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A Novel secured approach for result processing system

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ABSTRACT
The end-of-course grades assigned by lecturers have become an essential and paramount part of the educational system in Nigeria. This is because it is a physical representation of the totality of a student's experience, exposure, and expertise both in character and learning. These grades could determine easily the future endeavors or academic pursuits of students and as such the die need for its accuracy, efficiency, timeliness, and security cannot be overemphasized. In this work, a computer software application was developed to facilitate the automated processing of the results processing and query. The application will use a novel Secured approach using the Advanced Encryption Standard (AES) Algorithm. The AES algorithm is applied to only the result and the user management table, where the data will be encrypted using a private key and then sent to the database storage. The decryption of the result sheet for the input and update process will only be carried out at the application end using the same private key for encryption. The software was developed using ASP.NET which comprises HTML5, CSS, Bootstrap, and JavaScript for client-side, C# as a server-side programming language, and Microsoft SQL Server 2019 as a relational database. This language was chosen because of its flexibility and features for developing online-based applications. The data used for testing was obtained from the Department of Computer and Information Technology. This program developed/designed will ensure easy flow of information and accurate information management in the Department. With it, it will be possible to compute Grade Point Average and Cumulative Grade Point Average for each student based on examination scores entered being the core idea behind the design.Grade Point Average and Cumulative Grade Point Average for each student based on examination scores entered being the core idea behind the design.

Keywords: AES, ASP.NET, Grade Point, Encryption, and Decryption

1.1 Introduction

In Nigeria, the education system focused strongly on examinations. Lord Fredrick Lugard, the first governor of the unified colony in 1961, set up a school inspectorate, discipline, buildings and adequacy of teaching staff were to be inspected, but the most points given to a school's performance went to the number and ranking of its examination results. This stress on examinations was still used in 1990 to judge educational results to obtain qualifications for jobs in government and the private sector.
(Beka, 2015)

A result is an official school report on the academic record of student, listing courses offered and grades received. Student's result is a critical component of admission, transfer credit unit processing, and graduation processing (Beka, 2015)

Students' result computation seems to be an old area of research which is Significant to every educational institution; continuous improvement on the existing systems provides better solution to the challenges of managing students' academic records (Orobor, 2015)

Over the years, several efforts have been made to alleviate the burden of result processing by the Examination officers in Veritas University, Abuja. Also, the effort expanded by the University in the process of registration of students and computation of their examination results is worrisome. More worrisome is the fact that these processes are carried out every academic session, putting the examination officers in a continuous and ever demanding cycle.

1.2. Problem Statement

The problems posed by manual methods of result processing are enormous. The situation is the same in Veritas University, Abuja and

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correspondingly, Computer and Information Technology Department. The issues here can only be addressed by employing upper hands. The effort expended in the process of registration of students and computation of their examination results is tedious. Quite worrisome is the fact that these processes are carried out every academic session, putting the operators in a continuous and ever demanding cycle.

A major defectof the old systemsis the absence of a unified database system thereby increasing the time required to search or query a student's record and there is no structure that maintains a comprehensive database which is error free and secure that will assist in result generation or to keep or build a database of results in the university that will facilitate students' results computation.

Other problems identified in the old system are as follows:

i. Inability to ensure confidentiality or Privacy ofdata by allowinginformation to be seen by unauthorized persons.

ii. Lack ofIntegrity where unauthorized persons can make changessuch as delete, add or modify information. Easy Omission, wrong entries or Misplacement of Students record.

iii. Absence of Audit trail to track a person from denying the performance of an operation.

iv. It is very cumbersome to manually reconcile all students' results from different files sources into their work sheet for the purpose of result computation.

v. Late computation of Students result, facilitation of management to see trends in result at various levels is difficult and Insecurity of database against Potential Malicious attack.

1.3. Research Question

Can the design andimplementation of a Result Processing System using a Novel Secured Approach Facilitate improvement in efficiency and security of student records?Arising from this research question, the following questions will be asked before the design of this project begin:

i. Whatis the Requirement for the design of a student Result Processing System?
ii. What are the design models for the implementation of a Student Result Processing System?
iii. What is the Implementation of the design Model for Student Result Processing System?

1.4. Aimand Objectivesof the Study

The aim of this project is to design and implement a Result Processing System using a Novel Secured Approach for a more secured, scalable and efficient system.In order to achieve this aim, the following objectives were formulated;

i. Provide a software that will generate result that is accurate, timely and error free.

ii. Maintain a reliable database for storage of students' records and update as the need arises.

iii. Develop a secured, authentic, efficientand role-based authorization access to the students' record.

iv. Produce relevant report of students' general performance at the end ofevery academic semester, presented in the form oftables, charts and graphs, etc.

2.1. Secure Method for Data Encryption-Decryption

This chapter is aimed at exposing the fundamental ideas behind Result Processing Systems. It contains a background study on the topic, reviews of existing literatures and a review of relevant and similar systems in the field. Literatures on Advanced Encryption Standard were also reviewed to understand the basic concept and applicability. Reviews on existing systems in this context were scrutinized. Journals, Citations, articles books and research papers were studied.

In the work, A Novel Simple and Highly Secure Method for Data Encryption-Decryption, A simple light weight and highly secure encryption decryption (SHSED) method was introduced and it was applicable for various data processing applications including Cloud based applications (Amjad, 2019).

An algorithm that secures the key used in AES by converting key into an image and splitting it into n shares using Visual Secret Sharing techniques that is hardware friendly andoffers backward compatibility was proposed in(Kalubandi, 2016).

In A Novel Digital Envelope Approach for A Secure E-Commerce Channel, a software implementation of a digital envelope for a secure e-commerce channel that combines the hashing algorithm of MD5, the symmetric key algorithm of AES and the asymmetric key algorithm of Hyper Elliptic Curve Cryptography (HECC) was proposed. (Ganesan, 2010)

2.2. Result Processing

In the work, A Software Application for University Students Results Processing, a computer software application was developed to facilitate the automated processing of the results. The software was developed in Java programming language in the form of a database, employing MYSQL

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Relational Database Management System (EYO, 2012)

In the work, SRAERCA which is an acronym for "Student Record Analysis and Examination Result Computation Algorithm". The algorithm provides a comprehensive solution to the demandof examination result computation as well as student information and academic record management. The algorithm hereafter referred to as SRAERCA is written in FORTRAN, a programming language especially suited to numeric computation with great speed and precision (Abel, 2014).

In the work, An Object-Oriented Software Model for Students' Registration and Examination Result Processing in Nigerian Tertiary Institutions, The principles of Object-Oriented Software Engineering are employed to model a software application known as Undergraduate Registration and Examination Processing System (SPERU) for Nigerian Tertiary institutions (Bamigbola, 2003).

Also in the work, An Online Result Processing and Transcript Generation System: A Case Study ofKwara State Polytechnic, a computer software application was developed to facilitate the automated processing of the results. The software was developed using HTML5, CSS8, and Java Script for client side, PHP (Hypertext Pre-Processor) as server side programming language andMySqli (My Structural Query Language Improved) as relational database. This language was chosen because of its flexibility and features for developing online based applications. WAMP (Window Apache MySqland PHP) server was used for local hosting and testing (Matemilayo, 2017).

A similar work was done In Development of Students Result Management System. In this paper, an automated platform for managing result of all categories of students in a seamless and interactive manner is presented. The system was developed using PHP, CSS, HTML, and MYSQL and was hosted locally using Apache web server.(Akpasam, 2017).

A tool to mitigate against the inadequacies in wrong computations of students' result, delay in processing and releasing of the said results. The system was engineered on internet the online the net platform exploitation five (5) major web programming languages. The frontend interface was designed using PHP, HTML, CSS3 and JavaScript, while the backend functionalities are powered by MySQL Database server side scripting language and which runs on a WAMP server (Sarjiyus, 2019).

An Automated Students' Results Management Information System (SRMIS) was carried out to automate the manual processes of compiling Students Examination Results. It was necessitated because of some setbacks in manual result processing. An Online Result Processing and Transcript Generation System: A Case Study ofKwara State Polytechnic, A web based application was developed to facilitate the online processing of the results(UDEZE, 2017).

Work on Development of Multi-Modal Result Processing Software for Tertiary Institution. A multimodal, 3-teir (separating the application into data access layer, program logic layer and the user interface) methodology was adopted in re-writing this software. The tools used include visual studio, Borland Delphi and SQL Server database (Oyeyinka, 2015).

According to Matemilayo et.al. (2017) in the work, Design and Implementation of an Integrated Result Processing System in a Networked Environment, a software was developed to facilitate the automated processing students result immediately after they graduate from the institution. The system enables students register courses and in turn, enable lecturers upload students results every semester. The software was developed using HTML5, CSS8, PHP (Hypertext Preprocessor) as server side programming language and MySQL I (My Structural Query Language improved). This language was chosen because of its flexibility and features for developing online based applications. WAMP (Window Apache MySQL and PHP) server was used for local testing.

Similarly in the work Automated Students Result Management System Using Oracle's Database, Forms and Reports, The research was focused on creating an automated students result management system using oracle's database, forms and reports. This is a computerized examinations results management system for tertiary student's examination records. The system designed was meant to register students as soon as they have paid their departmental registration and only then will they be able to view their results. The system presented a single platform that will be used to manage the processing of all examination records within the institution (James, 2014).

In the work, Enhancing the Management of Student's Examination Records using an Interactive Website for Tertiary Institutions in Ghana, a proposed system that would keep track of the flow of information to and from the institution, keeps details of Students, lecturers, courses as well as examinations taken by students. Accurate and timely reports can then be generated from the system with ease for decision making by management and for the consumption of the

general public. The system has a database support and also allows students, staff and the general public to interact with management of the institution for further clarifications. Students would also be able to check and print their results online. Provision would also be made to display the latest events and announcements associated with the Institution online. HTML and WAMP (Windows, Apache, MySQL, andPhP) technology would be used to carry out this project. Apache, MySQL andPhP are open source software.That allows access to the source code, which is free, and its use does not attract license fee (Abukari., 2016).

In the work, Result Processing System for Hand Held Mobile Devices, the paper examined the inadequacies involved in the current system of automated result processing and presented a new form of Result Processing that enables students to get instant results at the end of every semester using their hand phones. The system calculates the Grade Point Average (GPA) and the Cumulative Grade Point Average of each student, at the end of each semester and forward it to the student. With that, the student will know his or her performance at the end of every session. The system was designed with HTML, andPhP at the front end while MYSQL at the back end. The system was implemented in Windows 8 and the result was that students were able to get their GPA and CGPA at the end of each semester (Nwosu, 2019).

In the Design and Implementation of a Client Server Distributed Database for Student Results Processing, the researcher proposed a relational database designed in a way that each academic department in the university has its own database including the Central Record Processing Unit (CRPU), Exams and Record Unit, Student Affair Division, Dean's Offices, and Senate. The master database is hosted at CRPU. Microsoft Visual Basic 6.0®and Structured Query Language (SQL) were used to design a prototype of a client server distributed database for processing student records (Bamigbola, 2003).

According to Fadhil et al.(2016) in the work, Design of Computerized Students Grades Database Management System, a computer software application was developed to facilitate the automated processing of the results. The software was developed in Visual Basic programming language as an interface and in the form of a database, SQL Relational Database Management System was used. The developed software is a useful easy user interface; furthermore, it is a controlling data management, data retrieval, and data manipulation. It will grant more ease for managing the data than manually maintaining the documents. This work is useful for saving valuable time and reduces the huge paperwork.

In SACET: Result Management System, an application is developed basing on the Data Mining concept which means process to extract information from a data set and transform it in to an understandable structure for further use. It involves database for storing the data which the user wantsand can retrieve the data from the database. In the application, the user interface is developed using HTML (Hyper Text Mark-up Language) in which different types of tags are used to enter the data. And to store the entered database is used and in connection to the database and HTML the server-side scripting language PHP (personal-Home-Page Hypertext Pre-Processor) is used for storing and retrieving the data. The validation for the text fields is done using the java script. It uses the Oracle Database (commonly referred to as Oracle RDBMS or simply as Oracle) is an object-relational database management system (ORDBMS) produced and marketed by Oracle Corporation (Sandeep, 2016).

In the article, Modelling and Implementation of a Result Processing System, soft technologies such as the hypertext preprocessor - a high level scripting programming language and MYSQL database management systems were combined in the implementation of the student result processing system. The designed and implemented system was able to provide a robust database that generates various reports that are relevant to secondary schools. The reports included results' summary, results' broadsheet, students' result sheet, and so on. These reports are all downloadable because the system is able to generate them in PDF format. The system is unique in that it can be adopted and adapted to suit the result processing idiosyncrasies of any public secondary school. The software was developed 5 using Hypertext preprocessor (PHP) scripting language and employing MySQL Relational Database Management System in designing the database. The developed software was tested and work as expected. With the use of computers for information processing, the following are possible: instant access to students' personal and subjects' information, instant student information updating, automatic computation of students' results, storing students and subject information such as student's bio data, subject identity, subject name, and scores for the purpose of result computation, and producing user friendly data entry screens for ease of use (Oluwadamilare, 2020)

In the work, Multivariate Analysis of Performance of Hybrid Result System Model for

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Nigerian Universities, the design and development process, the HRPMS input-output modules and computing components were developed with the following tools: UML designs, Excel Binary VBA, Java 8.0, PHP Designer 8.0 and MySQL5.4 programs, which optimized the standalone-internet hybrid functionalities of the socket-subsystem. Using the Agile fourth-quadrant tests in the beta test stage, the HRPMS performance was validated. The hypotheses test and the probability density function (PDF) prediction shows that the non-functional requirement variables actually and positively drives HRPMS performance to becoming improved over the existing single-platform system model. Finally, the HRPMS promises to provide more efficient, more secured and hard-to-crash system for result processing and management in Nigerian Universities (Chukwuemeka, 2019).

