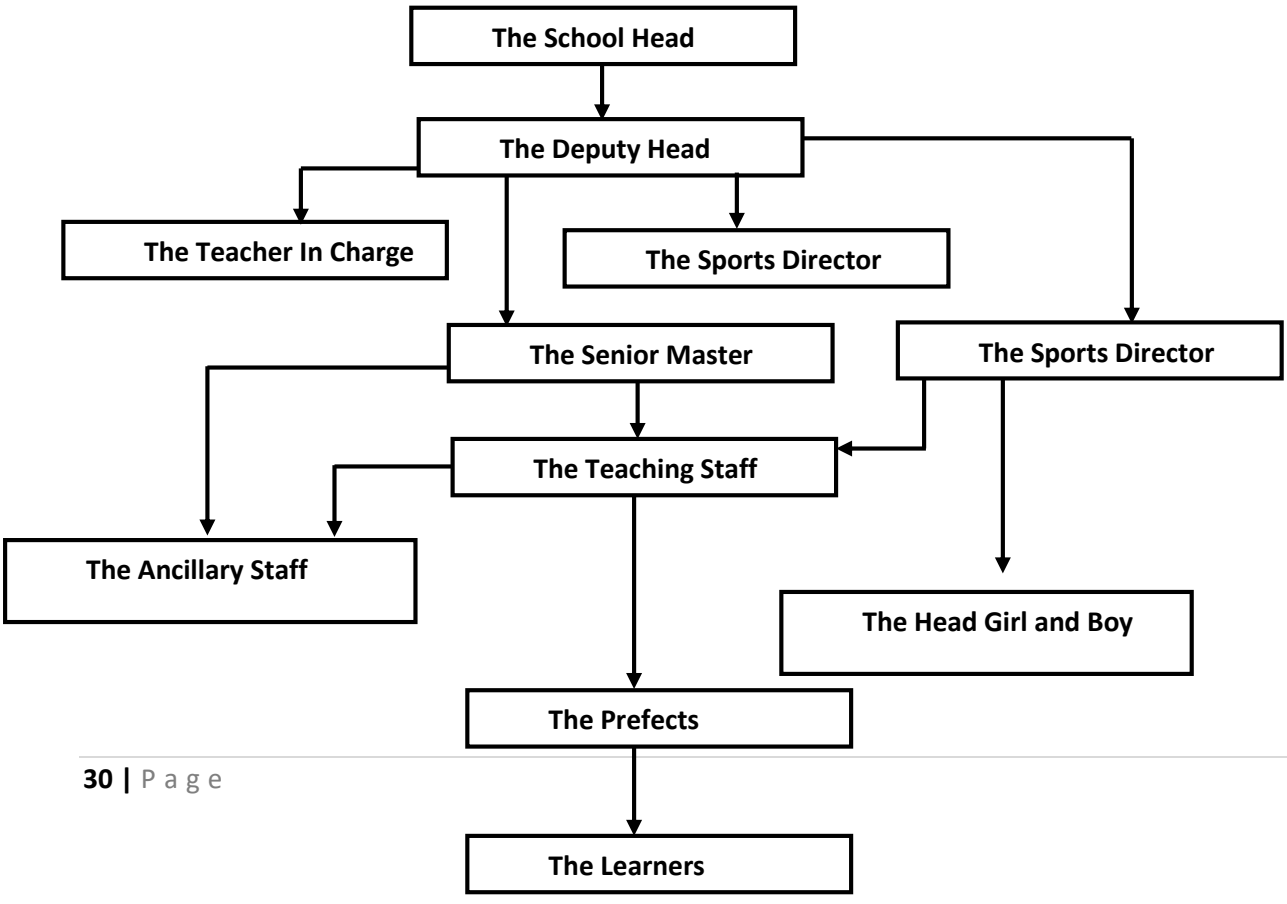
which attracts learners from far beyond its official catchment area. However, with donor funding the small schools, Tramore and Templeton primary schools are slowly registering improvements. It is when these improvements become significant that the Sutton Mine Primary School may start to lose its learners and potential learners to the competing schools.

2.2.12 Organisation Summary

Sutton Mine Primary school is essentially a non-profit making institutions thus its organisation is relatively simple. At the helm of the station is the School Head, the deputy follows before the Teacher in-charge. These three make up the administration. The School Development Committee is a constituted by parents' representatives who help run the school. The senior teacher plays an intermediatory role between the Administration and the rest of the staff. The Sports director may be co-opted into the administration and directs all the sporting activities at the school. Students are led by prefects who are also led by the Head boy and Head girl among them. The diagram below shows the organogram of the school. The ancillary staff is also found in the organogram but are basically controlled by the senior teacher and directly by the Administration. However, the ancillary staff have minimal influence to the decision making processes of the school.

FIGURE 2.0. Organogram of Sutton Mine Primary School

Figure 2.0



2.2.13 Ownership

Sutton Mine Primary School is basically public school under the control of the government of Zimbabwe through the Ministry of Primary and Secondary education. The School is still under the responsible authority of The Zimalloys Ltd which built it but the company has since expressed their inability to continue funding the school. Though the Zimalloys built the school, the company did so on behalf of the ministry of education. This means that the teacher staffing and general control of the school is done by the government of Zimbabwe through the ministry of Primary and Secondary Education.

2.2.14 Bio Data and Technical Qualifications

All members at Sutton Mine Primary school are trained and qualified. The minimum professional qualification is the Diploma in Education. Two members have obtained up to master's degrees, while two have undergraduate degrees.

2.2.15.0 Operational feasibility

Kang et al (1990) state that there is no point in developing a solution which does not really solve anything. It follows therefore that any project, being a solution to a specific problem must fulfil what it is developed to achieve. This is the operationality of the project. Operational feasibility is thus concerned with investigating whether the proposed system operates in the very way it is intended to. It is important before discussing any costs or technical aspects of a solution before it is ascertained if the solution can actually be operational practical.

Operational feasibility must answer the following questions: -

-Will the software be able to perform all the operations the way it should?

-Is the solution suggested by the development team acceptable?

-How easy will it be for the user to adopt the software?

-Is the client satisfied by the alternative solution being given by the development team?

The InClaRS was found to be operationally feasible since its design is simple enough to limit bugs but complex enough to carry out the targeted tasks.

The classroom teachers interviewed expressed their eagerness to adopt the systems. All the 12 teachers at the Sutton Mine Primary school indicated that they would be more than ready to utilise the system.

Prototypes presented to the teachers showed that teachers will meet only minimal challenges in navigating the system. However, the benefits of the system, by far, outweighs these challenges.

The teachers are most excited by the technological solution that is replacing a cumbersome system.

2.2.15.1 Technical Feasibility

Technical feasibility speaks to the practicality of developing the solution. It is widely understood that the means, technical knowledge and technology for developing certain solutions are not available yet. This means that the project or solution may remain an idea awaiting the necessary technical support to materialise them. Software applications are no different, there exists some solutions which are yet to be materialised because they lack the technical support to practicalize them. It is important to study the technical side of a proposed system to check and ascertain if it is feasible to implement.

Technical feasibility must therefore answer the following questions: -

-Is the project doable?

-Are there requisite resources to develop the solution

The developer is confident that the system can be developed with minimum challenges. The developer has a firm background in the education system thus has the maximum understanding of what needs to be done. The training the developer has had thus far, is adequate to ensure a working system.

- The developer is trained and a thorough programmer in C. C#, C#, SQL, Java, HTML, Java Script and many other programming languages.
- The developer is also a system analyst who did a course in Software Engineering at under grad degree level

- The developer also did data structures and algorithms which enhances his technical skills to develop a professional software system
- The developer also did a course in Management of Information Systems which integrates business and technology.

2.2.15.3.0 Hardware Requirements

Table 2.0 Client Computer Specifications:

Item	Minimum	Recommended
Processor	Quad Core	Core i5
Memory	2GB	4GB
Hard Drive Disk	20GB free	50GB
Network Cards	10/100	100/100

Table 2.1 Software Specifications:

Software	Version Required
Visual Studio	2019
SQL Server	Current

The data gathered pertaining the technical facet of the project has helped to reach the conclusion that the project is technically feasible.

2.2.15.3 Economic Feasibility

Isaa et al (2017) point out that the technical feasibility only does not warrant the implementation of a software solution. It is also important to check the cost side for developing the system to decide whether there are enough funds to embark on the project. The economic side of the project entail the cost it will take to develop the project. When the cost exceeds what the developers can afford, it means therefore that embarking on the project is not economically feasible. Sometimes the cost of producing the software is affordable but

is more than or almost equal to the return on investment. This situation also calls for the discontinuity or adjustment of the project. The economic feasibility contributes to the overall decision to proceed, modify or stop the project.

Economic feasibility should sufficiently attend to the answer the following questions:

-Is project under budget?

-How much economic advantage can we obtain

2.2.15.3.1 Cost Benefit Analysis

Table 2.2

	2021	**2022**
Currency	$USD	$USD
Benefits		
Reduced Stationary costs per year	300	300
Reduced logistic costs	1000	1000
Total Benefits	**1300**	**1300**
Year	**2020**	**2021**
Developmental Costs		
Personnel Costs		
Systems Analyst 100 hrs @ $ 5/hr	450	50
Programmer 500hrs @ $5 /hr	1500	1000
Internet Data Bundles 70GB	50	20
New Equipment *(computer Hardware)*		
Desktop Computers	450	0
Backup Hard drive x1	50	0
Computer Software		
Visual Studio 2019 Community edition	0	0
MySQL Work Bench	0	0
Total Development Cost	**2500**	**1070**

Developmental Costs		
Analyst Programmer (*System maintenance)*		
Computer Usage	0	0
Stationary costs	10	10
Equipment Maintenance	20	0
Total Operational Costs	**30**	**10**
Total cost	**3 830**	2 380

It is apparent that the costs of acquiring the system exceeds the monetary benefits for the institution. It should, however, be noted that Sutton Mine Primary School is basically a non-profit making institution. There may be limited monetary benefits of the system to the institution but the main objective here is to improve efficiency of the teaching processes and increased success in the achievement of the school objectives. More so, the cost of development is within the financial capability of Sutton Mine Primary School. InClaRS is therefore an excellent investment as it will ensure the achievement of the institution's overall goals. This then implies the economic feasibility of the project.

2.2.15.4 Schedule feasibility

Is it possible to build a solution in time to be useful?

- What constraints are there on the project schedule?
- Can these constraints be reasonably met?

This researcher, being informed by the information obtained, is confident that the product can be delivered within the set time frame. This conclusion is reached at on the basis that the required technology to build the system along with the expertise is available.

However, not all components of the alpha version may be functional but the developer is certain that the minimum viable product will be ready by the set deadline.

The system is expected to be ready in a 4 months' time. This desirable deadline can be met with hard work. The Rapid Application development (RAD) tools are expected to be used

as well as Object oriented approaches coupled with powerful computer hardware make the

09 April 2021 deadline practical.

2.2.16 Project Schedule Chart

The following table is a scheduling of the project indicating expected start dates and finish dates of activities and the activity duration.

Table 2.3 Project Schedule Chart

ACTIVITY	START DATE	END DATE	DAYS	RESPONSIBILITY
Submission of proposal to department and approval	05- Dec-21	18- Dec-21	14	J. Jafari
Information gathering	29-Dec-21	07-Jan-21	10	J. Jafari
Analysis of the as-is system	10-Jan-21	14-Jan-21	5	J. Jafari
Analysis of the to-be system	15-Jan-21	18- Jan-21	4	J. Jafari
Findings and presentation of data	20-Jan-21	24-Jan-21	5	J. Jafari
Planning	26-Jan-21	31-Jan-21	6	J. Jafari
Review with Supervisor	03-Mar-21	08-Mar-21	5	J. Jafari/Supervisor
Design and Coding	10-Mar-21	23-Mar-21	14	J. Jafari
Final system review with the supervisor and Viva	25- Mar-21	29-Mar-21	4	J. Jafari/Supervisor
Presentation and implementation of the system	05- Apr-21	08-Apr-21	3	J. Jafari

The project time allocation for each individual phase is shown below in the Gantt chart with their respective dates.

Table 2.4 Project Time allocation

PHASE Week	1	2	3	4	5	6	7	8	9	10	11
Project proposal											
Planning											
Analysis											
Design											
Implementation											
Presentation											

Documentation											

KEY:

Phase Duration (Weeks)

2.3.0 Conclusion

After carrying out the feasibility studies, it has been found that the project is practically feasible. The system development team can actually continue with their plan since it has been shown that all the requirements are going to be met and all the constraints have been considered including the risks associated and the plans to mitigate them have been taken into consideration. The researcher-cum-developer thus recommends proceeding with the project. The feasibility study has basically given a 'Go' indication.

Chapter 3 Requirements Analysis

3.0 Introduction

This chapter is meant to give an analysis of requirements for the Integrated Class Record System. The results of a preliminary survey shall be presented. The researcher shall start by explaining the methods that were used in the survey. Thorough exploration and examination of the fundamentals of the system will be done here to concretise the idea behind the proposed systems. The analysis shall manifest in the form of dataflow diagrams, context diagrams, use case diagram and activity diagrams.

3.1.0 Survey Report

This section shall present the various methods which were used in the survey. The requirements engineer considered information gathering tools that included Interviews, questionnaires and introspection. Introspection as a term shall be used interchangeably with 'observation'. The report of the survey shall be presented following the brief discussion on the information gathering tools.

3.1.1.0 Information gathering tools

This researcher has considered a variety of data elicitation methods so that they augment each other in the processes of gathering information form stakeholders. Due to the effects of the COVID-19 pandemic and the lockdowns associated with it, most of the data gathering processes were done virtually. However, this turned out to be beneficial as the virtual sessions cut down on transport costs and commitment constraints. Below are the data collection methods used for information gathering:

- Interviews
- Questionnaires
- Observation/ Introspection

Interviews were done with the classroom teachers, the school administration, the parent's representatives (SDC) and the learners.

3.1.1.1 Interviews

Interviews are basically sessions involving the researcher orally asking pre-planned questions while the respondent answers the questions. Participants typically speak in their own words and their responses are recorded by the researcher through handwritten or in short term

memory for later note taking. The researcher is largely in control of the response situation. In qualitative research the interview format is not highly structured because the researcher's goal is to help respondents express their view of the phenomenon in their own terms (Parton, 2001). The informal conversational interview relies entirely on the spontaneous generalisation of the questions in a natural interaction, typically the one that occurs as part of an ongoing participation observation. Since the conversation appears natural, the participants may not even realise they are being interviewed.

The questions in the interview were meant to assess the general feeling of the classroom teacher regarding record book keeping. The questions also elicited information on the ease or difficulty with which manual record keeping is associated. The administration responded to questions pertaining the processes of classroom record keeping and, in their opinion, if the duty is being done to their satisfaction.

The researcher considered all the 12 classroom teachers at the Sutton Mine Primary School, the school head, deputy head and the Teacher in charge three of whom comprise the administration, 3 members of the school development committee, 5 learners and the headmaster of the Sutton Mine Secondary school. These interviews were largely virtual since COVID-19 induced restrictions rendered face to face interviews almost impossible.

3.1.1.2 Questionnaires

Sidhu (1997) defines questionnaires as forms prepared and distributed to secure responses to certain questions. Questionnaires were prepared for both teachers and the pupils. Close ended questionnaires are those whereby respondents are given alternative answers. The data are easy to tabulate and analyse since answers are brief and uniform. However, this type of questionnaires limits the amount of information from respondents as they do not give room for personal opinion or suggestion on matters that require elaboration. To solve this problem the researcher decided to also use interviews in the research.

The researcher used various question types in creating the questionnaire, tailoring each question to the preferable type:

- Multiple choice radio buttons with one answer possibility.
- Multiple choice checkbox questions with multiple answer possibilities.
- Drop-down menu question.

- Open-ended textbox question.

Nominal, ordinal and interval scales (5-point Likert scale) were used when designing questions. Sample of the questionnaire is provided in Appendix A. The questionnaire was formulated based on the review of related literature.

Multiple sources allowed for triangulation. Yin (1994) also suggested using multiple sources of evidence as a way to ensure construct validity. Triangulation is the use of various methods in collecting data. In this study, triangulation was also used during data collection and analysis.

3.1.1.3 Observation/ Introspection.

Goguen and Linde (1993) state that introspection, the term of which is used interchangeably with observation, is obvious first step taken in trying to gain understanding of a scenario or situation. By observing the developer can create a rough idea of what kind of system would be required for the problem at hand. Introspection is important because it allows the requirements engineer to make interpretations that are based on his or her understating of the situation. The requirements engineer's lack of a general knowledge of the domain in which a system is going to operate means that the engineer can only depend on second hand explanations by the users. Introspection is useful in bringing the engineer in the context of user's environment thus according him some insight which cannot be obtained by a distant engineer.

Introspection was particularly important to this research because of its nature. As an action research, the researcher identified a problem and intends to solve. The problem was identified over a period of time through introspection. The researcher being a practising teacher was able to understand the problem and being trained in computer science was able to map how the problem may be solved.

Introspection may also have its disadvantages that include:

- Misrepresentation of facts caused by the engineer's incomplete understanding of the user's circumstances.
- The engineer's observation may be in conflict with what is regarded as the problem by the actual users.
- Requirements engineer can only introspect on the current situation and not the operational circumstances the new technology will work in.

Introspection is limited by the inadequacies noted above, therefore is important to use the method along other empirical methods of data collection.

3.2.0 Software Requirements Specification (SRS)

This section is dedicated to the task of software requirements specification process which is defined by Hickey and Davis (2004) as document detailing what specific functionality the proposed system will have and how it will happen. This is also where the target stakeholders' needs and demands are reconciled with the product. Sommerville and Viller (1998) explain that a standard SRS document should satisfy the following qualities:

- ✓ Correct
- ✓ Unambiguous
- ✓ Complete
- ✓ Consistent
- ✓ Ranked for importance or stability
- ✓ Modifiable
- ✓ Traceable

The SRS document must consist of deliberate elements which include specifying the purpose for the product, an overall description of the product, the functionality of the software and what it is intend to do, a description of the operational performance of the software, non-functional requirements, external interface and the anticipated limitations the operational environment of the software. Requirements of the system are defined within the SRS document. Requirements take two general forms which are Functional requirements and non-functional requirements. Functional requirements describe the specific use case stories specifications of the software, while non-functional requirements describe the quality attributes of the software.

There are a number of standards used for the specification of the collected requirements, these include the IEEE 830, ISO/IEC/IEEE 29148 and the Volere template. The Volere template is preferred in this research because it is more details about each requirement specified.

3.2.1 Purpose of the product

The product, here named the Integrated Class Records System (InClaRS), is purposed to computerise the record keeping processes for class record books of a primary school teacher.

The product is intended to increase the teacher's efficiency by leveraging on Management of Information Systems. The InClaRS collects, stores and process data for learners within a specific class. The system is intended for use by the teacher as opposed to institution-oriented systems.

3.2.2 Description of the product

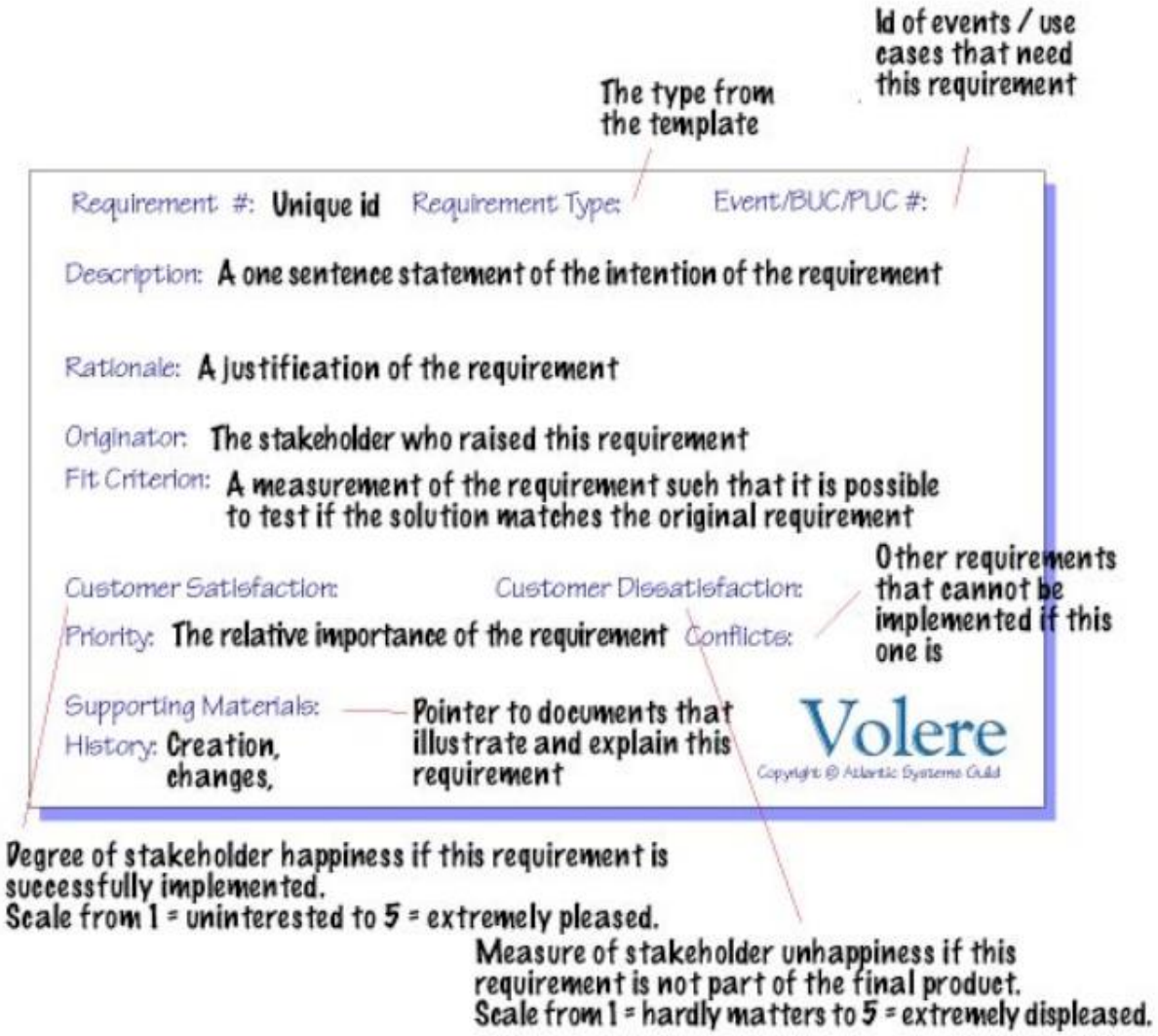
The InClaRS is a software application developed primarily in the C# programming language. The software has an application side whose role is to provide an interface for the user. The application side also passes user commands to an external database management system. The application is separated from the database management systems to avoid tempering with the databases during maintenance of the application. The database management system is used to store, process and provide data to the user through the application. The application is thus connected to the database through an SQL connection.

