DECLARATION

"I declare that the following is my own work and does not contain any ***unacknowledged*** work from any other sources. This thesis was undertaken to fulfill the requirements of the Undergraduate Major Project for the Bachelor of Science in Computer Science (Honors) program at Universiti Sains Malaysia".

Signature : ……

Name : ……

Date : ……

ABSTRAK

Sistem kehadiran konvensional yang sedia ada memerlukan pelajar untuk menandatangani lembaran kehadiran. Lembaran kehadiran ini biasanya akan ditangani oleh semua pelajar secara bergilir-gilir di dalam kuliah ketika pensyarah sedang menjalankan kuliah. Di samping itu, pengambilan kedatangan secara konvensional dengan memanggil nama sangat membuang masa dan tidak selamat serta tidak cekap. Dalam projek ini, Pengenalan Frekuensi Radio (RFID) yang aktif sistem pengurusan kehadiran akan direka untuk memenuhi kelemahan sistem kehadiran konvensional. Sistem kehadiran RFID boleh digunakan untuk mengambil kehadiran pelajar di sekolah, kolej, dan universiti. Keistimewaan sistem ini ialah sistem ini boleh mengenal pasti setiap orang secara unik berdasarkan jenis tag RFID mereka. Kad ID membolehkan proses mengambil kehadiran pelajar dengan lebih mudah , lebih cepat dan lebih selamat berbanding kaedah konvensional. Pelajar hanya perlu mengambil kad ID mereka mendekati pengimbas kad dan kehadiran mereka akan diambil dengan segera. Dengan keupayaan merekod masa secara langsung, kehadiran yang diambil akan lebih tepat. Di samping itu, kehadiran pelajar menghadiri kelas merupakan salah satu faktor utama untuk meningkatkan kualiti pengajaran dan pensyarah dapat memantau prestasi pelajar.

Projek ini mencadangkan satu aplikasi laman web dan aplikasi telefon Window 8. Pelajar dan pensyarah boleh mengesan dan memeriksa kehadiran mereka berdasarkan kelas masing-masing. Dari segi pihak pentadbiran, mereka boleh mendaftar pengguna dan kursus berdasarkan setiap individu. Selain itu, pihak pentadbiran boleh menggunakan Monte Carlo Simulator untuk mensimulasikan satu kelompok pelajar yang menggunakan sistem ini. Di samping itu, cabaran sistem kehadiran yang sedia ada termasuk kesilapan pertindihan semasa membaca dan kesilapan membaca. Oleh itu, sistem yang dicadangkan ini dapat memberi penyelesaian yang cekap bagi kedua-dua masalah yang dibincangkan.

ABSTRACT

The existing conventional attendance system requires students to manually sign the attendance sheet, which is normally passed around the classroom while the lecturer conducting the lecture. In addition, the conventional method of taking attendance by calling names is very time consuming and insecure, hence inefficient. In this project, Radio Frequency Identification (RFID) enabled attendance management system will be designed to cater to the limitation of conventional attendance system. RFID attendance system can be used to take attendance for student in school, college, and university. Its ability to uniquely identify each person based on their RFID tag type of ID card make the process of taking the attendance easier, faster and secure as compared to conventional method. Students only need to take their ID card close to the reader and their attendance will be taken immediately. With real time clock capability of the system, attendance taken will be more accurate since the time for the attendance taken will be recorded. Besides that, students' attendance to classes is one of the key factor in improving the quality of teaching and monitoring their students' performance.

This project proposes a web page application and a windows phone 8 application. Students and lecturer could track and check students attendance by each class. Administrator could register users and register courses for each user, besides that, administrator could use Monte Carlo Simulator to simulate a batch of students using this system. In addition, the challenges of current existing attendance system are duplication reading and miss reading, and this system provides an efficient solution for these two problems.

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1.0 Introduction

1.1 Background of Project

The emergence of electronic paradigm for learning compared to traditional method and availability of almost all information on the information superhighway (Internet), nowadays have caused students to be less motivated to come to the lecture rooms than ever before. Laziness on the part of students, nonchalance to schoolwork, extra social activities that have no importance in aiding the objectives of the institution and a lot more, may prevent students from attending lectures. Sequel to these, lecturers and administrators in most developing countries have had to come up with ways to ensure a healthy participation from students, and make sure that the student-lecturer interactive relationship is kept intact. This in some cases have come in simple forms like roll calls, while in more interesting cases, can be formats like surprise quizzes, extra credit in class, etc. These strategies are however time consuming, stressful and laborious because the valuable lecture time that could otherwise been used for lectures is dedicated to student attendance taking and sometimes not accurate. In addition to all these challenges, the attendances are recorded manually by the tutor and therefore are prone to personal errors. There arises a need for a more efficient and effective method of solving this problem. A technology that can solve this problem and even do more is the RFID technology [6].

1.2 Problem Statement

The existing conventional attendance system requires students to manually sign the attendance sheet every time they attend a class. As common as it seems, such system lacks of automation, where a number of problems may arise. This include the time unnecessarily consumed by the students to find and sign their name on the attendance sheet, some students may mistakenly or purposely signed another student's name and the attendance sheet may got lost [1]. For instance, in the last time our school held a career fair for students to hunt internship. This fair is compulsory for students of third

and final year to attend. Then, the attendance list had to be used. In the process of students signing attendance, attendance list had to be passed one by one, if some students signed wrongly the administrator would not recognize any more, if the last student finished signing putted it aside and forgot to back to administrator, the list is easy to be lost. Therefore, the traditional attendance system has a lot of weaknesses.

Besides that, the old attendance system has another drawback, which is the data of attendance list is hard to connect to other system. If the user wants to calculate the percentage of attendance or some others, he has to calculate manually or input by typing. Therefore, the RFID attendance system generated and this system can solve all problems as before.

1.3 Motivation

Attendance system is one of the most important things to ensure students attend for the particular lectures. Some universities regulate class attendance as compulsory to each student who registered for a particular course. Normally in Malaysian university, students are required to attend the class not less than 80% per semester otherwise student will be barred from taking any examinations [3]. Therefore, the attendance system is very significant in school or university.

1.4 System Objectives& Aim

This project is expected to provide a smart attendance system for different users to sign attendance and view situation of attendance. When the users enter the classroom or lecture hall, they have the option either to swipe their card on the reader or simply let the card detected by the reader. The card attached with RFID tag, which can be detected by the reader as long as certain range of distance between the tag and the reader is complying. Once the reader detect and obtain the information, it will be then saved to its own database automatically. In addition the lack of automated attendance system in the School of Computer Sciences especially in our lecture halls is our main motivation undesigning this prototype.

The aim of this project is for improving the efficient and accuracy of students signing attendance and lecturer could view and track students' attendance The objectives of the system are i) to design a webpage-enabled RFID system that functions on Smartphone and ii) to provide an effective system capable of detecting miss reading and duplication reading and iii) integrate Monte Carlo simulation algorithms in generating RFID EPC ID linked to students cards information for enrollment purposes. The significant of this system is to implement a complete and novel prototype application for Windows Phone application

2.0 Background& Relate Work

In early edition of wireless communication systems, there are a few technology have been successfully applied in attendance system such as biometrics, barcode, smart card and etc. RFID nowadays has taken a concern in providing wireless communications with security features as well as improved the previous technology such as the communication done in wireless, fast, and easy to operate [3].

Biometric Time Attendance System

Biometric Time Attendance System with USB flash drive data download facility, this facility is useful for attendance data gathering when your Biometric Attendance Machine is installed on gate of office and your server or pc is placed far. LAN cable connectivity is not possible. UBS pen drive data download option will be very convenient for such case. You can collect employee attendance records from Attendance Device whenever required to generate Attendance reports [3].

Barcode

Barcode technology is a method of identification, which is used to retrieve in a shape of symbol generally in bar, vertical, space, square, and dots, which have different width with each one. A reader or scanners are required to identify the data that represent by barcode by using light beam and scan directly to barcode. During scanning process a scanner measured intensity of reflected light at black and white region. A black region will absorb the light meanwhile white region will reflect it [3].

Smart Cards

Smart card is built with variety of chip with a simple memory consisting of byte of information may have range from 1K up to 64K of microcontroller or multi-application memory. Smart card is used as individual identification; building access and network access are part of a multi-tiered program that is in the final stage of rolling out. The data in

smart card can be read when a physical contact has whit a reader [3].Next a comparison of different kinds of attendance systems will be shown in Table 1.

Table 1 Comparison of Different Types of Attendance System

Type	Advantage	Disadvantage	Reference
Traditional Attendance System	1. Easy to conduct2. Cheap	1. Human error2. Cheat3. Easy to lost the attendance paper	[1], [2]
Biometric Time Attendance System	1. Do not have to input the information manually. 2. Do not have to use papers.3. Attendance data can be saved automatically, and use for other systems.	1. Twins have identical biometric traits (identical fingerprints, irises...). 2. Finger can be cloned. 3. Stolen body parts can be reused.4. Biometric features can be reconstructed from the template.5. Making a fake finger is easy.	[4]
Barcode Attendance System	1. Do not have to input the information manually. 2. Do not have to use papers.3. Attendance data can be saved automatically, and use for other systems.	Some disadvantages of barcode are read range, data capacity and others, barcode technology is not suitable to implement for attendance. Because implement attendance record system for huge amount at wide area using barcode will take a long time.	[3]
Smart Cards Attendance System	1. Do not have to input the information manually. 2. Do not have to use papers.3. Attendance data can be saved automatically, and use for other systems.	Smart card need physical contact to the reader before the data in the smart card can be transfer; the implemented attendance record system for huge amount at wide area using smart card will take a long time.	[3]
RFID Attendance System	1. Sign attendance very quick. 2. Do not have to input the information manually. 3. Do not have to use papers.4. Attendance data can be saved automatically, and use for other systems.	More trouble statistical data, data vulnerable, vulnerability is more also. This way is not really suitable for college students to the management; the reason is data quantity is too big.	[5]

3.0 Methodology

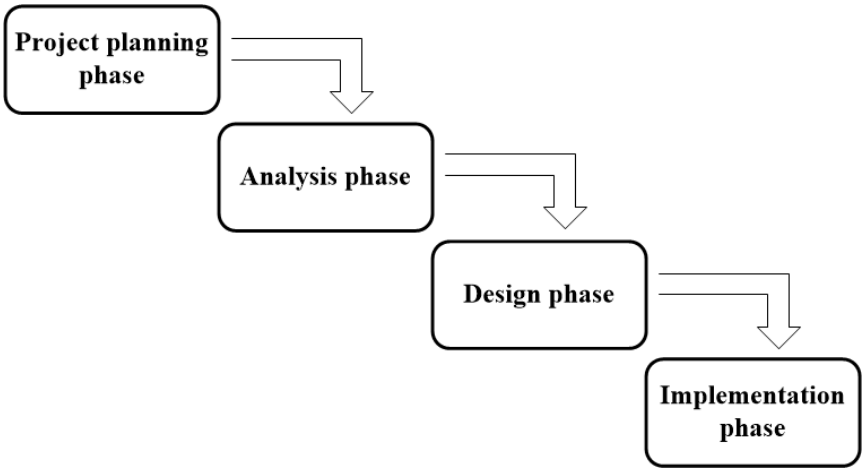

Figure 1 System Development Life Cycle (SDLC)

We use the SDLC in completing this project. Among the steps involve here is listed as below:

a) Project Planning: In the project planning phase, it will present the plan and the structure of the project.

b) Project Analysis: This section will present the analysis of this project according to the current attendance system and user requirement.

c) Project Design: This section shows the design and seven main functions will be designed of the project.

d) Project Implementation: This section will explain which programming language and what tools will be used to develop this project. Monte Carlo simulation and data flow diagram of the project will be presented also.

3.1 Project planning

This project has two parts (shown as Figure 15 in appendix), one is web page system and the other is smartphone system. After student enters or leaves the classroom by scanning RFID card lecturer could view the attendance situation of the class and the movement of different student through web page system and smartphone system. Student could view his attendance only and movement only through the web page system and smartphone system. Besides that, lecturer or student could track the attendance history by both systems.

This project is planned to use ASP.Net, C# to build the web page system, and smartphone system is planned to use C#. This project is developed by using Microsoft Visual Studio 2013 and database part is developed by using MySQL. Gantt Chart is shown in appendix Figure 35, Figure 36, Figure 37.

3.2 Project Analysis

Attendance system is one of the most important things to ensure students attend for the particular lectures. Some universities regulate class attendance as compulsory to each student who registered for a particular course. Normally in Malaysian university, students are required to attend the class not less than 80% per semester otherwise student will be barred from taking any examinations [3]. In Universiti Sains Malaysia, it is still use paper for student to sign attendance. Therefore, the attendance system is very significant in school or university. The Use Case Diagram is shown in figure 14 and ERD is shown in figure 16 in appendix.

3.3 Project Design

This system has seven major functions, those are:

1. Web-based application of this system can let user to insert, display and track student's attendance and movement in the class.

