Design and Development of an Examination and Results Management System: A Case of the ICT University

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Abstract
The traditional method of assessment (examination) is most at times marked by examination question leakages, human errors when marking of scripts, result compilation, and recording of scores. The advancement of technology in the field of computer science has necessitated the need for computer usage in majorly all areas not excluding the educational sector. This project aims to bring a solution to these problems faced by examiners (administrators) and students. The system is developed to help examiners set their questions online and students write the examination electronically. When this has been done, the system does the automatic grading, recording of scores, and creation of report cards. This system has been developed using HyperText Markup Language (HTML), Cascading Style Sheets, JavaScript (Bootstrap), Hypertext Preprocessor (PHP), and MySQL. After the development of this project, it was tested by a group of teachers and students. The data was gathered and it was discovered that this platform handled the different processes much faster, and solved 90% of the problems faced when carrying out the traditional paper-based examination. The time taken to set questions, answer them, and process results were greatly reduced with much more accuracy.
Keywords: Examination, Web-based, Management System, Agile Methodology, Examination Results management system

I. Background to the Study

We live in the era of Information Technology, where almost all aspects of life have been affected by Information and Communication Technology (ICT) (Ekanem et al., 2017). ICT has been incorporated into our everyday lives and has changed how we work, research, do business, and communicate with each other. In particular, the Examination and Result Management System (ERMS) is one of the main information systems that readily attract the attention of most universities Ekanem et al. (2017). The final grades assigned by the lecturers are intended to convey the level of achievement of each student in the class. These grades are used to make a multitude of decisions. If a system of grading is not adequately reliable and effective, the grades are likely to communicate confusion and deceive the decision-maker Clinton (2012). In itself, the processing of results is found to be very cumbersome, particularly when carried out manually and when the number of students is high. It's time-consuming and error-prone Ekanem et al. (2017). A task that is both difficult and fascinating is to find a sufficiently quick and reliable method of processing students' grades in schools. In this research, a computer software program was developed to enable the automated processing of results.

II. Review of related literature

2.2.1 Computer Systems and Result Processing

Computers are key aspects of the electronic workplace, and it is important to be aware of the reasons why information is processed using a computer better than a manual system. The computers process information or results more quickly with big data. Whatever method or combination of methods used, it can be seen that the

result can progress through the same basic stages of the processing cycles Ekanem et al. (2017). Honesty (2017) explained that "Computers are seen as obedient servants who are ever ready to free man from time-consuming procedures and generate results compared to human computing time.". Ekanem (2017) defined the computer as a system capable of accepting input data, storing and processing data based on to them, instructions provided by the computer user, and thus producing expected results generally referred to as output.

2.2.2 Empirical review of related literature
In an attempt to solve these problems faced in the education sector, some researchers proposed solutions. Yilmaz et al. (2014), in their attempt to resolve some of these issues, came up with an object-oriented system. After assessing other similar works, the system was brought up for an engineering faculty in Turkey. The application consisted of three types of users, namely the Administrator, the Teacher, and the Student. The Administrator has more privileges to create students, teachers, and programs of evaluation. The teachers can create examinations and students write examinations. After this is done, the system can calculate the score of the student and then give the marks. This work is based on C# .net 4.5 Framework. The gaps noticed in this work include the handing of all registration and creation of Teachers, Students, and Courses to the Administrator. In a case where the school has thousands of students, the work will be too much and tedious for the administrator. The process of course selection was not well defined in the work and how students are enrolled for each course has not been specified. Therefore the developed and proposed system is aimed at solving the gaps in the previously developed systems that aim at solving a similar problem.

Olalere et al. (2017), came up with a similar solution, having examination setters and students coming to write the exam. A different model from the previous work cited has been used. This web application comprises of two types of users, the main administrator and the students who will write the exams. The system is built with PHP and MySQL powering the back end and HTML, CSS, and JavaScript at the front end. After completion of the exam and submission made, the system can calculate the student's score and give the results later on. Much like the previous platform cited, only the Administrator has the power to create students and lecturers. Also, the examinations are not restricted to particular students. There is no special constraint that ensures that functionality.

Shubham et al. (2017) have analyzed the evaluation procedures and processes in a school and identified potential difficulties with the management of examination halls. In this research work, students' who are not present in school on the day of the exams, face a lot of difficulties to be evaluated. Also, the difficulty is faced when trying to get details of a student and courses registered. Their solution offers students' the ability to login from wherever they may be, and take the exam, which shall then be graded and their results displayed later on. Their platform has an Administrator, who programs and sets exams. After the administrator has finished setting and programming exams, coordinators will create and upload the various exam papers for each course, and students' can take the exams. The administrator has the majority of the workload which if it is not properly done, students would not get report sheets at the end but rather, will only get results for a particular test or examination at the end.

Bello et al. (2016) In their work, came up with a three-party system, comprising of the Administrator, Lecturers, and Student. The Administrator is the most powerful party and he has the power to create students, teachers, courses, view, and modify courses. He can also view examinations created and their various results. The creation of exams is done by the teachers. The students take the exams and then the online system grades them. Just like the works before, the administrator has the bulk of work which includes the creation of all other parties. This solution has some improved features such as the creation of exams by the teacher. The students in this system are not enrolled for specific courses which means, a student can take an exam which is not ideal. Also, the system is not able to give an average of all test scores which can be used to get a final score and even GPA values at the end of the semester.

III. Methodology
Methodology is a system of methods used in a specific field of research. It is a body of practices, procedures, and laws that are used by those who work in a profession or are involved in an investigation Nicholls (2017). Methodology requires a procedure whereby the existing or current system is analyzed to determine the information requirements. It is used to refer to a specific sequence of steps or procedures that control the study and design of a particular project. Clinton (2012). The dominant methodologies used in systems designs and developments are; prototyping, object-oriented analysis, and design methodology (OOADM), Expert systems, and structured systems analysis and design methodology. The Agile methodology is given little/minimum attention by the developers and scholars. Therefore the researchers used agile methodology because the system developed has many components that are dependent on each other. Such a system cannot be developed using waterfall/linear methodology. Agile methodology is flexible and has a higher percentage of success rates when applied in systems/project development Aşlıyan (2008).

3.1 Problem Definition:

There is a need to give a clear picture of the problems that call for the creation of a new system; these are usually the problems of the old system Honesty (2017). Students and Teachers face a lot of Challenges during examination periods. The manual method for analyzing the results was time-consuming and frustrating. The method was found to be inefficient and as such, resulted in delays in the academic process Honesty (2017). It was also found that the results of the calculation were characterized by errors. These problems call for a more effective process of processing the results employing an automation system.