3.2.3.0 Functionality of the software

The functionality of the software speaks to the functional requirements of the product. The InClaRS shall have the following functions:

1. Allow a user to login
2. Verify the user details
3. Alert user if the login fails
4. Takes the user into the system if login is successful
5. Provide a menu to select a record book to work on
6. Allow the authorised user to enrol a new learner
7. Allow the authorised user to view learner information
8. Allow user to update learner's information
9. Allow the authorised user to remove learner entries from the database
10. Allow user to print reports

Figure 3.1 Volere Template at illustrated by Robertson and Robertson (2012:5)



3.2.3.1 Satisfaction scale

Customer Satisfaction Scale: 1 happy -------- 5 Extremely happy

Customer Dissatisfaction Scale 1 not happy: ------5 Extremely not happy

Table 3.0 Volere Card 1

Requirement ID	FR001	**Requirement Type**	User/System Requirement	**Associative Event**	Verification event
Description	System allows the user to login				
Rationale	This is done to give the user an entry point into the system. It is also the security check for user authentication				
Originator	Mr Baison Lovemore (Grade 7 Teacher and senior master Sutton Mine Pry Sch)				
Fit Criterion	Unauthorised users should be blocked. An authorised user should be taken to the main menu of the system.				
Customer Satisfaction	5	**Customer Dissatisfaction**	5		
Priority	Very High Priority	**Conflicts**	FR003, FR004, NF001		
Support Material	Use Case diagram system on user login				
History	Created 29 December 2020				

Volere Card 3.1

Requirement ID	FR002	**Requirement Type**	System requirement	**Associative Event**	Verification Events
Description	The system should be able to verify user login details				
Rationale	This is the systems way of deciding which user to allow or disallow in the				
Originator	Mrs Gura Miriam (A teacher at Sutton Mine primary School ECD Department)				
Fit Criterion	Error message to be displayed if unauthorised user is detected.				
Customer Satisfaction	4	**Customer Dissatisfaction**	5		
Priority	Very High Priority	**Conflicts**	FR001, NF001		
Support Material	Use Case diagrams on verification and the data flow diagrams				
History	29 Dec 2020				

Volere Card 3.2

Requirement ID	FR003	**Requirement Type**	User/System requirement	**Associative Event**	Login event
Description	Alert user if the login fails				
Rationale	This is to alert the user of the results of his or her attempt to login. The requirement ensures that wrong input is reported.				
Originator	Mr Emmanuel Dove (A System developer and programmer)				
Fit Criterion	A message box must be displayed showing the username and an error message				
Customer Satisfaction	3	**Customer Dissatisfaction**	3		
Priority	High Priority	**Conflicts**	FR001, NF001, NF002		
Support Material	Context flow chart diagram				
History	29 Dec 2020				

Volere Card 3.3

Requirement ID	FR004	**Requirement Type**	User/System Requirement	**Associative Event**	Loading Interface
Description	Takes the user into the system if login is successful				
Rationale	This provides the main entry point into the main system. The user can now view and interact with the main system.				
Originator	Mr Mazaranhanga (Grade 6 class teacher Sutton Mine Primary school)				
Fit Criterion	On successful login the main user interface is loaded showing the main menu of the system.				
Customer Satisfaction	5	**Customer Dissatisfaction**	5		
Priority	Extremely High Priority	**Conflicts**	NF003		
Support Material	Dataflow Diagrams, the context flow chart.				
History	29 Dec 2020				

Volere Card 3.4

Requirement ID	FR005	**Requirement Type**	System Requirement	**Associative Event Id**	Main form load event
Description	Provide a menu to select a record book to work on.				
Rationale	This gives a graphical selection options for the record book items selection. The menu provides record books options to select and interact with.				
Originator	Ms Muchehiwa Diedre A. (Grade 3 Teacher Sutton Mine Primary School)				
Fit Criterion	The user should be able to easily identify record books to from the menu.				
Customer Satisfaction	4	**Customer Dissatisfaction**	3		
Priority	Very High	**Conflicts**	FR007, FR008, FR009, FR010, NF00		
Support Material	Database schema, Entity-Relation Model				
History	30 Dec 2020				

Volere Card 3.5

Requirement ID	FR006	**Requirement Type**	User requirements	**Associative Event**	Insert and update events
Description	Allow the authorised user to enrol a new learner				
Rationale	This requirement defines how the user can modify the database by inserting and updating entries.				
Originator	Mrs Makubalo (Grade 5 Teacher Sutton Mine Primary School)				
Fit Criterion	Once the information has been inserted report should be given through a success of failure message.				
Customer Satisfaction	4	**Customer Dissatisfaction**	3		
Priority	Very High Priority	**Conflicts**	FR009, FR010		
Support Material	Use case diagram showing the user and administrator interacting with the insert object.				
History	30 Dec 2020				

Volere Card 3.6

Requirement ID	FR007	**Requirement Type**	User requirement	**Associative Event**	View events
Description	Allow the authorised user to view learner information.				
Rationale	This gives the user a quick display for the information of learners in the database.				
Originator	Mrs Mpedziswa Rumbidzai (Deputy Head Sutton Mine Primary School)				
Fit Criterion	Information from the database should be displayed in fields on the loaded form.				
Customer Satisfaction	4	**Customer Dissatisfaction**	4		
Priority	Very High Priority	**Conflicts**	NF006, NF005		
Support Material	Use case diagram				
History	31 Dec 2020				

Volere Card 3.7

Requirement ID	FR008	**Requirement Type**	User/System requirement	**Associative Event**	Update event
Description	Allow user to update learner's information.				
Rationale	This requirement gives the user the control to modify information of entries in the database.				
Originator	Ms Chigariro Samantha (Student Teacher at Nyadire Teachers' College)				
Fit Criterion	A success or failure message should be displayed after the transaction has been processed.				
Customer Satisfaction	4	**Customer Dissatisfaction**	3		
Priority	Very High Priority	**Conflicts**	NF006		
Support Material	Database schema, use case diagram				
History	31 Dec 2021				

Volere Card 3.8

Requirement ID	FR009	**Requirement Type**	System Requirement	**Associative Event Id**	Delete entry event
Description	Allow the authorised user to remove learner entries from the database				
Rationale	Allows the administrator transfer or remove an entry from the database system.				
Originator	Mr Cizivano Jeffrey (School Head Sutton Mine Primary School)				
Fit Criterion	Searching a removed entry should result in the display of a message indicating that the entry was removed.				
Customer Satisfaction	4	**Customer Dissatisfaction**	2		
Priority	Low Priority	**Conflicts**			
Support Material	Use case diagram				
History	04 Jan 2021				

Volere Card 3.9

Requirement ID	FR010	**Requirement Type**	User requirement	**Associative Event**	View reports event, print
Description	Allow user to print reports				
Rationale	This allows the user to view consolidated information based on the data entered into the database.				
Originator	Mr Chinofura Shingirai (School Head Sutton Secondary School)				
Fit Criterion	On call the report should be shown as printable pdf document.				
Customer Satisfaction	3	**Customer Dissatisfaction**	4		
Priority	High Priority	**Conflicts**	NF006		
Support Material	Use case diagram				
History	04 Jan 2021				

3.2.4 Operational performance

The InClaRS is designed to operate any machine running a Microsoft Windows operating system. The software is optimised for Windows 7 operating system and upwards. The software is an online application that is tailor-made to suit the prevailing technological description of the Zimbabwean context. Precisely, most schools in Zimbabwe are in the rural peripheries of the country where internet connective is not only limited but very expensive to install or pay for. Thus, the InClaRS is basically an off the web application which performs perfectly without the aid of connectivity. The application is designed such the school admin can view the teachers records from the teacher's machine since the application is not yet provisioned for networking and remote access.

The Integrated Class Record System was designed from the perspective of a teacher. The teacher's work is not entirely on record keeping thus the system should give the user minimum difficulty to learn since the teacher has to do other core duties. Primary school teachers are basically trained more or less the same way thus, as users of the system they may have similar view of the software. However, some teachers are generally aged and out of touch with trending technologies. This prompted the developer to also ensure that the software is simple enough to navigate as to allow the older teachers to relate. The administrators are also one type of user who interact with the system. The school administrators are given privileges to allow them supervise the teacher's work.

3.2.5.0 Non-functional Requirements

Sommerville and Viller (2004) intimate that non-functional requirements are not actually literally non-functional but the term is only meant to distinguish them from those that are named functional requirements. Non-functional requirements are specifications that describing the quality attributes of a software application. These are important because they impose operational standards on the software.

Table 3.10 Non-Functional Requirements for InClaRS:

The system should be:

Requirement ID.	Requirements Statement	Must/Want	Comments
NF001	The application must be secure from intrusion	Must	
NF002	The application shall be easy to use for a primary school teacher	Want	
NF003	The application shall have a downtime not exceeding 24 hours per year	Must	
NF004	The application should perform well in low latency conditions	Must	
NF005	The application should be interoperable with other software applications	Want	
NF006	The application should be efficient	Must	

3.3.0 Use Case

Use case may be defined as a diagrammatic representation of actions or events of a system and how the defining how an actor interacts with the system to achieve a specific goal. Use case is a concept that is developed in the Unified Modelling Language (UML). Actors can be users interacting with the system or some another external system acting on the system. Use cases are typically used at the high level, describing the general framework of user-system interaction. The actual nitty gritty of the software engineering are abstracted within the use cases.

Figure 3.0 Use case for the InClaRS

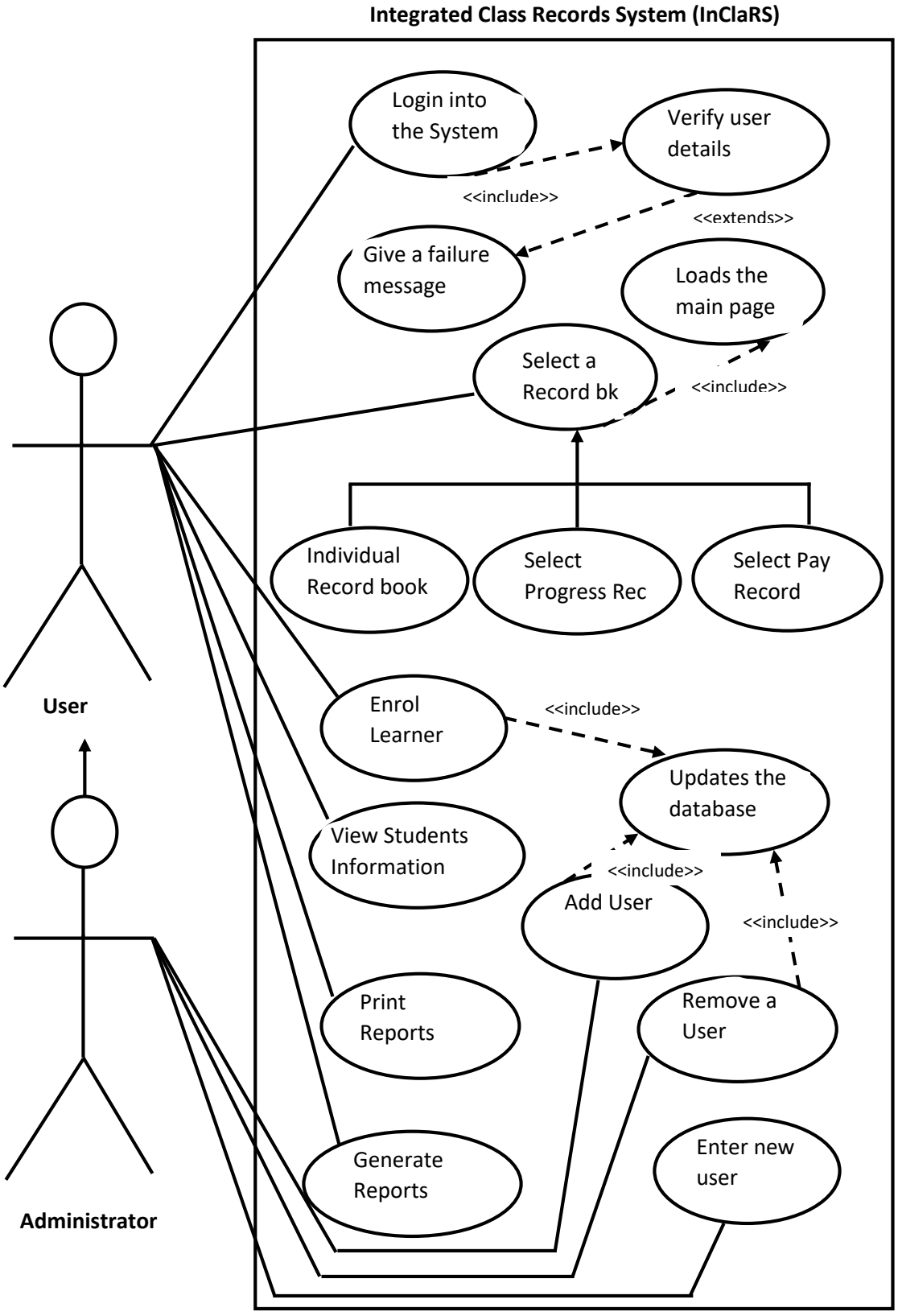
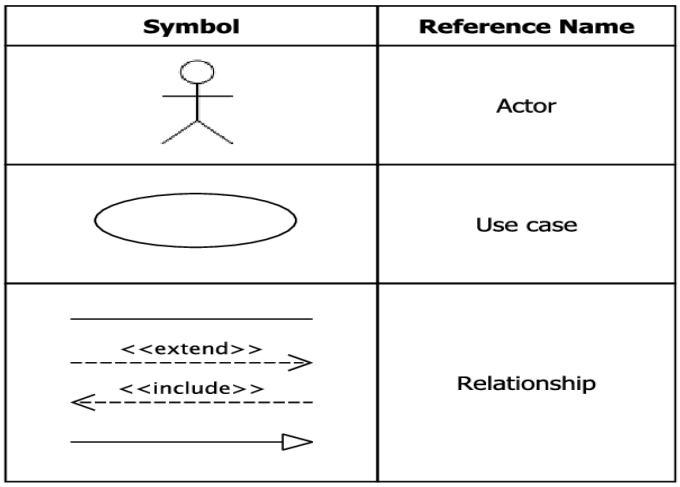


Figure 3.1 Use case Symbols key



3.4.0 Evaluation of Ethical Considerations

The development of software applications have been seen to directly influence the increase of revenue in businesses. This has led to almost aggressive software engineering techniques which present an oversized impact in the domain of the software. Ethical considerations are basically moral standards that guides the process of building software. Thomson and Schmoldt (2001:86) postulate that "Ethics is the study of value concepts such as 'good,' 'bad,' 'right,' 'wrong,' 'ought', applied to actions in relation to group norms and rules.". Ethical considerations are meant to trim the excess developmental aggression and the perceived moral 'ills' with which the engineering process may be associated with. Without ethical considerations software engineering intents to overstep which may lead to violations of the user or stakeholder's rights.

In this research four ethical considerations shall be discussed and strictly observed to ensure the professional implementation of the solution being proposed. These four include addictive design, questionable ownership of data, legal and privacy.

3.4.1 Addictive design

Addictive design speaks to the situation where the application is designed in such a way that the it goes beyond just attracting a user but also hijack their attention. These designs include features that prompts the user to continuously interact with the system even without the need to do so. This researcher, though exercising extreme legal caution, can give an example of known social media software applications. The applications may have features such as 'status' view, 'news feeds' and others which are meant to arrest the attention of the user.

Social media applications are basically intended for communication but it can be seen that they now offer services which outperforming the software's original objective.

The design of the InClaRS notes the important aspect that most of the teacher's time should be spend on the task of teaching. Therefore, the design is only attractive enough to make the application fun to work with but also simple enough as to avoid drawing too much of the teacher's attention. Though such things as media players could have been embedded in the application to carter for the entertainment aspect of the application, it was found these additional functionalities may lead to deviation from the core purpose of the system.

3.4.2 Questionable personal data ownership

The massive collection of data by software for sophisticated profiling of users and prediction of behaviour in such a way that the user's control is compromised. Data can be used to investigate patterns in user's information which will reveal facts about them they would not have revealed. This gives unauthorised control over the users to the owners of the software. A case in point is Facebooks trial, where it was alleged that the social media giant was collecting using information for sale to different businesses. This is considered unethical because the user's personal information would have been used without their consent. This further disenfranchise the user because his or her information is being used against the user for the benefit not of the user but of the data owner.

The InClaRS is within the bounds of what may be considered ethical regarding questionable data ownership. The software protects data stored on the database and does not have capability to upload the data on the internet. The data collected by the InClaRS is only for professional use and cannot be used for marketing purposes. Users of the system do not have privileges to obtain the 'soft data' but only view the entries or handle the printed hard copies. This minimises the risk of having data transferred to other locations where such data may be used to disenfranchise the users.

3.4.3 Privacy

Thomson and Schmoldt (2001) generalises invasion of privacy to any improper access to personal information. Invasion of privacy include data fusion where different data aspects about the same person is supposed to kept in separate places by different data handlers. The fusion of data about an individual, say, from a bank with the individuals work data may give

the bank or the workplace an insight about the individual which they are not supposed to have. Public information is when the data about individuals is used to in reports that are published publicly. A survey on a school's fees payment patterns may entail publishing essential information about individuals who would have consented to be part of the survey. The InClaRS, however, is designed with safety nets as to avoid such things as data fusion. The application does not allow fusion of learner data with anything else that is not authorised by the Ministry of Primary and secondary education.

Information that is collected by the system cannot be used by the same system for public use. The InClaRS is designed to log the user of a system such that any publication of information can only be done as maybe allowable in the education sector of Zimbabwe. The Information also cannot be shared with other players such as politicians and business people who may use it in the public domain.

3.4.4 Legal

Legal considerations may not in themselves purely ethical but may also be used to address ethical inadequacies of the software. As an example, some social media such as Whatsapp are seen t be used to breach privacy and propagate 'immoral' practices. Legal considerations will help to guide how a software maybe build to avoid its use as a platform where devious individuals break the law. The Integrated Class Records System is designed in such a way that no other extra-professional activities may be conducted using the software application.

3.5 Conclusion

This chapter has sufficiently provided the technical basis upon which the product is to be built. A survey was carried out which resulted in the specification of the requirements of the system. The researcher used scientific ways of presenting and analysing the requirements. The Volere template was used to specify and analyse the functional requirements of the software. In the closing sections of this chapter ethical considerations that guided the development of InClaRS were also discussed.

Chapter 4

System Modelling

4.0 Introduction

This chapter may be described the as the logical phase of the system development process. Here, the researcher attempts to give diagrammatic form of the software being developed. The diagrams will act as the conceptual prototype of the actual system thus providing reference for the developer. To be considered for this work are context diagram, dataflow diagram and activity diagrams.

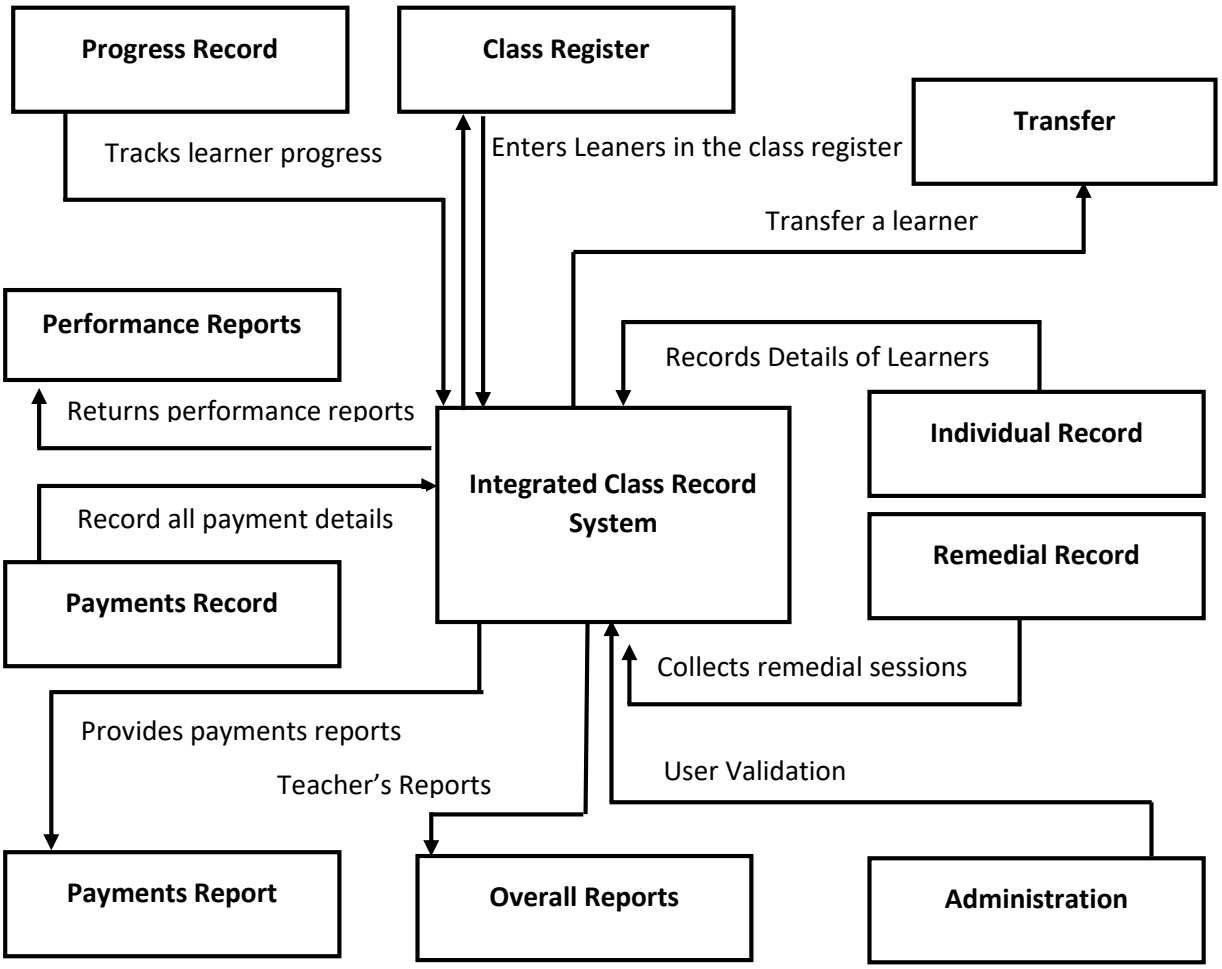
4.1 System Modelling

System modelling is defined by Sommerville and Viller (2004) as saying it is the process of developing the graphical representation of the system. The system model helps the developers gain an understanding of the functionality of the system. The graphical models are relatively easy to understand thus they can be used to communicate with the users. There are a number of developing the graphical representations but it agreeable that the Unified Modelling Language has deservedly gain popularity and respect over the years. The Unified Modelling language shall thus be the modelling language of this developer.

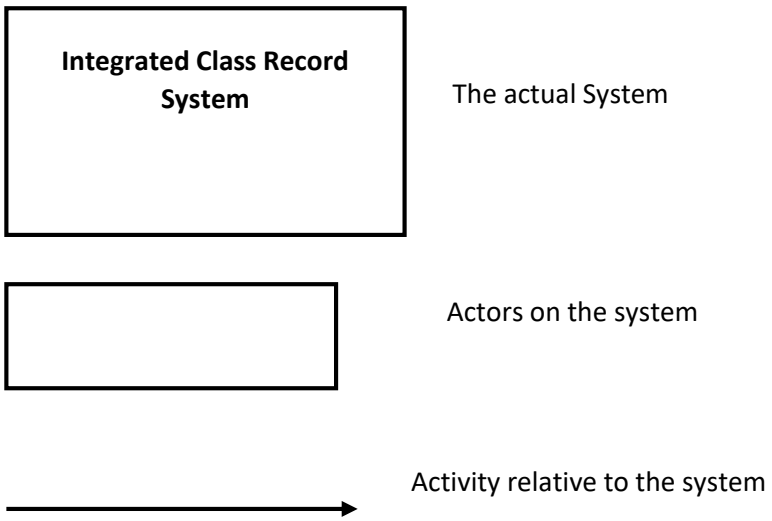
4.2 Context Diagram

The context diagram is an important tool that represents the overall system. The system is located at the centre surrounded by entities it interacts with. The entities may be real life objects or events that may be carried out on the system. A brief description is given for each entity and pertaining how it interacts with the system.