2. Lecturer could view the situation of his/her courses attendance.

3. Displaying and monitoring lecturer information (courses taught or shared and usage of lecture hall).

4. Administrator can track the allocation of classes.

5. Administrator can arrange the schedule of class and facility.

6. Administrator can monitor the usage of facilities.

7. Simulate a classroom using RFID-enabled smart card. Besides that, this system will also have some issues have to be solved like allocating two different courses to one lab at the same time happens. This is due to human error in manually assigning courses according to the classroom. For attendance model, when dozens of students sign attendance, missed reading occurred how students recognize that.

3.3.1 DFD (Data Flow Diagram)

This system has two applications, one is web page application and the other one is smartphone application. Figure 13 (in appendix A) shows the data flow diagram of the whole system. Next I will explain the details of each system function.

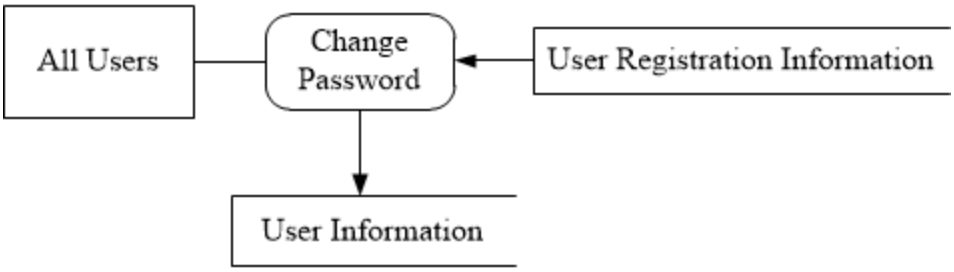

Figure 2 User Changing Password

Figure 2 is the DFD of users changing password process. In this process, users have to enter the correct information (Old Password) from user registration information. At last, the system will store the new password in the user information.

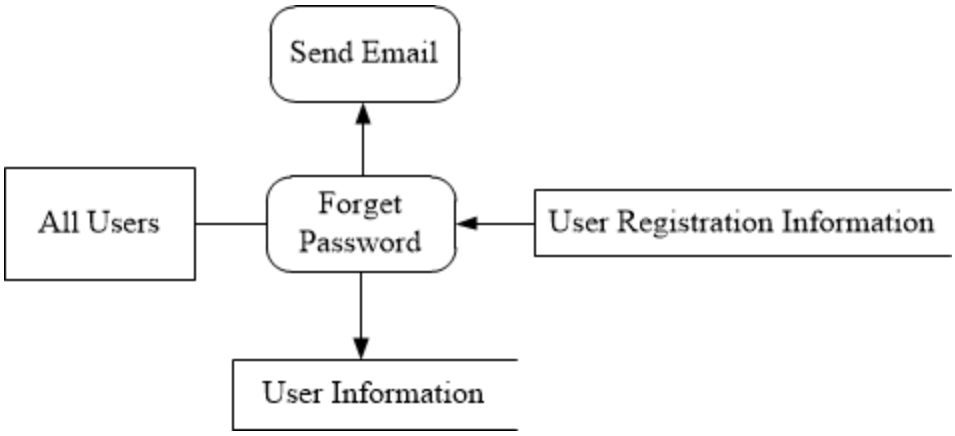

Figure 3 DFD_Users Forget Password

Figure 3 is the DFD of users forgetting password process. In this process, users haveto enter the correct information (Email Address and Matric Number /Staff Number) from user registration information. At last, the system will randomly generate a new password and store it in the user information; next system will send an email to user to tell him/her the new password.

Administrator

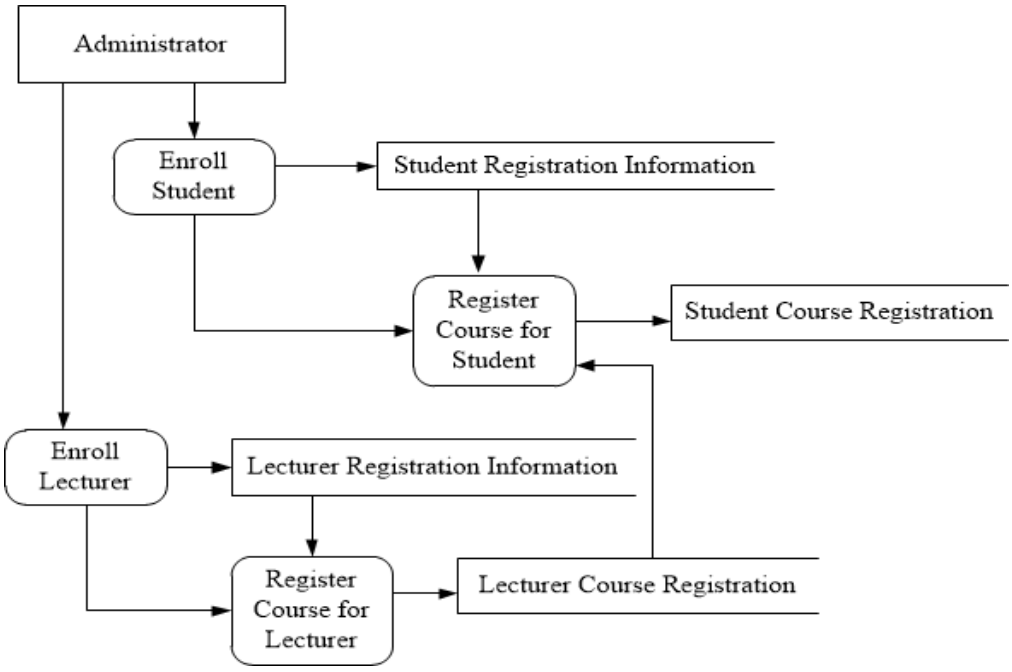

Figure 4 DFD_Admins enroll student and enroll lecturer

Figure 4 is the DFD of administrator enrolling student enrolling lecturer. Admin has to enter the lecturer basic information before he enrolls the lecturer, and after admin finishes Enrolling Lecturer process, the information of lecturer will be stored in the database, and next admin could use this information to conduct Register Course for Lecturer, and Register Course for Lecturer process finished, the system will store the course registration information into the database.

For student, admin has to enter the student basic information before he enrolls the student, and after admin finishes Enrolling Student process, the information of student will be stored in the database, and next admin could use this information and lecturer course registration information to conduct Register Course for Student, and Register Course for Student process finished, the system will store the course registration information into the database. If one course is not registered for lecturer, system will not allow any student to register this course also.

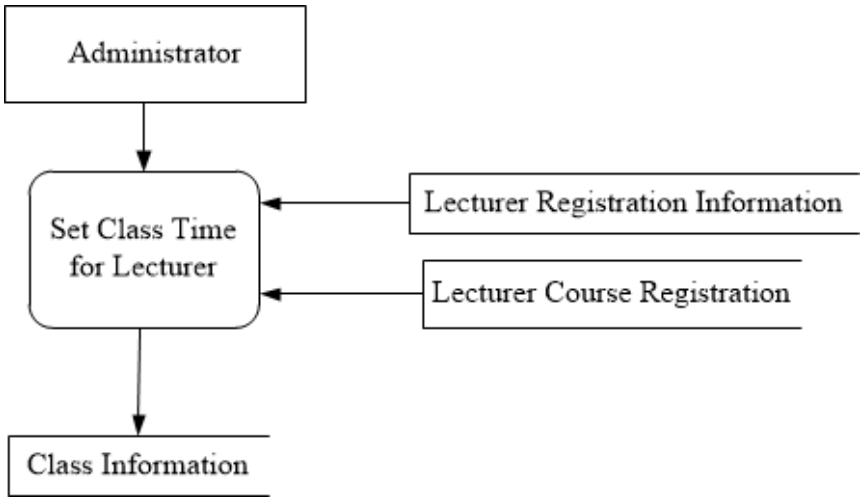

Figure 5 DFD_Admins set class time for lecturer

Figure 5 is the DFD of admin setting class time for lecturer. Before that, admin has to enter the correct class time information and location information. After Set Class Time process finished, the class information will be stored in database.

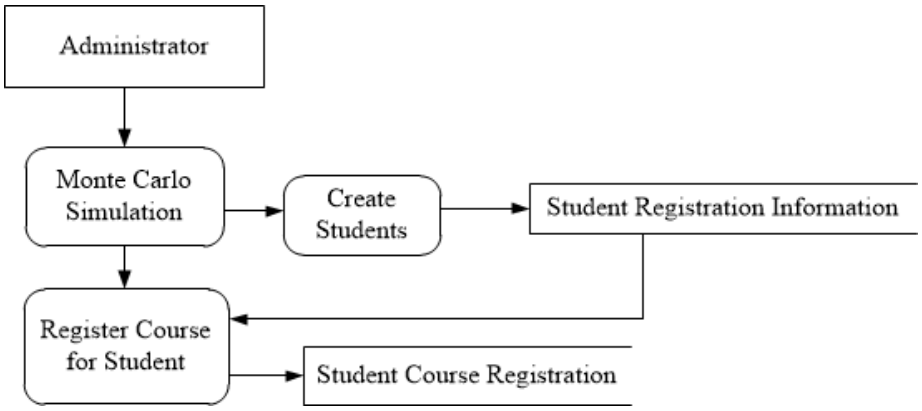

Figure 6 DFD_Admins using Monte Carlo Simulation

Figure 6 is the DFD of Monte Carlo Simulation process, admin could use this simulation process to generate a batch of students (200 students) and register the courses for each student through this simulation process.

Lecturer

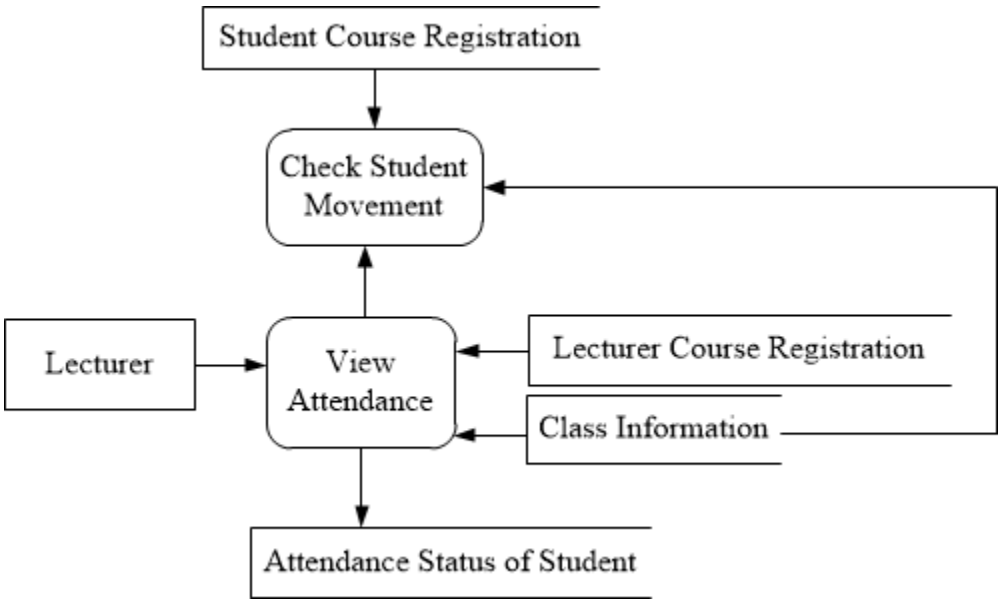

Figure 7 DFD_Lecturers View Student Attendance

Figure 7 is the DFD of lecturers view student attendance, before View Attendance process is triggered, lecturer has to specify a course and class base on the teaching year and semester. Then, the attendance information of the class will be listed and the

statistic of attendance will be shown to lecturer also. If the View Attendance process is triggered first time, the attendance status of each student will be stored in database and if it is not the first time trigger this process, the system will not store it anymore.

After that, lecturer could conduct Checking Student Movement process, and system will show all the movements of each student for lecturer. So that, lecturer could know more attendance detail of each student.

Student

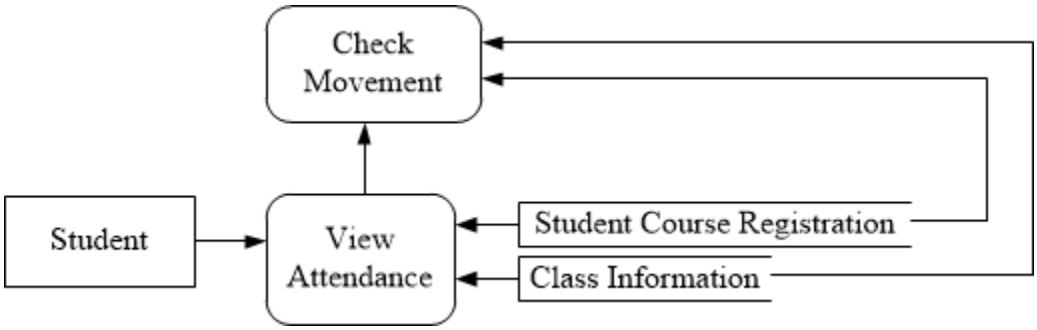

Figure 8 DFD_Students View Attendance

Figure 8 is the DFD of students view student attendance, before View Attendance process is triggered, student has to specify a course and class base on the teaching year and semester. Then, the student attendance status of the class will be shown to the student. After that, student could conduct Checking Movement process, and system will show all the movements of this student in the current class. So that, student could know more attendance detail for each class.