3.2 System Requirements
This Web Application has three phases. Namely:
(i)   The front end or user interface (UI), which is the visible part of the application to users.
(ii) The back end side which serves as the middleware that is responsible for
      processing the user's requests to and from the database.
(iii) The database or question bank serves as the repository of a pool of questions to be answered by the student,
      and also holds all data about the application.
The system equally has three sub-systems (The Administrator, Teacher, and Student). They have the following functions:

Administrator	Teacher	Student
Log In or Register	Log in or Register (sign up)	Log in or Register
Can view, create, edit and delete **Students**, **Teachers**, **Courses** and **Departments**	Manages the courses assigned to him Accepts and enrolls students into the course or rejects them	View all available courses for the semester Send enrollment requests for courses
Can assign courses to teachers	Can create exams and questions	When accepted, the student can get to the course
Can view statistics about the school and also semester statistics	Can open or close exams	Get announcements from the teacher
Can open exams and close them from students	View grades of exams from students. Confirms students' final grades	Take exams View grades
Sends announcements to the students or teachers	Sends announcements concerning the course to students	At the semester end, the final grade is produced Can view announcements from the admin

3.3 Planning and Scheduling
The system developed is made up of three sub-systems whose activities are inter-related hence one subsystem cannot be developed fully till the end without having to implement some of its features in the other sub-system. The functionalities of each system are as follows

1.   Administrator:
The administrator is the central and most powerful party in the system, with the highest abilities to create other entities. He has the following functions
-   Create, edit and update and delete teachers and students
-   He can create, update, and delete courses, departments, and study programs.
-   Can view statistics about the system, start exams, and stop them and can delete exams as well.
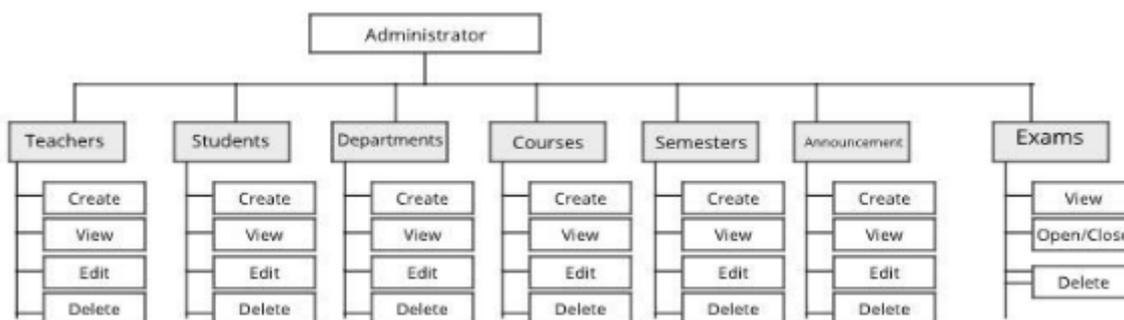
Figure 1 **Administrator Actions and Functionalities in System**

Apart from these CRUD functionalities on the main entities, the Administrator can also view exams, and open or close them on their due dates or due times. He possesses the majority of the privileges in the system.

2. The Lecturer/Teacher:

The lecturer's role in the system is to manage courses assigned to him by the administrator. In these courses, he can view enrollment requests from students, either accept or delete them, can set examination questions, then he validates the students' final grades
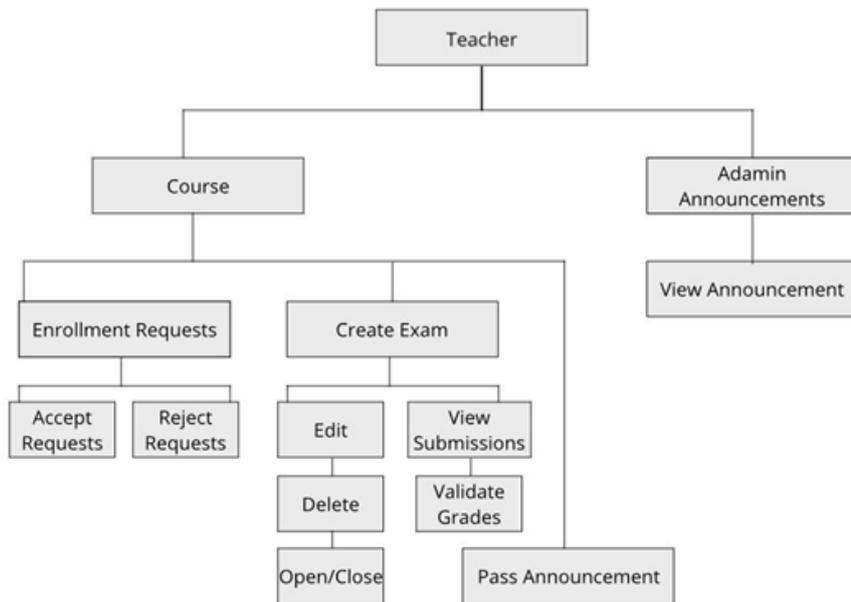
Figure 2 Teacher functionalities and methods in the system

3. The Student:

The student is the final party in the system and his role is to send enrollment requests to the teachers managing those particular courses. If the requests are accepted, they will be able to see announcements, take exams and view their scores later on.
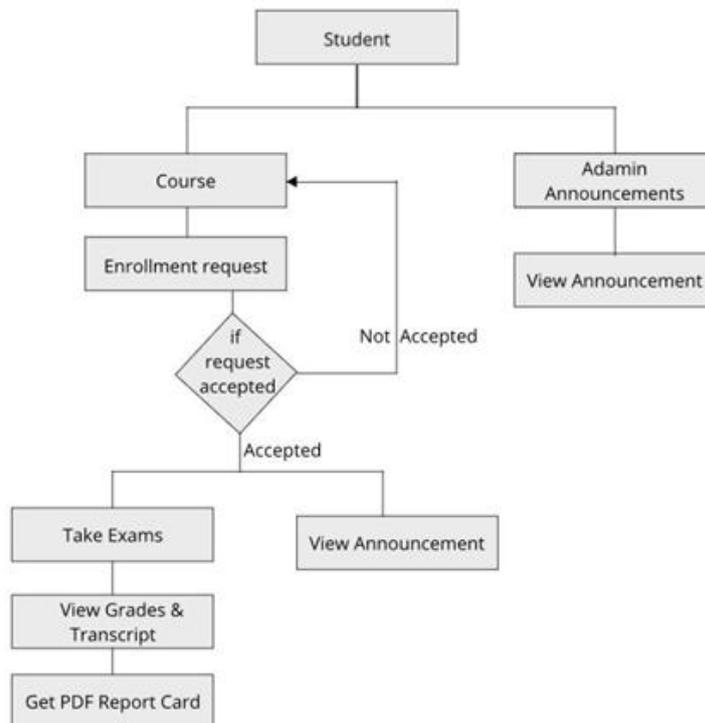
Figure 3 Student functionalities and methods in the system