Figure 4.0 Context Diagram for the InClaRS.



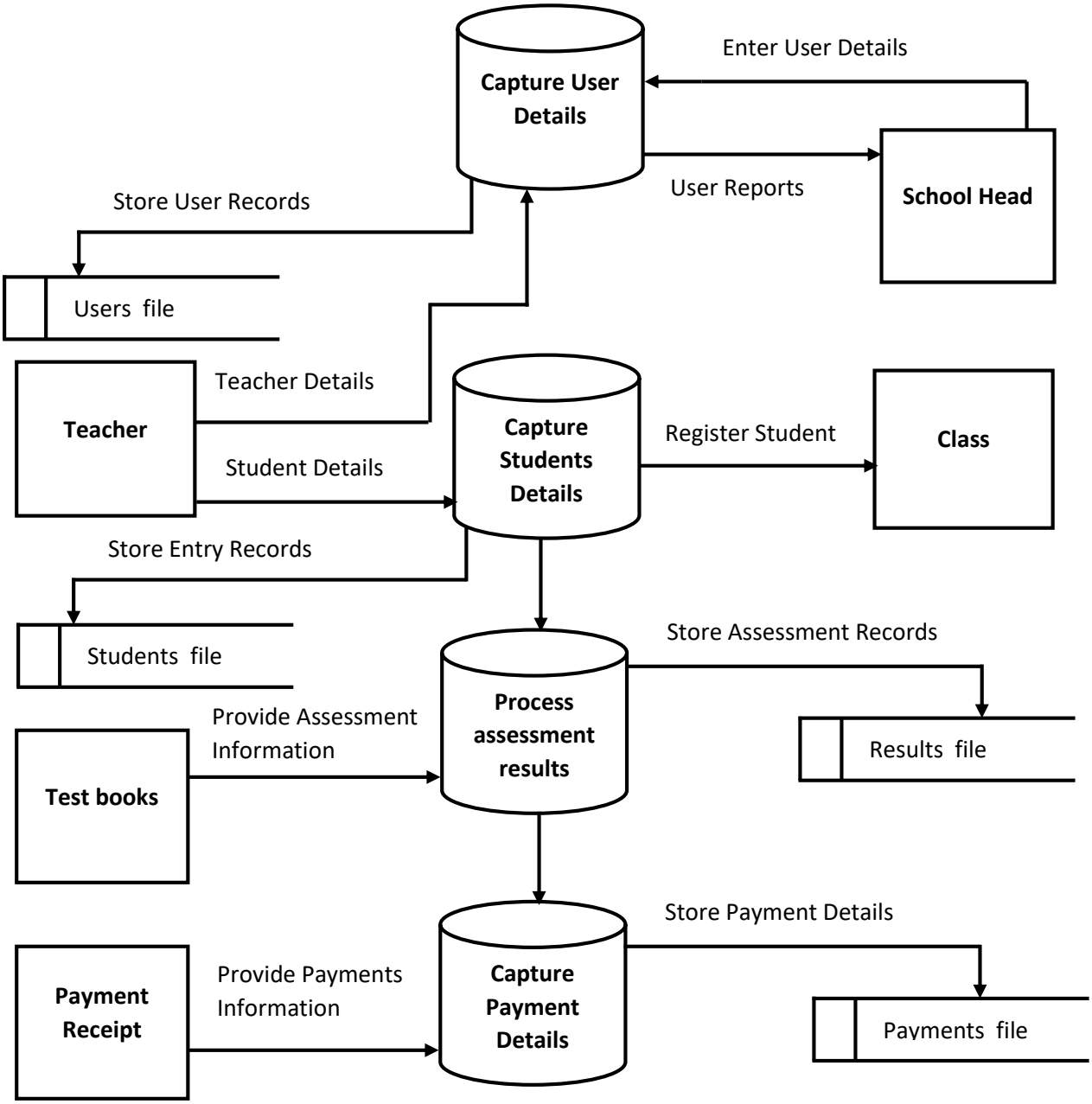
Key



4.1 Dataflow Diagram (DFD)

The dataflow diagram is a graphical depiction showing the channels through which the data moves from one component of the system to the other.

Figure 4.1 Dataflow diagram of the Integrated Class Records System



4.4 Activity Diagram

An activity diagram shows a set of activities and describes how they must be coordinated. An activity diagram models behavioural aspects of the domain. The activity diagrams that represents the login, student enrolment and that of capturing the payment details of a learner shall be provided here.

Figure 4.2 Activity Diagram for User Login.

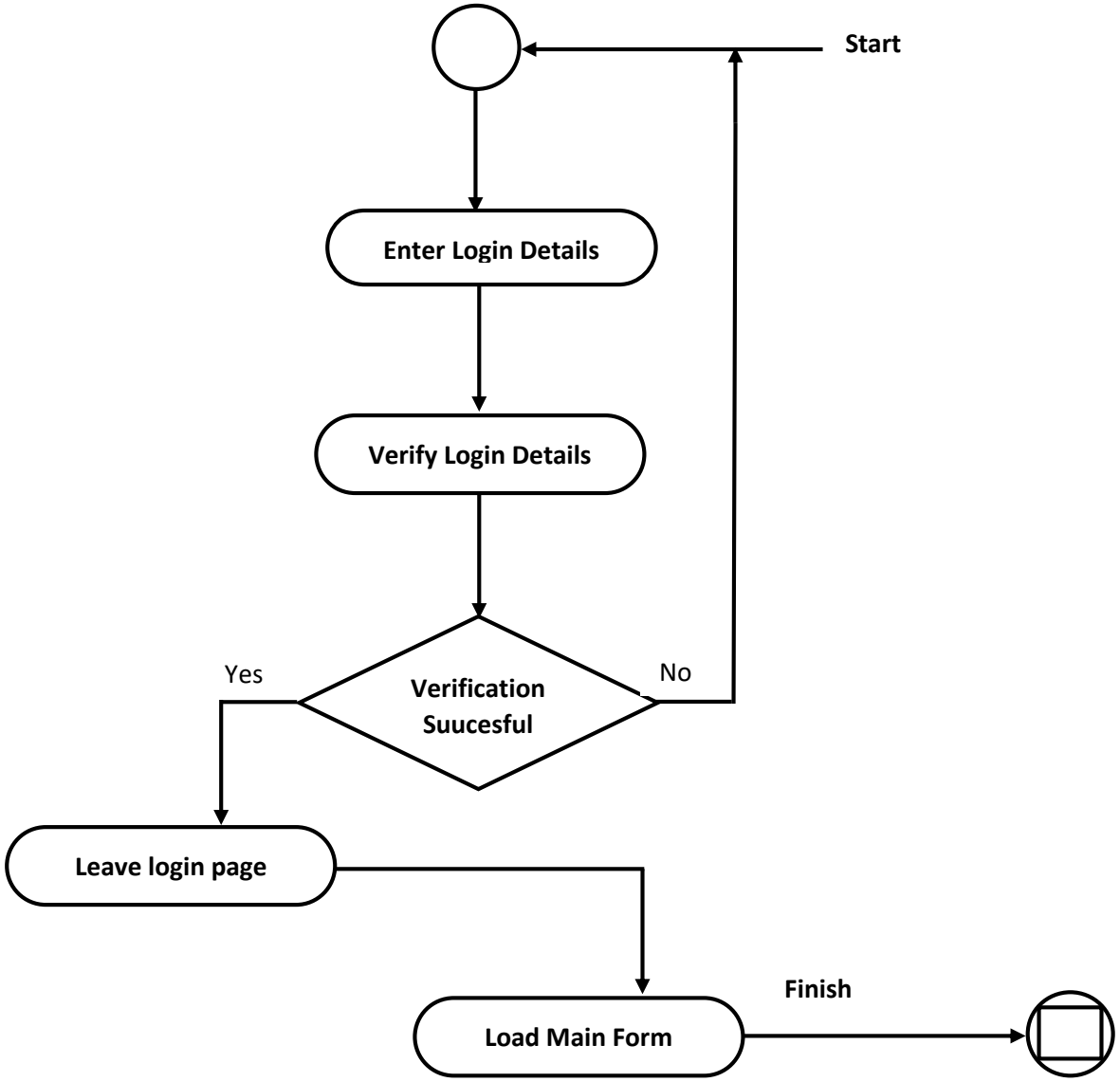


Figure 4.3 Activity Diagram for enrolling a new Learner.

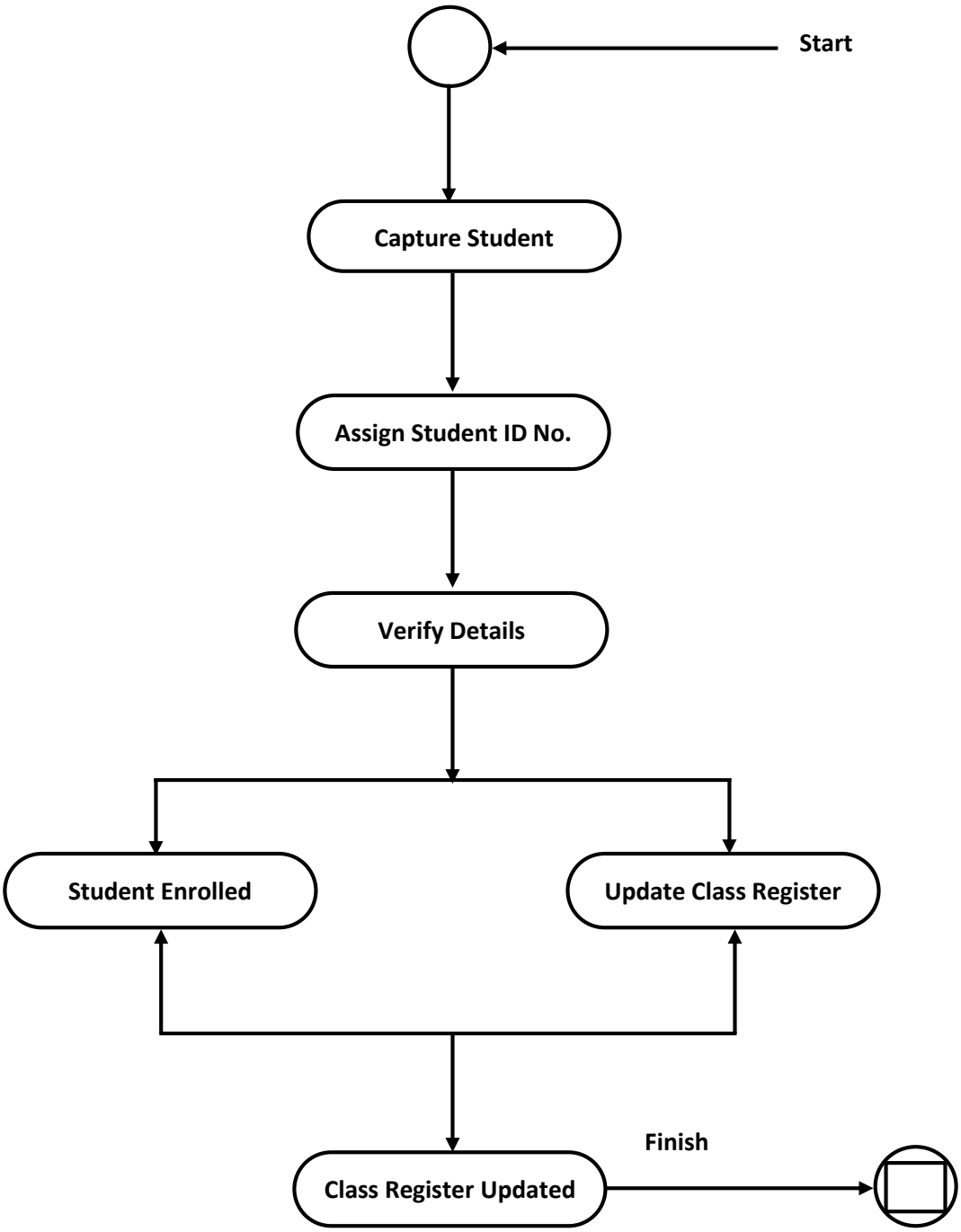
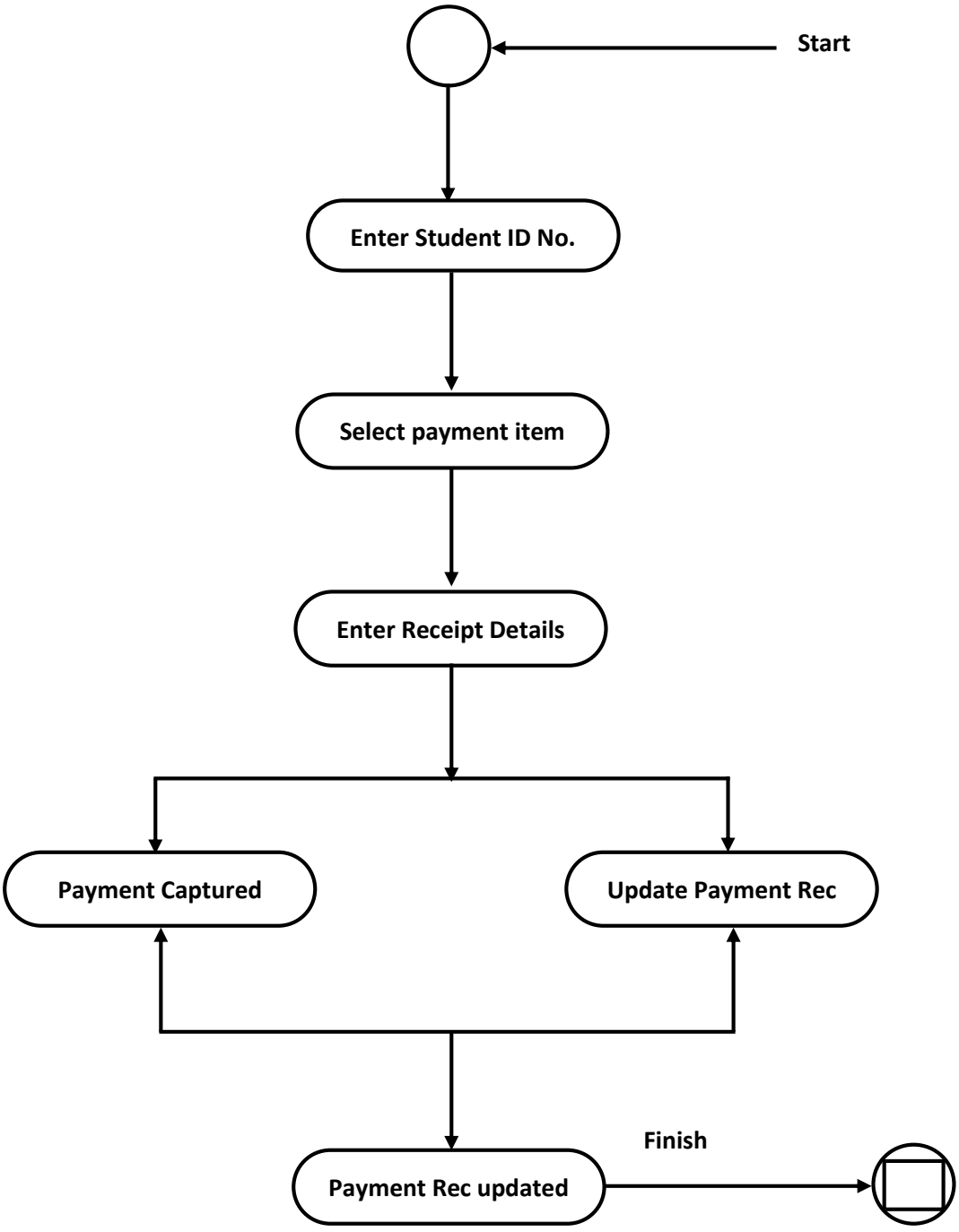


Figure 4.4 Activity Diagram for capturing payment record.



4.5 Conclusion

This chapter represented the conceptual framework of the system to be developed. Different diagrams of the system have been drawn to put into perspective the requirements analysed in chapter three. The diagrams provided here show the basic functionality of the system and how it relates to the entities that interact with it. This chapter shall therefore form the basis upon which the software is developed. The next chapter shall therefore see the actual implementation of the system.

Chapter 5

System Design

5.0 Introduction

As the preceding chapters have laid the base upon which the system is build, this chapter shall begin to concretise the solution suggested by the researcher. In this chapter the attention is now drawn to the design of the system. The chapter shall highlight the interface design, menu design, system architecture and the module design of the software.

5.1.0 System design

Grotker et al (2007) define system design as the process in which the unitary elements of a system are designed. These elements include the architecture, modules, components, interface and the data that goes into the system. To start this process the system is first analysed by decomposing its different elements for the purposes of ascertaining how well these components integrate and work with each other.

The InClaRS is designed in two parts, which are the application side and the database side. The application side shows all the forms of the system. The menu to the left side of the screen shows top level items within which other sub menus are contained. Before the main form is shown, the first thing that appears is the splash screen that shows the details of the system and the developer's detail. After the splash screen finishes loading its instance is destroyed giving way to the login platform. The login platform are actually two forms which are loaded one at a time. The user can login either as a general user or an administrator. The general user has fewer authority privileges than the administrator who, in addition to the general user's privileges, can also add, remove, block or unblock users and can also assign privileges to users and view overall reports.

5.1.1The Splash screen

The first form is a splash screen that initialises the system. On loading, the splash screen appears on the centre of the screen. The details of the system are clearly shown. The logo of the system also shows on the screen. While the systems the progress is shown at the bottom of the screen. Here, the details of the developer and contact details are also shown.

The splash screen is designed in such a way that it changes its colour from pale grey to pitch black. This gives the system a dark them look which is consistent through out the system. The

dark theme was preferred for its simple design and also because dark themes are trending in most software applications these days. The dark theme which is contrasted by bright fonts makes it easy for the user to see the text properly.

Picture 5.0 Splash screen showing 26% Loading progress.

Picture 5.1 Splash screen showing 98% Loading progress.

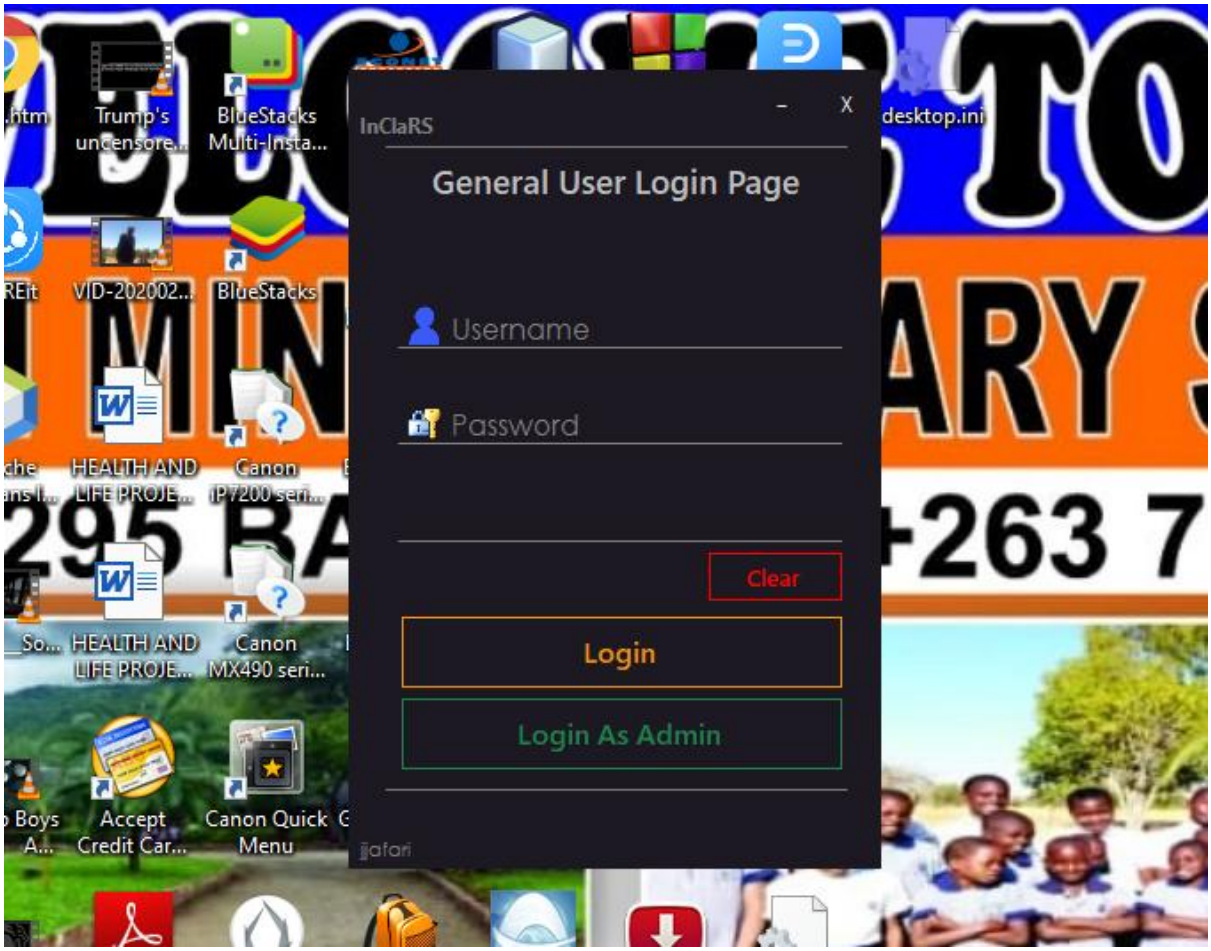
The details of the developer and contacts are also shown.