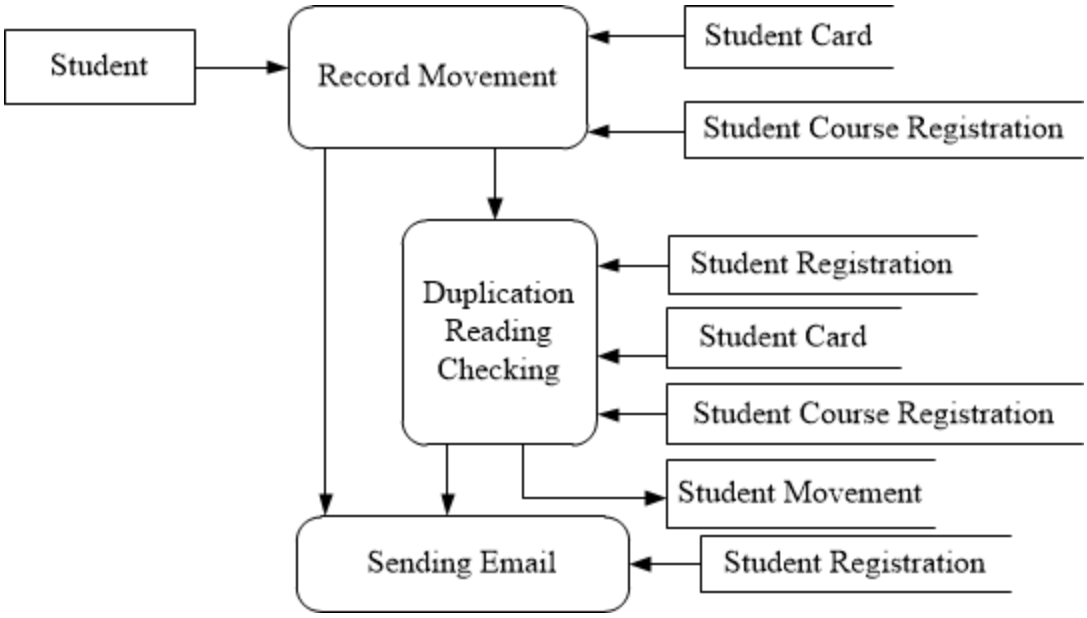

Figure 9 DFD_Students ScanRFID Card

Figure 9 is the DFD of RFID system working, in this section RFID system has three main processes, and there are Record Movement, Duplication Reading Checking and Sending Email. When students scan his/her RFID tag, Record Movement process will be triggered and system will automatically conduct the Duplication Reading Checking process to check the truth of the RFID tag. If the tag is real one, the system will record the student movement to database base on the student course registration information, and if the tag is fake one the system will beep three times and send an email to the real student to tell him/her.

3.4 Project Implementation

This project is expected to provide a smart attendance system for different users to sign attendance and view situation of attendance. When the users enter the classroom or lecture hall, they have the option either to swipe their card on the reader or simply let the card detected by the reader. The card attached with RFID tag, which can be detected by the reader as long as certain range of distance between the tag and the reader is complying. Once the reader detect and obtain the information, it will be then saved to its own database automatically. In addition the lack of automated attendance

system in the School of Computer Sciences especially in our lecture halls is our main motivation undesigning this prototype. Figure 13 shows the data flow of the whole system.

For web page application, we have used ASP.Net, CSS, and JavaScript through Microsoft Visual Studio 2013 to implement. The other one is smart phone application, in this application we will adopt Windows Phone 8 platform to implement. The simulation algorithm, which is Monte Carlo, will be integrated as well. Monte Carlo simulation is a method for exploring the sensitivity of a complex system by varying parameters within statistical constraints. These systems can include financial, physical and mathematical models that are simulated in a loop, with statistical uncertainty between simulations. The results from the simulation are analyzed to determine the characteristics of the system [6].Monte Carlo is used in our system aim to generating a new batch of students automatically.

4. Attendance System

The system includes three different parts. The first part is the web page. The second and the third are the RFID platform and the Smartphone. All this parts are integrated to function together. The system is able to function according to three different user roles. This roles and privileges follow the access control and authorization principles. We are following the Discretionary Access Control (DAC) model [7]. Among the three users listed below are:

a) Administrator

An administrator is a user with the highest privileges and authorization. Typically, an administrator can enroll students and lecturer, register course for students and lecturers, using Monte Carlo simulation.

b) Lecturer

A lecturer is a user who has enrolled by administrator. Typically, a lecturer can check and track the students' attendance and class movement.

c) Student

A student is a user who has lowest privileges and authorization. Typically, a student can only check his attendance and class movement.

4.1 RFID-enabled Smart Attendance System-Web Page

Web page system has eight main functions; these are user login, user forgetting password, user registration, course registration, setting class time, lecturer and student checking attendance, and Monte Carlo simulation. Next is the detail of each function.

Login/Logoff Function

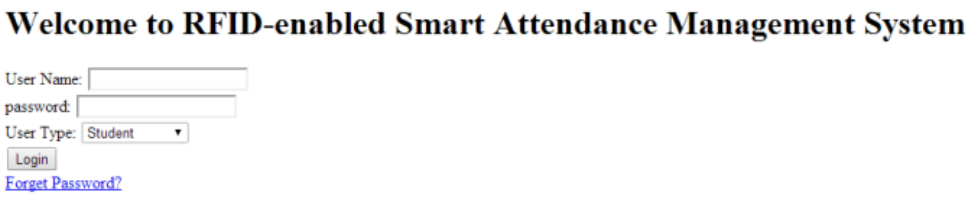

Figure 10 Login Interface

When user login the system (web page part), user has to enter their correct username, password and choose correct use type. Username is the users email address, and initial password is user matric number or staff number. If one of the information does not correct user cannot login and system will show an error message to user. After user login the system, user could change his/her password through this system (Figure 10 shows the login interface).

Forgetting Password

If user forgets his/her password user could fetch his/her password through this system. User has to enter the correct email address and matric number or staff number, and then system will generate a six alphabets password and send it to user's mail box. After that, user could login through this new password and change to his/her familiar password.

Registration

Lecturer

After admin click the Enroll Student link system will jump to student registration page. In this page, admin could register student by entering student basic information (First Name, Last Name, Matric No., Email Address, Birthday, Gender, Year of Study, School Name), after all the information finish entering just click Register button, this student will be registered and you will see this student will be record at the bottom table. If one of the information does not enter correctly, system will not register this student and a red "*" will be shown beside the

required field. Lecturers cannot register a new account for themselves, and only the administrators have right to register a new account for lecturer. After admin register a new account for lecturer, lecturer could login by his/her email address as username and staff number as initial password. At last but not least, admin could click Finish Registration to go back to home page.

Student

After admin click the Enroll Staff link system will jump to staff registration page. In this page, admin could register staff by entering staff basic information (First Name, Last Name, Staff No., Email Address, Birthday, Gender, Year of Study, School Name), after all the information finish entering just click Register button, this staff will be registered and you will see this staff will be record at the bottom table. If one of the information does not enter correctly, system will not register this staff and a red "*" will be shown beside the required field. Staff cannot register a new account for themselves, and only the administrators have right to register a new account for staff. After admin register a new account for staff, staff could login by his/her email address as username and staff number as initial password. At last but not least, admin could click Finish Registration to go back to home page.

Register Course

For Lecturer

After admin finishes register a lecturer, admin could help lecturer to register the course. Before the course registration, admin has to choose the teaching year and semester of the course; otherwise the system will not register the course and a red "*" will be shown beside the required field.

For Student

After admin finishes register a student, admin could help student to register the course. Before the course registration, admin has to choose the teaching year

and semester of the course; otherwise the system will invoke the validation checking. If one course is not registered for lecturer, system will not allow any student to register this course also.

Lecturer Set Class Time

Admin could click the Set Class for Lecturer link to help lecturer to set class time. After admin choose a lecturer and a course the system will jump to the set class time interface, then admin has to choose a building number, room number, start time, end time and class date. Admin could enter a range of class date, and then system will register the class for every week. When admin fill in all the class information, he just click Confirm button, the system will setting class successful, and admin just clicks Finish button to set another course. If admin does not fill in all required information and click Confirm button, the system will not set the class and a red "*" will be shown beside the required field.

Lecturer Checking Student Attendance& Movement

After lecturer login the system, he could click View Attendance link to check student attendance for each class, which he taught. Next lecturer could search the courses by teaching year and semester, after the lecturer click the check button of one course, system will list all the classes, which are set by admin. Next lecturer could click the check button of one class and system will jump to Student Attendance interface. At this time, if it is the first time of checking attendance of this class, lecturer has to click refresh button to get the latest situation of student attendance. If it is not the first time checking, lecturer does not have to click refresh button anymore. And then, system will show the situation of attendance and attendance statistic of this class. Next, lecturer could click check button of each student to check his/her movement of such class. After lecturer click check button of each student, system will jump to Student Movement interface and it will show the movement record of this student. At the bottom of this interface, system shows the time of this student staying in classroom. At last but not

least, lecturer could click Choose Another Student button to check movement of another student.

Student Checking Attendance & Movement

After student login the system, he could click View My Attendance link to check his attendance for each class, which he has to attend. Next student could search the courses by teaching year and semester, after the student click the check button of one course; system will list all the classes and his attendance status. And then, student could click check button of each class and system will jump to Student Movement interface and it will show his movement record. At the bottom of this interface, system shows the time of this student staying in classroom. At last but not least, student could click Choose Another Class button to check his movement of another class.

Monte Carlo Simulation

After admin login the system, admin could click Monte Carlo Simulation link to generate a new batch of students and register the courses for each through the simulator. When the system jump to the Monte Carlo Simulation interface, click Create Student button, and system will generate a batch of students (200 students) and admin could click Log button to check the students' information. After that, admin could click Register Course button to register the courses for each student, which are generated by Monte Carlo simulator. Then, admin could click Register Course button of each student to check the situation of course registration. Then, admin could click Register Course button of each student to check the situation of course registration. Figure 11 is the simple code of Monte Carlo Simulation.

```
public string generateEmailAddress()
{
      ...
}
DateTime RandomDay()
{
      ...
}
public string generateTime()
{
      ...
}
public static string GenRandomLastName()
{
      ...
}
public static string GenRandomFirstName()
{
      ...
}
```

Figure 11 Monte Carlo Simple Code

4.2 RFID-enabled Smart Attendance System- Smartphone

Login/Logoff Function

When user login the system (Smartphone part), user has to enter their correct username, password and choose correct use type. Username is the users email address, and initial password is user matric number or staff number. If one of the information does not correct user cannot login and system will show an error message to user. After user login the system, user could change his/her password through this system.

Lecturer Checking Student Attendance & Movement

After lecturer login the smartphone system, he could press View Attendance button to check student attendance for each class, which he taught. Next the system will show the course list base on teaching year, after the lecturer press one of the courses, system will list all the classes, which are set by admin. Next lecturer could press one of the classes and system will jump to Student Attendance interface. System will show the situation of attendance and if lecturer presses the Statistic button, system will jump to next

interface and show the attendance statistic of this class. Next, lecturer could press any of the students to check his/her movement of this class. After lecturer press one of the students, system will jump to Student Movement interface and it will show the movement record of this student. At the bottom of this interface, system shows the time of this student staying in classroom. At last but not least, lecturer could press back button to check movement of another student.

Student Checking Attendance & Movement

After student login the smartphone system, he could press View Attendance button to check his attendance for each class. Next the system will show the course list base on teaching year, after the student press one of the courses, system will list all the classes, and his attendance status. And then, student could press one of the classes and system will jump to Student Movement interface and it will show his movement record. At the bottom of this interface, system shows the time of this student staying in classroom. At last but not least, student could press back button to check his movement of another class.

4.3 RFID

4.3.1 Pre-Attendance Process

Signing Attendance for Students

When students enter the class room he just let his RFID card on the reader and he will hear two beep sounds, it means the reader have detected the card and recorded student enter the classroom. If students want to go out of the class, he also has to scan the card and he will hear a beep sound. It means the system have record the students already out of the classroom. At last, lecturer will calculate the attendance time and determine the attendance for each student through this system.

Duplication Reading

After the students scan the card, system will check the truth of the card, if the card is a fake one, system will beep three times and it will not be record in the system. If the card is a real one, system will record the data in the system.

Email Generation

In this function, system will send an email to user in three situations. One is at first fifteen minutes of each class student only have to scan the card once and system will recognize the student enter the class room. This time is for students enter the class, and if student scan twice in this fifteen minutes, system will send an email to tell the student he has already enter the classroom.

Second, with in fifteen minutes after the class finished student only have to scan the card once and system will recognize the student leave the class room. This time is for students leave the class, and if student scan twice within such fifteen minutes, system will send an email to tell the student he has already left the classroom.

Third, if a person uses a fake card to sign attendance for a student, system will find it out and send an email to the real user to tell him someone has duplicated your card.

4.3.2 Post-Attendance Process

Checking Statistic of Attendance & Tracking Attendance History

After one class finished, lecturer not only could check the statistic of attendance but also could tracking attendance history. More detail please refers “Lecturer Checking Student Attendance & Movement” in section 3.1.