The students and teachers can create their own accounts. This is to help facilitate the administrator's work, should there be a large number of personnel to be registered. These are the different roles for the different and main entities in the database.
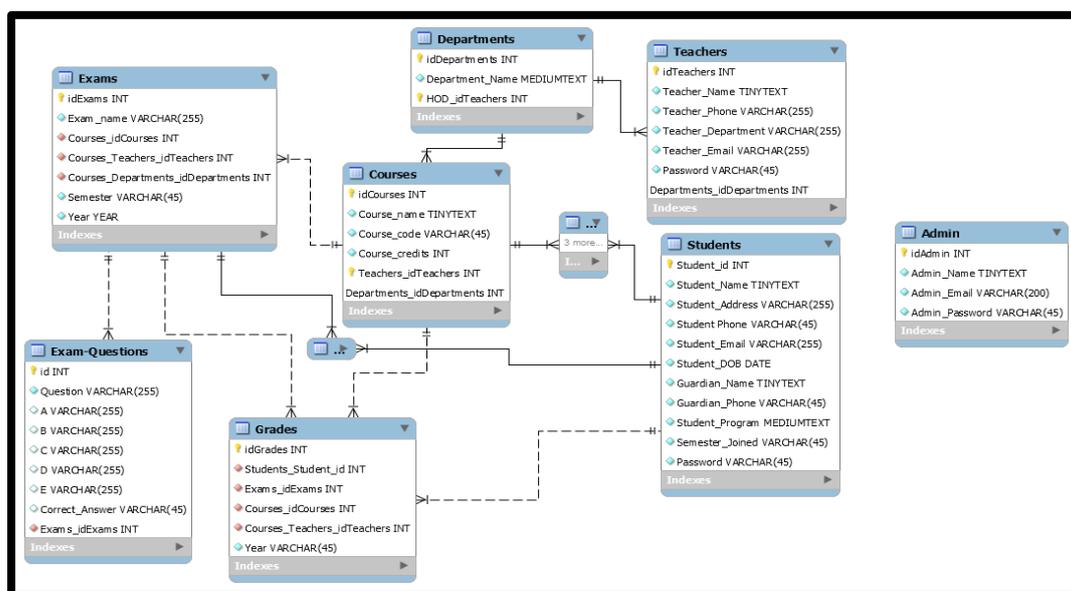
Figure 4: Database Logical Design(Logical data model)

The database used is a relational one, with the main entities being the Students, Teachers, and Administrators. The other sub-entities are Courses and Departments. Entities like exams, exam questions, and grades are dependent on the courses and teachers. Without them (Courses, teachers, admin), the exam-related entities will not exist. They are related by one-to-one, one-to-many, and many-to-many relationships where necessary, to get the right data at the right point.
However, the final database has some more tables of records, which are there to help in the running of some activities, the reason why they have not been included in the original database logical design.

How the System does the grading:
At the time of the exam setting, the teacher gives the question together with the allocation and the marking guide. When the student submits or validates his or her answers, the system compares them to the correct answer in the database, set by the teacher. If they match, the marks are added to the final score; else, the student scores a zero for that question.

Typical Functions of the ERMS
● **Registration:** To carry out any activity on the platform, one must get registered (signed up). When the account is created by the administrator, teacher, or students', other features can be accessed
● **Exam Creation:** When the teacher has been given courses to handle, he can set (create) examinations. When these exams have been created, they are by default closed. The teacher or administrator can change their status to open so that students can take the exams.
● **Course enrollment:** when the student registers on the platform, he then is presented with all the courses available that semester. When he wants to take a course, he sends an enrollment request to the lecturer. If the lecturer is okay with the student's wish to offer the course, he accepts the request. Else, he will reject the application request.
● **Exam Taking:** When the student has been accepted to offer a course, he can receive notifications from the teacher concerning when a course exam is going to be written and also other events concerning the course.
● **Grade processing and validation:** When the exam submissions have been made, the system does the automatic grading and recording of the score. After all the different continuous assessments (CA), normal session, and re-sit exams have been written, the system gets all the scores and calculates the total on twenty (20). The lecturer can then add marks and validate the overall grade.
● **Generation of report sheet:** The system then generates a downloadable report sheet with a cumulative score the student has had for the time he has been in school.
● **Statistics and CRUD functionalities:** This is mostly at the administrator's level, where the statistics about the entire system are presented to the administrator. Also, the administrator can create, update, or delete

entities such as teachers, students, courses, and departments. The system can also give statistics about a particular semester.

Functional Requirements of the ERMS
Responsiveness:
The system like every other web platform today is responsive. That is, it adapts to different screen sizes. Not everyone will own a computer at every given point in time. The platform is accessible and user friendly on different types of screens.

Easy to use and understand:
The platform is easy to use and understand. All steps and processes are clearly set out and will not be difficult for anyone to quickly grab and understand.

Users of this platform
The users of this platform include:
- The administrator (The one who will oversee activities going on in the platform)
- The teacher (The one to manage courses and give examinations)
- The student (The one to take exams)

IV. Result and Discussion
A dynamic examination and Result quality system was developed using PHP and MYSQL as a side-server and HTML and CSS as a client-side. The database used in the ERMS was developed with the MYSQL Database Management System (DBMS). All information of the ERMS is stored in the system database. With the use of the XAMMP as a local server, the researchers created the database containing sixteen (16) tables with main entities and the dependent entities. Sample output/results are shown in the various screenshots shown the figures below

Administrator/Lecturer/Student Home page
At the start, one gets the welcome screen with options to log in or register for teachers and students' who wish to access the system as can be seen in the figure below.
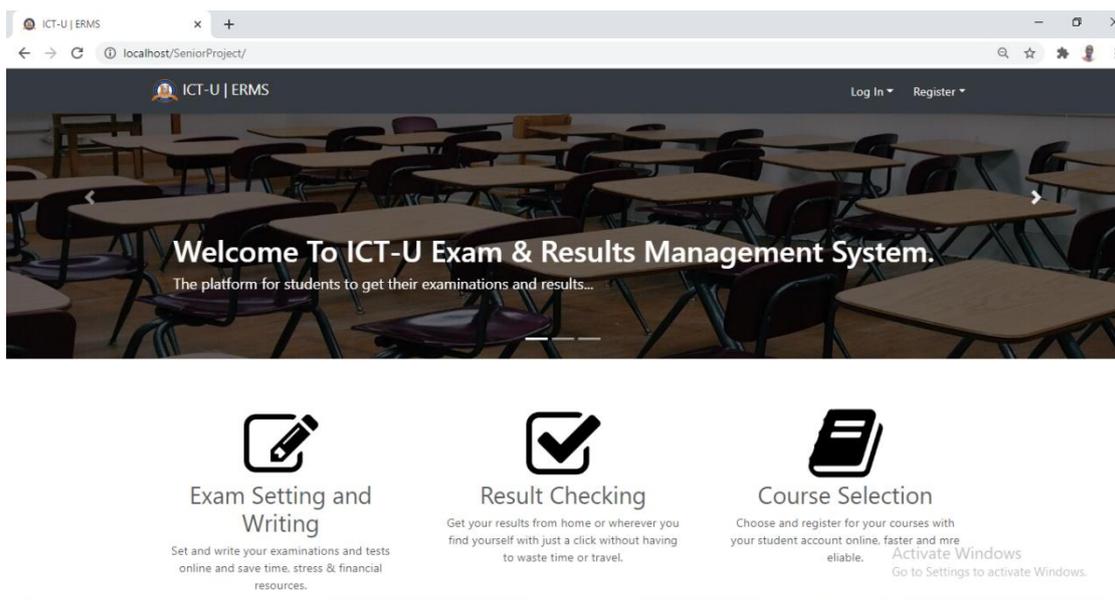
Figure 13: Home page