5.1.2 The Login forms.

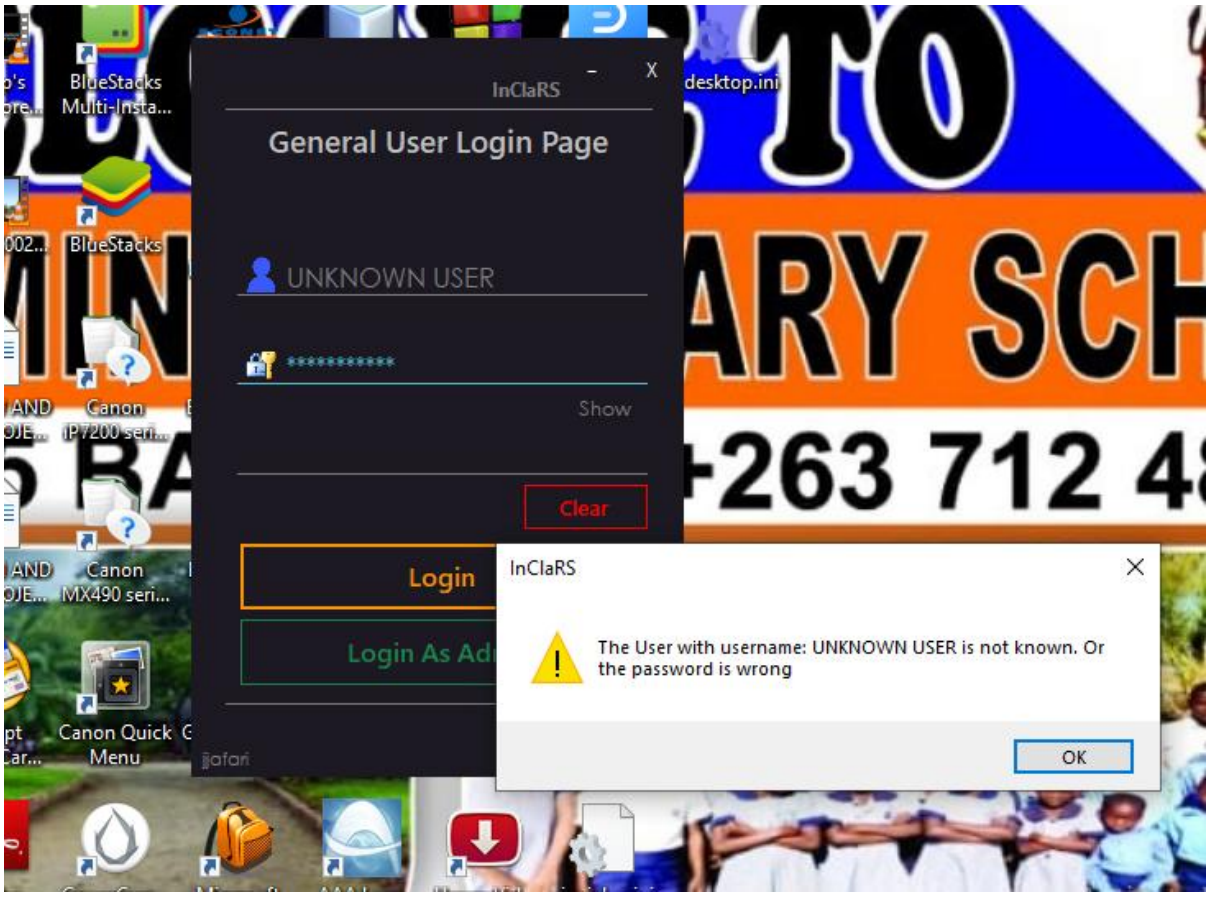
After the successful loading of the system's components and the termination of the splash screen, the user login form is loaded. The general user login form is the one that is loaded initially. However, an admin form can be called at any time by clicking the "Login As Admin" button. The two login forms alternate in appearance and can be both visible at the first time. Switching to the other user is done by clicking the switching button either "Login as general user" to switch from the admin from to the general user form. The opposite is also true about switching to the admin user.

A graphical transition with a sliding look effect was implemented to make the process fun to look at. The two login forms have validation processes for checking the users' login details. When the user details are wrong aa error message alerting the user is displayed and the login fields are refreshed. The user also has a show or hide password to either see their password in plain text or protecting the password by the use of the password character.

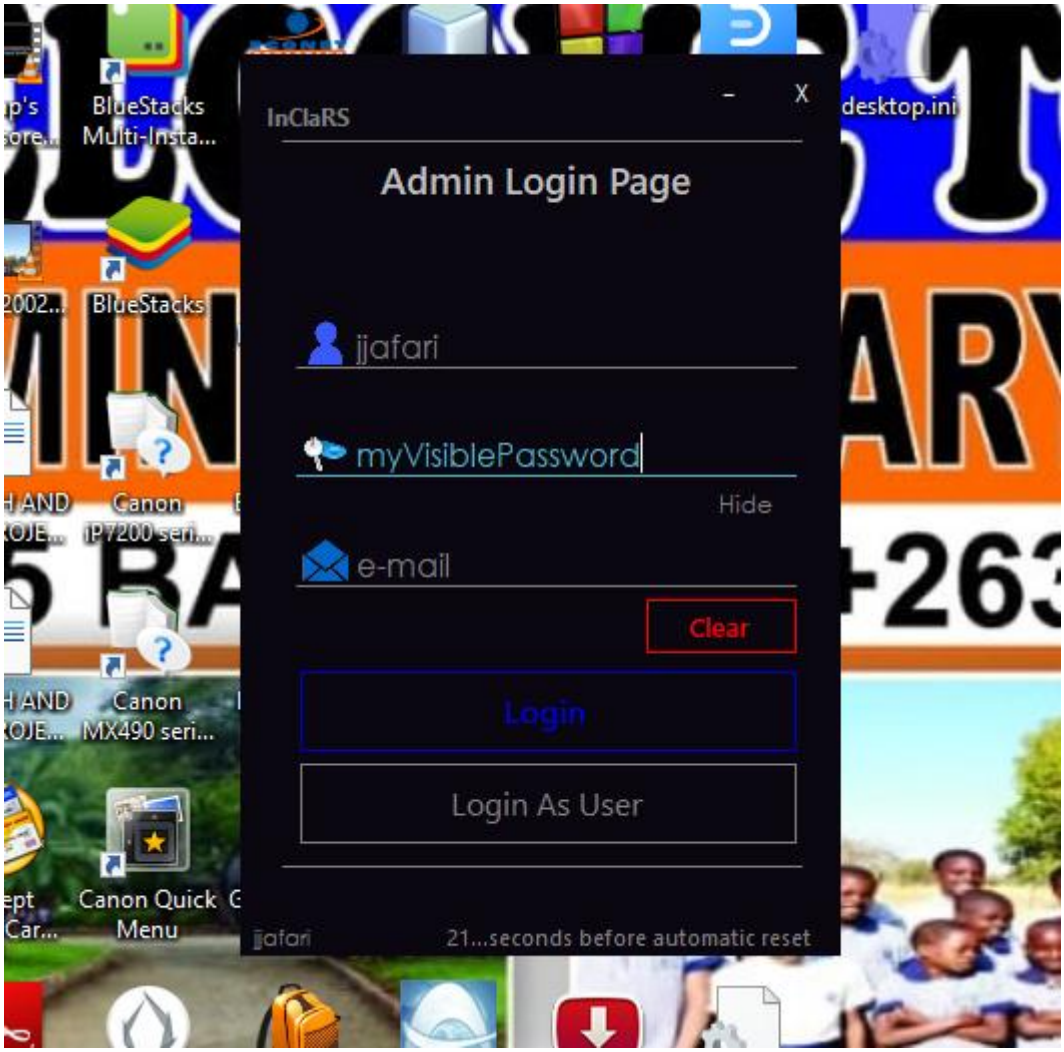
Picture 5.2 The General User Login form.



Picture 5.3 The General User Login form. Login error message shown.



Picture 5.4 The Admin Login form. Unmasking the password with the "show/hide" button.



5.2.0 Elements of a System

5.2.1 Interface Design

Bowen and Reeves (2008) explain that "User-centred design (UCD) and an iterative approach to building user interfaces (UIs) allows us to keep users' requirements central to our design and ensure that we consider their feedback as we amend that design. At the same time, we can ensure that our interface designs reflect the requirements of both the user and the overall system by incorporating them into a formal design process". This gives the InClaRS its

interface designing paradigm. The developer aims at producing an interface which is in strict tandem of the user requirements as specified in the requirements document.

To ensure that the interface does not conflict with user requirements non-functional requirements were fully implemented. The design of the systems also abstracted the logic and inner complexity of the software from the user. Using the Visual Studio integrated development environment (IDE) as the development platform presents the opportunity to maintain the user interface design. The Visual Studio IDE allows for rapid application design (RAD) which makes it easy to create the front-end for the software. RAD is basically a drag-and-drop way of building user interfaces. The different elements of each form or page are dragged form a tools menu and placed at their proper location inside the form. This makes the process of building and designing the front-end sail faster than when having to use code to create each element. Rapid application design also helps reduce time spend on the design and allows more time for coding and setting up logic for different actions and controls of the system.

An incremental approach is also employed as the developer realises that the product takes many faces before it assumes its final look. Therefore, the developer will continuously review the interface until it resembles the user requirement on design. Bowen and Reeves (2008:7) defines refinement as "a formal process which allows us to transform one system into another in a manner which ensures that required properties of the original system are preserved." The development of the InClaRS takes the processes of refinement seriously since, like its name suggests, refines the product at different stages until it becomes just about pure as it can be.

5.3 Menu Design

Ahlstrom et al (2010) defines a menu simply as a primary control in current interface. A menu gives the user a graphical selection panel from which they can select an item to load or view. Bernard and Hamblin (2003) state that there are a number of menu designs which are generalised to be either hierarchical cascading or index menus.

Cascading menu are those that rolls down to reveal the menu items once on mouse hover. Bernard and Hamblin (2003:1) observe that "Cascading menus have the advantage of requiring little screen real estate." The presentation of cascading menus means that little screen space is taken up by the menu. This allows for other elements of the page to find space

on the page. However, according to Bernard and Hamblin (ibid), cascading menus tent to present a certain level of difficulty to the user as navigating menu demands good control of the mouse. Also, when there are many levels of access, straying of the cursor means that menu item is deselected. This may give the user enough frustration to quit an operation. Cascading menus also has another disadvantage of hiding information until the mouse is position on the menu top level above the hidden item.

Index menus are those menus that contain all the items in a categorical index. Index menu have the advantage of ease of use and navigation. All the items of the menu are easily identifiable. However, the index menu tent to use up a lot of screen estate. The more items the menu has means the more space it need on the screen. This design, also, sometimes give unnecessarily too much information on the screen.

The design of the Integrated class Records System the researcher is consider a hybrid design that enjoins the advantages of the cascading and index menus. This is done to eliminate the disadvantage and inadequacies associated with just one menu design. As such the main menu shall be designed to show all the record books on the system. Since each record book may have other internal books or sections, the cascading menu shall be used to show these hidden books.

This way the consolidate menu can show just enough information on the screen while hiding the submenus which are not intended to be readily displayed. This will help to manage screen estate and still maintain a semblance of order on the user interface. This design approach also minimised the difficulty in navigating the menu. On clicking a menu item, a submenu should be shown and will remain displayed until the submenu is closed or another higher level item is selected.

5.4 System Architecture

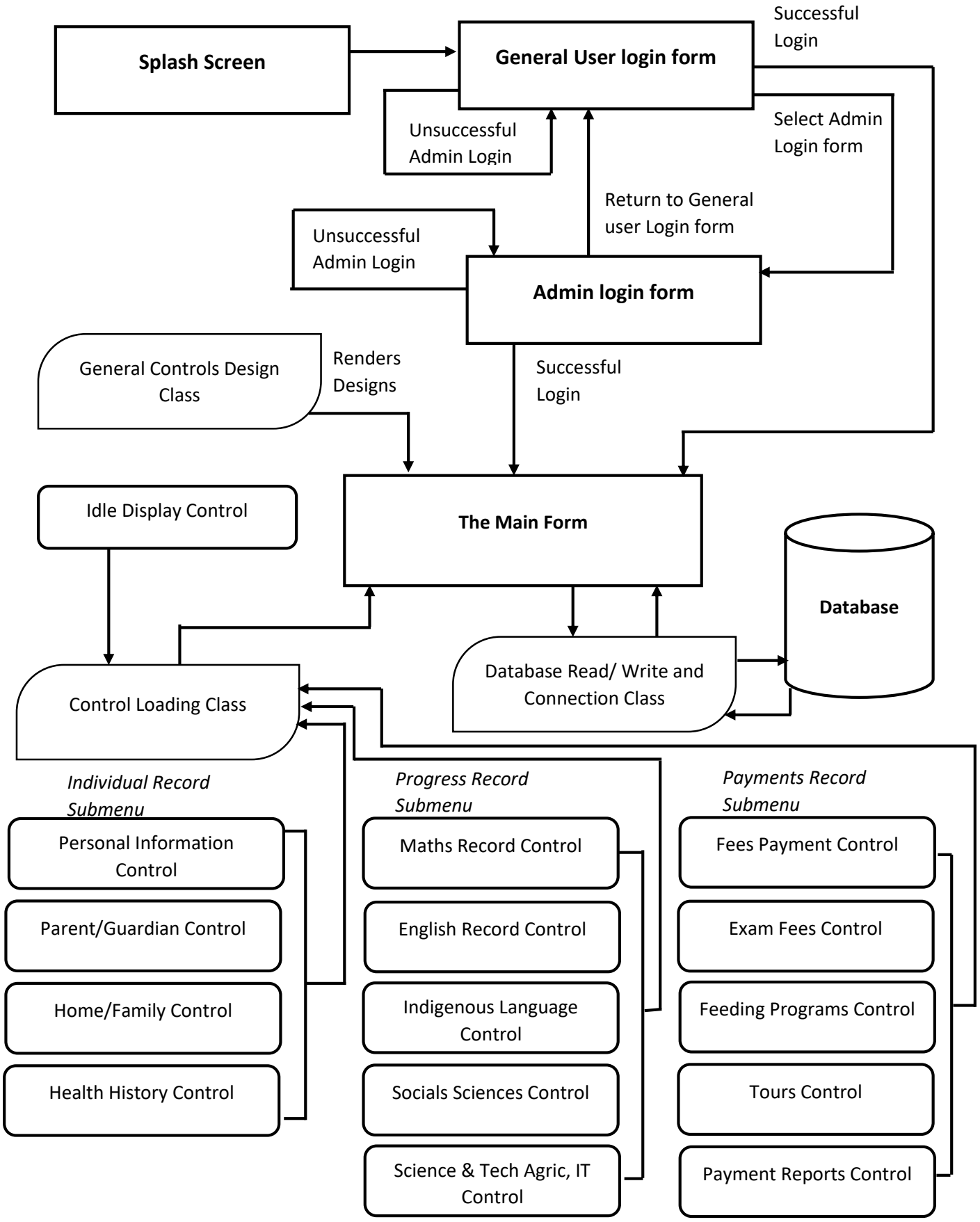
The system architecture is the conceptual representation of the system that details the structure, behaviour and other views of the system. Perry and Wolf cited in Gacek et al (1995:2) intimate that a system architecture is “a set of architectural (or, if you will, design) elements that have a particular form.”. Gacek et al (1995) groups the architectural elements of a system into three groups which are processing elements, data elements, and connecting elements. A flow chart may be drawn for the purpose of illustrating the system’s architecture. This will help in giving the developers the form and state of the software to be developed.

The InClaRS follows the objected oriented narrative thus the system architecture for the software may be described as such. The language chosen for the development of the Integrated Class Records System is C# which is an Object-Oriented Language. The Software is designed to be a collection of objects working together. A core namespace is defined from which all the other classes are called. Different classes are to be built for the purposes of encapsulating some processes. The classes are all named with a prefix of cls- so as to identify them easily.

Only three forms exist in the system for direct interactions with the user. The first of the forms is the splash screen described in details in part 5.1.1. Two login forms present the entry point for the user. The main form is the main interface upon which all the other pages are loaded on selection. The main form has the menu from which other submenus can be accessed. All pages that are loaded onto the main forms are basically controls upon which other controls such as panels, buttons, textboxes, datetime pickers, data grid views and other are placed.

The user enters data through the input controls such as textboxes, date time pickers, radio buttons and option selectors. The same controls are also used to display information read from the database or other data sources such as external excel and word files. The buttons at each page are used to pass specific commands for processing by the application.

Flow Chart 5.0 System Architecture for the Integrated Class Records.

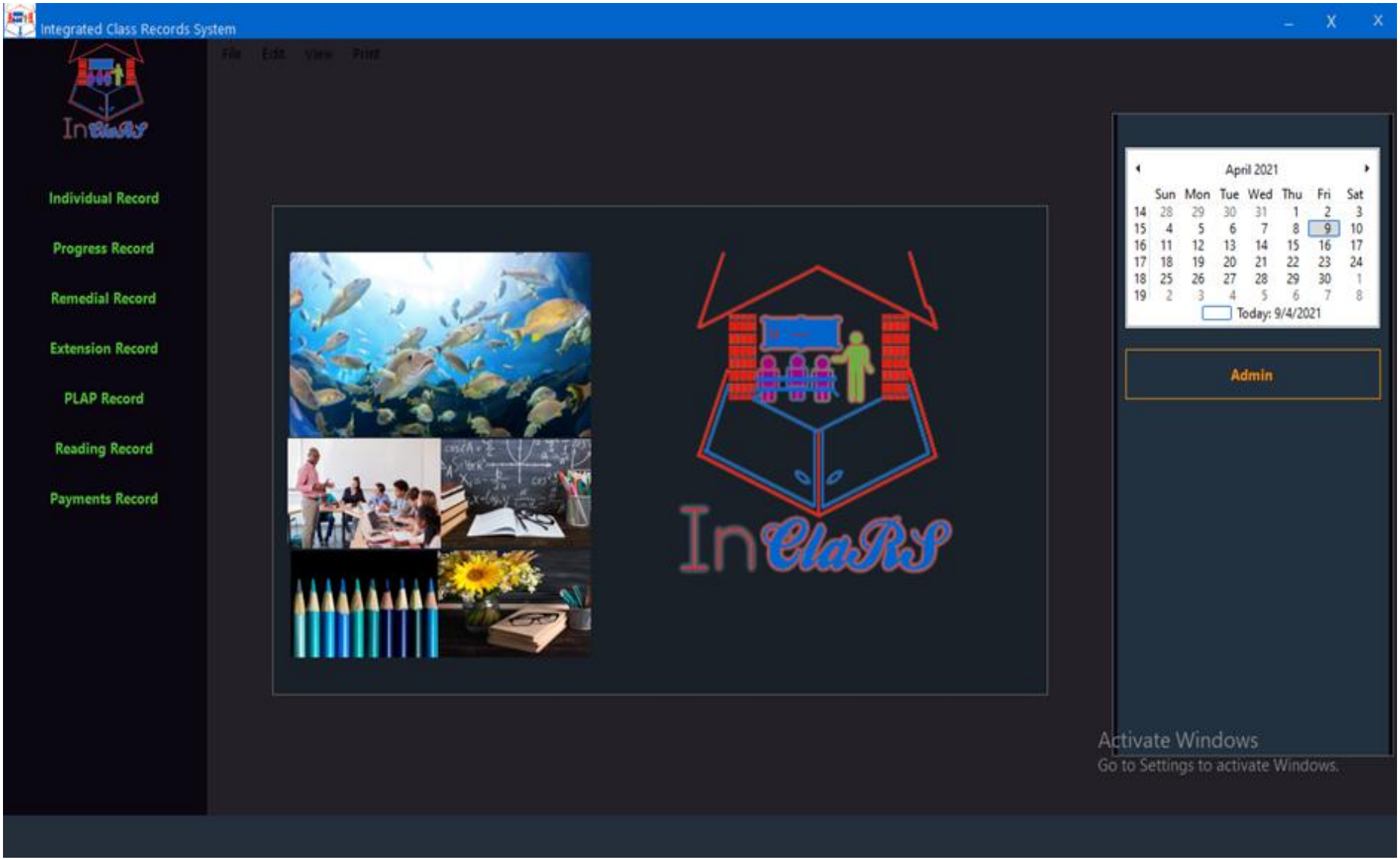


The diagram above shows the basic functionality of the Integrated Class Records Information. Each control shown above is loaded independently after a relative button click event. For example, to load the Personal Information Record, the Individual Record menu button is clicked to show the submenu which contains the Personal Information button.

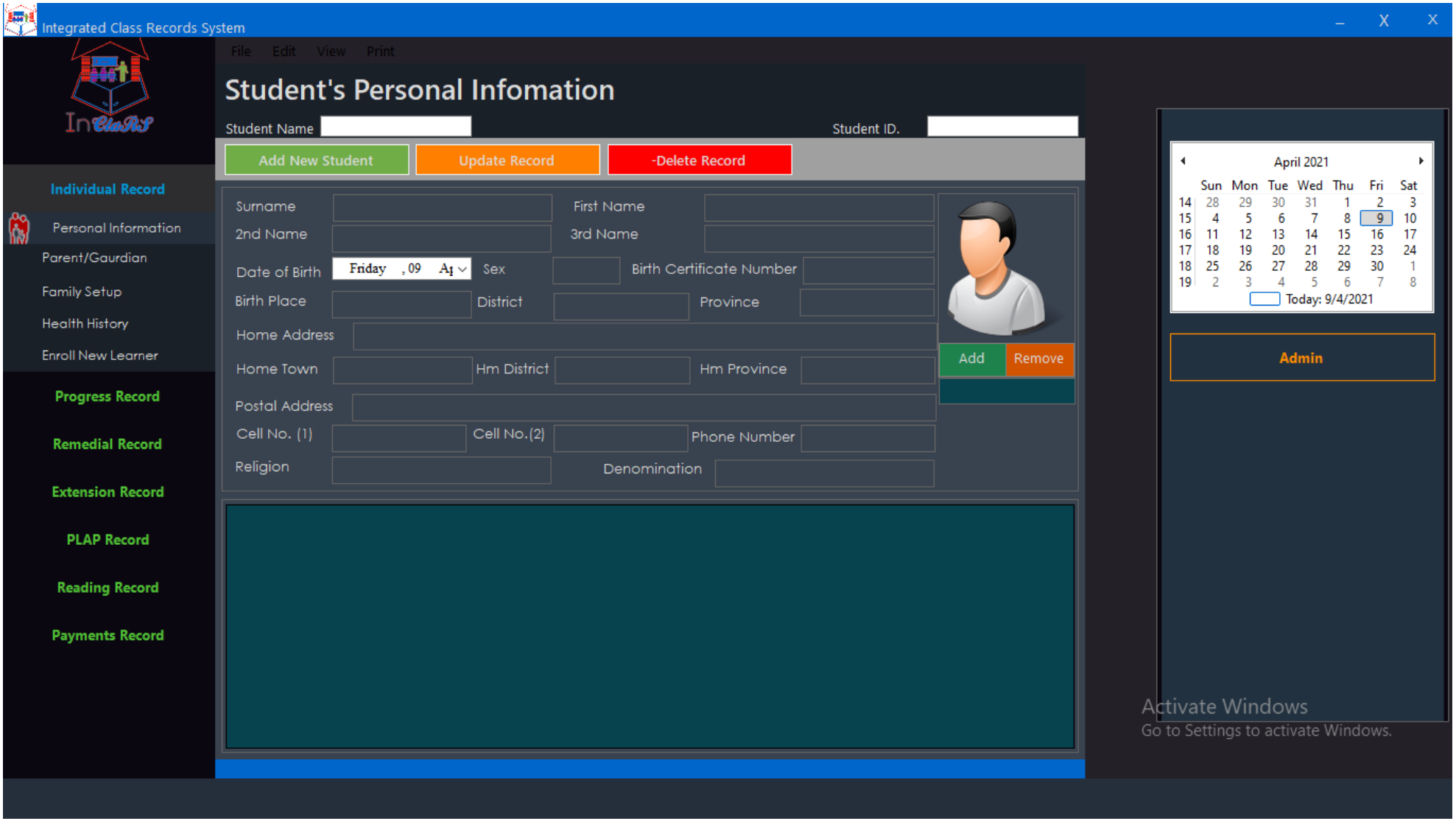
Clicking the button calls fires an instance of the Control loading class which would have the effect of clearing whatever was previously loaded in the main form and load the chosen control on the same form. On each loaded control the user can then enter or retrieve information that is either read or written to or from the database.

The screenshots which follow depict the main form and some controls loaded on it. Since several forms were created, only three forms from two submenus are to be shown for the purposes of demonstration.