4.4 Case Scenario

There are four case scenarios will be discussed in this section whereby how the students use this system to sign attendance. In these four cases, three assumptions will be made. Figure 12 is the assumption diagram and shows these three assumptions.

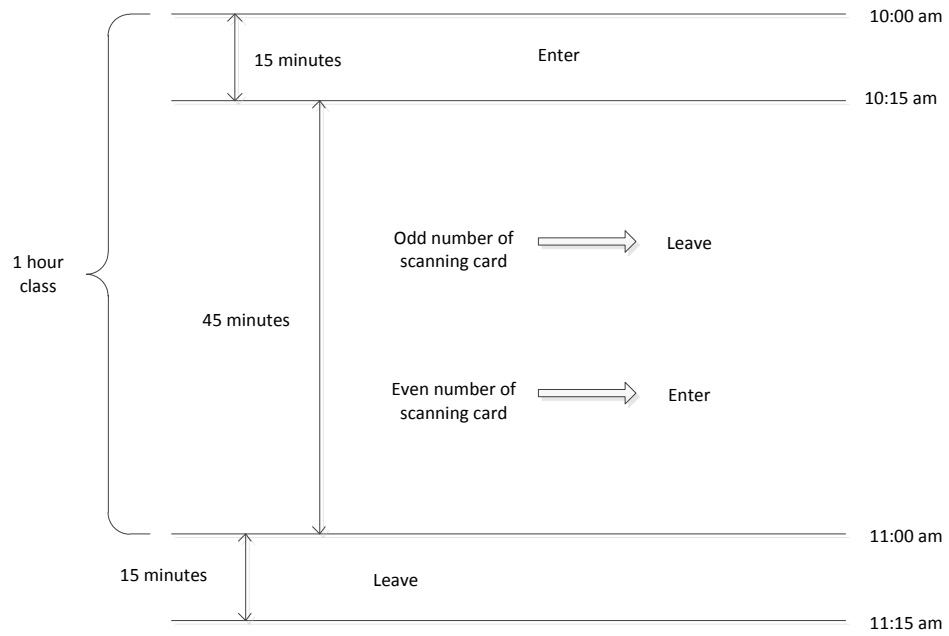

Figure 12 Assumption Diagram

1. If students scan their RFID cards at the first 15 minutes of one class, our system will recognize the students as entering the classroom.
2. If students scan their RFID cards within 15 minutes after the class end, our system will recognize the students as leaving the classroom.
3. Besides the first 15 minutes and last 15 minutes, if students enter or leave the classroom, the system will calculate the times of students scanning cards. If the number of scanning cards is an odd number our system will set the status of student as entering, and if the number of scanning cards is an even number our system will set the status of student as leaving.

Case 1: Students come in the classroom within first 15 minutes

In first 15 minutes of each class, it is for students to enter the classroom and student only have to scan his card once, the system will record this student enter the classroom. If a student scans more than once within these 15 minutes, system will send an email to this student and tell the student he has already entered the classroom.

Case 2: Students leave the classroom in 15 minutes after the class finished

In the 15 minutes after the class finished, it is for students to leave the classroom and student only have to scan his card once, the system will record this student leave the classroom. If a student scans more than once within these 15 minutes, system will send an email to this student and tell the student he has already left the classroom.

Case 3: Students enter and leave the classroom within the class time

After the first 15 minutes and before the class end, students could leave and enter the classroom freely, but students have to scan his card every time. At last, system will calculate the real time of each student stays in the classroom to judge the attendance status of every student. If the time of a student stays in the classroom more than 75% of a class, system will mark this student attend the class. If the student comes to the class but stays in the classroom less than 75% of a class, system will mark this student as incomplete. If the student does not come to attend the class, system will mark him as absent. At last but not least, if a student just scans the card when he enters the classroom, but does not scan the card when he left the classroom system will decide the time of his last leaving classroom as the leaving time.

Case 4: Duplication reading and miss reading

When the students scan the card, they will hear the beep sound from the system. If they heard two beep sounds, it means system record the student entered the classroom. If they heard only one beep sound, it means system record the student left the classroom. If a student heard three beep sounds when he scanning card, it means system found this card is a fake card and system will send an email to the real student to tell him his card has been duplicated. For every scanning system will check the truth of the card first, if system found this card is a real one, then the system will process next. However, if system found the card is a fake one, system will not store the data anymore and system will send an email to the real student.

5. Testing of Smart-Attendance

In order to do the testing, users log in as the administrator, lecturer and students. RFID system, web page and the smartphone were fully tested. Below are the results of the function testing.

5.1 Testing Web Page Function

The web page application has several functions such as user login, user changing password, lecturer checking student attendance and etc. Below are the tested functions.

Table 2 Web Page Function Testing

No.	Function	Working
1	User Login	√
2	User Forgetting Password	√
3	User Changing Password	√
4	Admin Register Student	√
5	Admin Register Lecturer	√
6	Admin Register Course for Student	√
7	Admin Register Course for Lecturer	√
8	Admin Setting Class Time	√
9	Mote Carlo Simulation	√
10	Lecturer Checking Student Attendance	√
11	Lecturer Checking Student Movement	√
12	Class Statistic	√
13	Student Checking Attendance	√
14	Student Checking Movement	√
15	Sending Email	√

Based on Table 2, we demonstrate that all the functions work successfully. The role of the administrator could register student and lecturer, register course for student and lecturer, setting class time for lecturer and simulate a batch of student by Monte Carlo simulator. The role of lecturer could check student attendance and movement of each student and check

attendance statistic of each class. The role of student could check his own attendance and movement.

5.2 Testing Smartphone Function

The smartphone application has several functions such as user login, user changing password, lecturer and student checking attendance and movement and etc. Below are the tested functions.

Table 3 Smartphone Function Testing

No.	Function	Working
1	User Login	√
2	User Forgetting Password	√
3	User Changing Password	√
4	Lecturer Checking Student Attendance	√
5	Class Statistic	√
6	Lecturer Checking Student Movement	√
7	Student Checking Attendance	√
8	Student Checking Movement	√
9	Sending Email	√

Based on Table 3, we demonstrate that all the functions work successfully. The role of lecturer could check student attendance and movement of each student and check attendance statistic of each class. The role of student could check his own attendance and movement.

5.3 Testing RFID Function

In RFID part, it has several functions such as students signing attendance, duplication reading checking, miss reading feedback and sending email. Below are the tested functions.

Table 4 RFID Function Testing

No.	Function	Working
1	Signing Attendance	√
2	Duplication Reading	√
3	Miss Reading	√
4	Sending Email	√

Based on Table 4, we demonstrate that all functions work successfully. RFID system could perform students signing attendance, duplication reading checking, miss reading feedback and email generation.

6. Discussion

This RFID-enabled smart attendance system implemented based on the requirement that has been set during the analysis stage and able to expand the requirement during the design stage to make the attendance system more advances. Based on SWOT analysis, I will present our discussion.

6.1 Strength

This system implements and meets the requirements of the system design, and next I will show the strength of this system.

- First, this system is a RFID-enabled attendance system, and it is a web page plus smartphone system. Therefore, this kind of design increases the portability of the system.
- Second, in the RFID embedded card, it just store the EPC (Electronic Product Code) of each student and this card does not store other personal information, so that, it protects users privacy.
- Third, this system solves the most significant problems, which are duplication reading and misreading. Therefore, it increases the accuracy of this system.

6.2 Weakness

This project still has some challenges and limitations to be improved. Next I list several weakness of this system have to be improved.

- First, the connection port of RFID reader is TTL port and the connection port of server uses USB port, but the efficient transmission distance between these two ports is about 500 meters, if the user wants to extend the distance he has to use repeater, this is very troublesome.
- Second, in the process of students scanning card and entering classroom, sometime the system will send the email to students, and in the period of system sending email, reader cannot read the card until it sent the email completely. This phenomenon decreases the efficiency of reading of RFID-enabled cards.

- Third, if a student scans his card at the beginning of this class and if he needs to leave the classroom to another location for example the restroom, he will then need to scan the card before he leaves. As he comes back again, he will need to re-scan the card again. Imagine that if the student forget to scan the card for the second time, the system will not be able to show the student attendance status. Thus human error is a threat in this system. And then he leaves the classroom until the class finished he comes back and scans his card. For another phenomenon, student could pass the card to other student to let them help to sign attendance, for these phenomena system cannot be detected. So that, this system still cannot eliminate student absent the class completely.

6.3 Opportunities

In this section I will introduce the opportunities, which this system will be faced. Next shows the details.

- Nowadays, NFC technology has become more and more popular in the mobile device. NFC technology is also based on RFID technology, thus this system could combine with NFC and in the future students do not have to use RFID embedded cards to sign attendance and they just use NFC smartphone to implement it. The RFID reader could also be changed to NFC mobile device and after students signing attendance the reader could transmit the information to server by wireless network, then the signal transmission distance problem could be saved.
- For another, this system could be combined with subway entrance guard machine to eliminate student absent the class. If students want to enter or leave the classroom, they must scan the card, otherwise the door will not open, and the door permits only one student pass for each opening.

6.4 Threats

This project could implement the majority requirement of user signing attendance; however, it still has some threats. Next I will explain some exciting threats of this system.

- If the human errors are occurred, which l mentioned in “Weakness” part, lecturers could not track these students attendance and movement record, so that this system will become useless.
- Besides that, this system still has some security problems. This system has to be connected to the internet and if this system does not be protected by security measures hackers could access and modify the data in database.
- Next threat of this system is card clone, although each RFID embedded card has a unique ID and it is very difficult to be duplicate, but it still has some software or machine could clone a same card. So that, this is also a serious threat for this system.

In the process of this project development we do not include the 2D modeling for viewing class room condition function. Because the most important object of this project is user could track and manage students’ attendance through web page and mobile device. Therefore we do not implement this function.

7. Conclusion

This project provides a smart attendance system for students to sign attendance and view movement of student. When the students enter the classroom or lecture hall, they have to let the card detected by the reader. The card attached with RFID tag can be detected by the reader as long as certain range of distance between the tag and the reader is complying. Once the reader detect and obtain the information, it will be then saved to its own database automatically.

Besides that, students can leave the class room but they have to let the card detected by the reader also. So that teachers or lecturers not only can view the percentage of coming students, earl leave and absent students, but also they can see which students come, early leave and absent no matter by web page system or smartphone system. As a student, he/she could through web page system or smartphone system to look up his/her attendance situation and movement situation.

The outcome of the project especially the importance of RFID based attendance system can stand as an extension to the existing student card currently used in our University. In addition the lack of automated attendance system in the School of Computer Sciences especially in our lecture halls is our main motivation undesigning this system.

Although this project has met the basic requirement, it still has space to be improved. In the future this project could combine with the NFC technology, the RFID reader and tag could be change to a mobile device has NFC function. Then students could use only smartphone to sign attendance and it is very convenience.

During the process of this project implementation I have faced a lot of difficulties and challenges, but I have never given up and got a lot of knowledge and skills. Through this project, I have learn how to use C# programming language to develop the ASP.Net web page application, Windows Phone application, how to build web service and etc. In the future, if I have chance I would like to improve this system more completely and powerful.

8. Future Work

In the future, this system could be combined with NFC (Near Field Communication) function to improve the weakness of this system. Nowadays, NFC becomes more and more popular in mobile device, and this function is based on RFID technology, hence this system could be combined with this function and let students to sign attendance by using smartphone. At last but not least, with the development of technology the completeness of this system could be improved and this system could be more and more completed.