Administrator Panel Functionalities and Interface:
The administrator login page permits the administrator to log into the system. The username and password are required for the administrator to be able to access the system as can be seen below.
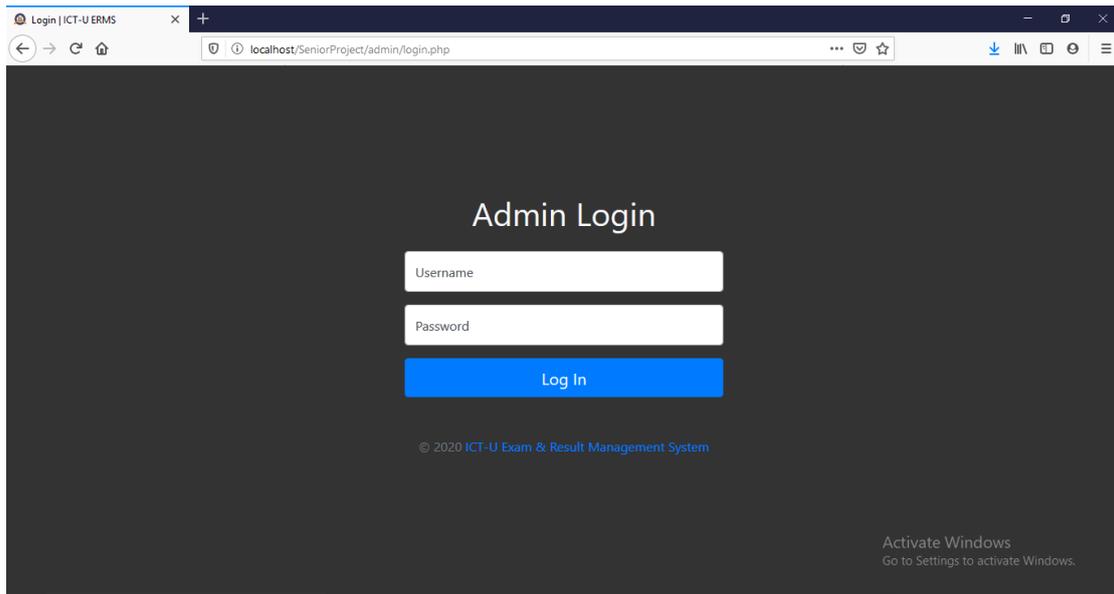
Figure 9: Administrator Login Page

Administrator Welcome Page

After logging in, the administrator dashboard is presented and the admin can view various statistics on the different entities in the system. As can be seen below, the administrator is verifying the number of students already registered on the platform.
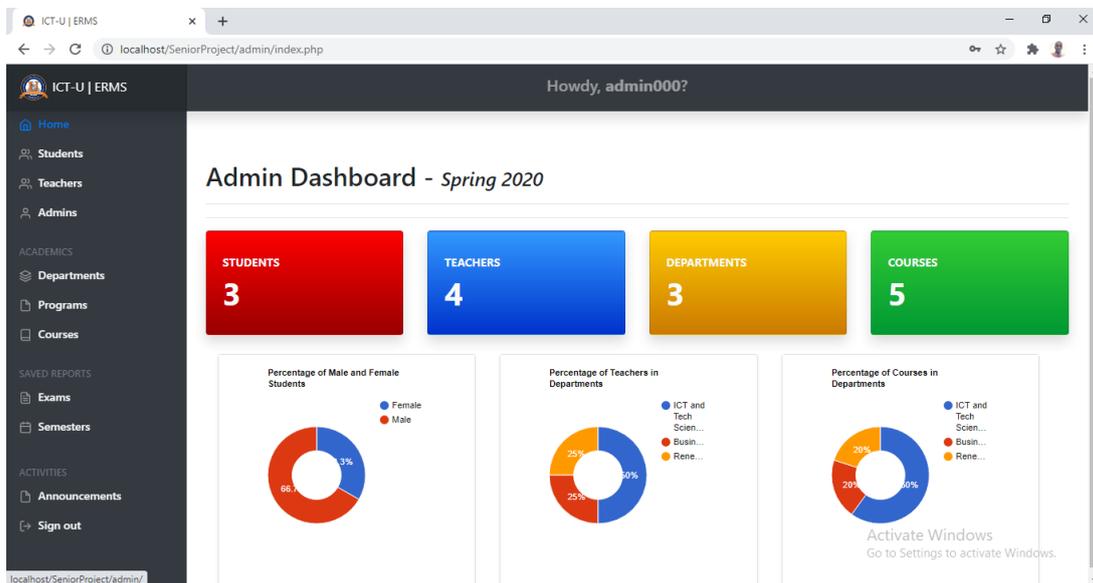

Figure 10: Administrator Welcome Page

Registered students' data

Below is information about all the various students registered in the system
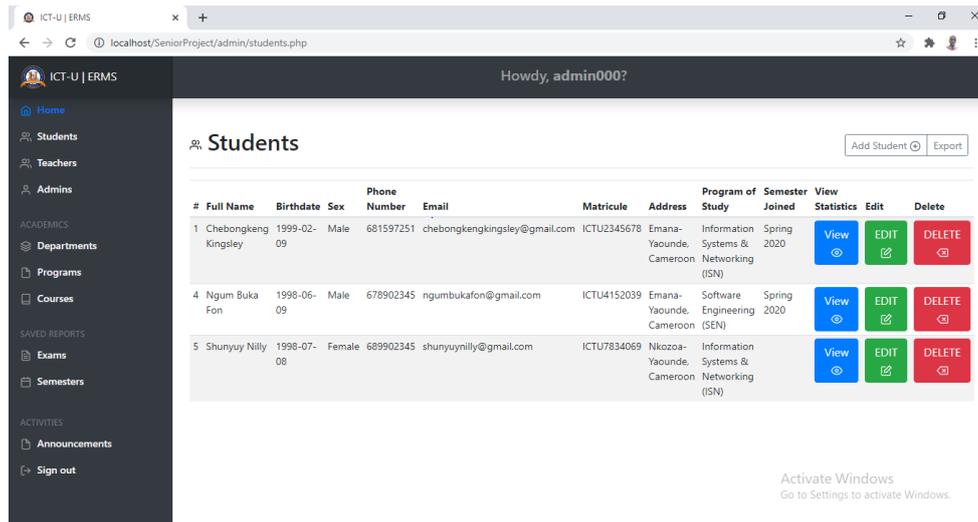
Figure 11: Student Data