In the work, Result Processing System for Academic Institutions, Object oriented analysis and design methodology (OOADM) was. The programming languages used for the software implementation was hypertext mark-up language (HTML), cascading style sheet (CSS), and Java script for the front-end interface while the backend functionalities powered by hypertext pre-processor (PHP) and my structural query language (MySQL) database were also employed. It is revealed that the system was able to compute grade point average (GPA) and cumulative grade point average (CGPA) for each cadets facilitating easy access to all users anytime (Akaiso, 2019).

According to Bharamagoudar et al. (2013) in the work, Web Based Student Information Management System, an application was created that tracks all the details of a student from the day one to the end of the course which can be used for all reporting purpose, tracking of attendance, progress in the course, completed semesters, years, coming semester year curriculum details, exam details, project or any other assignment details, final exam result and all these will be available through a secure, online interface embedded in the college's website. It will also have faculty details, batch execution details, students' details in all aspects, the various academic notifications to the staff and students updated by the college administration. It also facilitates us explore all the activities happening in the college, Different reports and Queries can be generated based on vast options related to students, batch, course, faculty, exams, semesters, certification and even for the entire college. Technologies used include HTML, CSS and JavaScript for the front end and PHP and MYSQL for backend.

2.3. Web-Based Information System

"Information systems are almost always web-based systems, where the user interface is implemented in a web browser"(Sommerville, 2016). In a web-based system, the Internet serves as the front end, or interface, for the database management system. Internet technology provides enormous power and flexibility because the related information system is not tied to any specific combination of hardware and software.

Access to the database requires only a web browser and an Internet connection. Web-based systems are popular because they offer ease of access, cost effectiveness, and worldwide connectivity, all of which are vital to companies that must compete in a global economy (Tilley, 2017)

According to Barry (2018), Web applications are composed of web components and other data such as HTML pages. Web components can be servlets, JSP pages, web filters, and web event listeners. These components typically execute in a web server and may respond to HTTP requests from web clients. Servlets, JSP pages, and filters may be used to generate HTML pages that are an application's user interface.

2.4. Literature Summary

From the various Literatures that have been reviewed, Result processing systems have always been designed and implemented and deployed on the cloud. This means that the systems are always uploaded online for both dynamic, static and responsive operations. This allows for easy result upload on the cloud. The draw back however is that security of data is often and easily breached between the times of upload from offline to online. This challenge is hereby addressed using the Advanced Encryption System Algorithm (AES) which encrypts data into a meaningless form using a key and there after decrypts it into a useful form making it impossible for the data to be successfully interpreted even when intercepted by un-authorized person thereby maintaining system security and efficiency.

3.1. Design Science Research Method

The methodology adopted for the researcher is Design Science Research (DSR). It is seen as a research activity that build new or invents, innovate artifacts for problems solving or improvement attainment such new innovative artifact creates a new reality, rather than the existing reality been explain or trying to make

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sense from it, it creates, and evaluates IT artifact which is intended to solve some identified organizational problems(Alturki, 2013).

The Design Science Research Methodology is relatively a new approach in the field of Information Systems, and Computer Science because of it prominence rapid growth in the discipline (Alturki, 2013).

Design Science Research Methodology basic logic of discovery is deductive, because an unsolved problem is taking and tries to find a justificatory knowledge or a kernel theory which help in solving the problem(Piirainen, 2014).

3.1.1. Software Development Methodology

The research method used in this research is the Iterative Development model of the System Development Life Cycle (SDLC) method. In iterative model, requirements are not completed and started iterative process with a small set of requirements. Each iteration evolves a small version of product and it is repeated until the final version is developed. Iterative process model starts implementation with a subset of requirement specifications. Each iteration is added new functionality in the process and continuous until it is completed. (Tarkhala, 2014)

The graphical representation of iterative model is given below

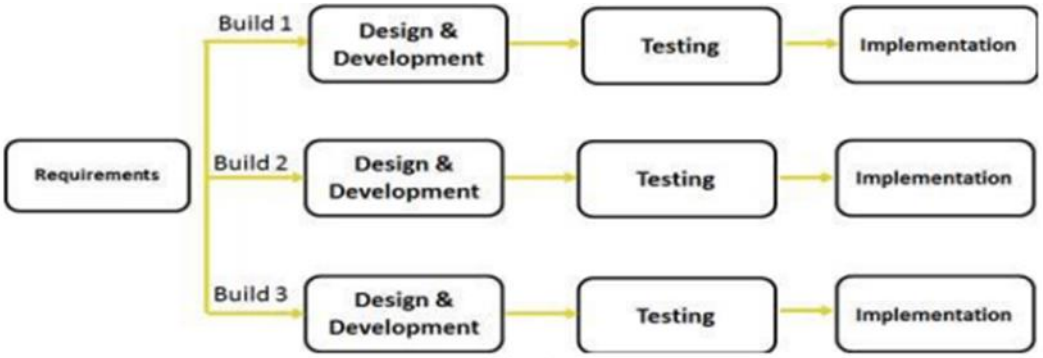

Figure3.1: Iterative model (Shylesh, 2017)

i) Iterative Process Model Application Like other SDLC model, Iterative model is also not fit for every application. However, this model is often used in the following scenario:

• When complete requirements of the system are cleared and well defined.

•Important and major requirements must be completed however some functionality may evolve with time.

•There is a time to market constrain.

•A new technology is being used while working on the project.

•Resources with needed skill set are not available and planned to be used on contract basis for specific iterations.

ii) Advantages and Disadvantages of Iterative Model Advantages and disadvantages of iterative SDLC model are shown in table given below

Table 3.1: Iterative Model Table

Advantages	Disadvantages
• Some of important working functionality is available quickly. • Results are derived soon and quickly. • Parallel development can possible. • Project progress can be measured. • Requirement change process within budget. • In small iteration testing and debugging is easy. • Risk identification and milestone management is easy. • Most risky part is done first there easy manage high risks. • After every iteration functional product is delivered. • Issues, challenges and risk which get from one iteration are applied to the next iteration. • Better risk analysis. • It supports changing requirements environment. • Minimum initial operations. • It is best for large and critical products. • During iterative model software product is developed early which facilitates customer evaluation and feedback report.	• Many resources are required. • Although requirement changing cost is low but not much appropriate for changing requirement. • More management is required. • System design issues are raised because not all requirements are available in starting. • Complete system definition is required for iterations. • Not best for small and tiny projects. • At the risk is unknowable. • For risk analysis and identifications, skilled persons are required. • Project progress depends upon risk analysis.

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3.2SystemAnalysis

A system is an organized collection of inter related subsystems with a collective responsibility of meeting a goal. Dependent subsystems are regularly interacting while independent group of components forming a unified whole work like standalone in achieving a specified task. A system also defined as an organized or complex unitary whole. The analysis phase answers the questions of who will use the system, what the system will do, and where and when it will be used. During this phase, the project team investigates any current system(s), identifies opportunities for improvement, and develops a concept for the new system. (Dennis, 2015)

System analysis is simply the investigative studies carried out on systems under consideration. These system maybe real and already existing systems or envisioned systems for future development. The primary goal of system analysis is to determine much improved and efficient ways in which systems should function. The analysis are usually based on proper knowledge of the organization and business process for which the system is developed as well as the knowledge of how Information Technology can be exploited to boost processes. (W3C, 2016)

System analysis is the procedure system analysts follow to determine how a system ought to out to work i.e., figuring out the functions, how achievable it is based on the constraints like budget and ensuring that advantages of the system will exceed the expenses incurred in setting up the system.

In the software engineering process, system analysis is one of the primary stages in the requirements engineering phase and it is a major pre-requisite for system design. It is a very important phase that will require both creative and critical thinking for the system developed to optimally provide solutions to the problems for which it was created and ultimately satisfy the needs of the users. Creating the system design specific at an early stage within the system development needs some analysis. The choices made in the analysis and design of the core competencies of the system have a profound impact on whether or not the system will meet crucial necessities such as performance, dependableness and maintainability (Sommerville, 2007).

3.3 Systems Architecture

In any system design, the output is considered first because it is the desired output that will determine both the input and the procedure. All the components of the program (such as different subprogram/modules designed separately) were integrated together to become a single program and then test run.

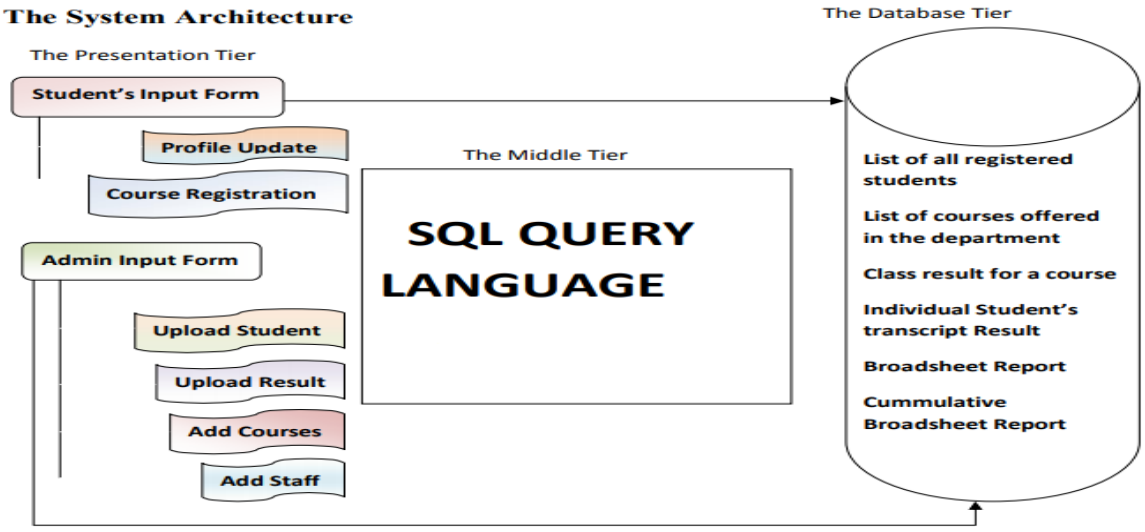

Figure3.2 Diagram of the System Architecture

Figure 3.1 above is a Pictorial representation which captures the full essence of the system.The system was designed in a 3tier architecture as shown in figure 3.1. The 3-tier architecture comprises of:

i. The Presentation Tier: - This software level presents the user with the interface. It was designed with a HTML and CSS using Bootstrap Framework.

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ii. The Middle Tier: - This level serves as an intermediary between the interface and the database. It picks data entered by the user through the interface and either inserts it into the database or compares with the already existing data in the database

iii. The Data tier: - This is the third tier of the software architecture. It is the database that allows the insertion, storage and retrieval of any information.'

3.4. Sources of Data Collection

Primary and secondary sources were used to gather information for this research project. Interviews were used to gather information more thoroughly primarily; moreover, it gave the interviewer the opportunity for more flexibility with the questions. These interviews also provided the option to get hands on functional and non-functional user requirement.

Secondary sources were used to gather information for this research project also. The data collection instruments issued for this study were the internet, books, and journals.

4.1. System Testingand Implementation

After the system architecture is designed, then the real development and testing of the system is done in this phase. Based on the diagrams above, a working application is developed in units, and later integrated to make a single fully functional program. Here, layouts are designed using ASP.NET website then, the coding for the functioning of the application is done using C# Dynamic Link Library (DLL). All the supervised models are written in Transact SQL stored as a procedure in MSSQL Server 2019. After the development of the application is complete, it is then forwarded for testing. After a thorough process of system analysis, system design and an exhaustive requirement elicitation and specification, the system was now implemented using appropriate tools. Software implementation is a phase in software life cycle where the actual software is developed or implemented with the programming language and platform of choice. The chapter provides an overview on the choice of platform and programming languages, software and hardware requirements, and the different modules, interfaces that were implemented.

Many researchers such as (Danaa, 2016)observed that when the results are processed manually, it may lead to problems such as Error during computation, Insecurity of results,untidy results after changes must have been affected and work load on the examination officers.

However, despite the activities of the examination officers, laborious processes are usually required to compute error-free students' examination results. For these reasons an effective, efficient and error free results processing system is required for proper result processing. Moreover, automating result processing system will minimize these problems.

Numerous works have been done regarding Result Processing in various institutions, however, all researchers and developers adhere to the standard and process on how their institutions process results.