9. Reference

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Appendix A: System Analysis and Design Diagram

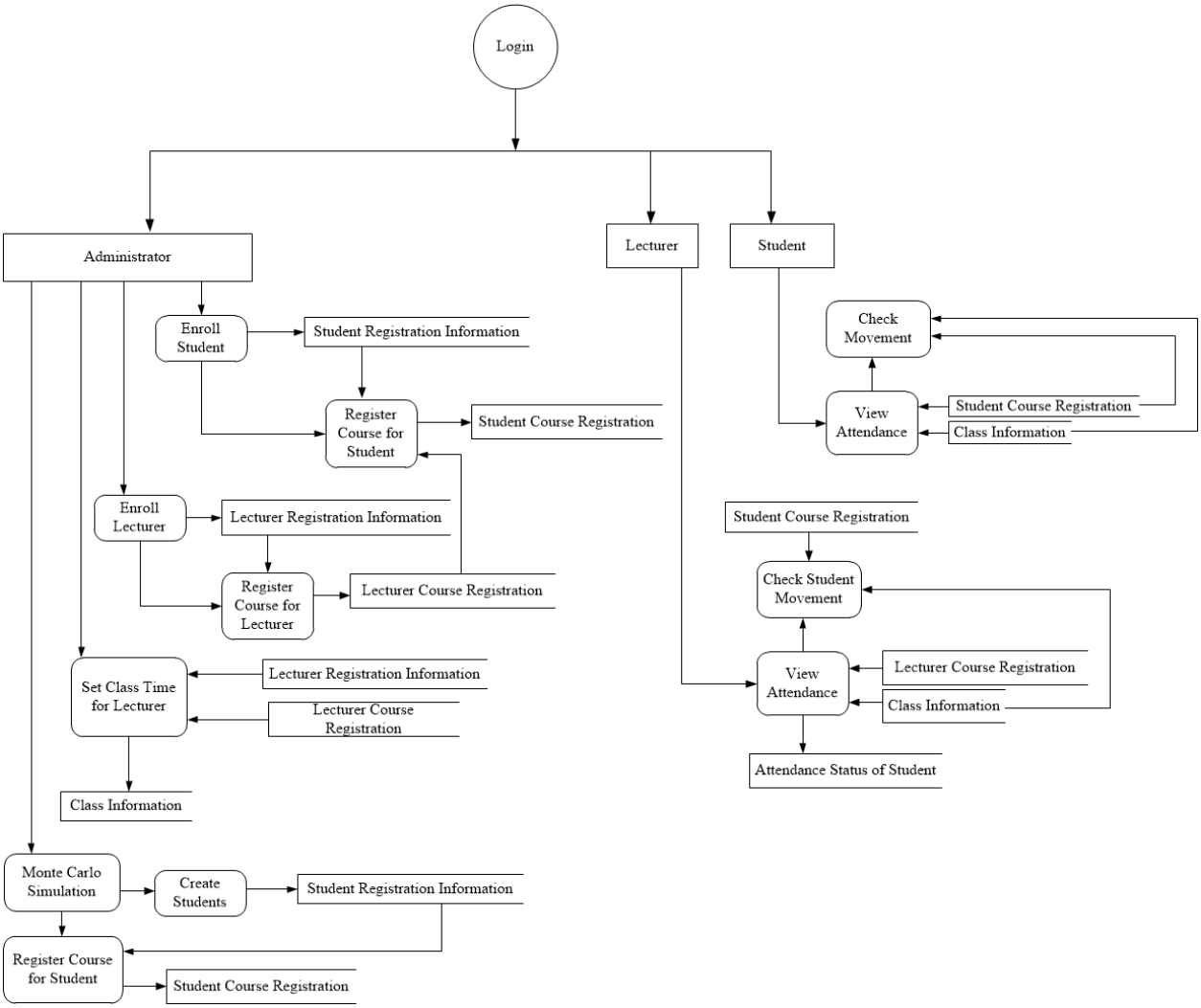


Figure 13 System Data Flow Diagram

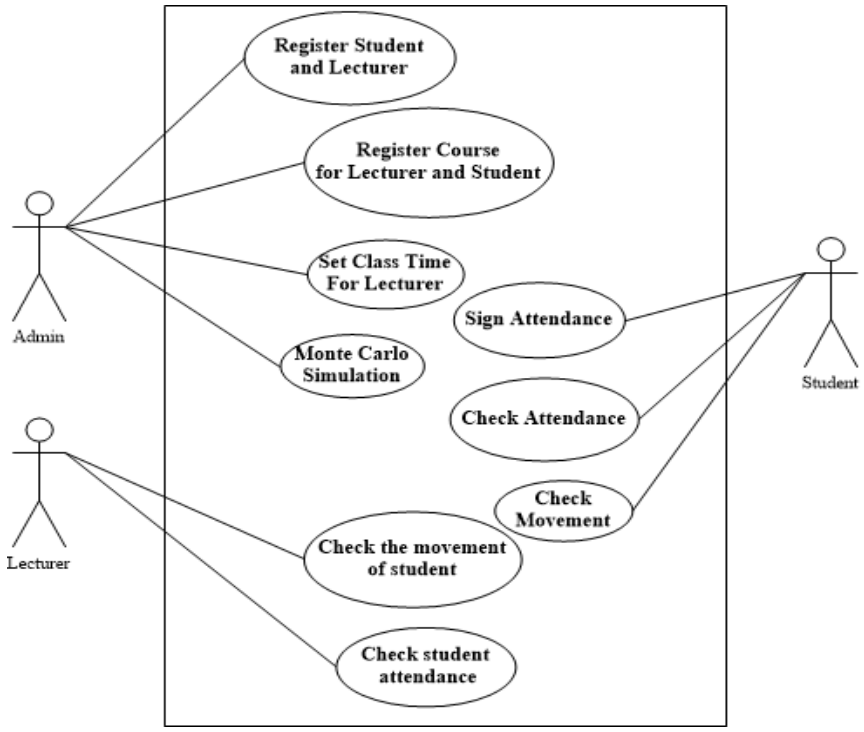


Figure 14 Use Case Diagram

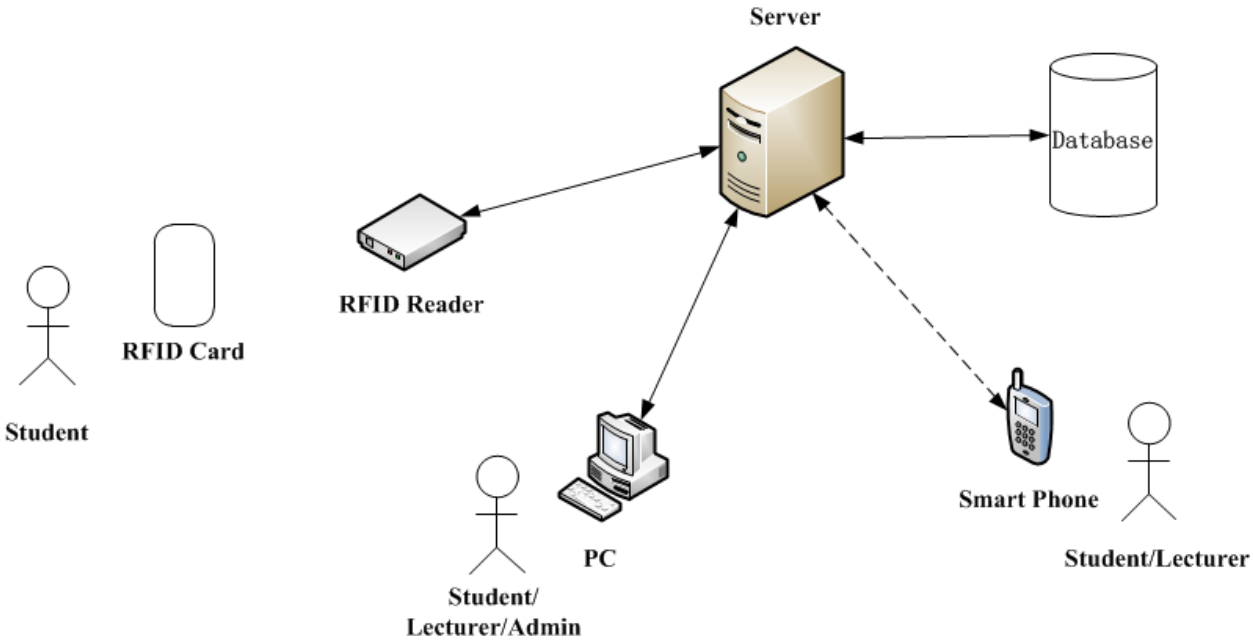


Figure 15 System Structure Diagram

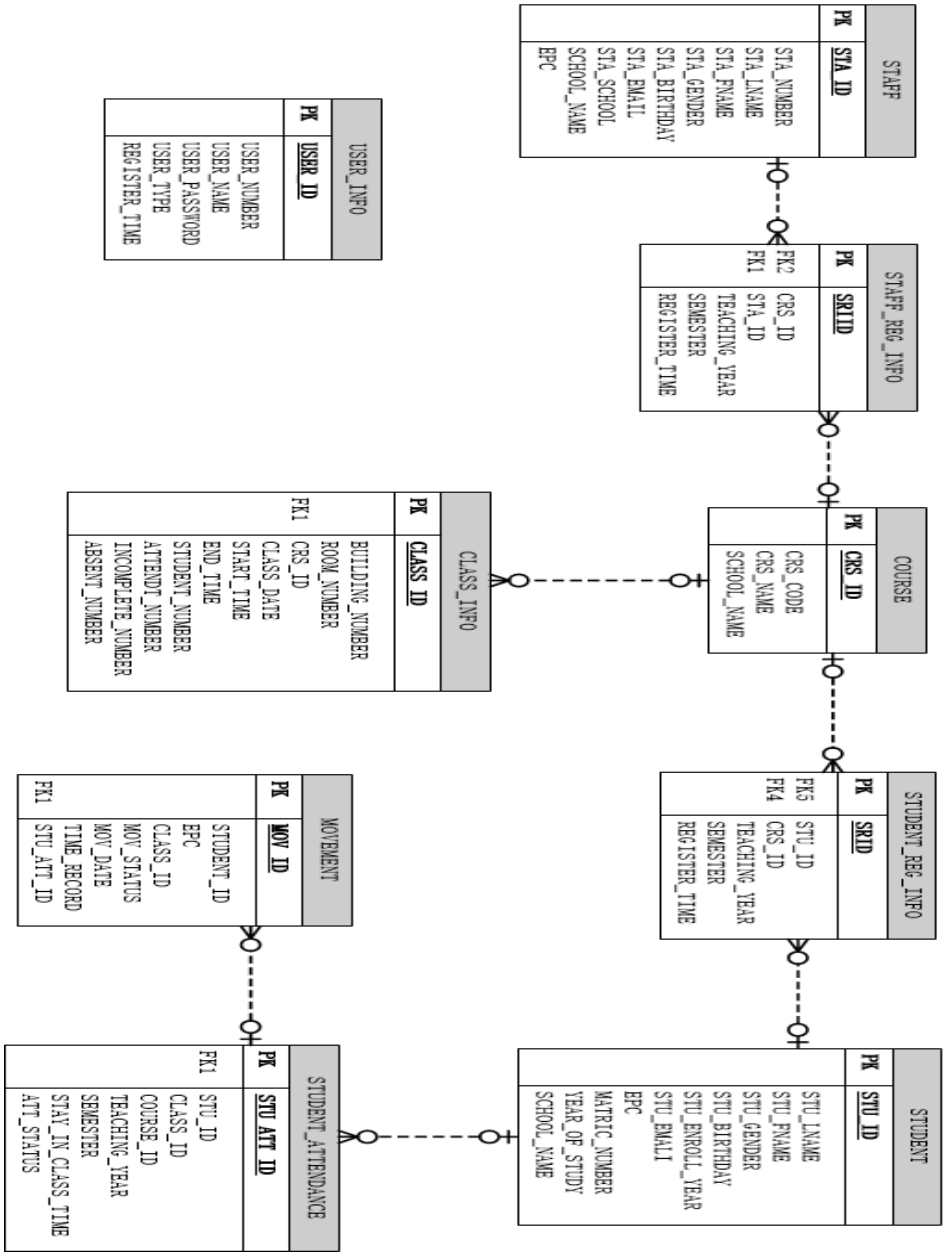


Figure 16 Entity Relationship Diagram (ERD)

Appendix B: System Partial Interface

Web Page Part

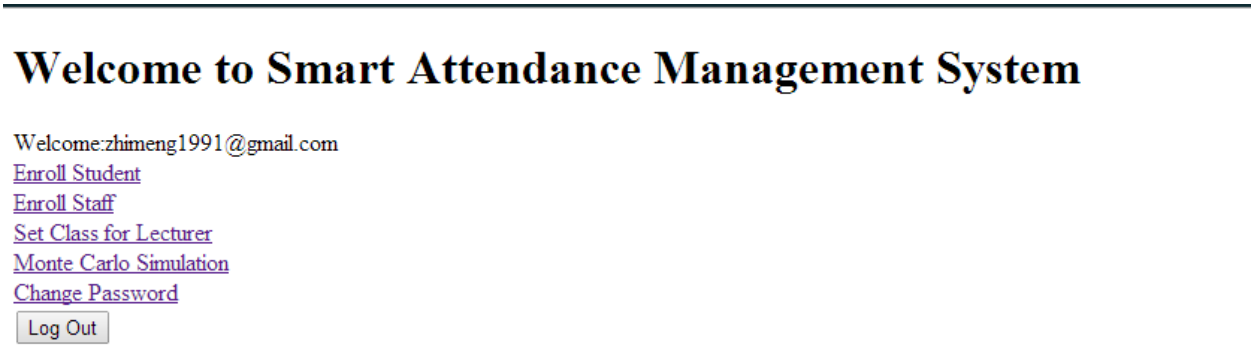


Figure 17 Admin Welcome Page

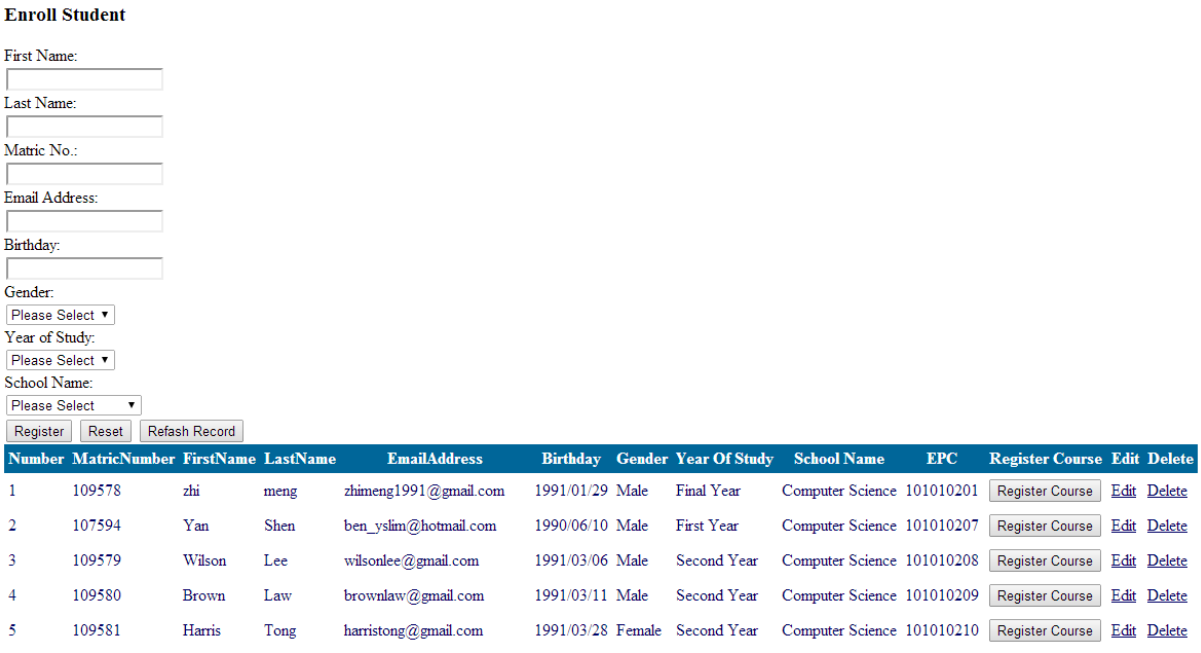


Figure 18 Admin Enroll Student Page

Enroll Staff

First Name:

Last Name:

Staff No.:

Email Address:

Birthday:

Gender:

Male

SchoolName:

Register Reset

Number	StaffNumber	First Name	Last Name	Email Address	Birthday	Gender	School Name	EPC	Register Course	Select	Edit	Delete
1	3333333	jerry	lim	503763316@qq.com	20140312	Male	Computer Science	201010003	Register Course	Select	Edit	Delete

Finish Registration

Figure 19 Admin Enroll Lecturer Page

Generate Students: Create Students

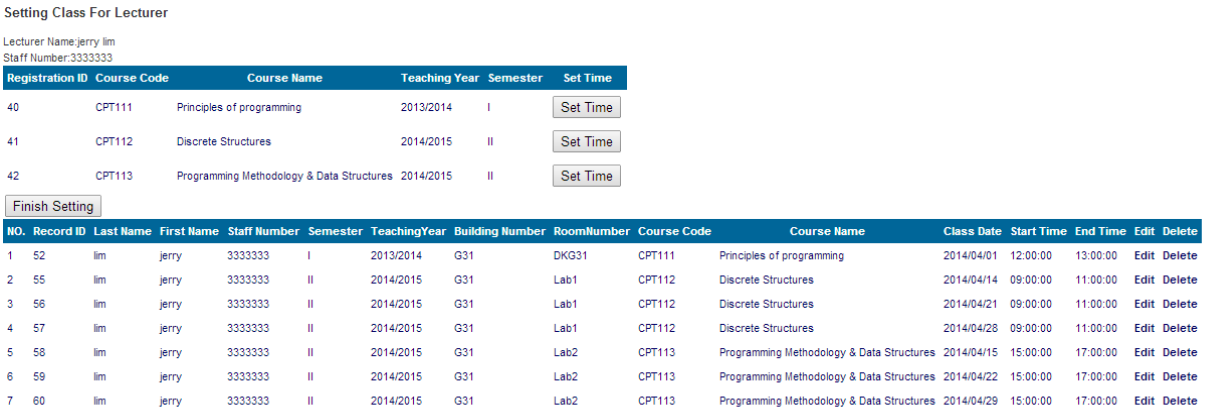
Register Courses for Students: Register Course

Show the Log of Student Generation: Log

Enroll Staff: Enroll Staff

Number	MatricNumber	First Name	Last Name	Email Address	Birthday	Gender	Year Of Study	School Name	EPC	Register Course
1	100001	Simmons	Isabelle	IsabelleSimmons@gmail.com	19890410	Female	Second Year	Computer Science	1010101	Register Course
2	100002	Davis	Justin	JustinDavis@gmail.com	19910724	Male	Second Year	Computer Science	1010102	Register Course
3	100003	Morris	Lucy	LucyMorris@gmail.com	19890802	Female	Second Year	Computer Science	1010103	Register Course
4	100004	Sanders	Aiden	AidenSanders@gmail.com	19890423	Female	Second Year	Computer Science	1010104	Register Course
5	100005	Scott	Carson	CarsonScott@gmail.com	19900615	Female	Second Year	Computer Science	1010105	Register Course
6	100006	King	Liliana	LilianaKing@gmail.com	19891202	Female	First Year	Computer Science	1010106	Register Course
7	100007	Coleman	Peyton	PeytonColeman@gmail.com	19900810	Male	First Year	Computer Science	1010107	Register Course
8	100008	Baker	Allison	AllisonBaker@gmail.com	19900410	Female	First Year	Computer Science	1010108	Register Course
9	100009	Edwards	Logan	LoganEdwards@gmail.com	19910427	Male	First Year	Computer Science	1010109	Register Course
10	100010	Morgan	Bryson	BrysonMorgan@gmail.com	19901004	Male	First Year	Computer Science	10101010	Register Course
11	100011	Adams	Isabelle	IsabelleAdams@gmail.com	19891029	Female	First Year	Computer Science	10101011	Register Course
12	100012	Harris	Hudson	HudsonHarris@gmail.com	19910511	Male	First Year	Computer Science	10101012	Register Course
13	100013	Kelly	Julian	JulianKelly@gmail.com	19900310	Female	First Year	Computer Science	10101013	Register Course
14	100014	Anderson	Sophia	SophiaAnderson@gmail.com	19911231	Male	First Year	Computer Science	10101014	Register Course
15	100015	Jones	Brianna	BriannaJones@gmail.com	19890124	Female	First Year	Computer Science	10101015	Register Course

Figure 20 Monte Carlo Simulator Page



Setting Class For Lecturer

Lecturer Name:jerry lim
Staff Number:3333333

Registration ID	Course Code	Course Name	Teaching Year	Semester	Set Time
40	CPT111	Principles of programming	2013/2014	I	Set Time
41	CPT112	Discrete Structures	2014/2015	II	Set Time
42	CPT113	Programming Methodology & Data Structures	2014/2015	II	Set Time

Finish Setting

NO.	Record ID	Last Name	First Name	Staff Number	Semester	TeachingYear	Building Number	RoomNumber	Course Code	Course Name	Class Date	Start Time	End Time	Edit	Delete
1	52	lim	jerry	3333333	I	2013/2014	G31	DKG31	CPT111	Principles of programming	2014/04/01	12:00:00	13:00:00	Edit	Delete
2	55	lim	jerry	3333333	II	2014/2015	G31	Lab1	CPT112	Discrete Structures	2014/04/14	09:00:00	11:00:00	Edit	Delete
3	56	lim	jerry	3333333	II	2014/2015	G31	Lab1	CPT112	Discrete Structures	2014/04/21	09:00:00	11:00:00	Edit	Delete
4	57	lim	jerry	3333333	II	2014/2015	G31	Lab1	CPT112	Discrete Structures	2014/04/28	09:00:00	11:00:00	Edit	Delete
5	58	lim	jerry	3333333	II	2014/2015	G31	Lab2	CPT113	Programming Methodology & Data Structures	2014/04/15	15:00:00	17:00:00	Edit	Delete
6	59	lim	jerry	3333333	II	2014/2015	G31	Lab2	CPT113	Programming Methodology & Data Structures	2014/04/22	15:00:00	17:00:00	Edit	Delete
7	60	lim	jerry	3333333	II	2014/2015	G31	Lab2	CPT113	Programming Methodology & Data Structures	2014/04/29	15:00:00	17:00:00	Edit	Delete

Figure 21 Admin Set Class Time for Lecturer Page

Register Courses For Student

Student Name:Yan Shen
Matric Number:107594
Please select teaching year: Please Select
Please select semester: Please Select
Course List For Registration Successful

User ID	Course Code	Course Name	Teaching Year	Semester	Delete
2289	CPT111	Principles of programming	2013/2014	I	Delete
2292	CPT112	Discrete Structures	2014/2015	II	Delete
2293	CPT113	Programming Methodology & Data Structures	2014/2015	II	Delete

Finish | Go Back to Monte Carlo

Course List For Registration

Course Id	Course Code	Course Name	Register
1	CPT111	Principles of programming	Register
2	CPT112	Discrete Structures	Register
3	CPT113	Programming Methodology & Data Structures	Register
4	CPT114	Logic & Applications	Register
5	CPT115	Mathematical Methods for Computer Science	Register
6	CST131	Computer Organisation	Register
7	CAT200	Integrated Software Development Workshop	Register
8	CMT221	Database Organisations & Design	Register
9	CMT222	Systems Analysis & Design	Register
10	CMT223	Information Systems Theory & Management	Register

Figure 22 Admin Register Course For Student/Lecturer Page

Welcome to Smart Attendance Management System

Welcome:503763316@qq.com
Staff Name: jerry lim
Staff Number: 3333333
View the Attendance
Change Password
Log Out

Figure 23 Lecturer/Student Welcome Page

Teaching Year: 2014/2015
Semester: II
Course Code: CPT112
Course Name: Discrete Structures
Class Date: 2014/04/14

Refresh

No.	First Name	Last Name	Matric Number	Email Address	Status	Check Movement
1	Yan	Shen	107594	ben_yslim@hotmail.com	Attend	Check
2	Wilson	Lee	109579	wilsonlee@gmail.com	Incomplete	Check
3	Brown	Law	109580	brownlaw@gmail.com	Attend	Check
4	Harris	Tong	109581	harristong@gmail.com	Incomplete	Check
5	Hall	Tang	109582	halltang@gmail.com	Incomplete	Check
6	Roberts	Wong	109583	robertswong@gmail.com	Absent	Check
7	Li	Yan	107890	zhimeng1991@hotmail.com	Absent	Check

Statistic of This Class

Status	Student Number	Persentage
Attend	2	28.6%
Incomplete	4	57.1%
Absent	1	14.3%

Total students number in this class: 7

Choose Another Class

Figure 24 Lecturer Check Student Attendance Page

Student Name: Yan Shen
Matric Number: 107594
Email Address: 503763316@qq.com
Teaching Year: 2014/2015
Semester: II
Course Code: CPT112
Course Name: Discrete Structures
Course Date: 2014/04/14

Refresh

No.	Status	Time
1	In	09:05:15
2	Out	10:05:42
3	In	10:06:02
4	Out	11:06:40

Time of this student staying in classroom: 02:01:05/02:00:00

Choose Another Student

Figure 25 Lecturer/Student Check Student Movement Page

Student Name: Yan Shen
Matric Number: 107594
Email Address: ben_yslim@hotmail.com
Teaching Year: 2014/2015
Semester: II
Course Code: CPT112
Course Name: Discrete Structures
Home
Logout

No.	StudentAttendanceId	Class Date	Status	Check Movement
1	90130	2014/04/14	Attend	Check
2	90137	2014/04/21	Absent	Check
3	90147	2014/04/28	Absent	Check