The administrator can view data about the students, teachers, departments, courses, and others. The figure below displays a single student's information.
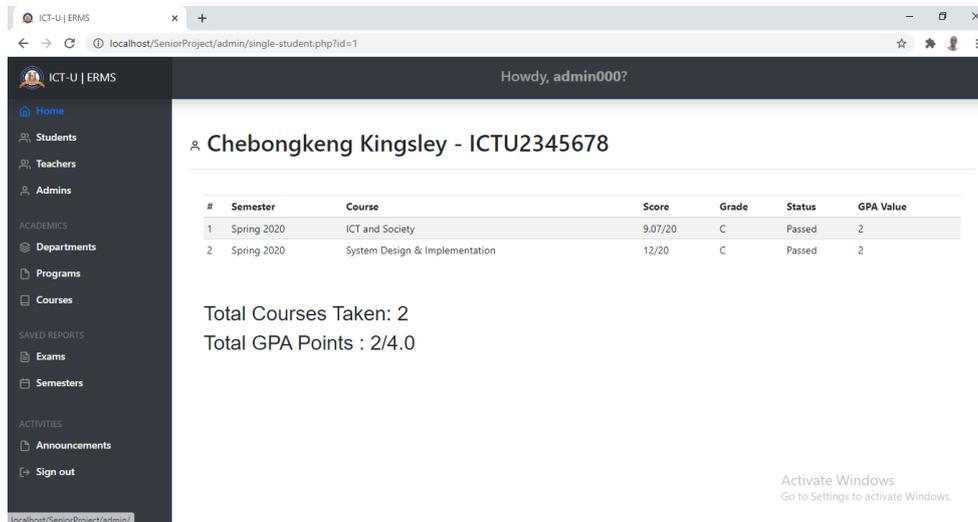
Figure 12: Single Student Data

The administrator can view data about single students, all their courses and automatically calculates their GPA based on their grades achieved throughout their time in school.
Other images and screen captures of the administrator's panel will be seen in the appendices.

Teacher's login page
From the home page, the teacher can now easily log in if there already exists an account or register as can be seen on the figure below
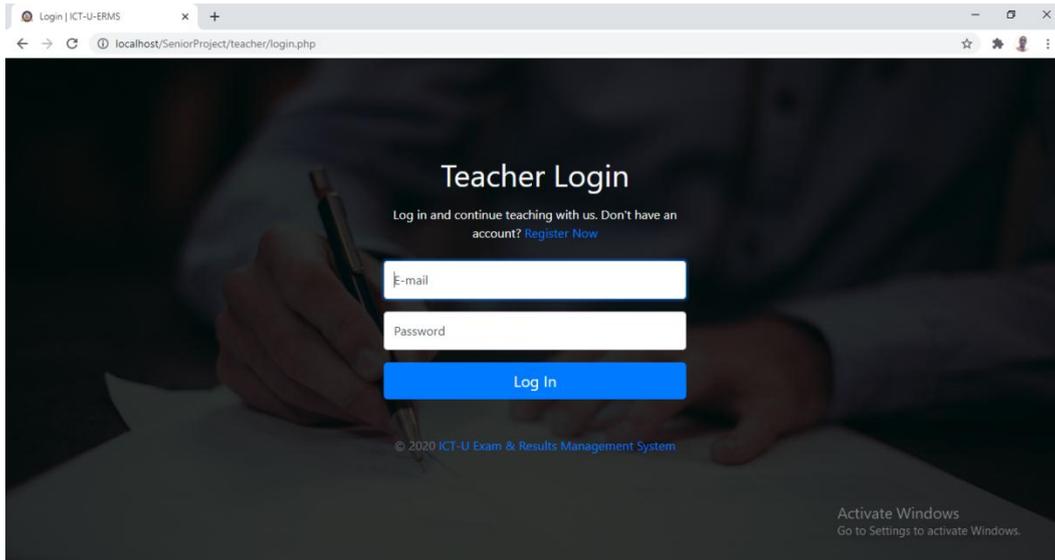
Figure 14:Teacher's Login Page

The teacher and the students both have similar login pages, to provide their emails and passwords to access the system.

Below is a welcome page that shows the courses assigned to a teacher.
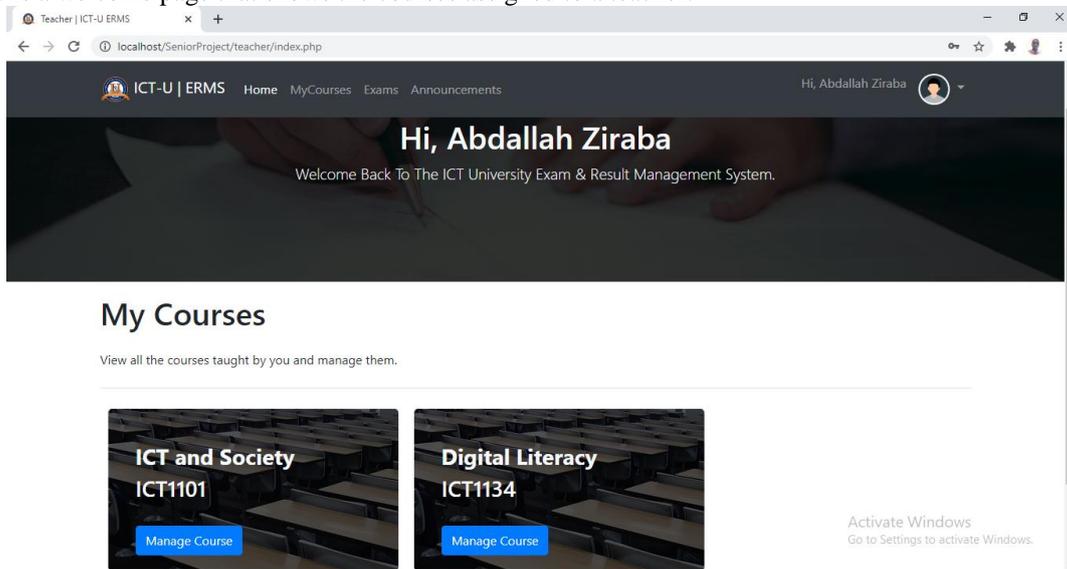
Figure 15: Teacher Welcome Page