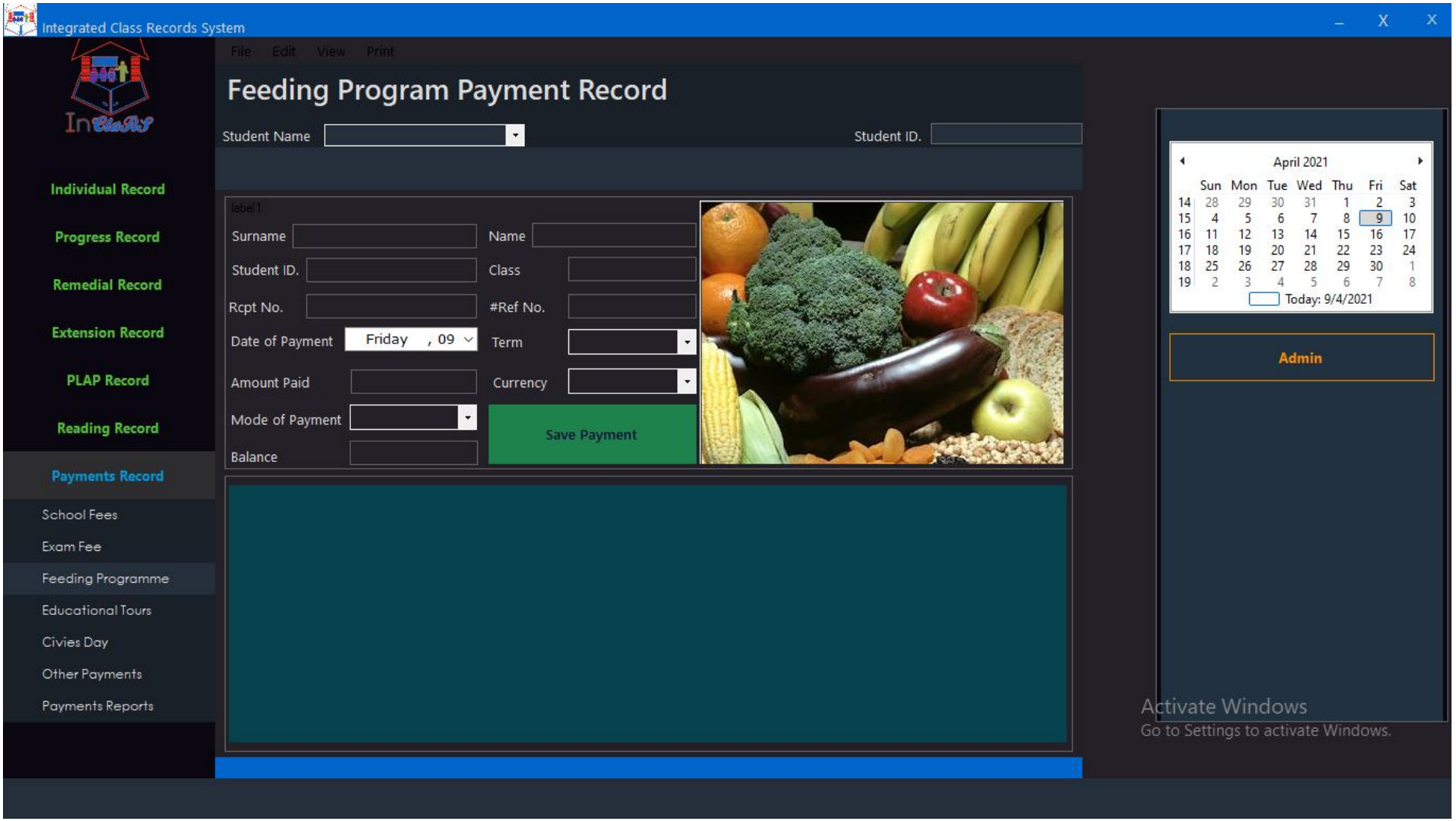
Picture 5.5 The main form with the idle display control loaded.



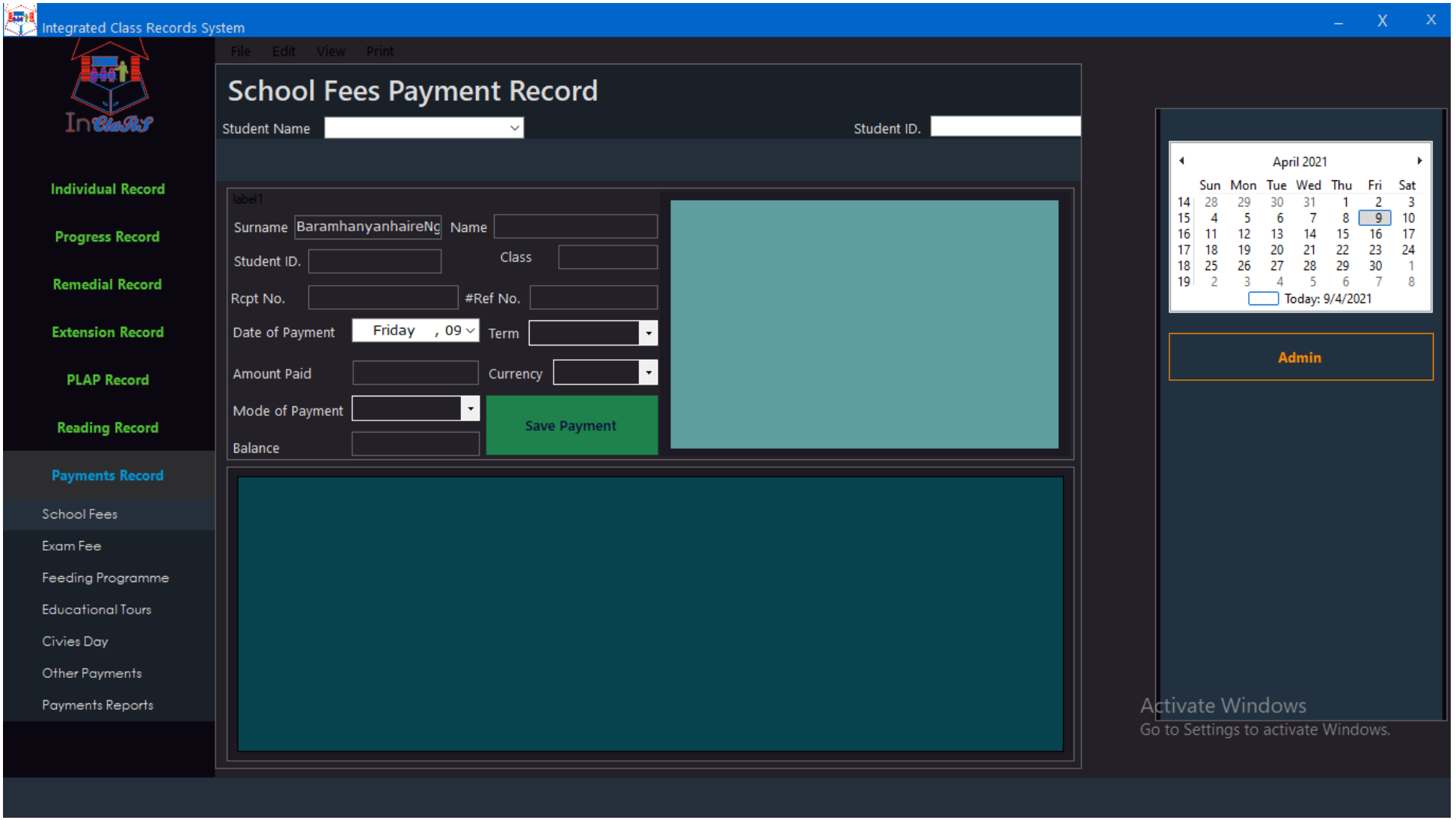
Picture 5.6 The main form with Personal Information control loaded.


Integrated Class Records System
File
Edit
View
Print
Student's Personal Infomation
Student Name
Student ID.
Add New Student
Update Record
-Delete Record
Individual Record
Personal Information
Parent/Gaurdian
Family Setup
Health History
Enroll New Learner
Progress Record
Remedial Record
Extension Record
PLAP Record
Reading Record
Payments Record
Surname
First Name
2nd Name
3rd Name
Date of Birth
Friday , 09
Sex
Birth Certificate Number
Birth Place
District
Province
Home Address
Home Town
Hm District
Hm Province
Postal Address
Cell No. (1)
Cell No.(2)
Phone Number
Religion
Denomination
Add
Remove
April 2021
Sun Mon Tue Wed Thu Fri Sat
Today: 9/4/2021
Admin
Activate Windows
Go to Settings to activate Windows.

Picture 5.7 The main form with Feeding Program Payment Record control loaded.



Picture 5.8 The main form with Schools Fees Payment control loaded.



5.5 Module Design

Fisler and Krishnamurthi (2001:1) declare that “Software designs must provide a coherent organisation for the code implementing actors and features. Traditional software organisation arranges programs around actors: each module reflects an actor, and the collection of actor modules forms the complete design”. The development of the InClaRS follows a modular design where each control represents an actor. Coding is done from the perspective of the control.

As an example, the control for Personal Information named cntrlPersonalInformation is coded directly in its associated code page which is cntrlPersonalInformation.cs. From the design view, the control is developed using the rapid application design.

However, there are other classes designed for the purpose of universally controlling the designs of other controls such as the buttons. These class are meant to encapsulate and abstract the process of the controls. One example of such modular classes is the class for controlling menu button designs. When a button is clicked it has to change properties such as font colour and background colour while resetting any previous changes which may have been done on any other previously selected button. The class to do so in the backend of InClaRS is the clsGeneralControlDesign.

Another module created is for connecting to with database of the system. A class is created where all the connection code is written and can be called from. This was made such that any changes to the connection code would be done only in one place but implemented uniformly wherever the class is called.

5.6 Conclusion

The logical design of the InClaRS has been discussed and demonstrated in this chapter. It was established that the system shall follow the Object-Oriented Design (OOD) to improve the modularity of the system. The screenshots provided gives an insight of how each actor of the system interacts with other actors. The general system designed has also been illustrated as a high-level flow chart to define the functionality and integrity of the system. Having gained the understanding of this chapter the following chapter shall therefore present the code for the system.

Chapter 6: Implementation

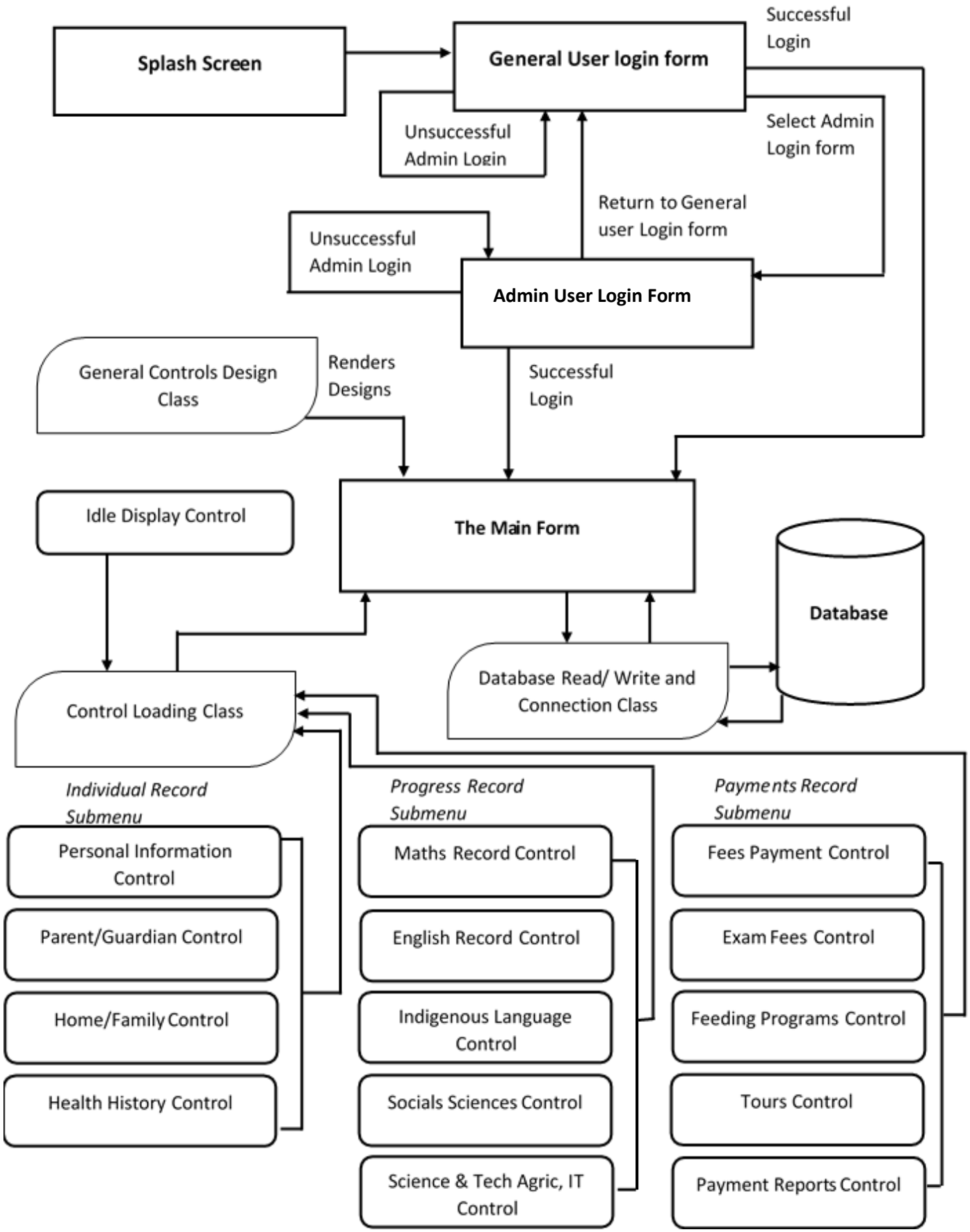
6.0 Introduction

The preceding chapters have sufficiently provided for the basis upon which the actual solution can be built. This chapter shall then provide, first, the program flow chart diagram then present the actual C# code used to develop the system.

6.1 Program flow chart

The program flow chart is a high-level representation of the system. The diagram shows how the system functions along with the definition of all the other object components of the program. Also included is are the control mechanisms of the program such the class and other important implementations.

Diagram 6.0 Program flow chart for the integrated Class Records System (InClaRS)



6.2.0 C# Code for InClaRS

The code which follows was done in C# taking advantage of the objected-oriented nature of the language. The code is well commented to make it easy to understand. The code is also organised according to the modules it is being implemented in. However the code that is generated by the IDE during design shall not be included, only written by this researcher shall be provided.

6.2.1 C# Code for the Splash Screen (frmLoadingForm)

```
using System;
using System.Collections.Generic;
using System.ComponentModel;
using System.Data;
using System.Drawing;
using System.Linq;
using System.Text;
using System.Threading.Tasks;
using System.Windows.Forms;

namespace InClaRS
{
    public partial class frmLoadingWindow : Form
    {
        public frmLoadingWindow()
        {
            InitializeComponent();
            setAndStartTimer();
        }

        //
        //functions to enable drag
        //
        Point offset;
        bool isPanelDragged = false;
        //Drag form Mouse_Down event
        private void pnlHeader_MouseDown(object sender, MouseEventArgs e)
        {
            if (e.Button == MouseButtons.Left)
            {
                isPanelDragged = true;
                Point pointStartPosition = this.PointToScreen(new Point(e.X, e.Y));
                offset = new Point();
                offset.X = this.Location.X - pointStartPosition.X;
                offset.Y = this.Location.Y - pointStartPosition.Y;
            }
            else
            {
                isPanelDragged = false;
            }
        }

        //Drag form Mouse_Move event
        private void pnlHeader_MouseMove(object sender, MouseEventArgs e)
        {
            if (isPanelDragged)
            {
                Point newPoint = pnlMainBackground.PointToScreen(new Point(e.X, e.Y));
                newPoint.Offset(offset);
                this.Location = newPoint;
            }
```

```
        }


        //Drag/release form Mouse_Up event
        private void pnlHeader_MouseUp(object sender, MouseEventArgs e)
        {
            isPanelDragged = false;
        }

        Timer tmrLoadingState = new Timer();
        //
        //Setting and starting my timer
        //
        private void setAndStartTimer()
        {
            tmrLoadingState.Interval = 300;
            tmrLoadingState.Tick += new EventHandler(tmrLoadingState_Tick);
            tmrLoadingState.Start();
        }

        //
        //timer tick event
        //
        static int count = 0;
        static int r = 75;
        static int g = 72;
        static int b = 79;
        private void tmrLoadingState_Tick(object sender,EventArgs e)
        {
            count += 2;
            lblLoadingProgress.Text = "Processing ...(" + count + "%)";
            pnlMainBackground.BackColor = Color.FromArgb(r, g, b);

            if (r>=4 && g>=1 && b>=8)
            {
                r -= 1;
                g -= 1;
                b -= 1;
            }

            if(count>=10 && count<=20)
            {
                lblLoadingState.Text = "Initialising ...";
            }
            if (count >=21 && count <= 40)
            {
                lblLoadingState.Text = "Loading Components ...";
            }
            if (count >=41 && count <= 60)
            {
                lblLoadingState.Text = "Finalising ...              reyrey";
            }
            if (count >=61 && count <= 80)
            {
                lblLoadingState.Text = "Welcome to InClaRS        v. 1.0.0.0 ***";
            }
            if (count >=81 && count <= 100)
            {
                lblLoadingState.Text = "Developed by: Jeffrey Jafari
(jjeafari@gmail.com)***";
            }
```

```
            if (count==100)
            {
                tmrLoadingState.Stop();
                this.Close();


            }
        }
        private void pnlLoadingWindowTitle_Paint(object sender, PaintEventArgs e)
        {

        }



        //
        //Form minimise and close functions
        //
        private void bntCloseLoadingForm_Click(object sender, EventArgs e)
        {
            Application.Exit();
        }

        private void btnMinimiseLoadingForm_Click(object sender, EventArgs e)
        {
            this.WindowState = FormWindowState.Minimized;
            Program.isMinimised = true;
        }

        private void frmLoadingWindow_Closed(object sender,FormClosedEventArgs e)
        {
            this.Dispose();
        }

        private void frmLoading_Activated(object sender,EventArgs e)
        {
            if(Program.isMinimised)
            {
                Program.isMinimised = false;
            }
        }
    }
}
```