Choose Another Course

Figure 26 Student Check Attendance Page

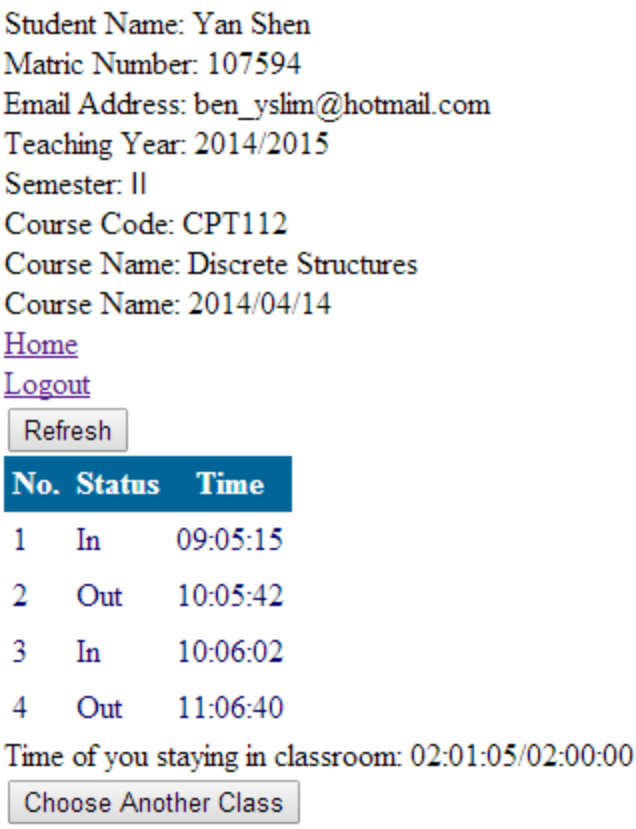


Figure 27 Student Check Movement Page

Smartphone Part

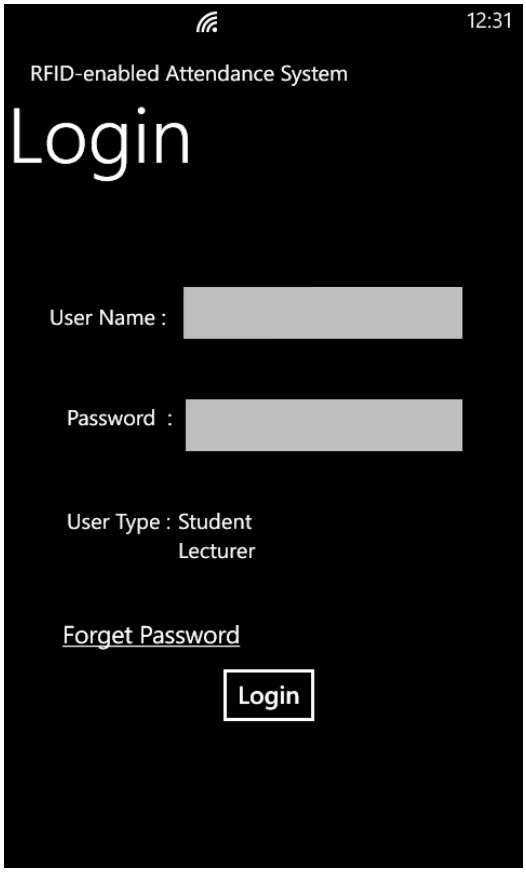


Figure 28 Login Page

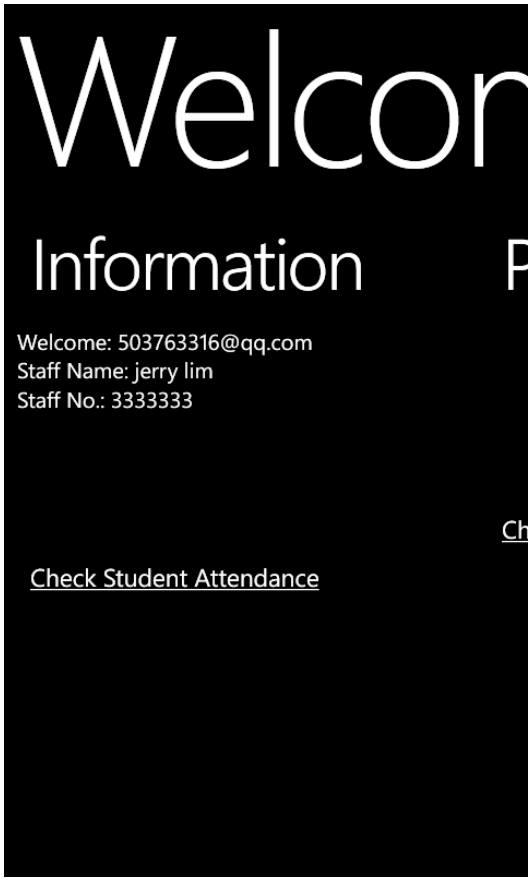


Figure 29 Lecturer/Student Welcome Page(1)

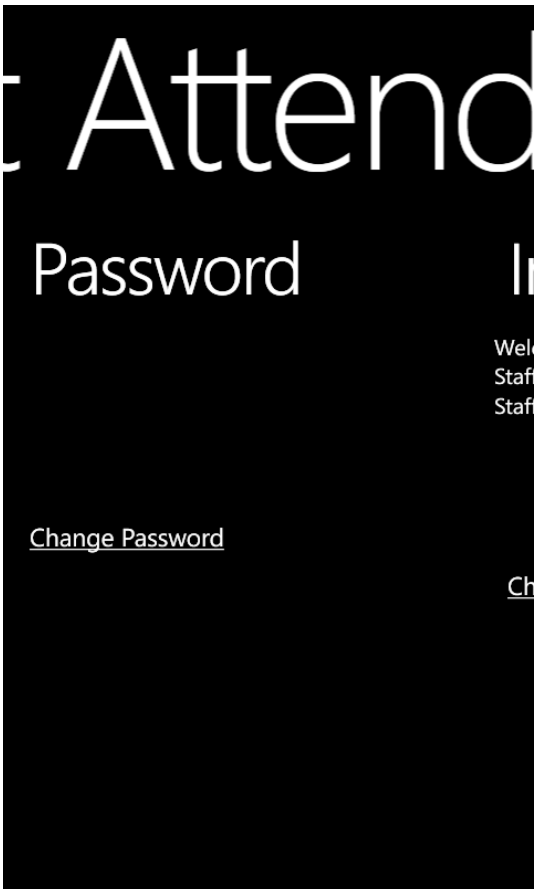


Figure 30 Lecturer/Student Welcome Page (2)