When the teacher is logged in, he or she can see the enrolment requests from students, the various enrolled students, exams, and grades as can be seen in the figure below.
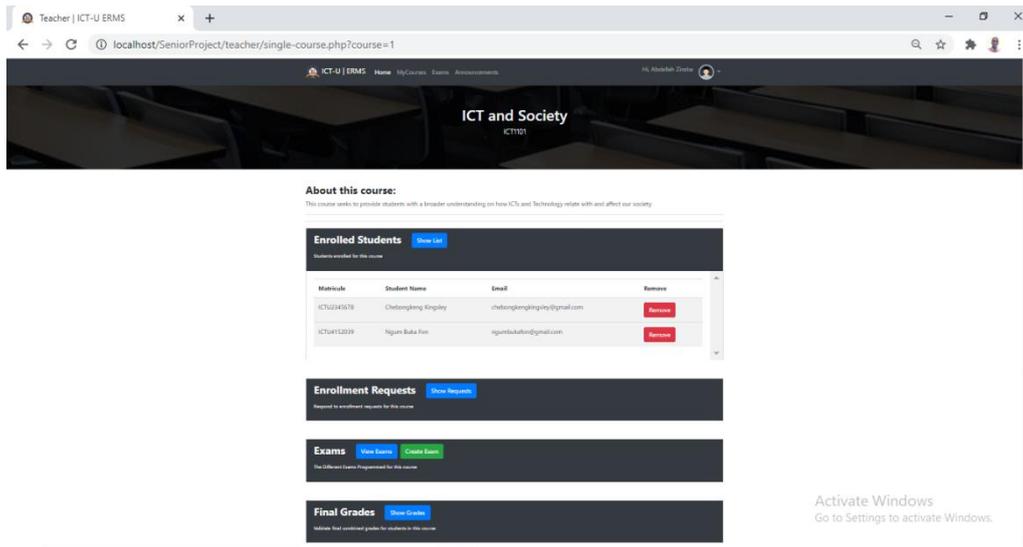
Figure 16: Single Course Dashboard

The teacher has another page where he can see all examinations created by him in each of the courses. He can update exam questions, edit the status of the exam, and delete an exam as can be seen below.
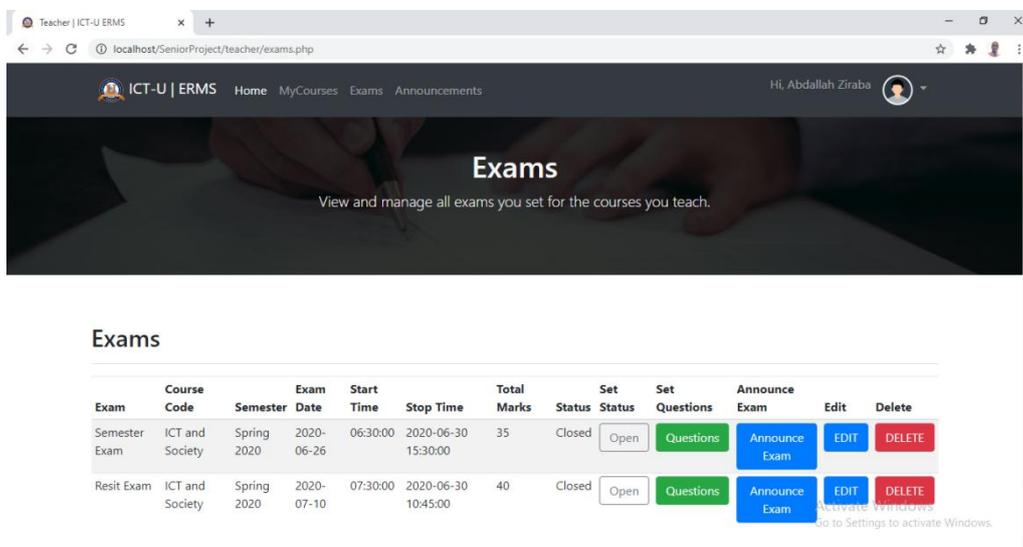
Figure 17: Exams Dashboard

The figure below displays a page where the teacher can create an examination and set all the parameters for the students who are registered in this course to be able to take the exams and submit as can be seen below.
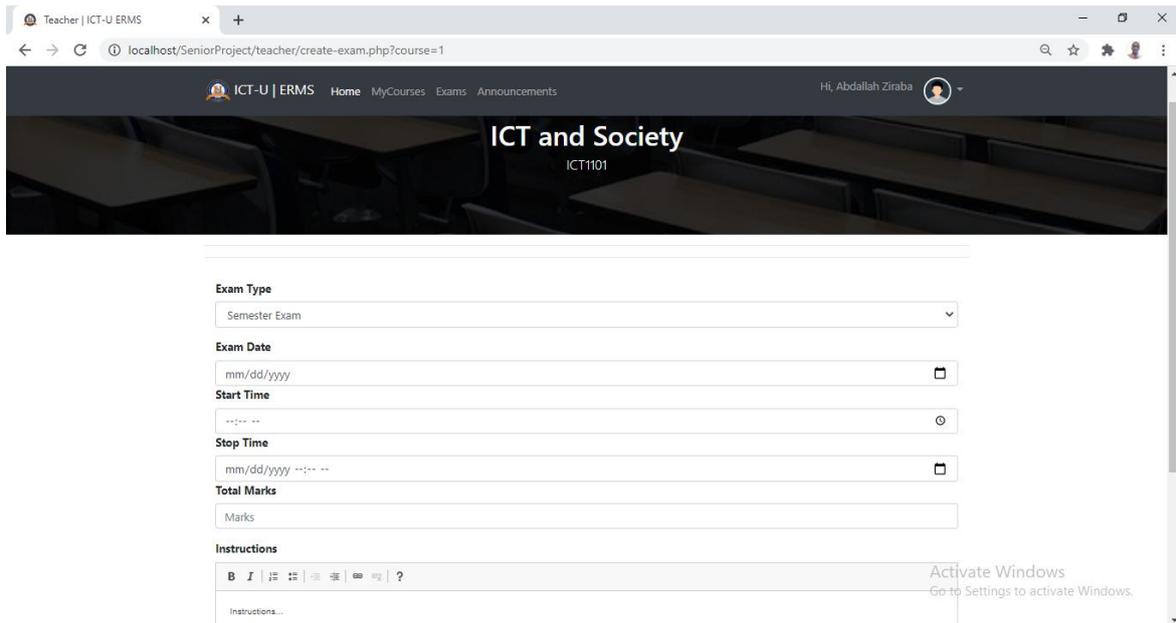
Figure 18: Exam Creation