6.2.2 C# Code for the Main Form (frmMainForm)

```
using System;
using System.Collections.Generic;
using System.ComponentModel;
using System.Data;
using System.Drawing;
using System.Linq;
using System.Text;
using System.Threading.Tasks;
using System.Windows.Forms;

namespace InClaRS
{
    public partial class frmMainForm : Form
    {
        public frmMainForm()
        {
            InitializeComponent();
            hideAllSubmenuPnls();
            setAllTimers();

        }

        //This function is to set individual timers so that they may be initialised at
once on form_Load
        private void setAllTimers()
        {
            tmrShowExpandSubmenu.Interval = 1;
            tmrShowExpandSubmenu.Tick += new EventHandler(tmrShowExpandSubmenu_Tick);

            tmrHideAdminSubmenu.Interval = 1;
            tmrHideAdminSubmenu.Tick += new EventHandler(tmrHideAdminSubmenu_Tick);
        }

//*************************************************************************************
*************

        Point offset;
        bool isPanelDragged = false;
        //Drag form Mouse_Down event
        private void pnlHeader_MouseDown(object sender,MouseEventArgs e)
        {

            if (e.Button == MouseButtons.Left)
            {
                isPanelDragged = true;
                Point pointStartPosition = this.PointToScreen(new Point(e.X, e.Y));
                offset = new Point();
                offset.X = this.Location.X - pointStartPosition.X;
                offset.Y = this.Location.Y - pointStartPosition.Y;

            }
            else
            {
                isPanelDragged = false;
            }
        }
//Drag form Mouse_Move event
        private void pnlHeader_MouseMove(object sender, MouseEventArgs e)
        {
            if(isPanelDragged)
```

```
            {
                Point newPoint= pnlHeader.PointToScreen(new Point(e.X, e.Y));
                newPoint.Offset(offset);
                this.Location = newPoint;
                if(this.WindowState == System.Windows.Forms.FormWindowState.Maximized)
                {
                    this.WindowState = System.Windows.Forms.FormWindowState.Normal;
                }
            }
        }

        //Header panel double click
        private void pnlHeader_DoubleClick(object sender, MouseEventArgs e)
        {
            if (this.WindowState == System.Windows.Forms.FormWindowState.Maximized)
            {
                this.WindowState = System.Windows.Forms.FormWindowState.Normal;
                this.Size = new System.Drawing.Size(1300, 700);
            }
            else
                this.WindowState = System.Windows.Forms.FormWindowState.Maximized;
        }

        //Drag/release form Mouse_Up event
        private void pnlHeader_MouseUp(object sender, MouseEventArgs e)
        {
            isPanelDragged = false;
        }


        //Hide all Submenu on Form_Load
        private void hideAllSubmenuPnls()
        {
        pnlIndividualRecordSubmenu.Visible = false;
        pnlProgressRecordSubmenu.Visible = false;
        pnlRemedialRecordSubmenu.Visible = false;
        pnlExtensionWorkRecordSubmenu.Visible = false;
        pnlPlapRecordSubmenu.Visible = false;
        pnlReadingRecordSubmenu.Visible = false;
        pnlPaymentsRecordSubmenu.Visible = false;

        }



//Hide active the active subMenu panel
        private void hideActiveSubmenuPnl()
        {

            if (pnlIndividualRecordSubmenu.Visible == true)
                pnlIndividualRecordSubmenu.Visible = false;

            if (pnlProgressRecordSubmenu.Visible == true)
                pnlProgressRecordSubmenu.Visible = false;

            if (pnlRemedialRecordSubmenu.Visible == true)
                pnlRemedialRecordSubmenu.Visible = false;

            if (pnlExtensionWorkRecordSubmenu.Visible == true)
                pnlExtensionWorkRecordSubmenu.Visible = false;

            if (pnlPlapRecordSubmenu.Visible == true)
```

```
                pnlPlapRecordSubmenu.Visible = false;

            if(pnlReadingRecordSubmenu.Visible==true)
                pnlReadingRecordSubmenu.Visible = false;

            if(pnlPaymentsRecordSubmenu.Visible==true)
                pnlPaymentsRecordSubmenu.Visible = false;

        }

        //Show Submenu on menu_button click
        private void showSubmenu(Panel Submenu,int length)
        {


            if (Submenu.Visible == false)
            {
                hideActiveSubmenuPnl();
                Submenu.Visible = true;
                Submenu.Size = new System.Drawing.Size(180,length);


            }
            else
                Submenu.Visible = false;

        }
//*************************************************************************************
*************************************************************************************
*********************************
        //These are the _Click events for the main menu buttons
        //
        #region Main Menu Buttons
        //***Individual Record Submenu load button
        private void btnIndividualRecord_Click(object sender, EventArgs e)
        {
            showSubmenu(pnlIndividualRecordSubmenu, 150);

clsBasicControlOperations.hideActiveControl(pnlParentContainer,pnlDefaultMainControl);
            clsGeneralControlDesigns.setMenuButtonColors(pnlIndividualRecordSubmenu,
btnIndividualRecord, btnProgressRecord, btnRemedialRecord, btnExtWorkRecord,
btnPlapRecord, btnReadingRecord, btnPaymentsRecord);

            clsGeneralControlDesigns.resetMenuButtonColors(btnPersonalInfo,
btnParentGInfo, btnFamilySetup, btnHealthHistory, btnEnrollNew,
            btnSubjMath, btnSubjForeignLanguages, btnSubjIndigLanguages,
btnSubjScieTech,btnSubjSocialSciences, btnSubjVpaPe, btnExamResults,
            btnRemMath, btnRemEnglish, btnRemShona, btnRemReports,
            btnExtMath,btnExtEnglish, btnExtShona, btnExtReports,
            btnPlapMath, btnPlapEnglish,btnPlapReports,
            btnReadingEnglish, btnReadingOther, btnReadingShona, btnReadingReports,
            btnPaySchoolFees, btnPayExamFees, btnPayFeeding, btnPayTours,
btnPayCivies,btnPayOther, btnPayReports);

        }

        //***Progress Record Submenu load button
        private void btnProgressRecord_Click(object sender, EventArgs e)
        {
            showSubmenu(pnlProgressRecordSubmenu,210);
            clsBasicControlOperations.hideActiveControl(pnlParentContainer,
pnlDefaultMainControl);
```

```
            clsGeneralControlDesigns.setMenuButtonColors(pnlProgressRecordSubmenu,
btnProgressRecord, btnIndividualRecord, btnRemedialRecord, btnExtWorkRecord,
btnPlapRecord, btnReadingRecord, btnPaymentsRecord);

            clsGeneralControlDesigns.resetMenuButtonColors(btnPersonalInfo,
btnParentGInfo, btnFamilySetup, btnHealthHistory, btnEnrollNew,
            btnSubjMath, btnSubjForeignLanguages, btnSubjIndigLanguages,
btnSubjScieTech, btnSubjSocialSciences, btnSubjVpaPe, btnExamResults,
            btnRemMath, btnRemEnglish, btnRemShona, btnRemReports,
            btnExtMath, btnExtEnglish, btnExtShona, btnExtReports,
            btnPlapMath, btnPlapEnglish, btnPlapReports,
            btnReadingEnglish, btnReadingOther, btnReadingShona, btnReadingReports,
            btnPaySchoolFees, btnPayExamFees, btnPayFeeding, btnPayTours,
btnPayCivies, btnPayOther, btnPayReports);

        }


        //***Remedial Record Submenu load button
        private void btnRemedialRecord_Click(object sender, EventArgs e)
        {
            showSubmenu(pnlRemedialRecordSubmenu,120);
            clsBasicControlOperations.hideActiveControl(pnlParentContainer,
pnlDefaultMainControl);

clsGeneralControlDesigns.setMenuButtonColors(pnlRemedialRecordSubmenu,btnRemedialRecor
d, btnProgressRecord, btnIndividualRecord,  btnExtWorkRecord, btnPlapRecord,
btnReadingRecord, btnPaymentsRecord);

            clsGeneralControlDesigns.resetMenuButtonColors(btnPersonalInfo,
btnParentGInfo, btnFamilySetup, btnHealthHistory, btnEnrollNew,
            btnSubjMath, btnSubjForeignLanguages, btnSubjIndigLanguages,
btnSubjScieTech, btnSubjSocialSciences, btnSubjVpaPe, btnExamResults,
            btnRemMath, btnRemEnglish, btnRemShona, btnRemReports,
            btnExtMath, btnExtEnglish, btnExtShona, btnExtReports,
            btnPlapMath, btnPlapEnglish, btnPlapReports,
            btnReadingEnglish, btnReadingOther, btnReadingShona, btnReadingReports,
            btnPaySchoolFees, btnPayExamFees, btnPayFeeding, btnPayTours,
btnPayCivies, btnPayOther, btnPayReports);

        }
        //***Extension Work Record Submenu load button
        private void btnExtWorkRecord_Click(object sender, EventArgs e)
        {
            showSubmenu(pnlExtensionWorkRecordSubmenu,120);
            clsBasicControlOperations.hideActiveControl(pnlParentContainer,
pnlDefaultMainControl);

clsGeneralControlDesigns.setMenuButtonColors(pnlExtensionWorkRecordSubmenu,btnExtWorkR
ecord, btnProgressRecord, btnIndividualRecord, btnRemedialRecord,  btnPlapRecord,
btnReadingRecord, btnPaymentsRecord);

            clsGeneralControlDesigns.resetMenuButtonColors(btnPersonalInfo,
btnParentGInfo, btnFamilySetup, btnHealthHistory, btnEnrollNew,
            btnSubjMath, btnSubjForeignLanguages, btnSubjIndigLanguages,
btnSubjScieTech, btnSubjSocialSciences, btnSubjVpaPe, btnExamResults,
            btnRemMath, btnRemEnglish, btnRemShona, btnRemReports,
            btnExtMath, btnExtEnglish, btnExtShona, btnExtReports,
            btnPlapMath, btnPlapEnglish, btnPlapReports,
            btnReadingEnglish, btnReadingOther, btnReadingShona, btnReadingReports,
            btnPaySchoolFees, btnPayExamFees, btnPayFeeding, btnPayTours,
btnPayCivies, btnPayOther, btnPayReports);
```

```
        }

        //***Plap Record Submenu load button
        private void btnPlapRecord_Click(object sender, EventArgs e)
        {
            showSubmenu(pnlPlapRecordSubmenu, 120);
            clsBasicControlOperations.hideActiveControl(pnlParentContainer,
pnlDefaultMainControl);

clsGeneralControlDesigns.setMenuButtonColors(pnlPlapRecordSubmenu,btnPlapRecord,
btnProgressRecord, btnIndividualRecord, btnRemedialRecord, btnExtWorkRecord,
btnReadingRecord, btnPaymentsRecord);

            clsGeneralControlDesigns.resetMenuButtonColors(btnPersonalInfo,
btnParentGInfo, btnFamilySetup, btnHealthHistory, btnEnrollNew,
            btnSubjMath, btnSubjForeignLanguages, btnSubjIndigLanguages,
btnSubjScieTech, btnSubjSocialSciences, btnSubjVpaPe, btnExamResults,
            btnRemMath, btnRemEnglish, btnRemShona, btnRemReports,
            btnExtMath, btnExtEnglish, btnExtShona, btnExtReports,
            btnPlapMath, btnPlapEnglish, btnPlapReports,
            btnReadingEnglish, btnReadingOther, btnReadingShona, btnReadingReports,
            btnPaySchoolFees, btnPayExamFees, btnPayFeeding, btnPayTours,
btnPayCivies, btnPayOther, btnPayReports);

        }

        //***Reading Record Submenu load button
        private void btnReadingRecord_Click(object sender, EventArgs e)
        {
            showSubmenu(pnlReadingRecordSubmenu, 120);
            clsBasicControlOperations.hideActiveControl(pnlParentContainer,
pnlDefaultMainControl);

clsGeneralControlDesigns.setMenuButtonColors(pnlReadingRecordSubmenu,btnReadingRecord,
btnProgressRecord, btnIndividualRecord, btnRemedialRecord, btnExtWorkRecord,
btnPlapRecord,  btnPaymentsRecord);

            clsGeneralControlDesigns.resetMenuButtonColors(btnPersonalInfo,
btnParentGInfo, btnFamilySetup, btnHealthHistory, btnEnrollNew,
            btnSubjMath, btnSubjForeignLanguages, btnSubjIndigLanguages,
btnSubjScieTech, btnSubjSocialSciences, btnSubjVpaPe, btnExamResults,
            btnRemMath, btnRemEnglish, btnRemShona, btnRemReports,
            btnExtMath, btnExtEnglish, btnExtShona, btnExtReports,
            btnPlapMath, btnPlapEnglish, btnPlapReports,
            btnReadingEnglish, btnReadingOther, btnReadingShona, btnReadingReports,
            btnPaySchoolFees, btnPayExamFees, btnPayFeeding, btnPayTours,
btnPayCivies, btnPayOther, btnPayReports);

        }

        //***Payments Record Submenu load button
        private void btnPaymentsRecord_Click(object sender, EventArgs e)
        {
            showSubmenu(pnlPaymentsRecordSubmenu, 210);
            clsBasicControlOperations.hideActiveControl(pnlParentContainer,
pnlDefaultMainControl);
            clsGeneralControlDesigns.setMenuButtonColors(pnlPaymentsRecordSubmenu,
btnPaymentsRecord, btnProgressRecord, btnIndividualRecord, btnRemedialRecord,
btnExtWorkRecord, btnPlapRecord, btnReadingRecord);
```

```
            clsGeneralControlDesigns.resetMenuButtonColors(btnPersonalInfo,
btnParentGInfo, btnFamilySetup, btnHealthHistory, btnEnrollNew,
            btnSubjMath, btnSubjForeignLanguages, btnSubjIndigLanguages,
btnSubjScieTech, btnSubjSocialSciences, btnSubjVpaPe, btnExamResults,
            btnRemMath, btnRemEnglish, btnRemShona, btnRemReports,
            btnExtMath, btnExtEnglish, btnExtShona, btnExtReports,
            btnPlapMath, btnPlapEnglish, btnPlapReports,
            btnReadingEnglish, btnReadingOther, btnReadingShona, btnReadingReports,
            btnPaySchoolFees, btnPayExamFees, btnPayFeeding, btnPayTours,
btnPayCivies, btnPayOther, btnPayReports);

        }

        #endregion Main Menu Buttons
        //
        //

//*************************************************************************************
*************************************************************************************
*********************************

        private void btnCloseMainForm_Click(object sender, EventArgs e)
        {
            clsMassagesClass.showMassage();
        }

        private void btnMinimise_Click(object sender, EventArgs e)
        {
            this.WindowState = FormWindowState.Minimized;
            Program.isMinimised = true;
        }



//*************************************************************************************
*************************************************************
        //These are the _Click events for the buttons within the
pnlIndividualRecordSubmenu
        //

        //+++Personal Information childForm load button
        private void btnPersonalInfo_Click(object sender, EventArgs e)
        {

clsGeneralControlDesigns.setpnlIndividualRecordSubmenuButtonColors(btnPersonalInfo,
btnParentGInfo, btnFamilySetup, btnHealthHistory, btnEnrollNew);
            cntrlPersonalInfomation cPInfoObject = new cntrlPersonalInfomation();
            clsBasicControlOperations.LoadChildControl(cPInfoObject,
pnlParentContainer);
        }

//+++Parent/Gaurdian childForm load button
        private void btnParentGInfo_Click(object sender, EventArgs e)
        {

clsGeneralControlDesigns.setpnlIndividualRecordSubmenuButtonColors(btnParentGInfo,
btnPersonalInfo, btnFamilySetup, btnHealthHistory, btnEnrollNew);
            cntrlParentGaurdianInfo cPgInfoObject = new cntrlParentGaurdianInfo();
            clsBasicControlOperations.LoadChildControl(cPgInfoObject,
pnlParentContainer);
        }
```

```
        //+++Family Setup childForm load button
        private void btnFamilySetup_Click(object sender, EventArgs e)
        {
            clsGeneralControlDesigns.setpnlIndividualRecordSubmenuButtonColors(
btnFamilySetup,btnParentGInfo,btnPersonalInfo,  btnHealthHistory, btnEnrollNew);
            cntrlFamilySetUp cFsetUpObject = new cntrlFamilySetUp();
            clsBasicControlOperations.LoadChildControl(cFsetUpObject,
pnlParentContainer);

        }

        //+++Health History childForm load button
        private void btnHealthHistory_Click(object sender, EventArgs e)
        {

clsGeneralControlDesigns.setpnlIndividualRecordSubmenuButtonColors(btnHealthHistory,bt
nParentGInfo, btnPersonalInfo, btnFamilySetup,  btnEnrollNew);
            cntrlHealthHistory cHhistObject = new cntrlHealthHistory();
            clsBasicControlOperations.LoadChildControl(cHhistObject,
pnlParentContainer);

        }
        //
        //One more component to add above (EnrolNewButton_Click)

//*************************************************************************************
*************************************************************************

        private void pnlHeader_DoubleClick(object sender, EventArgs e)
        {

        }
        //
        //These are the _Click events for pnlPaymentsRecordSubmenu

//*************************************************************************************
*************************************************************************

        //+++School Fees Payment childForm load button
        private void btnPaySchoolFees_Click(object sender, EventArgs e)
        {
            cntrlShoolFeesPayment cFeesPayObject = new cntrlShoolFeesPayment();
            clsBasicControlOperations.LoadChildControl(cFeesPayObject,
pnlParentContainer);
            clsGeneralControlDesigns.setpnlPaymentsRecordSubmenu(btnPaySchoolFees,
btnPayFeeding, btnPayExamFees, btnPayTours, btnPayCivies, btnPayOther, btnPayReports);

        }

        //+++Exam Fees Payment childForm load button
        private void btnPayExamFees_Click(object sender, EventArgs e)
        {
            cntrlExamFeePayment cExamFeesPayObject = new cntrlExamFeePayment();
            clsBasicControlOperations.LoadChildControl(cExamFeesPayObject,
pnlParentContainer);
            clsGeneralControlDesigns.setpnlPaymentsRecordSubmenu(btnPayExamFees,
btnPayFeeding, btnPaySchoolFees, btnPayTours, btnPayCivies, btnPayOther,
btnPayReports);
        }

        //+++Feeding Program childForm load button
        private void btnPayFeeding_Click(object sender, EventArgs e)
```

```
        {
            cntrlFeedingPayment cFeedingPayObject = new cntrlFeedingPayment();
            clsBasicControlOperations.LoadChildControl(cFeedingPayObject,
pnlParentContainer);

clsGeneralControlDesigns.setpnlPaymentsRecordSubmenu(btnPayFeeding,btnPaySchoolFees,bt
nPayExamFees,btnPayTours,btnPayCivies,btnPayOther,btnPayReports);

        }

        //+++Educational Tours Payments childForm load button
        private void btnPayTours_Click(object sender, EventArgs e)
        {
            clsGeneralControlDesigns.setpnlPaymentsRecordSubmenu(btnPayTours,
btnPayExamFees, btnPayFeeding, btnPaySchoolFees, btnPayCivies, btnPayOther,
btnPayReports);
        }

        //+++Civies Payments childForm load button
        private void btnPayCivies_Click(object sender, EventArgs e)
        {
            clsGeneralControlDesigns.setpnlPaymentsRecordSubmenu(btnPayCivies,
btnPayFeeding, btnPaySchoolFees, btnPayExamFees, btnPayTours, btnPayOther,
btnPayReports);
        }

        //+++Other Payments childForm load button
        private void btnPayOther_Click(object sender, EventArgs e)
        {
            clsGeneralControlDesigns.setpnlPaymentsRecordSubmenu(btnPayOther,
btnPayFeeding, btnPaySchoolFees, btnPayExamFees, btnPayTours, btnPayCivies,
btnPayReports);
        }

        //+++Payments Reports childForm load button
        private void btnPayReports_Click(object sender, EventArgs e)
        {
            clsGeneralControlDesigns.setpnlPaymentsRecordSubmenu(btnPayReports,
btnPayFeeding, btnPaySchoolFees, btnPayExamFees, btnPayTours, btnPayCivies,
btnPayOther);
        }
        //
        //

//*************************************************************************************
************************************************

        //MenuStrip File->Close button to unload the active childForm, hide
activeSubmenu and reset menu buttons BackColor
        private void closeToolStripMenuItem_Click(object sender, EventArgs e)
        {
            clsBasicControlOperations.hideActiveControl(pnlParentContainer,
pnlDefaultMainControl);
            hideActiveSubmenuPnl();

clsGeneralControlDesigns.resetMenuButtonColorsToDefaultBackColor(btnIndividualRecord,
btnProgressRecord, btnRemedialRecord, btnExtWorkRecord, btnPlapRecord,
btnReadingRecord, btnPaymentsRecord);

            clsGeneralControlDesigns.resetMenuButtonColors(btnPersonalInfo,
btnParentGInfo, btnFamilySetup, btnHealthHistory, btnEnrollNew,
```

```
            btnSubjMath, btnSubjForeignLanguages, btnSubjIndigLanguages,
btnSubjScieTech, btnSubjSocialSciences, btnSubjVpaPe, btnExamResults,
            btnRemMath, btnRemEnglish, btnRemShona, btnRemReports,
            btnExtMath, btnExtEnglish, btnExtShona, btnExtReports,
            btnPlapMath, btnPlapEnglish, btnPlapReports,
            btnReadingEnglish, btnReadingOther, btnReadingShona, btnReadingReports,
            btnPaySchoolFees, btnPayExamFees, btnPayFeeding, btnPayTours,
btnPayCivies, btnPayOther, btnPayReports);
        }
        //
        //

//*************************************************************************************
**********************

        //Creating a Timer object for showing and hiding pnlAdminSubmenu
        Timer tmrShowExpandSubmenu = new Timer();
        Timer tmrHideAdminSubmenu = new Timer();

        public bool isSubmenuVisible = false;
        int submenuHeight = 10;
        int submenuWidth = 10;
        private void tmrShowExpandSubmenu_Tick(object sender,EventArgs e)
        {
            submenuHeight+=10;
            submenuWidth+=10;
            pnlAdminSubmenu.Visible = true;
            if (pnlAdminSubmenu.Size.Height <160)
                pnlAdminSubmenu.Size= new System.Drawing.Size(submenuHeight,
submenuWidth);
            if (pnlAdminSubmenu.Size.Width < 260)
                pnlAdminSubmenu.Size = new System.Drawing.Size(Height, submenuWidth);
            if (submenuHeight == 260 && submenuWidth == 260)
                {
                    isSubmenuVisible = true;
                    tmrShowExpandSubmenu.Stop();
                }


        }

        private void tmrHideAdminSubmenu_Tick(object sender, EventArgs e)
        {
            submenuHeight -= 10;
            submenuWidth -= 10;
            if (pnlAdminSubmenu.Size.Height >= 10)
                pnlAdminSubmenu.Size = new System.Drawing.Size(submenuHeight,
submenuWidth);
            if (pnlAdminSubmenu.Size.Width >= 10)
                pnlAdminSubmenu.Size = new System.Drawing.Size(Height, submenuWidth);
            if (submenuHeight <= 10 && submenuWidth <= 10)
            {
                pnlAdminSubmenu.Visible = false;
                isSubmenuVisible = false;
                tmrHideAdminSubmenu.Stop();
            }

        }

        private void hideAdminSubmenu_MouseLeave(object sender, EventArgs e)
        {
            if (isSubmenuVisible == true)
```

```
            {
                tmrShowExpandSubmenu.Start();
                isSubmenuVisible = false;
            }
        }
        private void btnAdminSubmenu_Click(object sender, EventArgs e)
        {
            if (isSubmenuVisible == false)
            {
                submenuHeight = 10;
                submenuWidth = 10;
                tmrShowExpandSubmenu.Start();
            }
            else
                tmrHideAdminSubmenu.Start();
        }

        private void pnlUserTools_Paint(object sender, PaintEventArgs e)
        {

        }
    }


}
```

6.2.3 C# Code for the Form Loading Class (clsBasicControlOperations)

```
using System;
using System.Collections.Generic;
using System.Drawing;
using System.Linq;
using System.Text;
using System.Threading.Tasks;
using System.Windows.Forms;

namespace InClaRS
{
    class clsBasicControlOperations

    {

        public static Control activeControl;
        public static void LoadChildControl(System.Windows.Forms.Control childControl,
System.Windows.Forms.Control parentControl)
         {
            parentControl.Controls.Clear();
            childControl.Anchor = AnchorStyles.Top;
            childControl.BringToFront();
            childControl.Focus();
            parentControl.Controls.Add(childControl);
            activeControl = childControl;

         }


        public static void hideActiveControl(Control parentControl, Control
defaultMainControl)
        {
            parentControl.Controls.Clear();
            parentControl.Controls.Add(defaultMainControl);

        }

        public static void reduceControlSize(Control childForm,Panel bodyPanel)
        {
            childForm.Size = new System.Drawing.Size(820,580);
            bodyPanel.AutoScroll = true;
        }

        public static void restoreControlSize(Control childForm,Panel bodyPanel)
        {
            childForm.Size = new System.Drawing.Size(820,685);
            bodyPanel.AutoScroll = false;
        }
    }
}
```

6.2.4 C# Code for the Menu Buttons Design Class (clsGeneralControlDesign)

```
using System;
using System.Collections.Generic;
using System.Drawing;
using System.Linq;
using System.Text;
using System.Threading.Tasks;
using System.Windows.Forms;

namespace InClaRS
{
    //This class is for setting general designs for different controls such as buttons
and panels
    class clsGeneralControlDesigns
    {
        //This function is for setting the designs for menu buttons
        public static void setMenuButtonColors(Panel pnlSubMenuSelected,Button
menuButtonSelected,Button button1, Button button2, Button button3, Button button4,
Button button5, Button button6)
        {

            if (pnlSubMenuSelected.Visible == true)
            {
                menuButtonSelected.BackColor = Color.FromArgb(45, 45, 48);
                menuButtonSelected.ForeColor = Color.FromArgb(3, 148, 212);
                button1.BackColor = Color.FromArgb(11, 7, 17);
                button1.ForeColor = Color.FromArgb(80, 191, 53);
                button2.BackColor = Color.FromArgb(11, 7, 17);
                button2.ForeColor = Color.FromArgb(80, 191, 53);
                button3.BackColor = Color.FromArgb(11, 7, 17);
                button3.ForeColor = Color.FromArgb(80, 191, 53);
                button4.BackColor = Color.FromArgb(11, 7, 17);
                button4.ForeColor = Color.FromArgb(80, 191, 53);
                button5.BackColor = Color.FromArgb(11, 7, 17);
                button4.ForeColor = Color.FromArgb(80, 191, 53);
                button6.BackColor = Color.FromArgb(11, 7, 17);
                button6.ForeColor = Color.FromArgb(80, 191, 53);
            }
            else
            {
                menuButtonSelected.ForeColor = Color.FromArgb(80, 191, 53);
                menuButtonSelected.BackColor = Color.FromArgb(11, 7, 17);
            }
        }

//*************************************************************************************
*************************************************************************************
******************

        //This function sets the colors for the buttons within the
pnlIndividualRecordSubmenu submenu panel
        public static void setpnlIndividualRecordSubmenuButtonColors(Button
menuButtonSelected, Button button1, Button button2, Button button3, Button button4)
        {
                menuButtonSelected.BackColor = Color.FromArgb(112, 173, 71);
                button1.BackColor = Color.FromArgb(26, 32, 40);
                button2.BackColor = Color.FromArgb(26, 32, 40);
                button3.BackColor = Color.FromArgb(26, 32, 40);
                button4.BackColor = Color.FromArgb(26, 32, 40);
        }
```

```
//*************************************************************************************
*********************************************************************

        //This function sets colors for the buttons within the
pnlPaymentsRecordSubmenu submenu panel
        public static void setpnlPaymentsRecordSubmenu(Button menuButtonSelected,
Button button1, Button button2, Button button3, Button button4, Button button5, Button
button6)
        {
            menuButtonSelected.BackColor = Color.FromArgb(112, 173, 71);
            button1.BackColor = Color.FromArgb(26, 32, 40);
            button2.BackColor = Color.FromArgb(26, 32, 40);
            button3.BackColor = Color.FromArgb(26, 32, 40);
            button4.BackColor = Color.FromArgb(26, 32, 40);
            button5.BackColor = Color.FromArgb(26, 32, 40);
            button6.BackColor = Color.FromArgb(26, 32, 40);
        }

//*************************************************************************************
*********************************************************

        //This function resets all the buttons within all the submenus so they do not
appear as selected next time the submenu is open
        public static void resetMenuButtonColors(Button btn0, Button btn1, Button
btn2, Button btn3, Button btn4, Button btn5, Button btn6, Button btn7, Button btn8,
Button btn9, Button btn10, Button btn11, Button btn12, Button btn13, Button btn14,
Button btn15, Button btn16, Button btn17, Button btn18, Button btn19, Button btn20,
Button btn21, Button btn22, Button btn23, Button btn24, Button btn25, Button btn26,
Button btn27, Button btn28, Button btn29, Button btn30, Button btn31, Button
btn32,Button btn33)
        {
            //All buttons loading childControls onto pnlParentContainer (34)
            //pnlIndividualRecordSubmenu buttons (5)
            btn0.BackColor = Color.FromArgb(26, 32, 40);
            btn1.BackColor = Color.FromArgb(26, 32, 40);
            btn2.BackColor = Color.FromArgb(26, 32, 40);
            btn3.BackColor = Color.FromArgb(26, 32, 40);
            btn4.BackColor = Color.FromArgb(26, 32, 40);
            //pnlProgressRecordSubmenu (7)
            btn5.BackColor = Color.FromArgb(26, 32, 40);
            btn6.BackColor = Color.FromArgb(26, 32, 40);
            btn7.BackColor = Color.FromArgb(26, 32, 40);
            btn8.BackColor = Color.FromArgb(26, 32, 40);
            btn9.BackColor = Color.FromArgb(26, 32, 40);
            btn10.BackColor = Color.FromArgb(26, 32, 40);
            btn11.BackColor = Color.FromArgb(26, 32, 40);
            //pnlRemedialRecordSubmenu buttons (4)
            btn12.BackColor = Color.FromArgb(26, 32, 40);
            btn13.BackColor = Color.FromArgb(26, 32, 40);
            btn14.BackColor = Color.FromArgb(26, 32, 40);
            btn15.BackColor = Color.FromArgb(26, 32, 40);
            //pnlExtensionRecordSubmenu buttons (4)
            btn16.BackColor = Color.FromArgb(26, 32, 40);
            btn17.BackColor = Color.FromArgb(26, 32, 40);
            btn18.BackColor = Color.FromArgb(26, 32, 40);
            btn19.BackColor = Color.FromArgb(26, 32, 40);
            //pnlPlapRecordSubmenu buttons (3)
            btn20.BackColor = Color.FromArgb(26, 32, 40);
            btn21.BackColor = Color.FromArgb(26, 32, 40);
            btn22.BackColor = Color.FromArgb(26, 32, 40);
            //pnlReadingRecordSubmenu buttons (4)
```

```
            btn23.BackColor = Color.FromArgb(26, 32, 40);
            btn24.BackColor = Color.FromArgb(26, 32, 40);
            btn25.BackColor = Color.FromArgb(26, 32, 40);
            btn26.BackColor = Color.FromArgb(26, 32, 40);
            //pnlPaymentsRecordSubmenu buttons (7)
            btn27.BackColor = Color.FromArgb(26, 32, 40);
            btn28.BackColor = Color.FromArgb(26, 32, 40);
            btn29.BackColor = Color.FromArgb(26, 32, 40);
            btn30.BackColor = Color.FromArgb(26, 32, 40);
            btn31.BackColor = Color.FromArgb(26, 32, 40);
            btn32.BackColor = Color.FromArgb(26, 32, 40);
            btn33.BackColor = Color.FromArgb(26, 32, 40);
        }

//*************************************************************************************
****************

        //
        //This function Reset All Menu buttons BackColor to Default Color
        //This function is for setting the designs for menu buttons
        public static void resetMenuButtonColorsToDefaultBackColor(Button button1,
Button button2, Button button3, Button button4, Button button5, Button button6, Button
button7)
        {
            button1.BackColor = Color.FromArgb(11, 7, 17);
            button2.BackColor = Color.FromArgb(11, 7, 17);
            button3.BackColor = Color.FromArgb(11, 7, 17);
            button4.BackColor = Color.FromArgb(11, 7, 17);
            button5.BackColor = Color.FromArgb(11, 7, 17);
            button6.BackColor = Color.FromArgb(11, 7, 17);
            button7.BackColor = Color.FromArgb(11, 7, 17);
        }

//*************************************************************************************
*************************************************************************************
******************

    }
}
```