A student's work in Veritas University is presently graded in the following letters and each of the letters carries the following number of grade points:

Table 4.1: Veritas Grading System

Percentage Score	Letter Grade	Points	Rating
70 - 100	A	5	Excellent
60 - 69	B	4	Very Good
50 - 59	C	3	Good
45 - 49	D	2	Fair
40 - 44	E	1	Pass
0 - 39	F	0	Fail

To determine the final grade a student receives in a course at the end of a semester, 30% weight is given to the continuous assessment and 70% to the semester examination. At the end of

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each semester, a student's grade point average (GPA) is worked out. An example to demonstrate how the GPA is calculated is shown below in table 2. Suppose a student offered seven courses in the first semester of his first year. Assuming he or she obtains the following grades: A, B, A, C, D, E, F respectively in the seven courses offered, his GPA would be calculated as:

Table 4.2: Veritas Grading System Calculation Example

Course Code	Course Title	Credit Unit	Grade	Point	Grade Point(GP)
CSC 101	Intro. To Computer Science	2	A	5	5 x 2 = 10
MTH 111	Elementary Math. I	3	B	4	4 x 3 = 12
MTH 121	Elementary Math II	3	A	5	5 x 3 = 15
PHY 104	General Physics	2	C	3	3 x 2 = 6
PHY 191	Practical Physics	2	D	2	2 x 2 = 4
GST 131	Community Service	2	E	1	1 x 2 = 2
GST 101	Use of English	2	F	0	0 x 2 = 0
		16			49

GPA = Total Points / Total Credit Units = 49 / 16 = 3.0625 = 3.06 to 2 d.p.
The following classes of degree and grades of diploma/certificate are awarded on the basis of the following cumulative grade point averages:

Table 4.3: Veritas Grading System showing grades

CGPA	Degree	Diploma/Certificate
4.50 – 5.00	1st Class Honors	Distinction
3.50 – 4.49	2nd Class Honors (Upper)	Credit
2.40 – 3.49	2nd Class Honors (Lower)	Merit
1.50 – 2.39	3rd Class Honors	Pass
1.00 – 1.49	Pass	Pass
0.00 – 0.90	Fail	Fail

Due to enormous problems associated with manual computation of student grade points, brought forward cumulative grade point, total cumulative grade point, course units, carry over courses and outstanding courses, there is need for efficient method with error free that will enable result to be processed automatically for Departmental and Faculty approval in standard format for the Institution.

In this project, a novel secured approach was used to safeguard student result using AES (Advanced Encryption Standard). AES is a symmetric-key algorithm based on the Rijndael cipher developed by Joan Daemen and Vincent Rijmen. The AES algorithm has a block size of 128 bits. It supports three different key lengths of 128, 192 and 256 bits. AES (Nikita, 2014) replaced Data Encryption Standard and it is now used worldwide. In AES there is no Feistel Network as opposed to the previous standard DES. The cipher consists of rounds, where the number of rounds depends on the key length: 10 rounds for a 128-bit key, 12 rounds for 192 bit key, and 14 rounds for a 256 bit key.

The whole algorithm operates on a 4 x 4 matrix of bytes. The first rounds consist of four distinct transformation functions: Sub Bytes, Shift Rows, Mix Columns, and Add Round Key. The final round contains three transformations. The Mix

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Columns function is not used in the final round. Each transformation takes one or more 4x4 matrices as input and produces a 4x4 matrix as output. Provided that all the four rounds are reversible, it is easy to prove that decryption does recover the plaintext. (Nikita, 2014).

A proper qualitative research method will be carried out and a proper functional and non-functional testing will be carried out to ensure the integrity, efficiency and accuracy of the system.

4.2. System Requirement

The web part of the application is essentially the parts accessed by the users, these are the students, staffand the administrator, a dedicated staff who administers and oversees the usage of the application. The hardware and software requirement for implementing the web module of the system and running the application by the department is detailed in Table 4.1 and Table 4.2 respectively. Any department that would work with the application will basically require a device with internet access as the system is cloud based.

Table 4.4: Hardware and Software Requirements for implementing the system

Requirements	Specification
Operating System	Microsoft Windows 10
Database Management System	Microsoft SQL Server
Web Server	Internet Information Services (IIS)
Programming Language used	ASP.NET C# MVC , HTML, CSS, JavaScript, JQuery
Integrated Development Environment	Microsoft Visual Studio
Network	Internet access is required to deploy to cloud.
Internet Browser	Google Chrome, Mozilla Firefox, Safari, etc.
Processor	At least Intel Processor Core i3 with CPU speed of 2.50 GHz.
RAM	At least 6.00 GB.
Hard Disk.	At least 148GB

Table 4.5: Hardware and Software Requirements running the system by users

Requirements	Specification
Operating System	ANY
Device	ANY device with access to internet browsing capability this includes desktops, Laptops, Tablets.
Internet Browser	ANY
Network	Internet access is required to access the application.
Processor	Intel Processor Core i3 with CPU speed of 2.50 GHz.
RAM	At least 6.00 GB.
Hard Disk.	At least 148GB

4.3 Requirement Analysis

Requirement analysis refers to the process of obtaining all the functions and constraints of the proposed system as desired by the users and other stakeholders. The overall goal of the system requirement analysis is to generate a system requirement document. The requirement document is a well-structured document that clearly details careful descriptions of the systems functions and all that, the user hopes to achieve from the system. (Sommerville, 2007)

It is an official document of what the developers of the system ought to implement in the

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development of the system. It embraces each of the users' requirements as well as the system requirements. In some scenarios however, the user and system requirements may be constricted into a single description. Requirements are divided into the two types.

4.4 Functional Requirements

Functional requirements are statements showing services and functionalities that the system ought to provide. These include the system's response to ranges of input and gestures and the way the system should behave at each instance. Some scenarios in the functional requirement may also expressly state what the system must not do (Sommerville, 2007).

They are essentially focused on noting the key system performance points. These requirements are usually based on the kind of system being developed, the reason for its development, the predicted users of the system and also the method of approach of the organization at writing the requirements. Functional requirements describe the system operations in a clear and detailed form; its expected inputs, the probable outputs, the errors and exceptions, and so on (Sommerville, 2007).

Functional requirements may be in form or user requirements or system requirements.

User requirements refer to statements in the form of natural language and diagrams, of what services the system is expected to provide and also the constraints under which it must operate. Fulfilling the user requirements always remain the most important aim of system development and failure often stems from not completely meeting them. System requirement on the other hand refers to documents that enumerate the system's functions, services and operational constraints thoroughly. The system requirements document (sometimes known as a functional specification) ought to be precise. The system requirements document is ought to outline precisely what's to be enforced by the system. It should be a part of the contract between all the system stakeholders (Sommerville, 2007). Examples of functional requirements to be provided by this system includes:

The system should allow Lecturers to login, update student scores, view student score, check Result Analysis and submit result.

The system should allow the Exam officer to login, print Result Template and Print master sheet.

The system should allow the HOD to login, View Student Result, Check Result Analysis, Assign Courses, Approve or Disapprove Courses Result and Submit Result to the Dean.

The system should allow the Dean to login, View Student Result, Check Result Analysis, Assign Courses, Approve or Disapprove Courses Result and Submit Result to the Senate for approval by the Vice Chancellor.

The system should allow the Administrator to Login, Audit Trail, Perform CRUD (Create, Read, Update and Delete) Operations on Faculty, Department, HOD, SMS, Exam Officer, Course Registration, Course Type, User Management, Level, Semester, Course, Registrar, Program, Session, Dean ,Student ,Staff, Assign Course and Vice Chancellor Tables.

The system should allow Students to Login, Register Courses, Update Profile and Check or Print Result.

The system should directly message parents or guardians when Students Results are uploaded.

The SMS messaging functionality would work and integrate seamlessly with the application even in the presence of internet connectivity.

The System should secure the database using the Advanced Encryption Standard (AES) Algorithm.

4.5 Non- Functional Requirements

These are constraints on the functionalities and capabilities of the system. Non-functional necessities typically apply to the system as a whole and not just individual components or features of the system. They are used to refer to emergent attributes of the system as a whole. These attributes include security, information privacy, availability, reliability and performance (Sommerville, 2007).

According to Cremers and Alda (2007), these requirements are general concepts and are usually the same most times cutting across different domains of applications and systems. They can also to be used to set constraints on the processes being used in the development of the system and the approach used by the developer as well as state the qualities the overall system should have Some of the non-functional requirements of this project include:

4.5.1 Reliability /Dependability: This refers to the ability of the system to perform the functions it is required to under the expected conditions and in due time. They are constraints that must be followed especially at runtime. It could be in terms of

i. Availability: This answers the question of access to the system when needed. Even in the absence of

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internet connectivity, the patient can still send messages to the physician on the application via the SMS platform.

ii. Failure rate: This refers to how frequently the application is unavailable or inaccessible to the end users.

iii. Dependability: This points to the ability of the system to provide the services it is required of by the end users and that these services can be trusted.

iv. Reputation: This refers to the general feeling of the users of the system towards the system i.e. the users' opinion of the system. This will go a long way in determining if they will continue with their usage of the application.

4.5.2 Performance: This basically refers to the rate of operation and responsiveness of the application. It is also concerned with throughput and the efficiency at which the system uses the resources available on the host device – computer or mobile phone

4.5.3 Security: The system will ensure security of user information by ensuring the following:

All data exchange between the clients' device and the server, especially login and other access information will be encrypted.

The system will be banking on the Microsoft provided security features including using both the Microsoft authorization and authentication classes.

4.5.4 Usability: This is the ease with which the user can learn to operate the system, understand the required input at each stage as well as the output provided by the system

To attain the usability goals of the system, the following will provide:

i. Efforts will be made to ensure that the error messages are very well self-explanatory when errors are encountered.

ii. A clear and concise documentation on the usage of the application will be provided.

iii. The graphical user interface of the application will be very simple, elegant and easy to understand and use to even the most basic user.

iv. Adequate error handler will be integrated in the system so as to properly help and inform the user in the case of unnecessary input errors.

4.6 Software Design Modelling

System design is the stage where the system analyst outlines the physical components necessary to get the proposed system from the system analysis phase up and running. System Design is process of characterizing the segments, modules interfaces and information for the framework to meet the required prerequisites from system analysis. It is the process of creating new systems that entailing their models, practices, methodologies and processes. System design contains physical, logical and structural designs of the system.

4.7 System Modelling

System modelling is all processes that involve the creation of various representations of a system. It involves using models to conceptualize the features and components of the system in a whole as an entity. A model presents the system from a perspective ignoring the intricate details of the system. It involves a level of abstraction. Subsequent models can be developed to show other information about the system. (Sommerville, 2007)

4.8 Unified Modelling Language

Unified Modelling Language (UML) is an Object-Oriented approach to modelling. It may be defined as a consistent, general purpose modeling language consisting of a collection of graphic notations that are used for making visual models of object-oriented computer software and systems. UML combines many techniques used in modelling the data model, business model, object model and element model components of the system (Jacobson, 1999). There are various UML diagrams and that used for representing the system from different perspectives.

i. Use case Diagrams

Use case diagram is a diagram drawn primarily to express the functions and components of the system on a high-level perspective with certain levels abstraction (Bell, 2003). It describes the proposed functionality of a system. It represents a discrete unit of interaction between a user and a system, the user can be a human or a machine but in this case the user is human. Use cases describe this interaction in a manner the users can understand. A use case diagram describes the functionality provided by a system in terms of actors, their goals represented as use cases and any dependencies among those use cases. Use cases are as a result of decomposing the scope of the system. They represent graphically with the name of the use case appearing above or inside a horizontal eclipse (Sommerville, 2007).

Actors: They are stakeholders that represent the external entities of the system i.e. people or things that interact with the system that is being modeled. Use cases are triggered by actors, they initiate system activities for the purpose of completing a task.

Use Case Relationships: a relationship exist when an actor is involved in an interaction. There are also two kinds of relationships between use cases, they are;

Includes: Use cases that are associated with actors can be very general. Sometimes they "include" more specific functionality. Includes

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relationship is represented by dashed arrows that point to the included functionality. The arrow has an <<uses>> keyword beside it (Ambler, 2004).

Extends: An extension use case is an insertion to the base use case. For example, some stores may allow for different payment options like credit card, debit card, or cash on delivery (Ambler, 2004). These specific functionalities are extension of the general "pay for items." Extends relationship is represented by dashed arrows that point to the base functionality.