The teacher can view their account details and edit some of them. This is similar to the student's account as can be seen below.
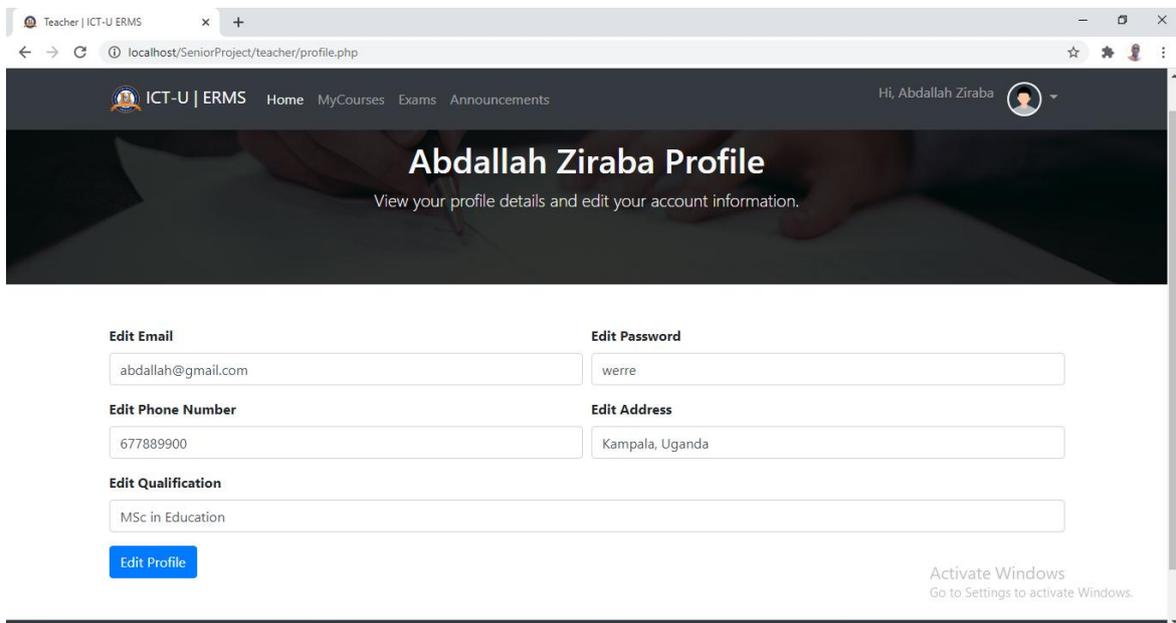
Figure 19: Profile Page

After the student is logged into the system, he or she is brought to this page where he can view his courses, grades and announcements as can be seen in the figure below.
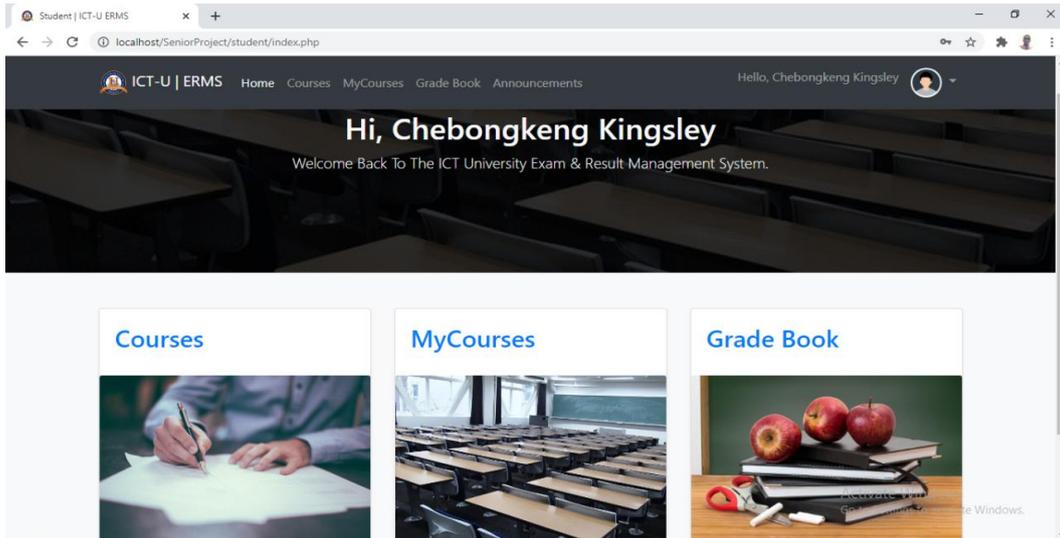
Figure 20: Student Welcome Page

The student can send a request for enrollment into a particular course. The teacher then validates the request and permits the student to get into that course in order to take exams or he can reject the student's request to get into that course as is seen below.
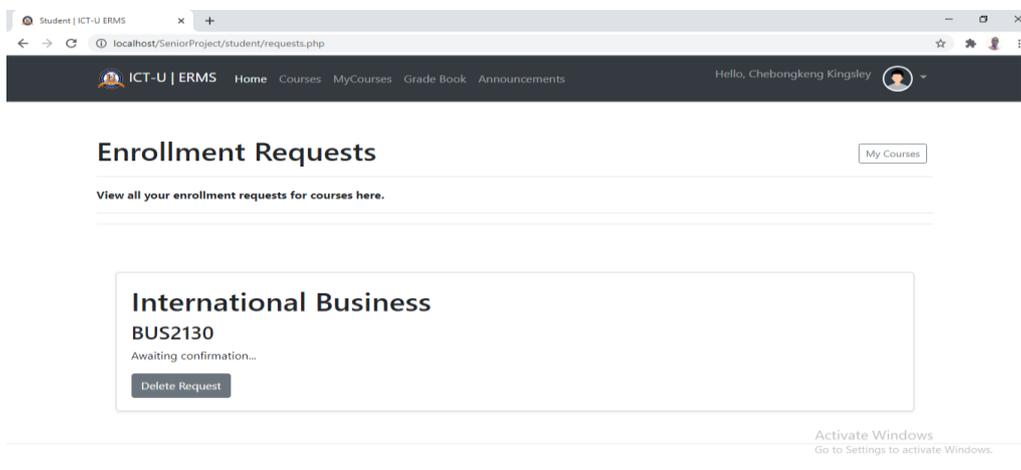