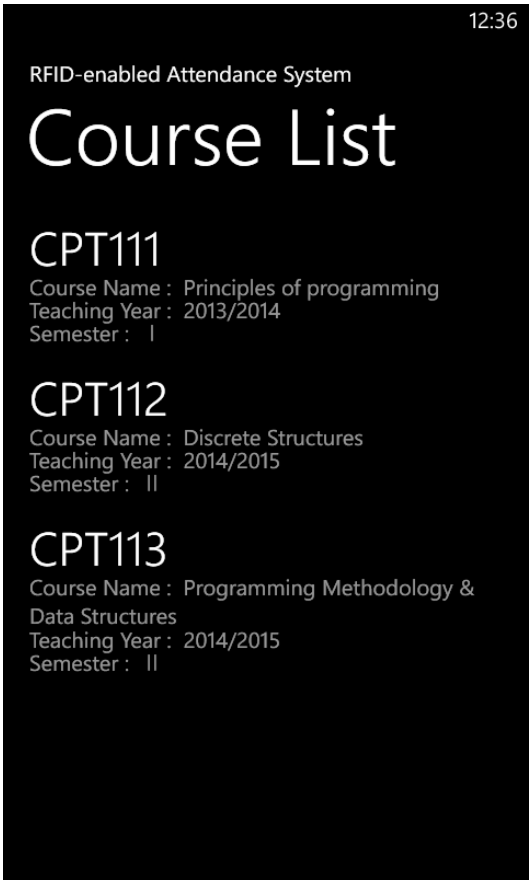


Figure 31 Lecturer/Student Course List Page

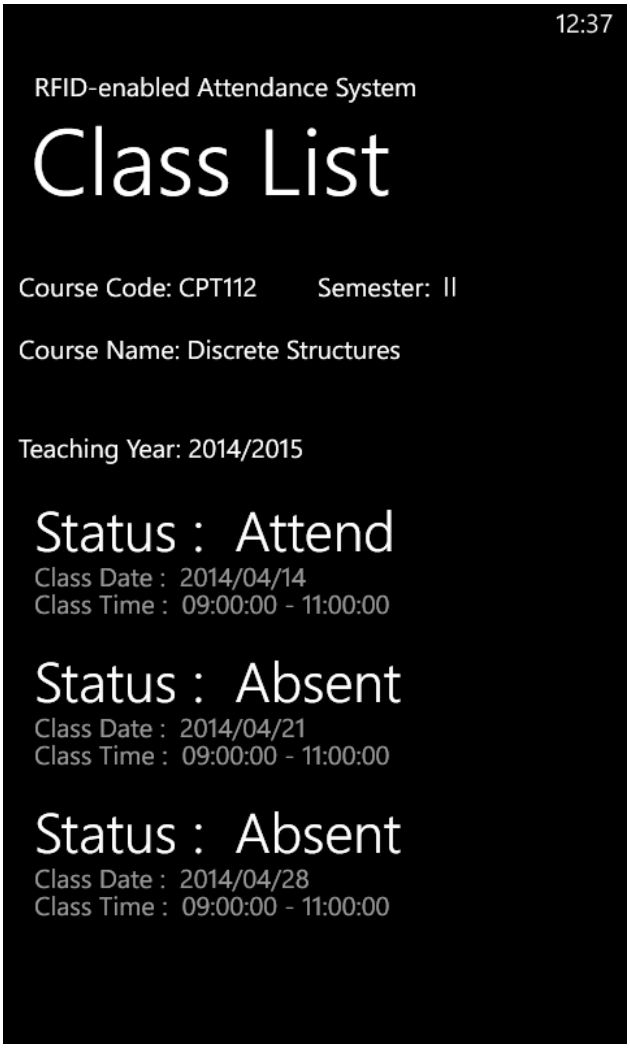


Figure 32 Student Check Attendance Page

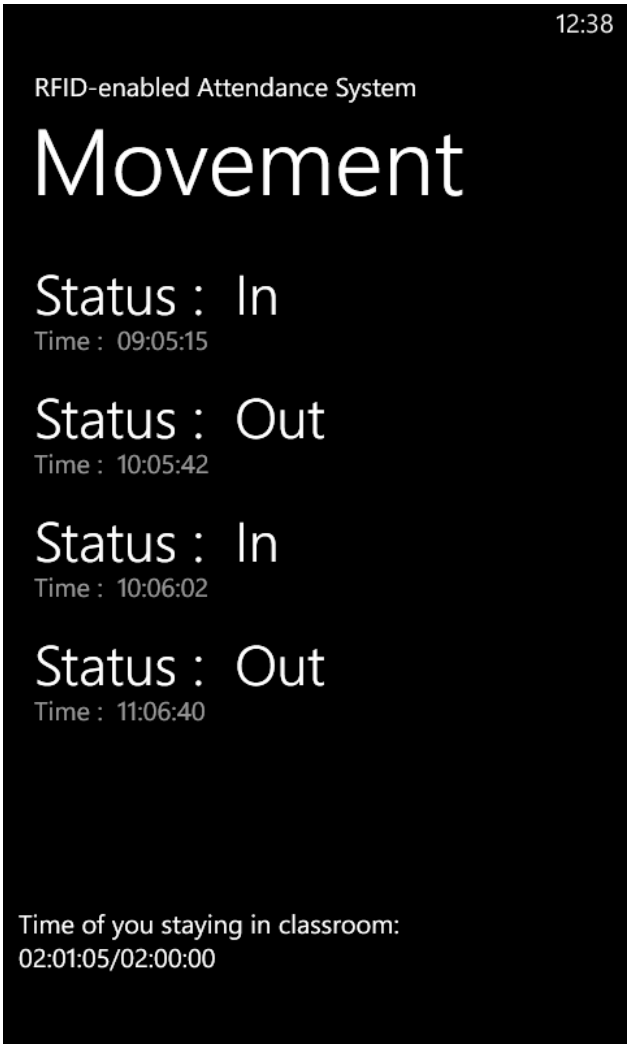


Figure 33 Student Check Movement Pag

RFID Part

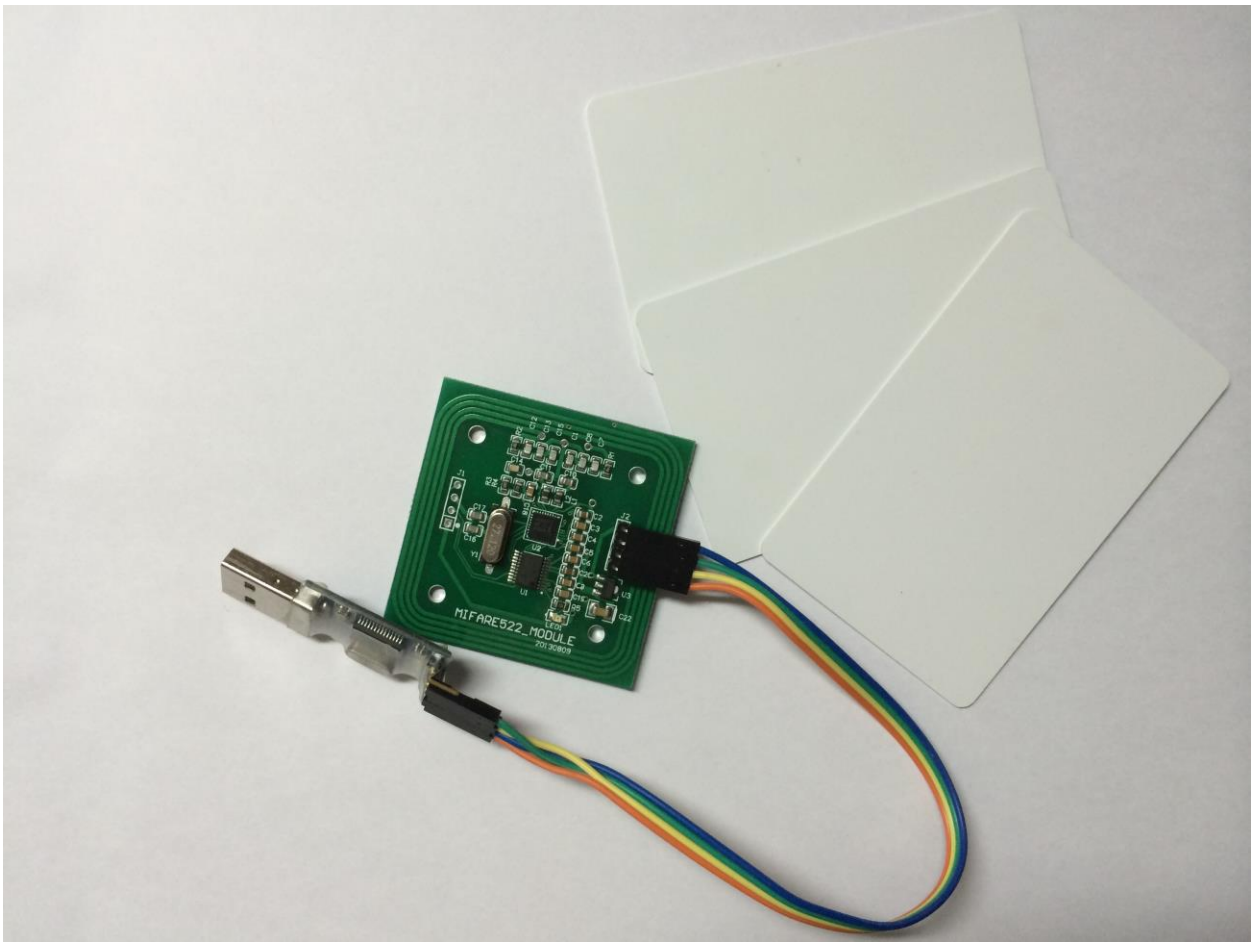


Figure 34 RFID Reader and Tags

Appendix C: Gantt Chart

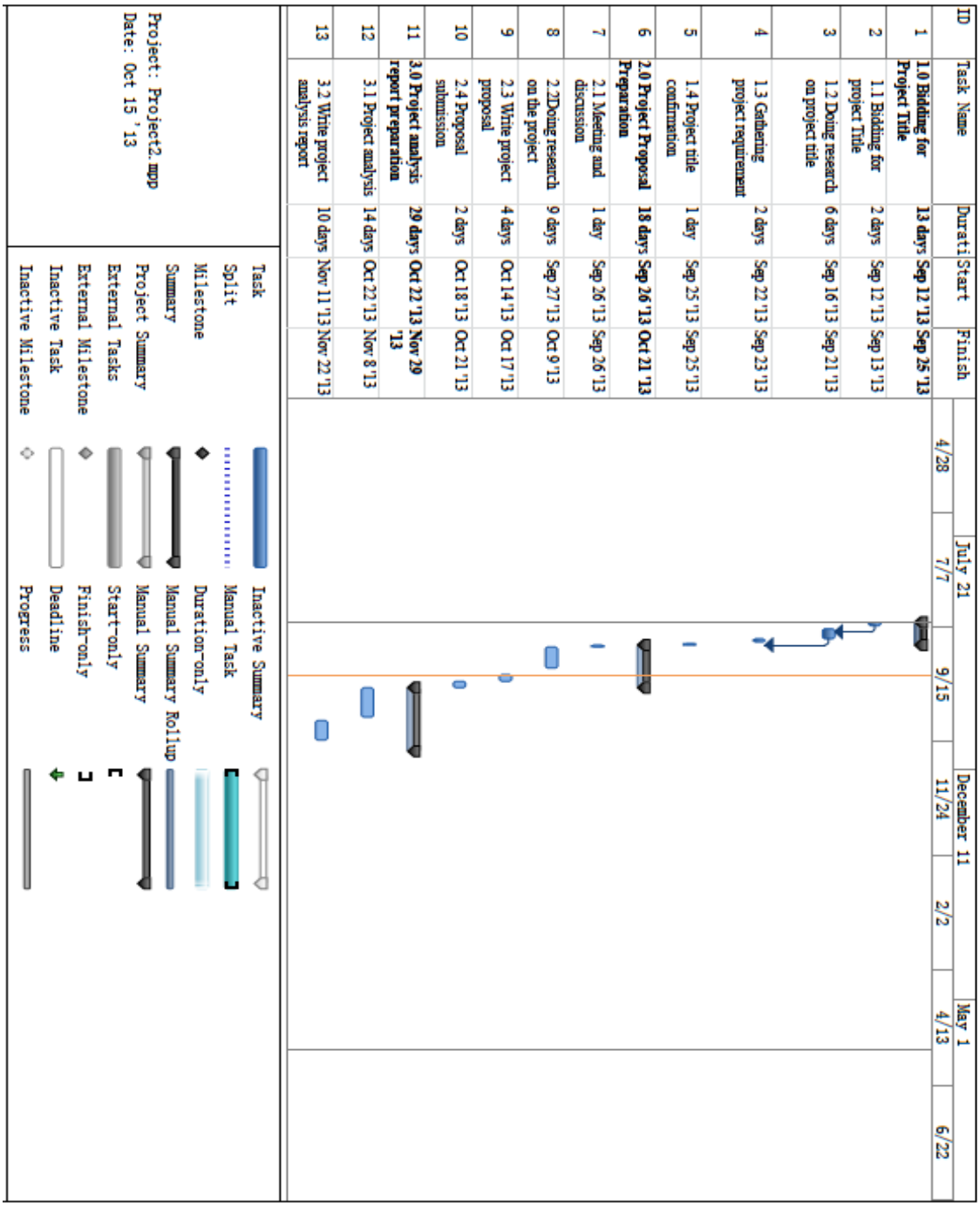


Figure 35 Gannt Chart for CAT 400 Development Project (1)

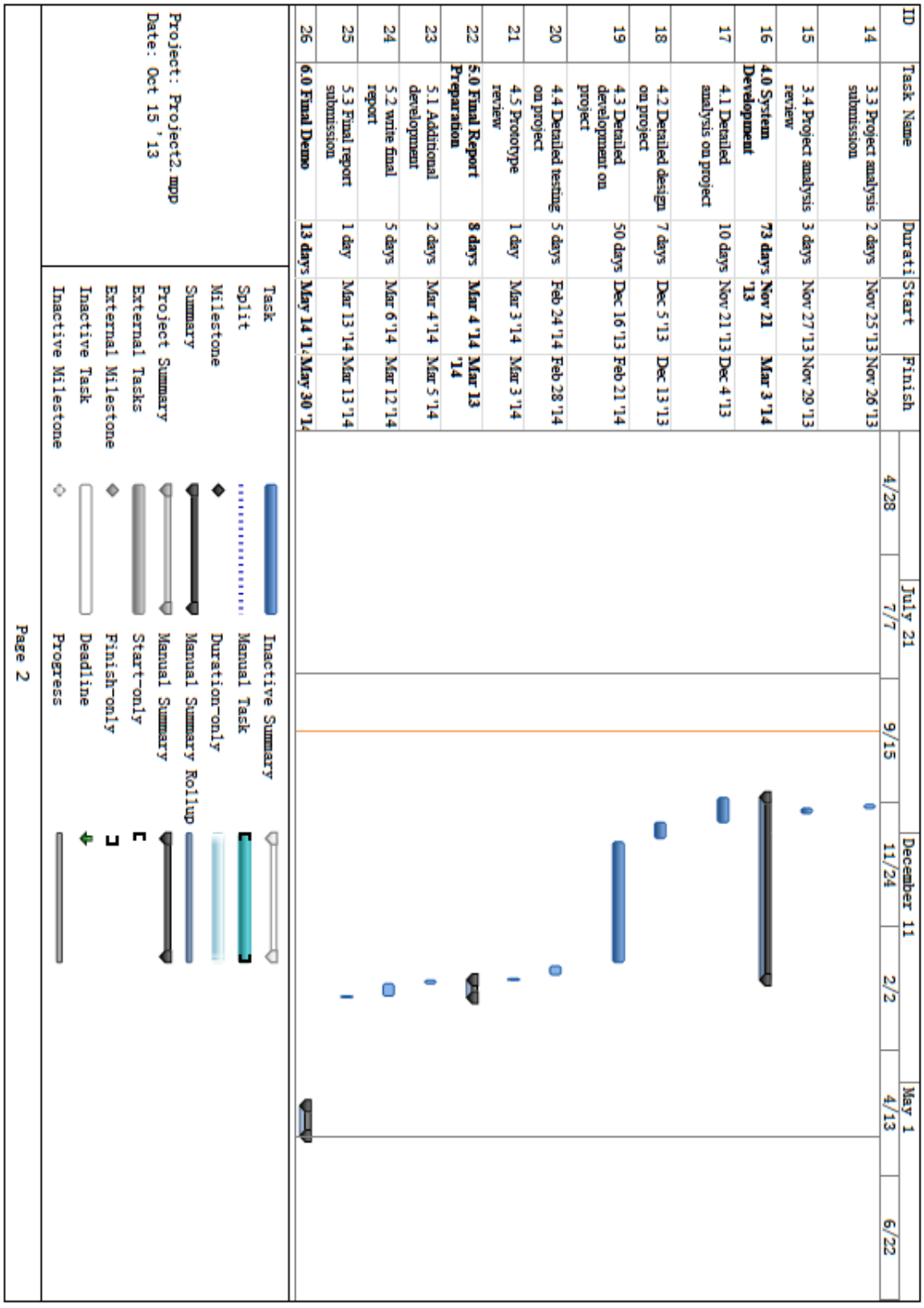


Figure 36 Gannt Chart for CAT 400 Development Project (2)

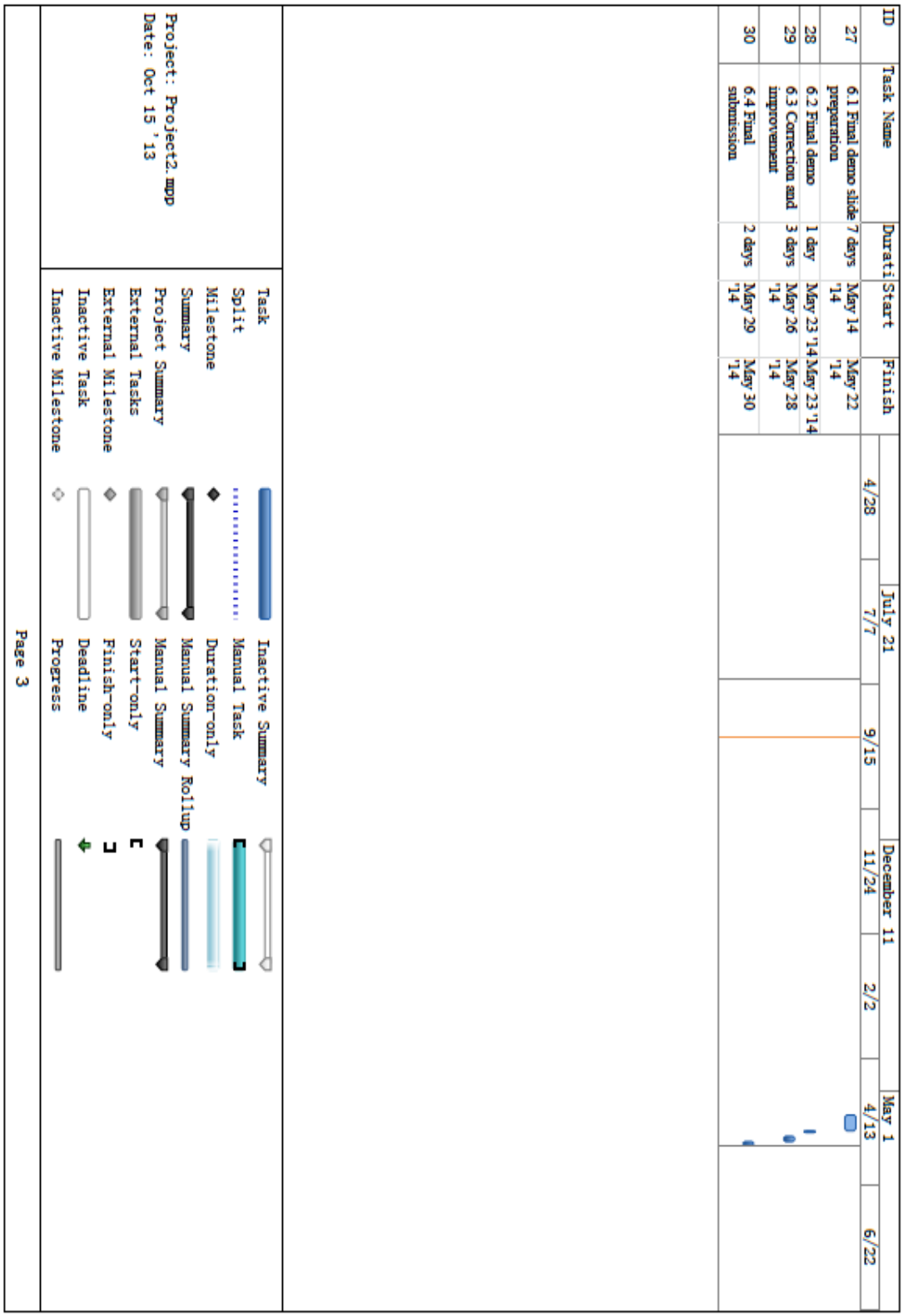


Figure 37Gannt Chart for CAT 400 Development Project(3)