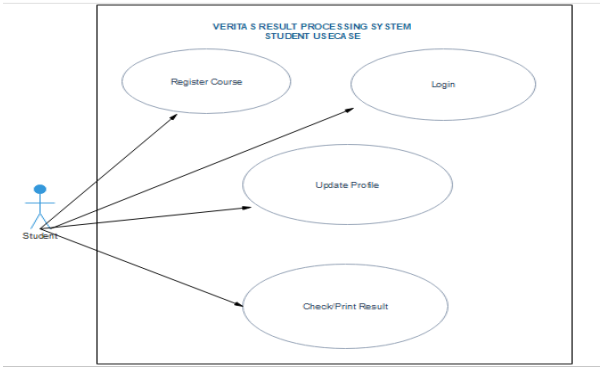

Figure 4.1: Students' use case diagram

Use Case Narratives

Table 4.6: Students use case table showing the login process

Use Case 1	**Student's use case**
Brief Description	This shows how the Student gets access into the system
Actors	Student
Flow of Events	Basic Flow The use case starts when the user accesses the system over the internet. The Student opens up the application. The Student enters his Matriculation number and Username and attempts to login. The Student is taken to the main application screen where he can then make use of the application's functionalities.
Level	Students use case.
Parameters	Input: Matriculation Number and Username Output: Main application interface
Pre-conditions	For usage of the application, all the student's computers or mobile devices must have internet access.
Post-conditions (success end)	If the use case is successful, access is granted into the system and the user can begin communicating effectively with his physician.
Post-conditions (failed end)	If the use case is unsuccessful, access is not granted into the system, hence the system state is redirected to the login page.
Trigger	A user requests to get access into the system and operate it.
Extension points	None

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Table 4.7: Students use case table showing the Register Courses process

Use Case 2	**Student's use case**
Brief Description	This shows the Student the process of registering courses
Actors	Student
Flow Of Events	Basic Flow The use case starts after Student has gotten access to the main activity interface of the application. The Student selects Courses from a list provided of all those registered on the platform. The Student can select from previous years in case of a carryover or an outstanding.
Level	Student use case.
Parameters	Input: Select courses to be registered Output: Confirmation of the registered courses
Pre-conditions	For usage of the application, all the Students computers or mobile devices must have internet access. The Student must have successfully logged in.
Post-conditions (success end)	On successful registration, student can print course form.
Post-conditions (failed end)	If the use case is unsuccessful, there is no internal change in the system, however the Student is notified of an incomplete attempt at registering a course.
Trigger	A User requests to get access into the system and operate it.
Extension points	None

Table 4.8: Students use case table showing the Update Profile process

Use Case 3	**Student's use case**
Brief Description	This shows the Student the process of Updating his or her profile
Actors	Student
Flow Of Events	Basic Flow The use case starts after Student has gotten access to the main activity interface of the application. The Student can update his/her profile
Level	Student use case.
Parameters	Input: Update profile Output: Profile successfully updated.
Pre-conditions	For usage of the application, all the Students computers or mobile devices must have internet access. The Student must have successfully logged in.
Post-conditions (success end)	On successful update, student can view updated profile
Trigger	A User requests to get access into the system and operate it.
Extension points	None

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Table 4.9: Students use case table showing the Check/Print Result process

Use Case 3	**Student's use case**
Brief Description	This shows the Student the process of Printing his or her Result
Actors	Student
Flow Of Events	Basic Flow The use case starts after Student has gotten access to the main activity interface of the application. The student can print his/her result when it's approved.
Level	Student use case.
Parameters	Input: Update profile Output: Result successfully printed.
Pre-conditions	For usage of the application, all the Students computers or mobile devices must have internet access. The Student must have successfully logged in.
Trigger	A User requests to get access into the system and operate it.
Extension points	None

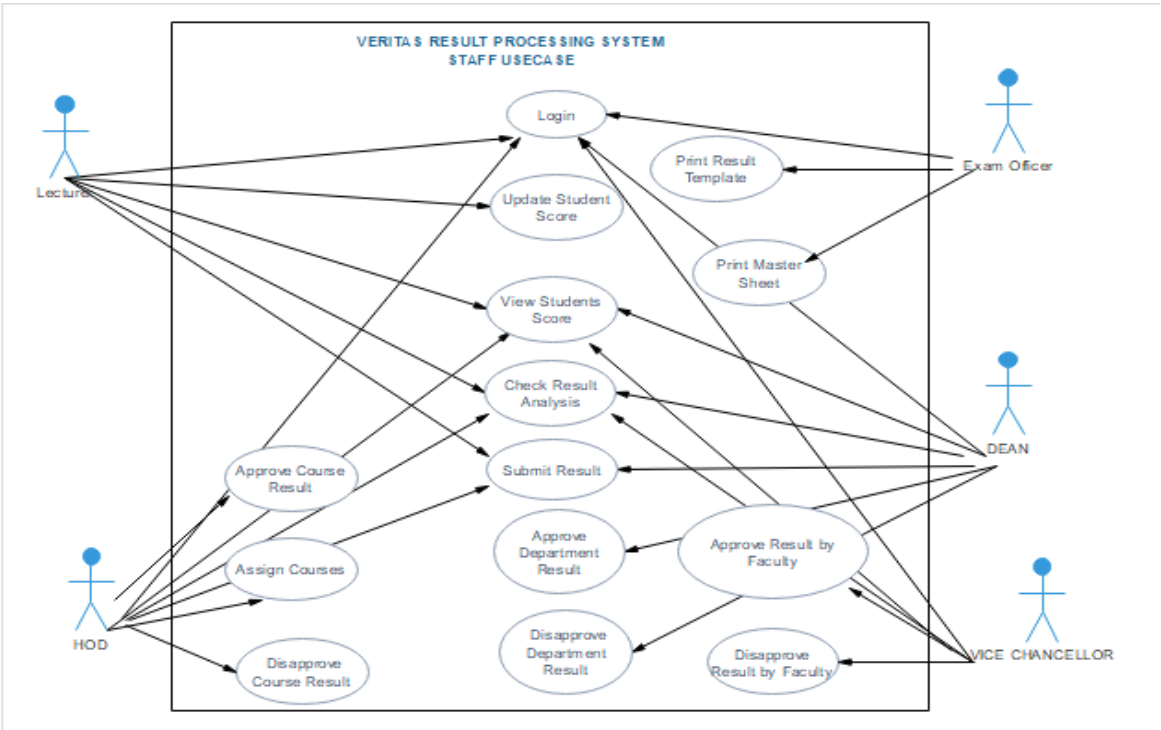

Figure 4.2: Staffs' use case diagram

Table 4.10: Staff (Lecturer) use case table showing all processes

Use Case 5	**Lecturer use case**
Brief Description	This shows the Lecturers process of logging in, updating students score, viewing students score, checking result analysis and submitting students result.
Actors	Lecturer
Flow Of Events	Basic Flow The use case starts after the lecturer has gotten access to

	the main activity interface of the application. The Lecturer enters his email and password and attempts to login The Lecturer is taken to the main application screen where he can then make use of the application's functionalities. The Lecturer can update students score, view students score, check result analysis and submit students result.
Level	Lecturer use case.
Parameters	Input: email, password Output: Main application interface
Pre-conditions	For usage of the application, all the lecturers' computers or mobile devices must have internet access. The Lecturer must have successfully logged in.
Trigger	A User requests to get access into the system and operate it.
Extension points	None

Table 4.11: Staff (Exam Officer) use case table showing all processes

Use Case 6	**Exam Officer use case**
Brief Description	This shows the Exam Officers process of logging in, Printing Result Template and printing the Master Sheet.
Actors	Exam Officer
Flow Of Events	Basic Flow The use case starts after the Exam Officer has gotten access to the main activity interface of the application. The Exam Officer enters his email and password and attempts to login The Lecturer is taken to the main application screen where he can then make use of the application's functionalities with Exam Officer Privileges. The Exam Officer can Print Result Template and can Print Result Master Sheet
Level	Exam Officer use case.
Parameters	Input: email, password Output: Main application interface
Pre-conditions	For usage of the application, all the Exam Officer s' computers or mobile devices must have internet access. The Exam Officer must have successfully logged in.
Trigger	A User requests to get access into the system and operate it.
Extension points	None

Table 4.12: Staff (HOD) use case table showing all processes

Use Case 7	**HOD use case**
Brief Description	This shows the HODs process of logging in, Assigning Courses, Approving Course Result, Disapproving courses, viewing students' scores, checking Result Analysis and Submitting Result.
Actors	HOD
Flow Of Events	Basic Flow The use case starts after the HOD has gotten access to the main activity interface of the application. The HOD enters his email and password and attempts to login

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	The HOD is taken to the main application screen where he can then make use of the application's functionalities with HOD Privileges. The HOD can then Assign Courses, Approve Course Result, Disapprove courses, view students' scores, check Result Analysis and Submit Result.
Level	HOD use case.
Parameters	Input: email, password Output: Main application interface
Pre-conditions	For usage of the application, all the HOD s' computers or mobile devices must have internet access. The HOD must have successfully logged in.
Trigger	A User requests to get access into the system and operate it.
Extension points	None

Table 4.13: Staff (Dean) use case table showing all processes

Use Case 8	**Dean use case**
Brief Description	This shows the Deans process of logging in, Approving Departments Results, Disapproving Departments Results, viewing students' scores, checking Result Analysis and Submitting Result.
Actors	Dean
Flow Of Events	Basic Flow The use case starts after the Dean has gotten access to the main activity interface of the application. The Dean enters his email and password and attempts to login The Dean is taken to the main application screen where he can then make use of the application's functionalities with Dean Privileges. The Dean can then Approve Departmental Results, Disapprove Departmental Results, view students' scores, check Result Analysis and Submit Result.
Level	Dean use case.
Parameters	Input: email, password Output: Main application interface
Pre-conditions	For usage of the application, all the HOD s' computers or mobile devices must have internet access. The HOD must have successfully logged in.
Trigger	A User requests to get access into the system and operate it.
Extension points	None

Table 4.14: Staff (Vice Chancellor) use case table showing all processes

Use Case 9	**Vice Chancellor use case**
Brief Description	This shows the Vice Chancellors process of logging in, Approving Faculty Results, Disapproving Faculty Results, viewing students' scores and checking Result Analysis.
Actors	Vice Chancellor
Flow Of Events	Basic Flow The use case starts after the Vice Chancellor has gotten access to the main activity interface of the application. The Vice Chancellor enters his email and password and attempts

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	to login The Vice Chancellor is taken to the main application screen where he can then make use of the application's functionalities with Vice Chancellor Privileges. The Vice Chancellor can then Approve Faculty Results, Disapprove Faculty Results, view students' scores and check Result Analysis.
Level	Vice Chancellor use case.
Parameters	Input: email, password Output: Main application interface
Pre-conditions	For usage of the application, all the Vice Chancellor s' computers or mobile devices must have internet access. The Vice Chancellor must have successfully logged in.
Trigger	A User requests to get access into the system and operate it.
Extension points	None

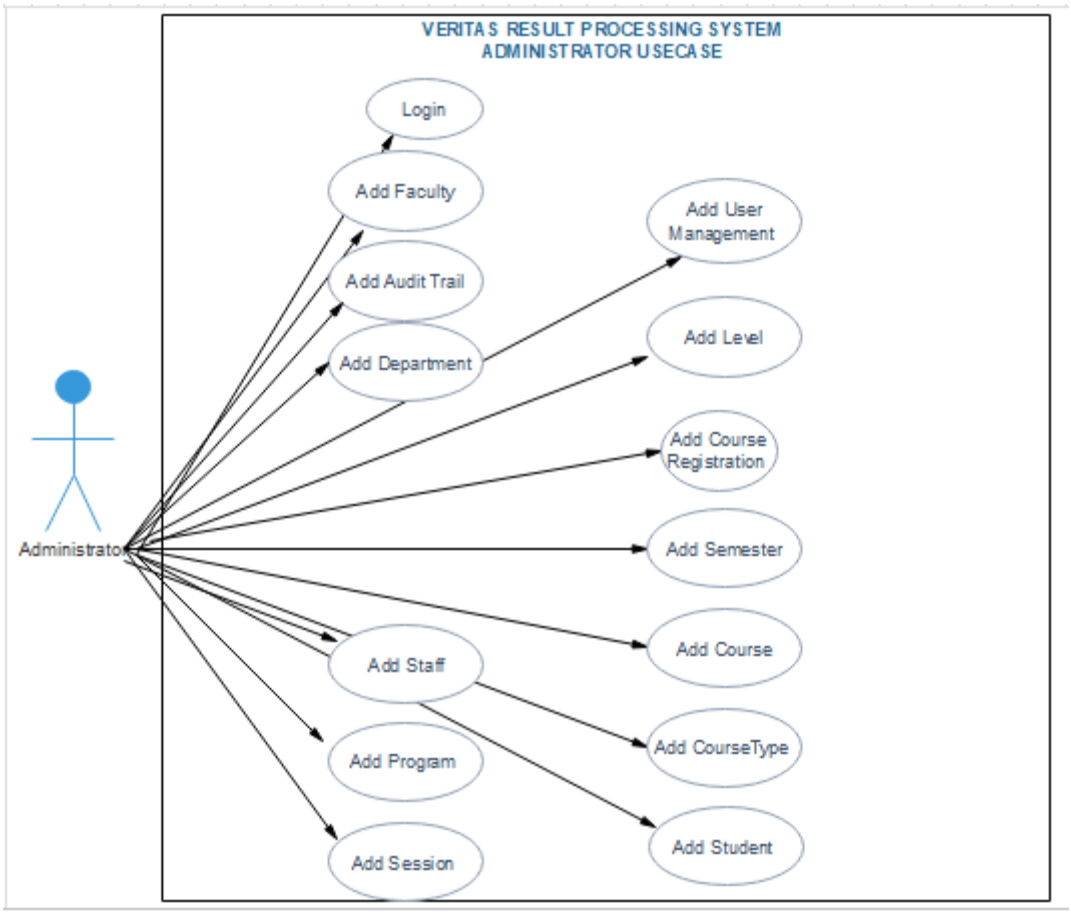

Figure 4.3: Administrator use case diagram

Table 4.15: Administrator use case table showing all processes

Use Case 10	**Administrator use case**
Brief Description	This shows the Administrator process of logging in and performing CRUD operations on all database tables.
Actors	Vice Chancellor

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Flow Of Events	Basic Flow The use case starts after the Administrator has gotten access to the main activity interface of the application. The Administrator enters his email and password and attempts to login The Administrator is taken to the main application screen where he can then make use of the application's functionalities with Administrator Privileges. The Administrator can then perform CRUD operations on all database tables.
Level	Administrator use case.
Parameters	Input: email, password Output: Main application interface
Pre-conditions	For usage of the application, all the Administrator s' computers or mobile devices must have internet access. The Administrator must have successfully logged in.
Post-conditions (success end)	If the use case is successful, the admin is notified of successful CRUD operation.
Post-conditions (failed end)	If the use case is unsuccessful, CRUD operation is not performed on the system, hence the system state is unchanged.
Trigger	A User requests to get access into the system and operate it.
Extension points	None

ii. Activity Diagram

Activity diagram is a model diagram showing the procedural flow of control between the objects during a system activity (Bell, 2003). Activity diagram is very similar to a flow chart. Like the flow chart and use case diagram, it is used to show the activities or functionalities as carried out by the users or actors. It helps the system designer to think functionally rather than Object-oriented as to the activities and unlike flowchart relays whether a user can perform independently or not. It describes the flow of activity to activity as essential features or operations of a system.