Figure 21: Course Enrollment Request

When the student has enrolled for the course, he can view it, and take exams set by the teacher.
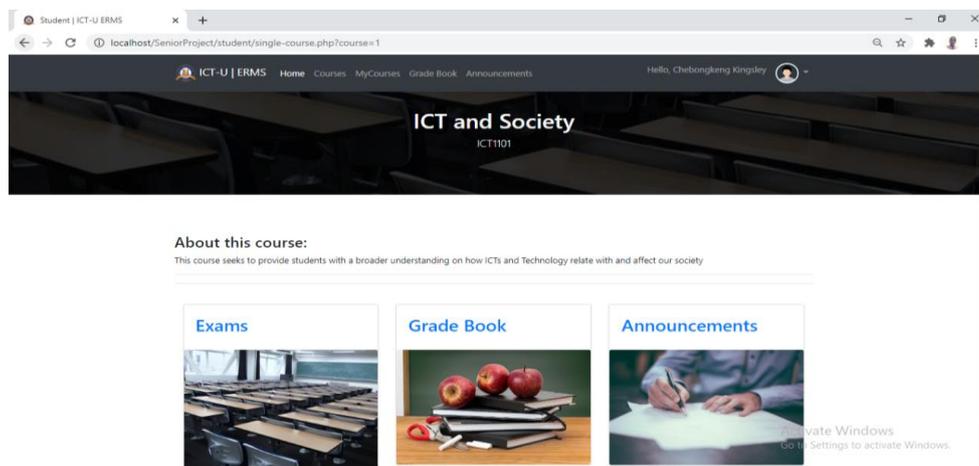
Figure 22: Single Course

The student can then attempt an exam when the lecturer opens it and is timed. When the time for the exam elapses, the exam gets deactivated and the student is forced to submit where he is. The figure below depicts the scenario.
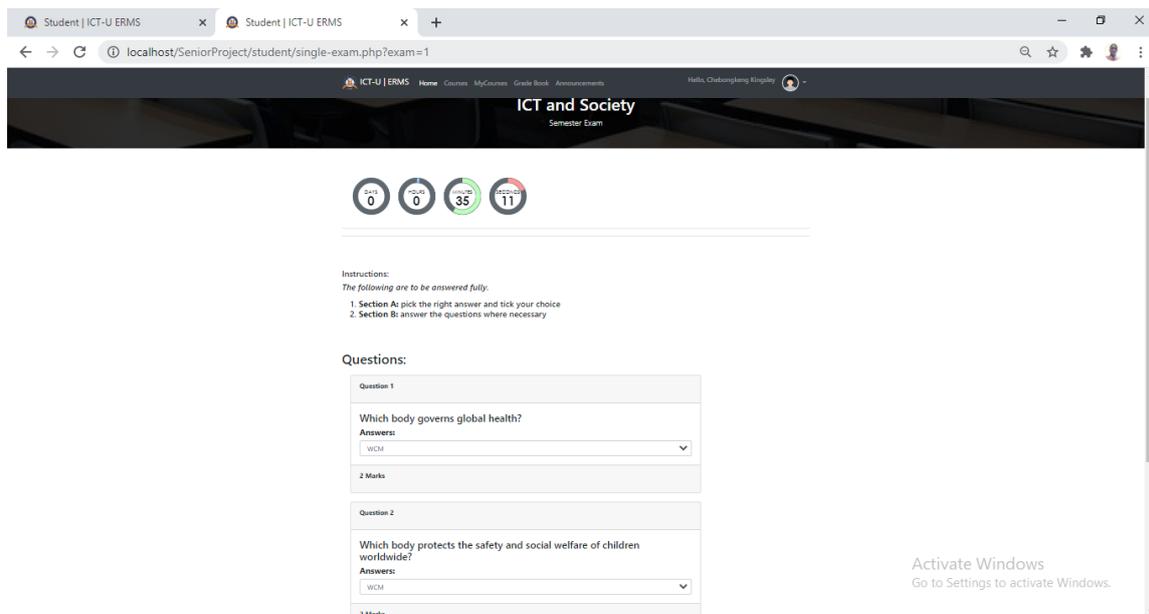

Figure 23: Exam

Immediately the exam has been submitted as can be seen below, the student can go check his grade book. This is to show that the system does the grading instantly and saves the teacher the time and stress of marking many different courses and making possible errors.
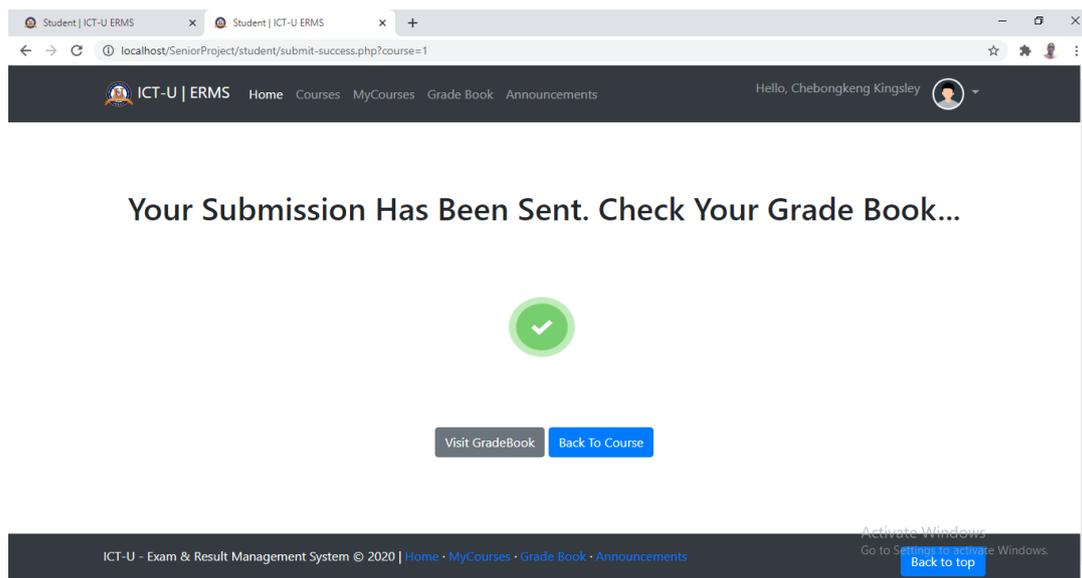

Figure 24: Submission Success

The student can see his final grades here, both for the semester and his overall performance during his stay in the school.

Figure 25: Grade Book

The student can get a downloadable report card at the end of the semester, showing all his courses taken, the grades achieved, and the GPA values. The final GPA value is calculated for the semester as well.

Figure 26: Student Downloadable Report Card

V. Conclusion

This paper presents the development of the Examination and Result Management System (ERMS). The program/application is designed to resolve the problems facing the grading and management of student marks and records at ICT University. The ERMS is developed using PHP, MYSQL, HTML, CSS, and JAVASCRIPT and was hosted locally with the XAMMP server. The Agile Methodology is used as the software development methodology. The functional decomposition of the system and its main modules is given to illustrate the main functions of the system. Also, researchers used case diagrams to display the various types of system users and the different functionalities associated with different system users.

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