6.2.5 C# Code for handling the Personal Information Control (cntrlPersonalInfo)

```
using System;
using System.Collections.Generic;
using System.ComponentModel;
using System.Data;
using System.Drawing;
using System.Linq;
using System.Text;
using System.Threading.Tasks;
using System.Windows.Forms;
using System.IO;
using System.Data.SqlClient;

namespace InClaRS
{
    public partial class cntrlPersonalInfomation : UserControl
    {
        public cntrlPersonalInfomation()
        {
            InitializeComponent();
            if (Program.isMinimised)
            {
                clsBasicControlOperations.reduceControlSize(this,pnlWorkingArea);
            }
            else
                clsBasicControlOperations.restoreControlSize(this,pnlWorkingArea);
        }
        //*************************************************************************
        //Connection declaration of the control
        SqlConnection sqlConn = new SqlConnection(@"Data Source =
(LocalDB)\MSSQLLocalDB;
AttachDbFilename=C:\Users\student\source\repos\InClaRS\InClaRS\InClaRSdatabase.mdf;Int
egrated Security = True; Connect Timeout = 30");
        int RegNum = 0;


        //Connection function for the
control*************************************
        public void populateDb()
        {
            /*sqlConn.ConnectionString = "server" + server + ";" + "user id=" +
username + ";" + "password" + password + ";" + "database" + dbName;
            sqlConn.Open();
            sqlcmnd.Connection = sqlConn;
            sqlcmnd.CommandText = "SELET * FROM inclarsDb.";
            sqlDR = sqlcmnd.ExecuteReader();
            sqlDT.Load(sqlDR);
            sqlDR.Close();
            sqlConn.Close();*/
        }

//*************************************************************************

        private void Form_Load(object sender, EventArgs e)
        {

        }


        private void btnAddPhoto_Click(object sender, EventArgs e)
        {
```

```
            try
            {
                OpenFileDialog opFileDialogObject = new OpenFileDialog();
                opFileDialogObject.Filter = "Image
Files(*.jpg;*.jpeg;*.gif;*.bpm;*.png;)|*.jpg;*.jpeg;*.gif;*.bpm;*.png;";

                if (opFileDialogObject.ShowDialog() == DialogResult.OK)
                {
                    txtFilePath.Text = opFileDialogObject.FileName;
                    pbxStudentPhoto.Image = new Bitmap(opFileDialogObject.FileName);
                }

            }
            catch (Exception)
            {
                MessageBox.Show("An Error has been encountered. Please try again.",
"Inclass");
            }


        }

        private void btnRemovePhoto_Click(object sender, EventArgs e)
        {

        }

        private void pbxStudentPhoto_Click(object sender, EventArgs e)
        {

        }

        private void btnDeleteStudent_Click(object sender, EventArgs e)
        {
            try
            {
                if (sqlConn.State == ConnectionState.Closed)
                    sqlConn.Open();
            }
            catch(Exception ex)
                {
                MessageBox.Show(ex.Message, "Error Massage");
            }
        }

        private void btnAddNewStudent_Click(object sender, EventArgs e)
        {
            try
            {
                if (sqlConn.State == ConnectionState.Closed)
                    sqlConn.Open();
                SqlCommand sqlcmnd = new SqlCommand("PersonalInfoAddInsert", sqlConn);
                sqlcmnd.CommandType = CommandType.StoredProcedure;
                sqlcmnd.Parameters.AddWithValue("@RegNum", 0);
                sqlcmnd.Parameters.AddWithValue("@Surname", txtLastName.Text.Trim());
                sqlcmnd.Parameters.AddWithValue("@FirstName",
txtFirstName.Text.Trim());
                sqlcmnd.Parameters.AddWithValue("@SecondName",
txtSecondName.Text.Trim());
                sqlcmnd.Parameters.AddWithValue("@ThirdName",
txtThirdName.Text.Trim());
```

```
                sqlcmnd.Parameters.AddWithValue("@DateOfBirth", dtpDateOfBirth.Value);
                sqlcmnd.Parameters.AddWithValue("@Sex", txtSex.Text.Trim());
                sqlcmnd.Parameters.AddWithValue("@BirthCertificateNum",
txtBirthCertificateNum.Text.Trim());
                sqlcmnd.Parameters.AddWithValue("@PlaceOfBirth",
txtBirthPlace.Text.Trim());
                sqlcmnd.Parameters.AddWithValue("@District",
txtPlaceOfBirthDistrict.Text.Trim());
                sqlcmnd.Parameters.AddWithValue("@Province",
txtPlaceOfBirthProvince.Text.Trim());
                sqlcmnd.Parameters.AddWithValue("@HomeAddress",
txtHomeAddress.Text.Trim());
                sqlcmnd.Parameters.AddWithValue("@HomeDistrict",
txtHomeDistrict.Text.Trim());
                sqlcmnd.Parameters.AddWithValue("@HomeProvince",
txtHomeProvince.Text.Trim());
                sqlcmnd.Parameters.AddWithValue("@PostalAddress",
txtPostalAddress.Text.Trim());
                sqlcmnd.Parameters.AddWithValue("@Cell1", txtCellNo1.Text.Trim());
                sqlcmnd.Parameters.AddWithValue("@Cell2", txtCellNo2.Text.Trim());
                sqlcmnd.Parameters.AddWithValue("@PhoneNum", txtPhoneNo.Text.Trim());
                sqlcmnd.Parameters.AddWithValue("@Religion", txtReligion.Text.Trim());
                sqlcmnd.Parameters.AddWithValue("@Denomination",
txtDenomination.Text.Trim());
                sqlcmnd.Parameters.AddWithValue("@StudentPhoto",
txtFilePath.Text.Trim());
                sqlcmnd.ExecuteNonQuery();
                MessageBox.Show("Saved successful. You May Proceed");

            }
            catch (Exception ex)
            {
                MessageBox.Show(ex.Message, "Error Massage");
            }
        }

        void FillDataGridView()
        {
            if (sqlConn.State == ConnectionState.Closed)
                sqlConn.Open();
            SqlDataAdapter sqlDa = new SqlDataAdapter("DetailsViewAndSearch",
sqlConn);
            sqlDa.SelectCommand.CommandType = CommandType.StoredProcedure;

sqlDa.SelectCommand.Parameters.AddWithValue("@Surname",txtSearchByIdNum.Text.Trim());
            DataTable dtbl = new DataTable();
            sqlDa.Fill(dtbl);
            dgvAllPersonalInfo.DataSource = dtbl;
            sqlConn.Close();
        }

        private void btnSearch_Click(object sender, EventArgs e)
        {
            try
            {
                FillDataGridView();
            }
            catch(Exception ex)
            {
                MessageBox.Show(ex.Message, "Search error occured");
            }
```

```
        }

        private void dgvAllPersonalInfo_CellContentClick(object sender,
DataGridViewCellEventArgs e)
        {

        }

        private void dgvAllPersonalInfo_DoubleClick(object sender, EventArgs e)
        {
            if(dgvAllPersonalInfo.CurrentRow.Index!=-1)
            {
                RegNum =
Convert.ToInt32(dgvAllPersonalInfo.CurrentRow.Cells[0].Value.ToString());

txtLastName.Text=dgvAllPersonalInfo.CurrentRow.Cells[1].Value.ToString();
                txtFirstName.Text =
dgvAllPersonalInfo.CurrentRow.Cells[2].Value.ToString();
                txtSecondName.Text =
dgvAllPersonalInfo.CurrentRow.Cells[3].Value.ToString();
                txtThirdName.Text =
dgvAllPersonalInfo.CurrentRow.Cells[4].Value.ToString();
                dtpDateOfBirth.Value =
(DateTime)dgvAllPersonalInfo.CurrentRow.Cells[5].Value;
                txtSex.Text = dgvAllPersonalInfo.CurrentRow.Cells[6].Value.ToString();
                txtBirthCertificateNum.Text =
dgvAllPersonalInfo.CurrentRow.Cells[7].Value.ToString();
                txtBirthPlace.Text =
dgvAllPersonalInfo.CurrentRow.Cells[8].Value.ToString();
                txtPlaceOfBirthDistrict.Text =
dgvAllPersonalInfo.CurrentRow.Cells[9].Value.ToString();
                txtPlaceOfBirthProvince.Text =
dgvAllPersonalInfo.CurrentRow.Cells[10].Value.ToString();
                txtHomeAddress.Text =
dgvAllPersonalInfo.CurrentRow.Cells[11].Value.ToString();
                txtHomeDistrict.Text =
dgvAllPersonalInfo.CurrentRow.Cells[12].Value.ToString();
                txtHomeProvince.Text =
dgvAllPersonalInfo.CurrentRow.Cells[13].Value.ToString();
                txtPostalAddress.Text =
dgvAllPersonalInfo.CurrentRow.Cells[14].Value.ToString();
                txtCellNo1.Text =
dgvAllPersonalInfo.CurrentRow.Cells[15].Value.ToString();
                txtCellNo2.Text =
dgvAllPersonalInfo.CurrentRow.Cells[16].Value.ToString();
                txtPhoneNo.Text =
dgvAllPersonalInfo.CurrentRow.Cells[17].Value.ToString();
                txtReligion.Text =
dgvAllPersonalInfo.CurrentRow.Cells[18].Value.ToString();
                txtDenomination.Text =
dgvAllPersonalInfo.CurrentRow.Cells[19].Value.ToString();
                txtFilePath.Text =
dgvAllPersonalInfo.CurrentRow.Cells[20].Value.ToString();
                btnSaveInfo.Text = "Update";
                btnDeleteStudent.Enabled = true;
            }
        }
    }
}
```

6.2.6 Stored Procedure SQL code for Inserting from the cntrlPersonalInformation

```
CREATE PROCEDURE PersonalInfoAddInsert
	@mode varchar(10),
	@RegNum int,
	@Surname varchar(50),
	@FirstName varchar(50),
	@SecondName varchar(50),
	@ThirdName varchar(50),
	@DateOfBirth date,
	@Sex char(10),
	@BirthCertificateNum numeric(50),
	@PlaceOfBirth varchar(50),
	@District varchar(50),
	@Province varchar(50),
	@HomeAddress varchar(50),
	@HomeTown varchar(50),
	@HomeDistrict varchar(50),
	@HomeProvince varchar(50),
	@PostalAddress varchar(100),
	@Cell1 numeric(50),
	@Cell2 numeric(50),
	@PhoneNum numeric(50),
	@Religion varchar(50),
	@Denomination varchar(50),
	@StudentPhoto image

AS
	if @mode='Add'
	BEGIN
	INSERT INTO PersonalInfoTable
	(Surname,
	FirstName,
	SecondName,
	ThirdName,
	DateOfBirth,
	Sex,
	BirthCertificateNum,
	PlaceofBirth,
	District,
	Province,
	HomeAddress,
	HomeTown,
	HomeDistrict,
	HomeProvince,
	PostalAddress,
	Cell1,
	Cell2,
	PhoneNum,
	Religion,
	Denomination,
	StudentPhoto)
	VALUES
	(@Surname,
	@FirstName,
	@SecondName,
	@ThirdName,
	@DateOfBirth,
	@Sex,
	@BirthCertificateNum,
	@PlaceOfBirth,
	@District,
```

```
@Province,
@HomeAddress,
@HomeTown,
@HomeDistrict,
@HomeProvince,
@PostalAddress,
@Cell1,
@Cell2,
@PhoneNum,
@Religion,
@Denomination,
@StudentPhoto)
END
```

6.2.7 C# Code for the Main Program namespace (Program.cs)

```
using System;
using System.Collections.Generic;
using System.Linq;
using System.Threading.Tasks;
using System.Windows.Forms;

namespace InClaRS
{
    static class Program
    {
        /// <summary>
        /// The main entry point for the application.
        /// </summary>
        [STAThread]
        static void Main()
        {
            Application.EnableVisualStyles();
            Application.SetCompatibleTextRenderingDefault(false);

            Application.Run(new frmLoadingWindow());
            Application.Run(new frmUserLoginWindow());
            Application.Run(new frmMainForm());
        }


        internal static bool isMinimised=false;

    }
}
```

6.3 Conclusion

The just ended chapter has been about demonstrating how the programming for the InClaRS was done using the C# language for the basic functions of the System. The SQL code for connecting and querying the database was also included. However, the InClaRS being a robust and dedicated application, not all code could be included but only that which would display the basic architecture of the system. Coding for the splash screen, the main form and one of the controls was included in this document. The rest of the code is presented in the application files attached to this documentation. All work was done to achieve full implementation of the requirements and the design architecture discussed earlier. The next chapter will thus focus on the testing of the finished product before the actual deployment.

Chapter 7 Testing

7.0 Introduction

Anchoring on the presumed successes and the termination of the previous chapter, this chapter shall thus put the product to workshop testing. This is the preliminary testing that is done before the product can be deployed. The main objective of this chapter is to trim any unwanted elements that may have outlived the development processes. Different test cases to test the functionality, operationality and compatibility of the InClaRS shall be presented and evaluated.

7.1 Test cases

1. The security test shall be done to determine the resilience of the security mechanisms of the application. Here the system is deemed to have passed the test if an unauthorised user is not allowed in the system and an error message to explain the failure to proceed displayed. The system would have failed if the unauthorised user finds a way to login without the correct user login details.
2. The confidentiality test shall be demonstrated to find what effort was invested in keeping the confidentiality of the user's login credentials. In this test, it shall be observed on the system how a user's login credentials already inputted are hidden once the system realises that the user's attention has been drawn away. The system will be considered to have passed the test if the user's credentials are successfully hidden after the application fail to capture the attention of a user. The system would have failed the test if the user's credentials are laid bare for more than 35 seconds after inputting the password.
3. User friendliness is tested by finding out what options does the system gives to a user who struggle to remember or input his or her password. The system would be regarded to have passed the test if the system is able to give the user show or hide password input options. When the user cannot show or successfully hide their credentials then the system is deemed to have failed.
4. Smooth progression of the system is also put to test. The system should be able to progress from one activity to another with minimum difficulty. The user should be allowed to progress from the login platform to the main from once their login details are verified positively. The system would have failed if the process do not warrant timeous progression. The next page should be fully accessible and active in less than 4 seconds on loading.

5. The system should be able to accept input of the user and be able obey given commands as they are. For example, the system should be able to save work immediately after the save button has been clicked. The system would have failed if no message, for the success or otherwise, of the transaction is not shown.
6. The system should also safeguard information by ensuring that all processes are complete and saved before a user closes the system. The system's ability to ensure data integrity is by asking the user through a popup message whether he or she is sure he or she wishes to leave the system. This must be able to curb inadvertent data loss. Failure to show the message entails that the system is not able to prevent mistaken data loss.

7.2 Test Results

Table 7.0 Test Cases

Test Case	Expectations	Observation	Decision
1. The login security test.	The system is expected to: 1. Disallow an unauthorised user form proceeding to the main form. 2. Display an error message when the login details are not correct.	Security test: It was observed over and over again that an unauthorised user cannot be allowed into the system. The error message for wrong login credentials was displayed in every trial instance. The system did not break down even after numerous attempts to strain it.	The InClaRS passed the login security test.

Table 7.1 Test Cases continued…

Test Case	Expectations	Observation	Decision
2. User credentials confidentiality test.	The system is expected to: 1. Try to recapture the attention of the user who password has already been inputted in the password field. 2. Refresh the login fields on failing to recapture the user's attention.	It was observed that after 30 seconds of inputting the password the system tries to capture of an oblivious user by moving the title on the top page from the left hand side to the right hand side. The title moves back again before refreshing the login fields.	The system passed the user credentials confidentiality test. The system was seen to be upholding the user's details integrity.
3. The user friendliness test.	The system should give the user the options to either hide or show the user's password input.	It was observed that the Hide/show password is visible enough to be seen by the user. The hide or show button work consistently throughout the test trials.	The InClaRS passed the user friendliness test. Thus it may be concluded that effort was invested to make the system user friendly.
4. Smooth activity progression or flow.	The system is expected not to exceed 4 seconds between calling a form and actually using it.	Observations made where to the effect that even when loaded with large volumes of data, the level of degraded performance is insignificant.	The InClaRS Passed the test in this aspect.

Table 7.2 Test Cases continued

Test Case	Expectations	Observation	Decision
5. Strict obedience to given commands.	The system must produced the desired results on instruction. The system should notify the user of results of all transactions.	It was observed that the system is able to give the notifications once a transaction has finished processing. However, frequent errors in accessing the database were observed.	This test was partially passed. The developer will go to the drawing board to employ means that will resolve the errors observed.
6. Protecting the system from inadvertent data loss.	The system is supposed to give warnings and notifications before the user proceeds to other activities.	It was observed that on clicking he exit button, the system displays a message to enquire on the certainty of the user's intention to leave the system. The user is also reminded make sure of having saved their transaction before proceeding to exit the system	This test was passed as the warnings given were see to be alerting users of potential data loss or compromise.

7.3 Unit/Black Box Testing

This kind of testing is done by fellow developers and software engineers. The goal is to identify any technical errors which may have eluded the developer during the development phase. The developers carefully inspect the code and the technical mechanisms of the system.

The service of Mr Emmanuel Dove, Mr Trevor Masimba and Mr Sunwet Shiri was enlisted for the black box testing. The three gentlemen are thoroughbred software engineers and developers who are vastly talented.

Mr Emmanuel Dove looked into the database design and coding. Mr Dove reported that some code needed to be put into stored procedure to separate the SQL code from the interface of the C# development. This, he said, is important because if changes are to be done on the database side, the changes will be done externally and will not grossly affect the main application coding.

Mr Dove's advise was taken into consideration thus all CRUD operations are now implemented in stored procedures. However, the developer was faced with a challenge of the application reporting failure to access some of the stored procedure.

Mr Trevor Masimba assessed and evaluated the C# code that controlled the start up and login phases of the system. Mr Masimba observed that continued flipflopping from the general user login form and the admin login form would result in an exception being thrown. This problem was attended to but it persisted. Thus, the user is given limited chances to switch from the two login platforms. In the interest of time the bug was left for correction at the point of the first maintenance.

Mr Sunwet Shiri looked at the C# coding of the main form and the rest of the controls that were created. His suggestion to encapsulate basic functions of the control was taken into consideration. Mr Shiri looked at all the mathematical calculations that rendered some graphical designs of the system. He recommended that after the adjustments the system may be deployed.

The team of expects finally recommended that the system be deployed. This signalled the readiness of the InClaRS to be finally put into its operational environment.