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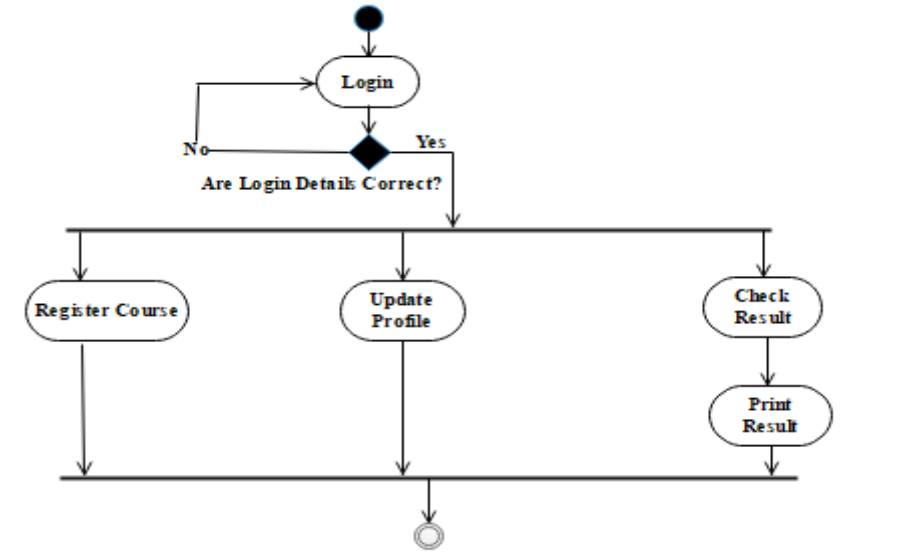

Figure 4.4: Student Activity Diagram

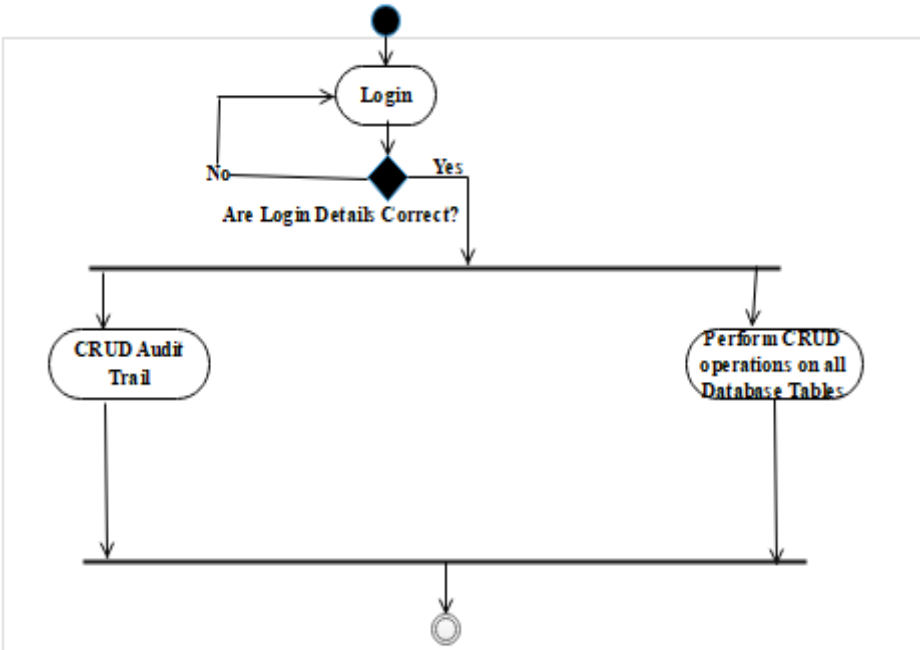

Figure 4.5: Administrator Activity Diagram

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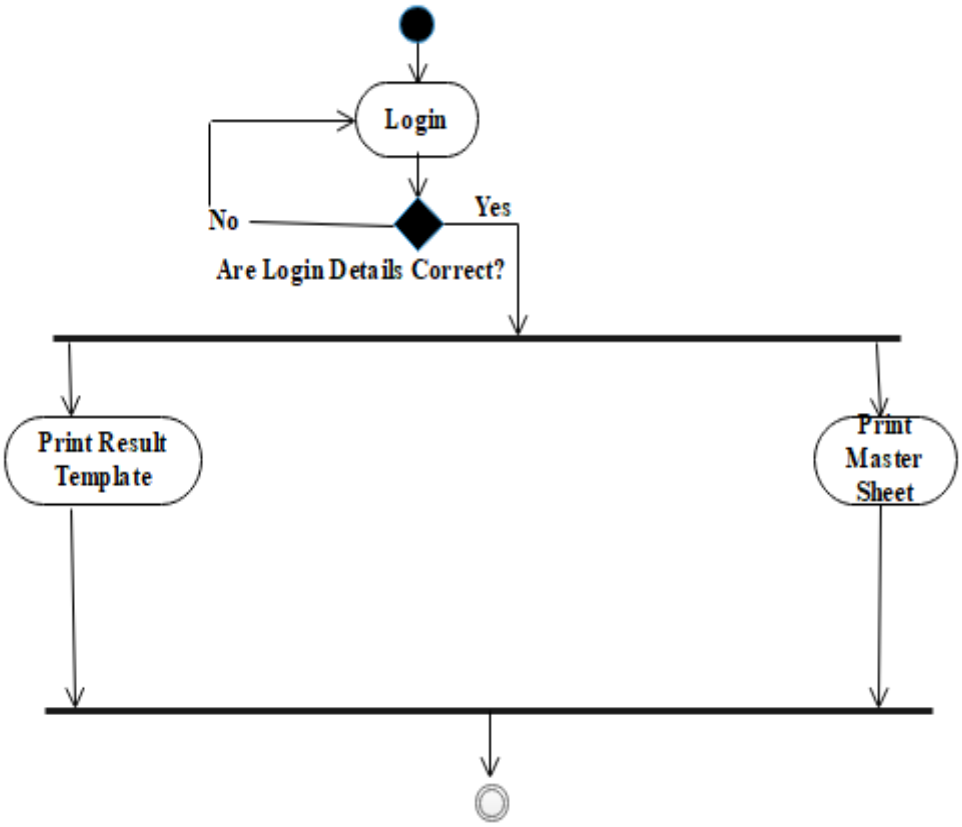

Figure 4.6: Exam Officer Activity Diagram

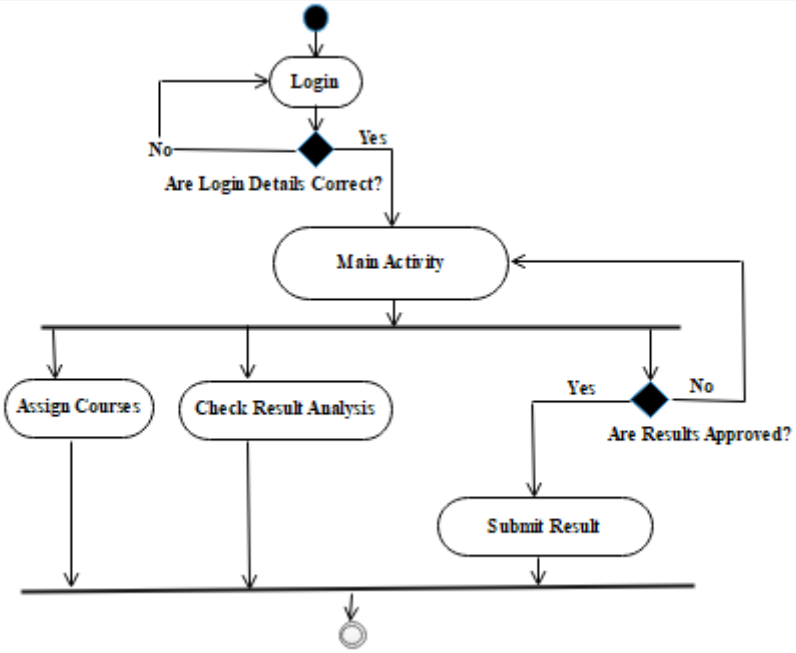

Figure 4.7: HOD Activity Diagram

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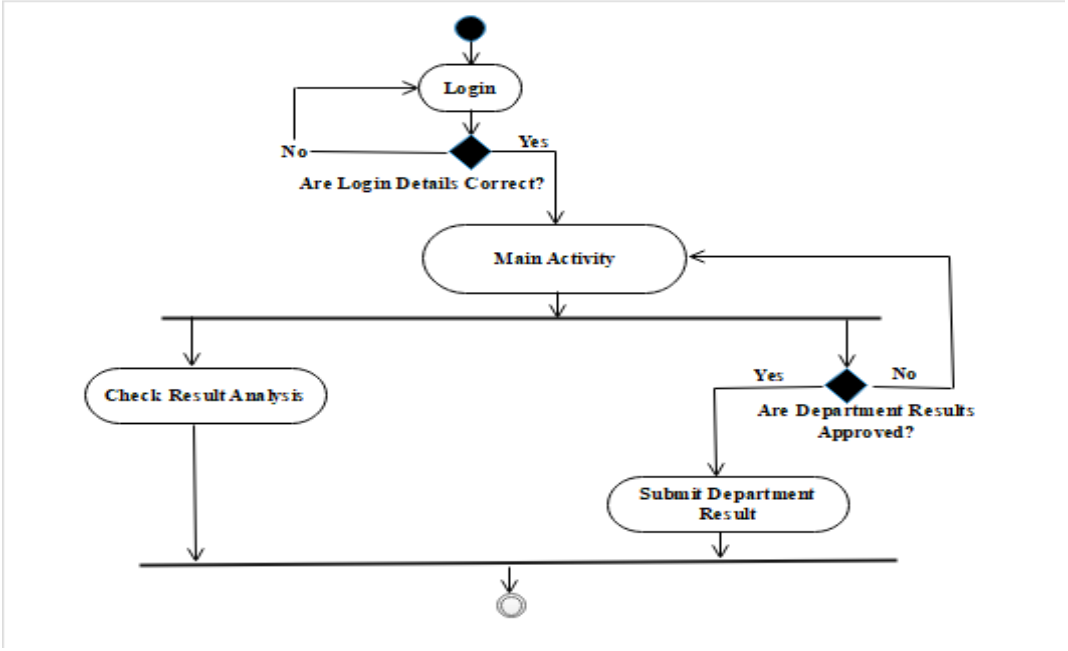
Figure 4.8: Dean Activity Diagram



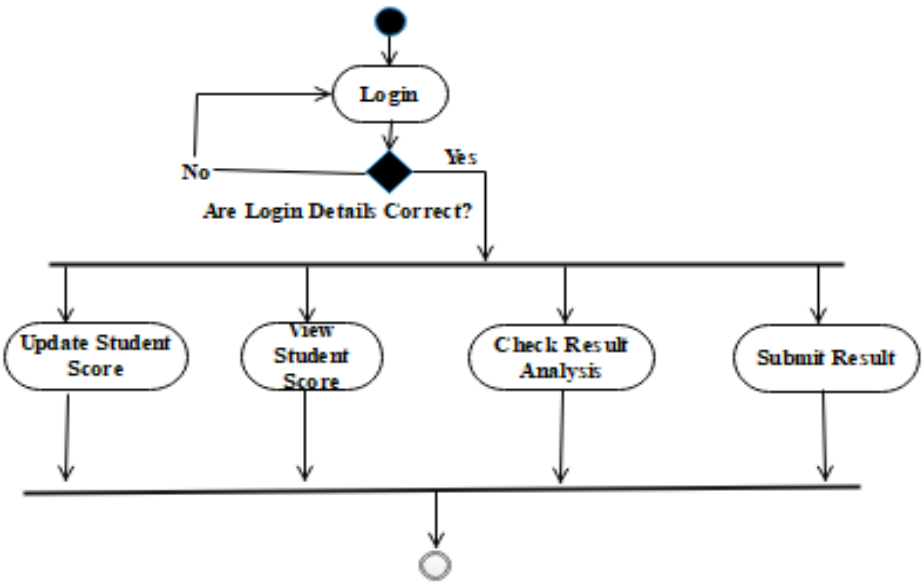


Figure 4.9: Lecturer Activity Diagram

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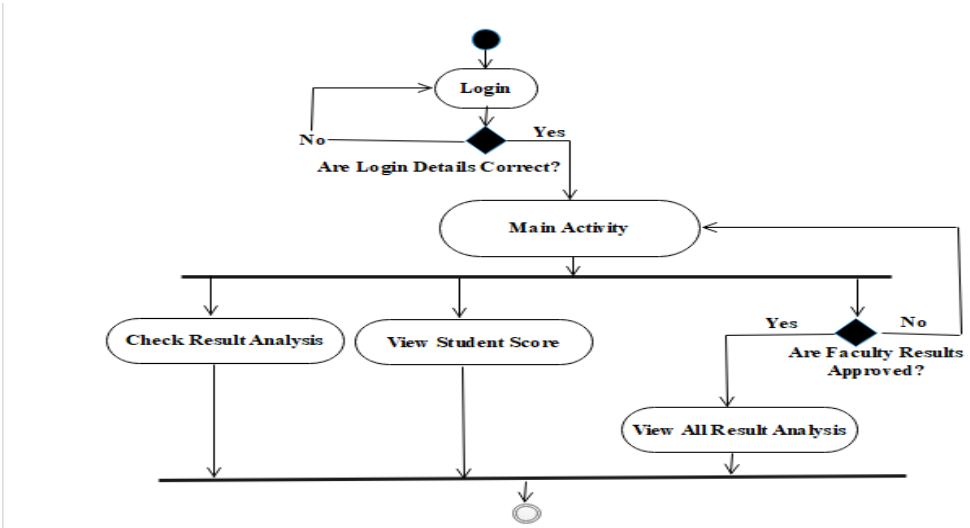

Figure 4.10: Vice Chancellor Activity Diagram

iii. Sequence Diagram

Sequence diagrams are simply interaction diagrams, they show in complete detail the flow of a particular use case (Bell, 2003). It is used in the in the system modelling to show how objects interact with one another through messages between the objects. Sequence diagrams help to illustrate the objects used in the use case and the messages that passed between them during the use case. A sequence diagram is therefore used to visualize the sequence of calls in a system to perform a specific functionality

Participants: The system parts that interact each other during the sequence

Classes or Objects: Each class in the interaction is represented by its named icon along the top of the diagram

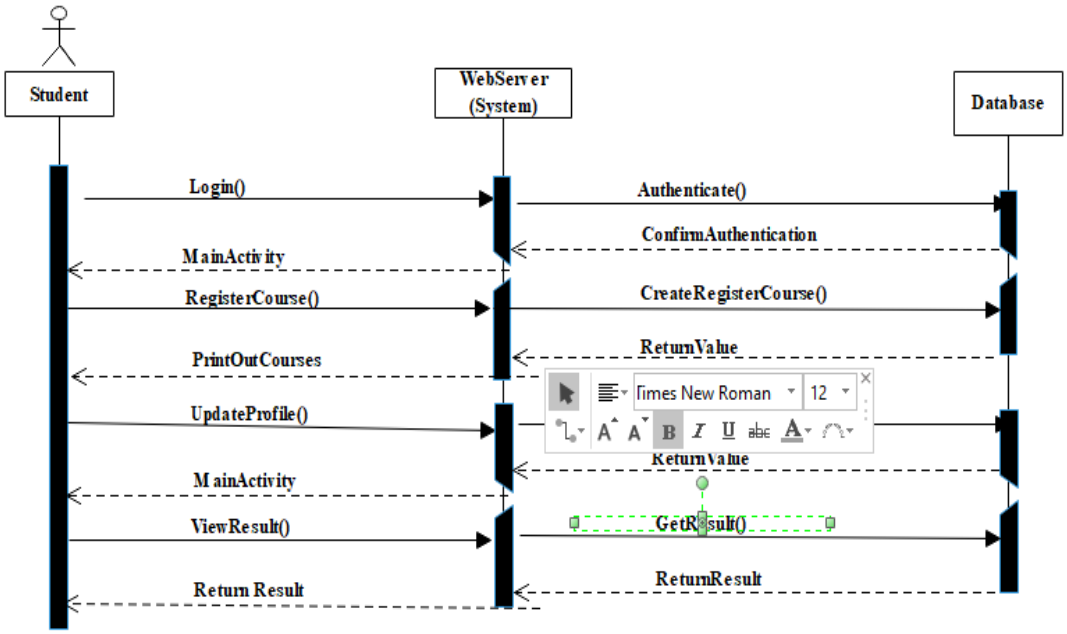

Figure 4.11: Student sequence diagram

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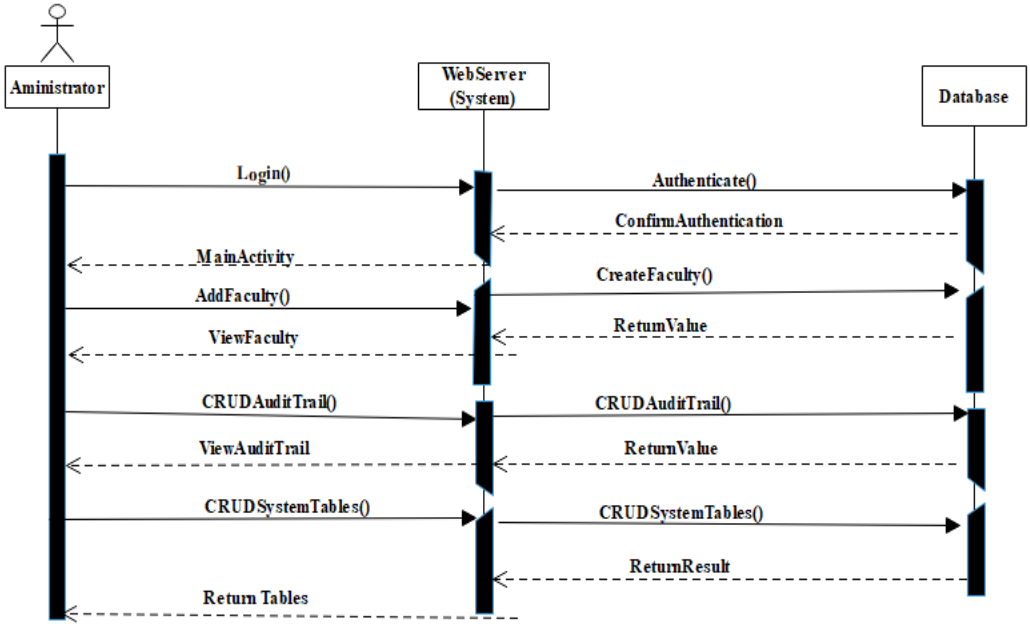

Figure 4.12: Admin sequence diagram

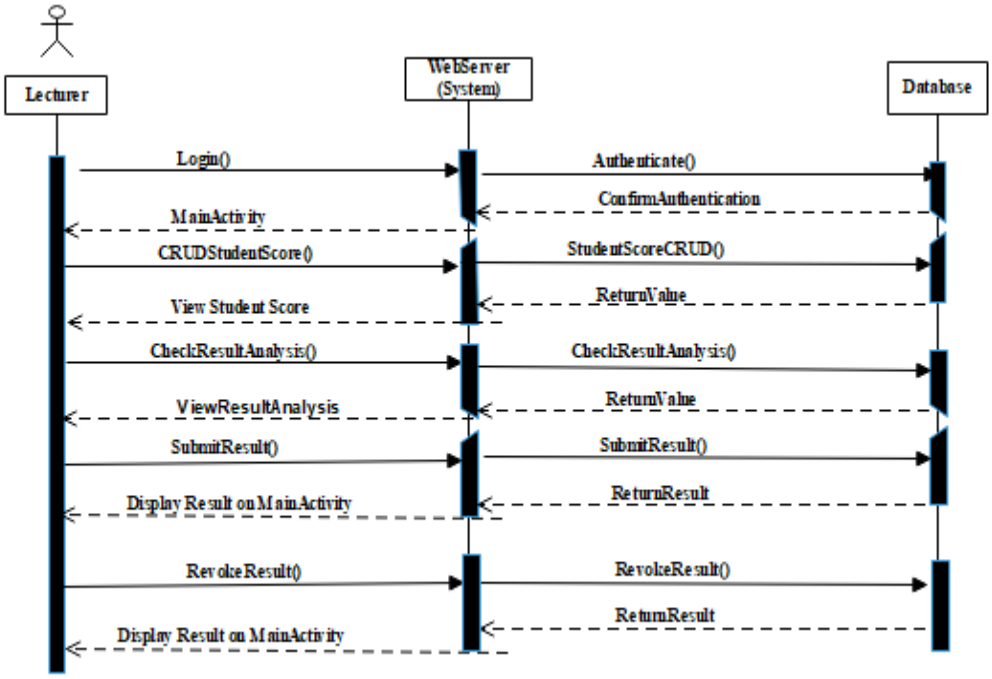

Figure 4.13: Lecturer sequence diagram

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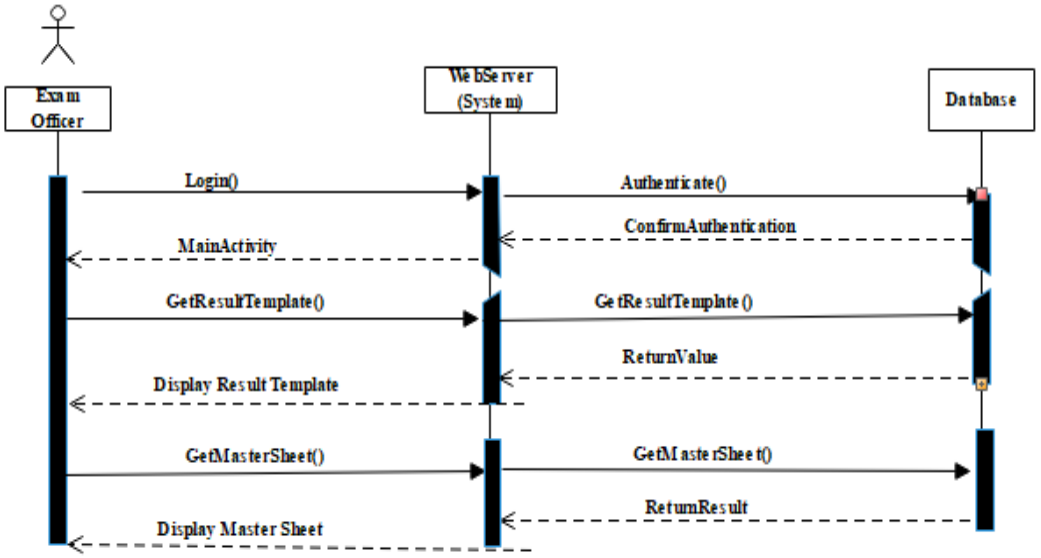