7.4 User acceptance testing

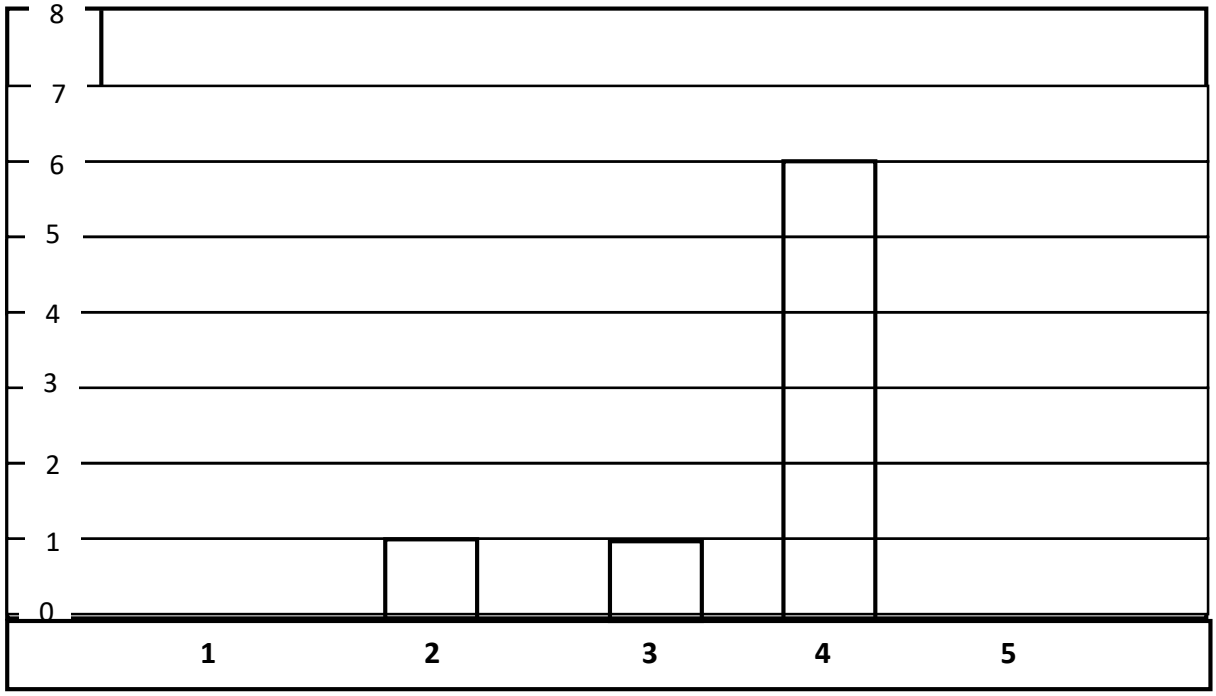
A final survey was undertaken to test the acceptance of the system by the general users. The Beta version of the application was presented to a controlled group sample to tests its acceptance among the end users.

The people within the sample group were given an opportunity to interact with the system and present their opinion on the application. Each participant was given a short questionnaire which they used to present their assessment.

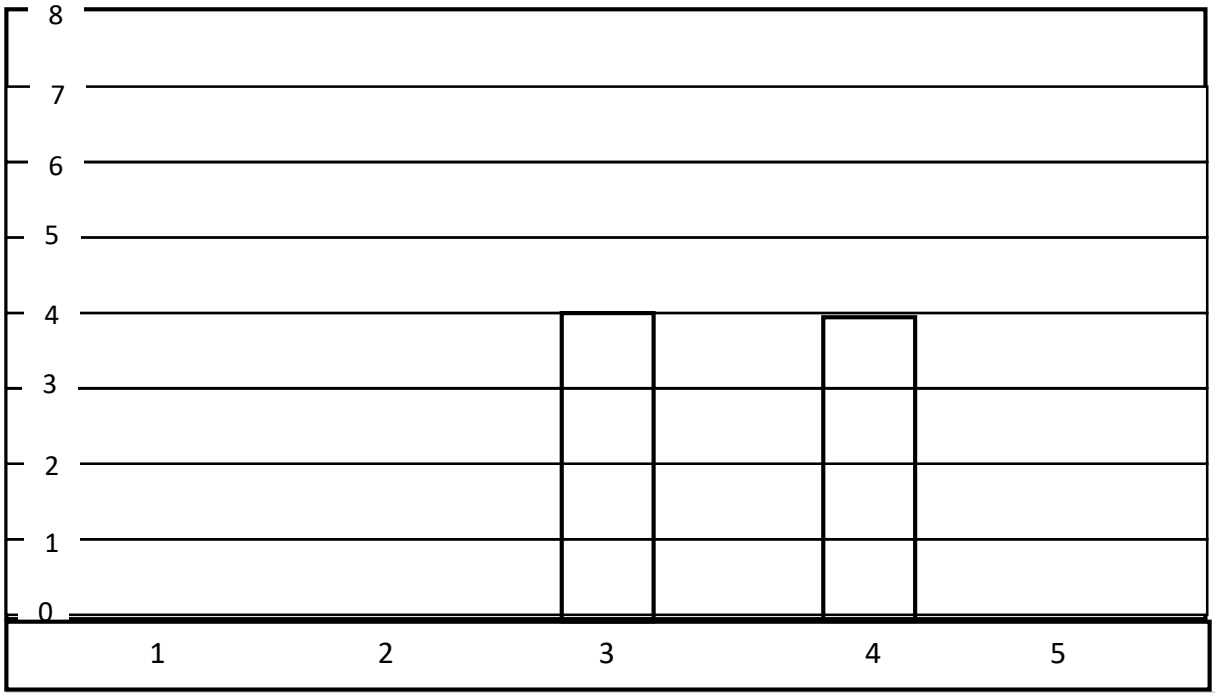
Table 7.3 The User Acceptance Questionnaire

Question	**Possible Responses**
1. On a scale of 0 to 5, how eager are you to use the final product? With 0 being not eager at all and 5 representing extremely eager?	Check the box representing your response. 1 2 3 4 5
2. How would you describe the functionality of the InClaRS at the moment?	1 It is not useful at all 2 It is still work in progress 3 Functional but need some improvements 4 Very functional 5 Extremely useful
3. What would be your choice for an information system between the manual system and the InClaRS?	1 None 2 Manual 3 Both 4 The InClaRS
4. To what extend does the InClaRS address the inadequacies of the manual system? 1 represents no effect at all while five represent to a very high extend.	Check the box representing your response. 1 2 3 4 5
5. How much do you feel the InClaRS should be immediately deployed. 1 represents no effect at all while five represent to a very high extend.	Check the box representing your response. 1 2 3 4 5

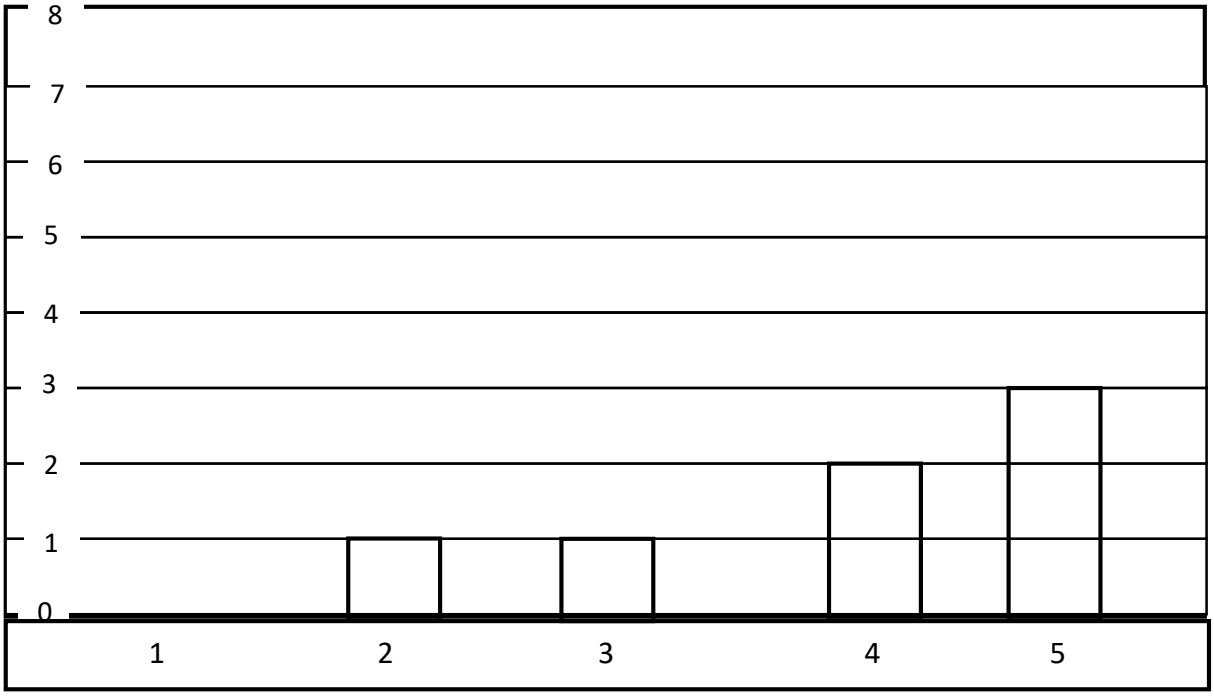
Graph 7.0 Question 1 responses



Graph 7.2 Question 3 responses



Graph 7.3 Question 4 responses



Graph 7.4 Question 5 responses

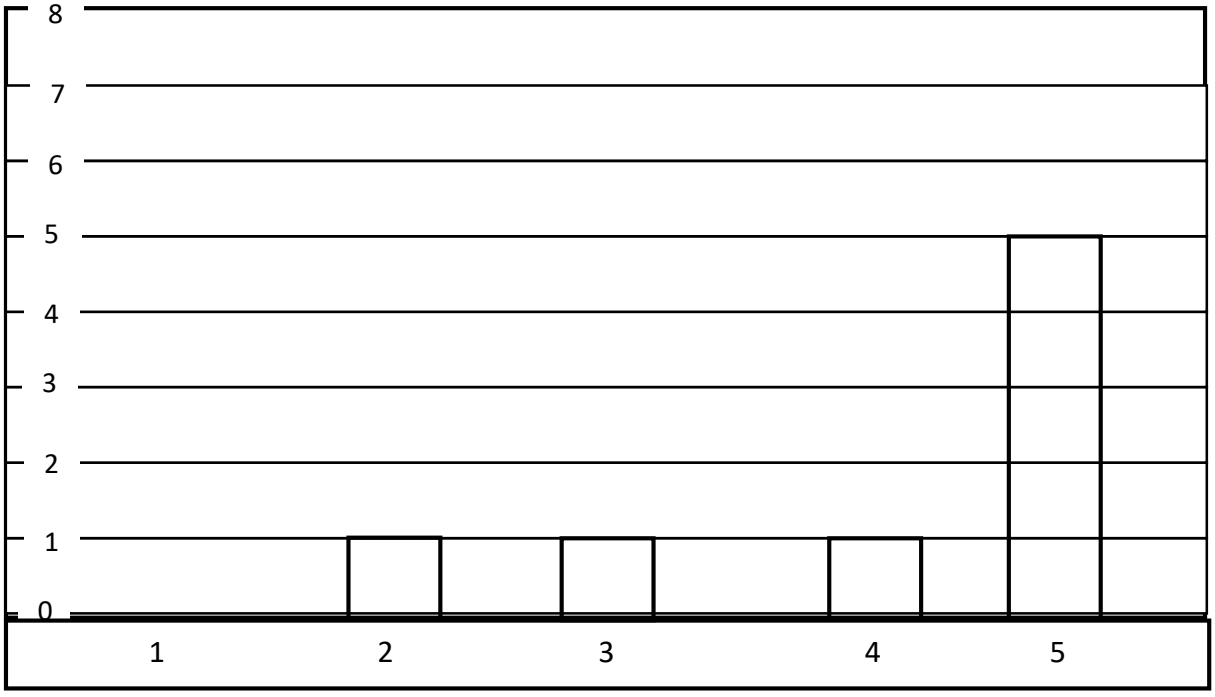


Table 7.0 Summary of Responses

Response Number	Total
1	**0**
2	**3**
3	**7**
4	**13**
5	**8**

7.3.1 Interpretation of the results

The results from the user acceptance survey shows that the majority of the respondents have very high hopes in the InClaRS. However, the low choices in the maximum rating of the system shows that users are cautiously optimistic of the system. The choice of 1 was never chosen showing that all users have some semblance of hope in the Integrated Class Records System.

7.5 Conclusion

This chapter served as the conduit that joined the workshop and the market for the first time since the product has been developed. Numerous test cases were assed and evaluated starting with the expert assessment then the user assessment. Basing on the results and observations evaluated by the researcher-cum-developer, it may be concluded that users are ready to receive the new solution being offered in the form of the InClaRS. High user acceptance has been noted thus the next step of deployment may be executed with confidents.

Chapter 8 Deployment

8.0 Introduction

This chapter is the concluding chapter of the project that was being undertaken. Here the researcher finally avails the complete product that has been under development throughout this project. The finished product is finally installed and put to optimum use in its operational domain. The user manual will also be presented which will act as user guide to the new product. A discussion on the results of the deployment shall be laid which will also proffer suggestions for future development and maintenance of the product.

8.1.0 Deployment and Installation of the InClaRS at Sutton Mine Primary School

The Deployment of the InClaRS was finally done at the Sutton Mine Primary School. The actual Installation was done after the teachers had been fully appraised of the functionality of the new product. Within a day on the 28th of March 2021 the staff workshop on the product and the installation activities were done. Following the installation of the InClaRS, the researcher was in constant and consistent monitoring of the product in operations.

The researcher was able to pick the strengths of the product along with areas that required improvement during maintenance activities in the future. The users of the system also kept providing feedback to the developer.

8.1.1.0 The Installation Process

The deployment of the InClaRS was done in a phased approach. Firstly, the staff members were appraised on the finished product to gauge their interest and level of appreciation for just the initiative. The mini staff workshop was also done to explain the processes of installation and requirements necessary for deployment.

8.1.1.2 Results of the appraisal:

All the 12 teachers at Sutton Mine Primary school indicated their immense interest and appreciation of the new initiative. Of the teachers at the meeting, 8 brought their personal computers in anticipation of the installation. The school also provided its two machines for installation of the InClaRS. At the end of the workshop all the 12 teachers indicated that they had full understanding of the general functionality of the InClaRS.

8.1.1.3 Results of the Installation Process:

The installation process was done by the developer with the help of Mr Shiri Sunwet (a Bed Computer Science Student with the Midlands State University). The Installation did not take too much time, spanning for exactly 2 hours. Of the 10 laptops that were present, all of them had on them the Windows operating Systems ranging from Windows 8 to Windows 10.

Of the 10 machines presented the installation was successful on 9 of them. The other one could not run the application because it had an outdated .Net version. The developer did not have the application thus the installation of the system for this one machine was postponed to a later date.

The installation indicated that there were no conflicts with other previously installed applications. Therefore, the installation process was a resounding achievement with a 90% success.

8.2.0 The User Manual

The user manual is intended to guide the end user in the navigation of the system. The manual explains only the basics and some troubleshooting options that the user needs to know about the system. The user manual for the Integrated Class Records System is presented in two ways, which are the pictorial guide and the video guide.

Table 8.0 User Manual Table 1

Activity	How to execute	Notes
1. Login for the first me	*Step 1.* Start the InClaRS application by Clicking on its icon from the program's menu or, if pinned, from the desktop *Step 2.* After the loading of the "**User Login form**" click on the "**Login As Admin**" button. *Step 3.* User the login details provided first time login *Step 4.* The System will load the main form from which you can change the login details. *Step 5.* Enter any new general users if there are any *Step 6.* Save your update and you are good to go.	The initial login details are: User name: **Admin** Password: **Admin** Please ensure that you use login details you will not forget. The user password must always be unique, if not, the system will reject it.
2. To add a new student	*Step 1.* Click on the "**Individual Record**" menu button and select "**Add New Student**" button. *Step 2.* Populate the text fields with student's information on the form that is loaded on the screen. *Step 3.* After you ahs made sure of the accuracy of your input click the "**Save**" button and your transaction is completed.	The "**Cancel**" button will undo any entries and refreshes the input fields.

Table 8.1 User Manual Table 2

Activity	How to execute	Notes
3. To view student's information.	*Step 1*. Select the appropriate menu button. *Step 2*. Click on the submenu button for the information you wish to see. *Step3*. Search the student's name by name, Reg number or by selecting their name from the data grid view below.	Information of the students is organised and stored in different forms. For example, to view the student's personal information. The user starts by selecting the "**Individual Record**" form the menu then select the "**Personal Information**" form the submenu. From the perspective of the form that is loaded the user can then search for the student by name or by Reg number for the student's information to be loaded.
4. To update a student's information.	*Step 1*. Select the appropriate menu button. *Step 2*. Click on the submenu button for the information you wish to see. *Step3*. Search the student's name by name, Reg number or by selecting their name from the data grid view below. *Step 4*. Select the field that you want to change by clicking in it. *Step 5*. Type in the change you wish to make and make sure it is accurate. *Step 6*. When you are satisfied of your changes, click the "**Update**" button and your changes will be effected. *Step 7*. Confirm your intentions in the popup message that appear on the screen by clicking the "**Yes**" button.	Once the update button has been clicked the changes are effected and the previous entry cannot be directly accessed again by the general user. The "**Cancel**" button will take the user back to the previous interface without effecting any changes to the database.

Table 8.2 User Manual Table3

Activity	How to execute	Notes
5. To remove a student from the system.	*Step 1.* Select the appropriate menu button. *Step 2.* Click on the submenu button for the information you wish to see. *Step3.* Search the student's name by name, Reg number or by selecting their name from the data grid view below. *Step 4.* Select the field that you want to change by clicking in it. *Step 5.* Type in the change you wish to make and make sure it is accurate. *Step 6.* When you are satisfied of your changes, click the "**Remove**" button and your changes will be effected. *Step 7.* Confirm your intentions in the popup message that appear on the screen by clicking the "**Yes**" button.	Once the "**Remove**" button has been clicked the changes are effected and the previous entry cannot be directly accessed again by the general user. Removing an entry means permanent deletion of their record. Only the Admin user has the authority to reverse a Remove Student transaction.

NB. From the login form, the user has 30 seconds to input their password upon clicking the password field. This is meant to protect the user details from prying eyes. Once the password input box has been clicked on the countdown timer is fired and the countdown can be seen at the bottom of the login form. On the lapsing of the 30 seconds, the application tries to recapture the user's attention by running the title at the top to the left then back to the right before refreshing the login page. This means the user has to reinput details in the login details.

8.3.0 Discussion of Results/ Further work.

The monitoring of the InClaRS in its operational environment showed that the system is robust and able to serve its purpose satisfactorily. The system showed resilience even in class where there are too many students. The biggest class at Sutton Mine is the grade 5 class with

60 learners. In this environment, the InClaRS did not show any sign of degraded performance.

The teachers using the system continue to heap praise on the new application for cutting down on the time it takes for generating and maintaining class records. The teachers testify that the system has great capability of securing student information. This was demonstrated by the security test which showed that an unauthorised user cannot be allowed into the system.

Comparing the InClaRS with the previous information system, one teacher using the application said "InClaRS is to manual record as vehicles are to walking". To the developer and researcher, this assertion appears to mean that though the two systems save the same purpose, the InClaRS is superior to manual record keeping as it immensely reduce the burden with which the manual system is associated.

However, due to time constrains, some items of the system are not yet activated. The developer will thus continue to develop the system until it realises it full capacity. With only the Individual Record and the Payment Record activated, the system has functionality only enough for demonstration purposes. The system shall therefore be developed to meet minimum market standard.

Teachers have also expressed concern on the privileges they enjoy as regards database acess. The argument presented was to the effect that if the application is for the classroom teacher, then the classroom teacher shall have the full privileges to the system. The developer does take the valid argument into consideration and shall consider increasing the classroom teacher's control on the overall system.

Some teachers also noted that the world is fast moving towards connectivity thus the application should, at some point, have the ability to be accessed over a network. The developer also takes the suggestion with enough seriousness and is determined to work out ways to carter both the connected and the unconnected users.

8.3.1.0 Maintenance

Maintenance is described by Fisler and Krishnamurthi (2001) as a system development life cycle phase where the product is reviewed in operation with the objectives that include system improvement, correcting faults or modify the elements of the system. Regardless of

flawless functioning of the system the system always has to be maintained to check for other unnoticed adjustments to the system.

8.3.1.1 Corrective Maintenance

Schmoldt (2001) state that corrective maintenance is the processes of repairing broken down systems. A system may breakdown due to the changing environment of its domain. This may cause constraints which where not previously anticipated by the developers.

The developer has shall respond as and when a breakdown is reported by the end users. This shall be done by carefully reassessing the requirements and adjust the code to accommodate any previously unanticipated circumstances.

8.3.1.2 Preventative Maintenance

After the deployment of a system the developers continues to study the system in the workshop. This may lead to discovering eventualities that may cause system misbehaviour. When such eventualities are detected, the developer designs what are called system patches which are intended to fix the bugs before they propagate to dangerous levels. System patches may include security patches, which are essentially mechanism designed to further fortify the system against intruders.

8.3.1.3 Adaptive Maintenance

Sullivan et al (2001) intimate that the business environment is everchanging and the only way to maintain relevance is by adapting to the changes. When a system is deployed some business dynamics may cause the adjustments of the user's requirements, however, these adjustments are difficult to capture during development. As such, the developer will strive identify any business changes which may affect the functionality of the system.

The InClaRS was designed in such a way that encapsulates other functions of the system. This will come in handy when there are changes to be made to the system. Changing code in one part will ensure that the changes are only implemented once and applied elsewhere.

8.3.2.4 Perfective Maintenance

As the name aptly suggests, perfective maintenance is the modification that are done on the system to enhance or increase on its efficiency. Jacobson et al (1992) state that in most cases

the first instance of software deployment is just the release of a minimum viable product. This is the product with the basic functionality, but as the system grows it is further improved to include functions that were not previously included in the initial product. As an example, when Ecocash was introduced, all it could do was sent and receive funds. However, with innovation new functionalities like connecting to other businesses and banks were added to enhance the system. This in actual fact is just one of the perfective maintenance that was done on the Ecocash system.

The InClaRS, likewise, is just but the minimum viable product and a lot of other modules are being developed to be integrated into the system at a later time.

8.4 Conclusion.

The processes of the whole endeavour that started in the first chapter finally terminates here. This chapter has sufficiently provided closure to all the processes and activities that preceded it. The research was guided fortified by the personal philosophy that "No swim instructor who has never been in the pool full of water can be trusted by his or her own student". The gruesome process of developing a working system and properly documenting it has been the pool and the water that this researcher has gained his experience from. Imparting the same knowledge to anyone else thus become a meaningful process because the researcher has gained adequate understanding of the challenges, dynamics and subtleties with which software engineering is associated. The researcher has identified a problem and was able to provide a working solution for it. It can therefore, be safe to conclude that the main objectives for engaging on this project was fully achieved.

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Appendix A

Interview Guide

The interview session is aimed at eliciting the participant's view regarding manual and automated class record keeping systems. The Sutton Mine Primary School has 12 teachers 8 of which were used for the purposes of this session. The trajectory of the interview session is dependent entirely on the prevailing situation at the time of interview. It follows therefore, that as much as a guide is provided the actual process is circumstantial and may not follow the same path for every interviewee.

The Question Guide for the Classroom Teacher

1. What is your view on class record keeping?
2. How Long does it take you to manually compile class record books?
3. How much time is lost during the updating of class record books?
4. Give the rationale, if any, for compiling and maintaining class record books.
5. What challenges do you face in designing and maintaining class record books?
6. What do you propose as the possible solutions for the challenges you have noted above?
7. What is your view on computerised information systems?
8. Contrast between any manual and computer-based system you know.
9. What computer skills do you have?
10. How do you think IT can be used to alleviate challenges associated with manual record systems?

The Question Guide for the school administrators

1. How important are class records to the school administration?
2. To what extend do class records fulfil their purpose at the school?
3. How do you ensure that class records are always in place and up to date?
4. Do the techniques you stated above really work?
5. How does IT solve the challenges you face in the using and supervising class records.

Observation

The observations are done in-loco and when the general environment is not disturbed or modified. The researcher randomly visit colleagues to see how they deal and make use of their class records. The researcher tries to find common patterns in the process of compilation and updating of record books.

Appendix B

Observation Guide

The researcher targets the following:

- The teachers' noticeable attitude towards record keeping
- The time it takes each teacher to compile class record books.
- The frequency and time it takes to update the class record books.
- The extend to which the collected data is effectively used by the teacher.
- The teachers' feeling on innovation class regarding record books.
- The administration's efficiency in supervising compilation and maintenance of class record books.
- The extend to which the administration uses business intelligence to leverage on the data collected in the class record books.