Figure 4.14: Exam Officer Sequence diagram

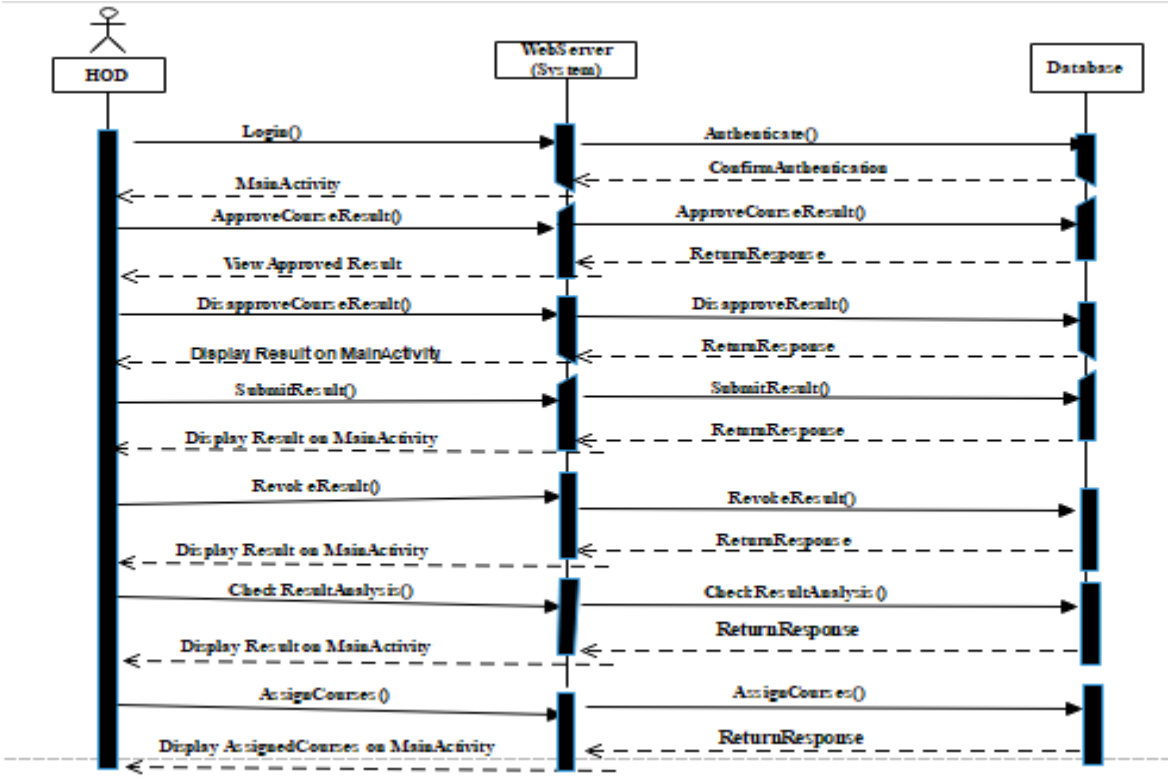

Figure 4.15: HOD sequence diagram

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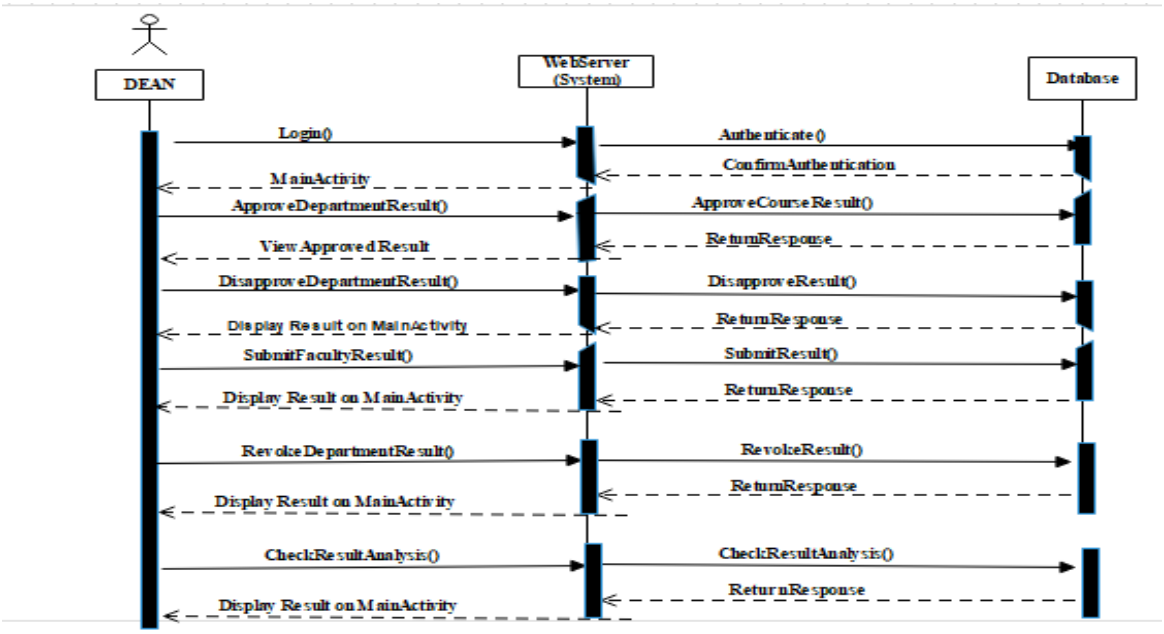

Figure 4.16: Dean Sequence diagram

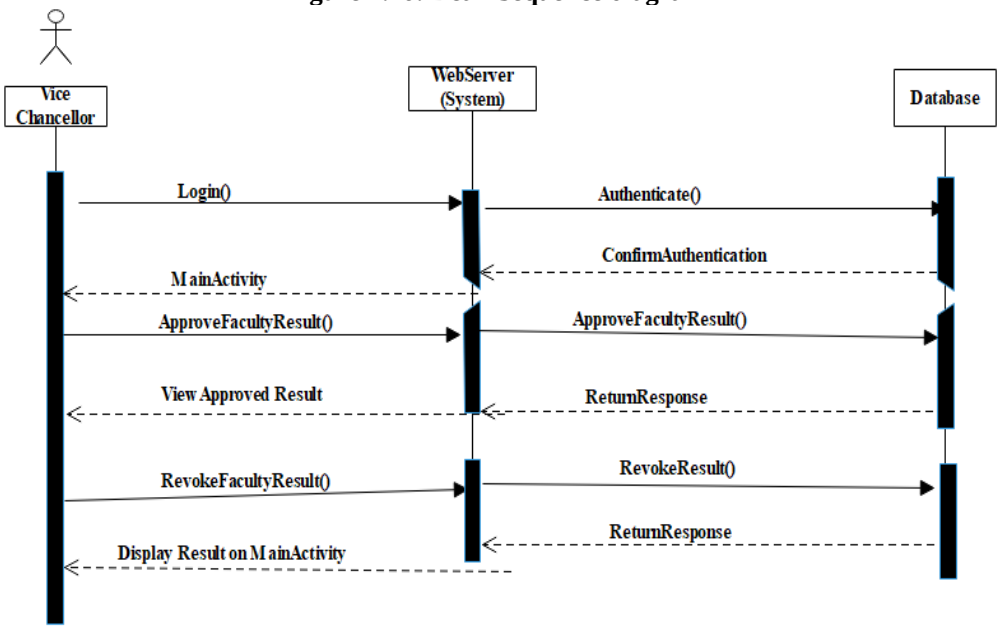

Figure 4.17: Vice Chancellor Sequence diagram

iv. Class Diagram

A class diagram is a static diagram that describes how the different entities in the system relate with one another. These entities could be objects like users and other classes. The structure of a system by showing the system's classes, their attributes the relationship and interaction between them. A UML class diagram is simply made up of a set of logical classes and a set of relationships between classes, its purpose is the analysis and design of the static view of an application and the description of the responsibilities of a system. (Bell, 2003)

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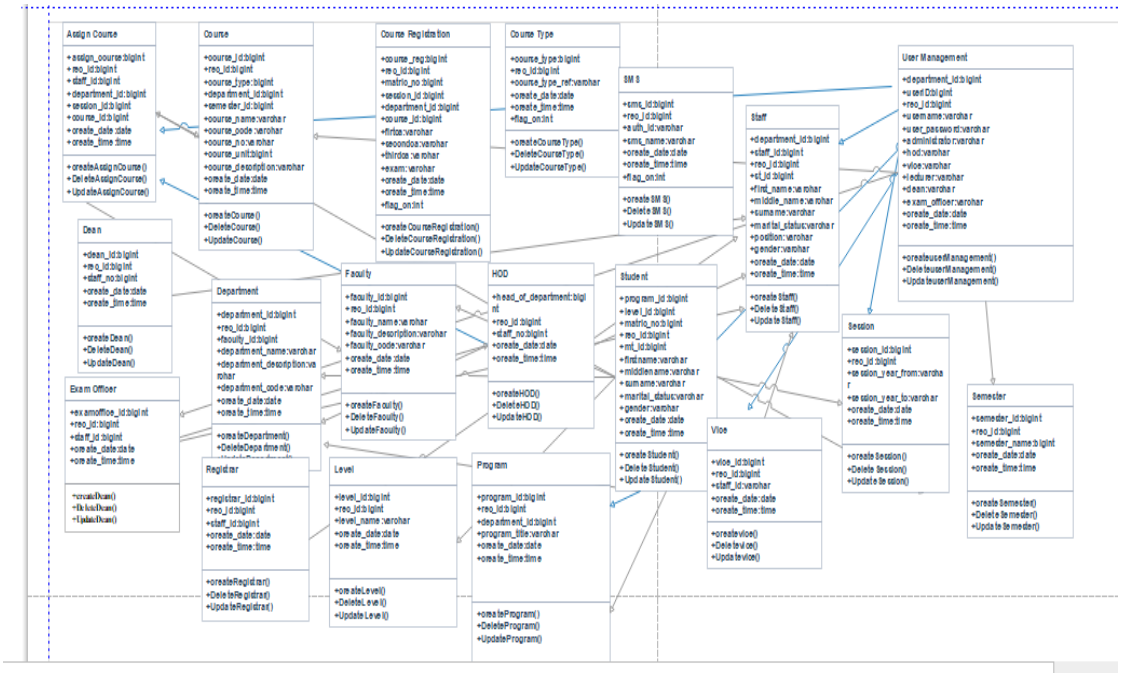

Figure 4.18: Class diagram of the application

4.10 DatabaseSchema and Design

The database schema and design were created using Microsoft SQL Server 2019 based on the attributes for our Result Processing System.

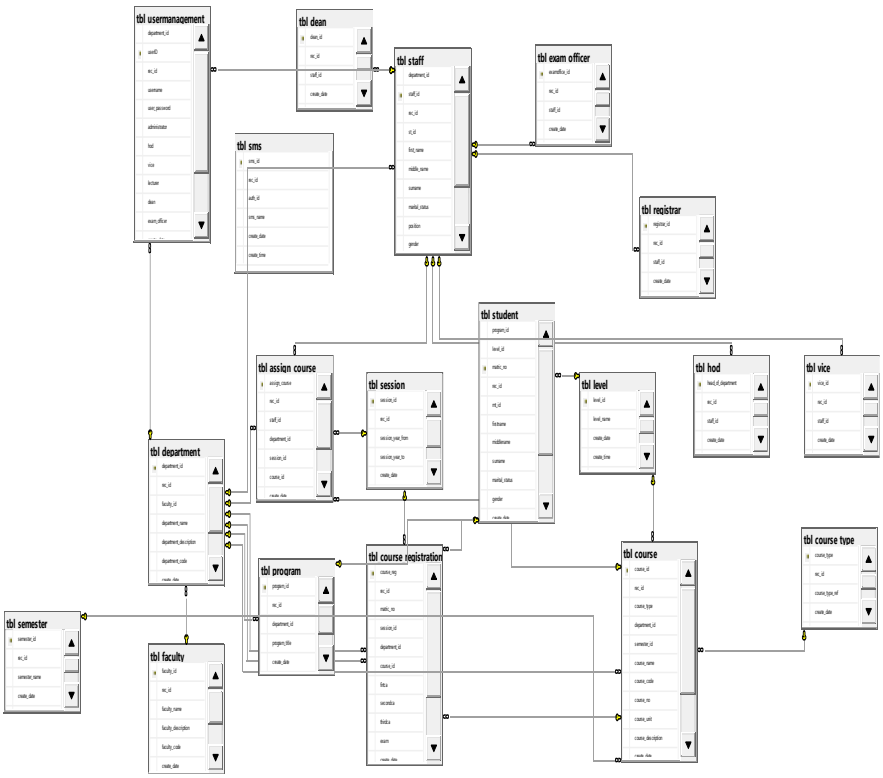

Figure 4.19: Database schema

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The database tables are created and normalized for the efficient production of the system. The user management stores the login details of the staff and students, manages all database tables and Audit trail table which automatically records all activities of the system.

The faculty table stores the faculties, the semester table stores the semesters, the program table stores the programs, the course registration table stores the registered courses, the course table stores the courses, the course type table stores the course types, the department table stores the departments, the assign courses table stores the assigned courses, the session table stores the sessions, the level table stores the levels, the HOD table stores the HODs, the vice table stores the vice chancellor, the student table stores the students, the dean table stores the deans, the staff table stores the staffs, the exam officer table stores the exam officer, the SMS table stores the SMS.

4.11. System user interfaces

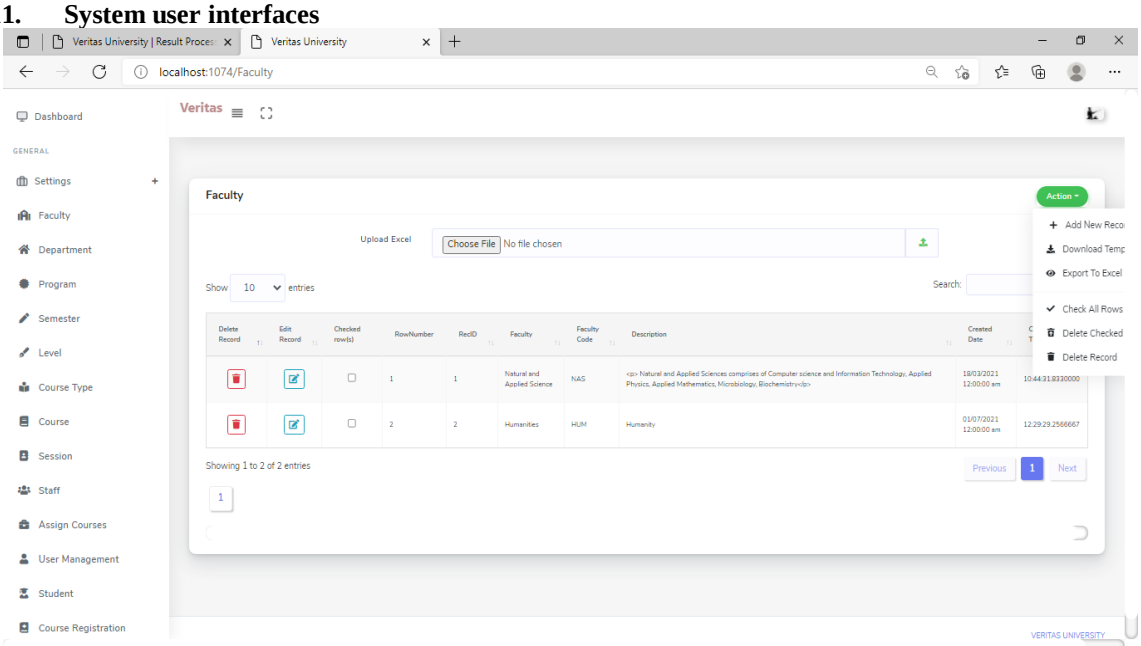

Figure 4.20: Admin interface for Faculty

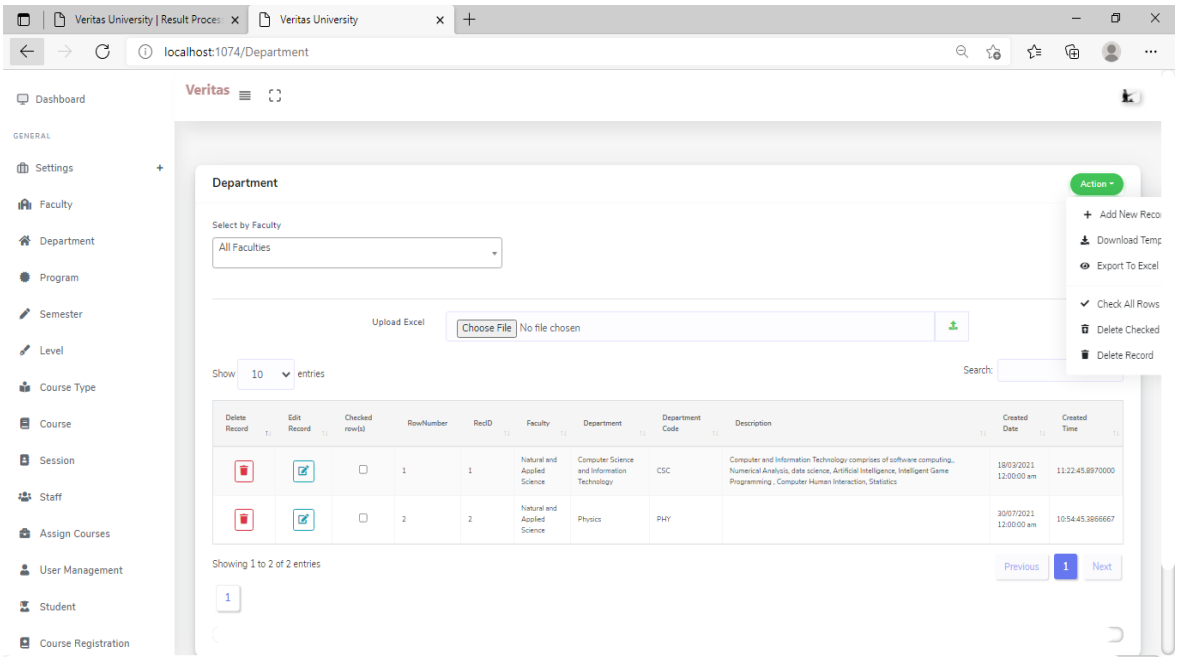

Figure 4.21: Admin interface for Department

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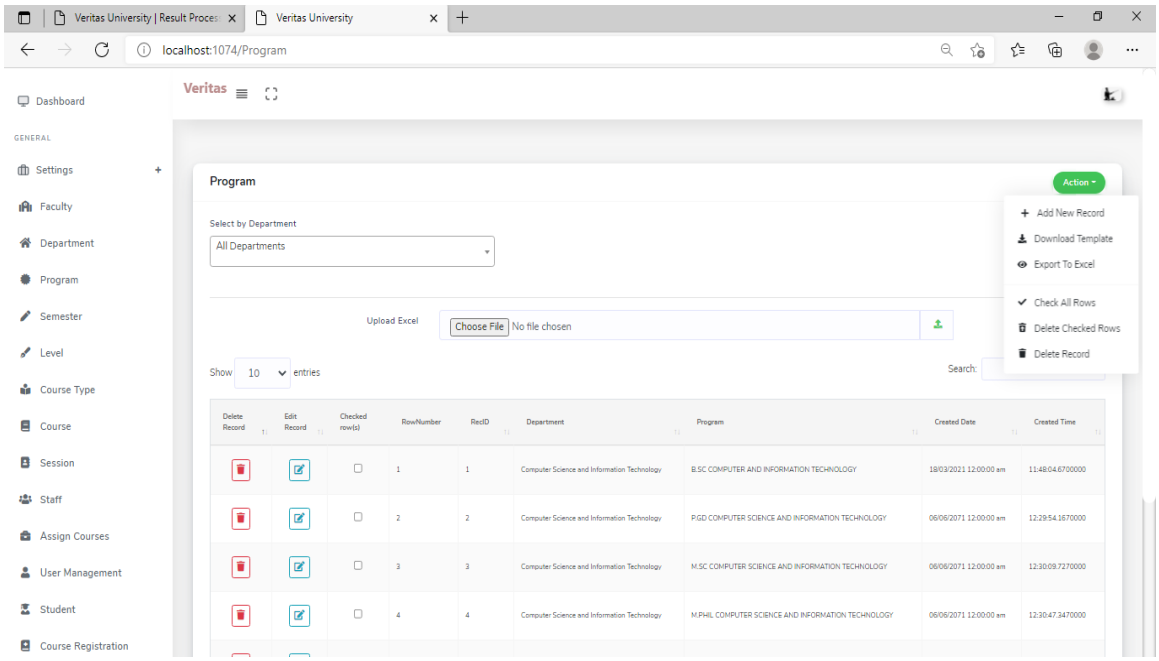

Figure 4.22: Admin interface for Program

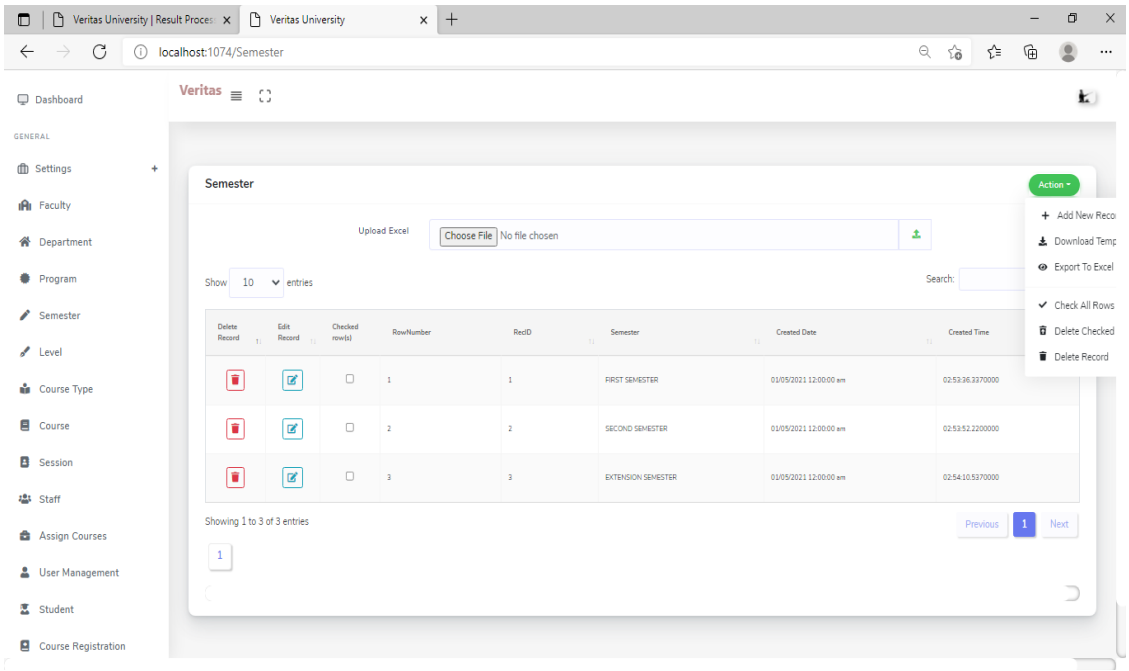

Figure 4.23: Admin interface for Semester

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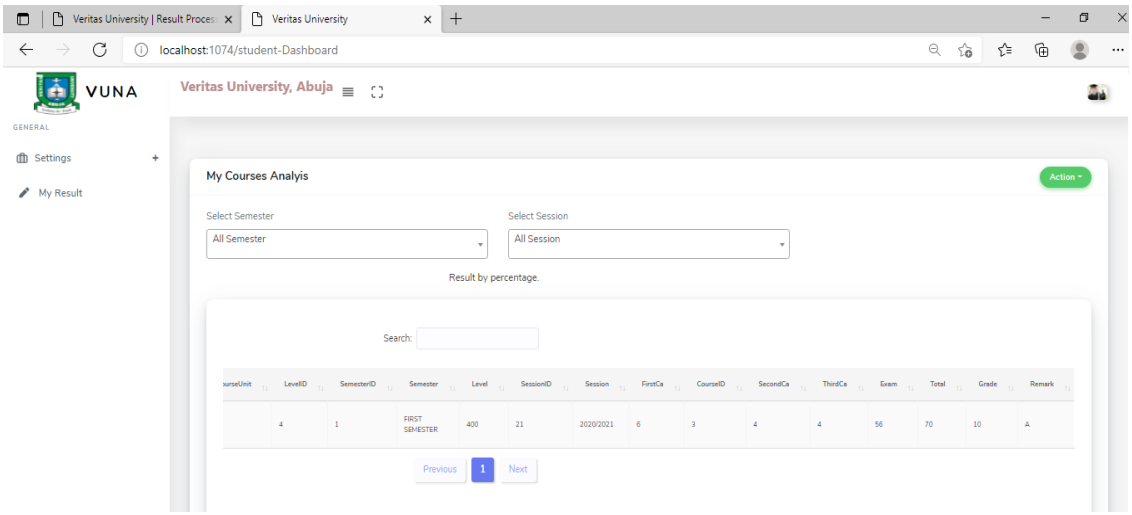

Figure 4.24: Student Result Interface

5.1 Findings and Discussions

We have worked towards the design andimplementation ofa Secured Result Processing System using a Novel Approach. We explored literatures on the problem, the requirements for solving, the tools for producing such solutions and area for implementation and deployment. During the course of the study, we also modelled possible solutions and analyzed the possibilities of each model considering the constraints of time, resources, tools and expertise.

We then developed a system to tackle the problem of the gulf incorporating the possible solutions after considering our constraints.

Also, study into the result processing system exposed the laborious nature of the system; it is time consuming and less effective. The new system is developed with the capability to extract students result from an excel result template and calculate the semester GPA for the student. This will not only enable the students to access themselves and improve their performance but will also help the exam officer to articulate and compile students result at final year.

5.2 Contribution and Recommendations

In this project, we have implemented some possible solutions, however there are further possibilities for the system. Some recommendations for furthering this system include: The findings of this study exposed some salient issues in the student's course registration process that would require further automation. It is hoped that these issues will advance and promote further researches in schools and colleges. The recommendations derived from this study are:

i. Student's awareness of their past academic performance increases their performance in subsequent semesters in school. It is recommended that students result should be made available on time so that he/she can access himself before registering for new courses.

ii. The system can be reprogrammed to allow semester transcript result to be duly endorsed by any staff in charge online before the student can print a copy of the result.

iii. A component should be built into the excel result template so that the HOD can endorse the result on the spreadsheet file and then submit it to the administrator himself. This is to increase the reliability of the data in the result template. Once the HOD handles and endorses the result, changes cannot be made to the result.

Iv. Beyond the SMS and email alerts and updates, the application should be integrated with certain cloud services that will allow it push real time notifications to the users of the applications.

5.3 Conclusion

In conclusion, there has been a several projects implemented around this topic round the world with the same features implemented in this program as well as a whole set of additional and extensive functionalities. This project has taken into consideration the challenges involved in creating a secured, efficient and Scalable Result Processing System, the downsides of this as well as recommended steps, towards its implementation.

5.4 Area for Further Research

As stated earlier in the limitations of the study, further research is needed for the effectiveness ofa secured Result Processing system using AES Algorithm. There is a need to research

areas that can be used for future research. Some other notable areas in which future work can be done include:
i. Implementation a chatbot using supervised learning to diversify interactivity on result processing system.
ii. Voice Recognition: It's possible to integrate voice recognition technology with result processing system to enhance efficiency and security.
iii. Using face recognition and Biometrics technology to further safeguard Result Processing System.
iv. Integrating a web-based notice board to the result processing system to further enhance its functionality.

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