Project Report
Version 2.0

CENG 408

Innovative System Design and Development II

Design and Implementation of Attendance Tracking and Monitoring System using with BLE Beacon and Android Platform

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Abstract

In most universities, tracking the attendance in lectures is processed by sheets that includes students' id numbers, names, surnames and signs but this method has many disadvantages. Mostly, students sign for their friends which do not attend to the lectures and if the lecturers do not count the class and compare the number of signs with the number of students in the class, students who not attend the lectures may be counted as they are in class. Additionally, if the attendance paper is lost, lecturer may have in trouble for deciding which student does not attend the lectures properly. Because of these reasons, our system has become necessary to develop. Our system is designed to track the attendance with the Bluetooth Low Energy (BLE) signals which are embedded into the BLE Beacon device and the mobile application which will be developed in Android platform and catches the BLE signals and process these signals to decide whether the student is in the lecture or not.

Key words:

Bluetooth Low Energy (BLE), BLE Beacon, Android Studio, Attendance Tracking System, MSSQL, Java, EddyStone, Windows Web Services, Android, BLE Signals

Özet:

Çoğu üniversitede, derslere devam etmenin takip edilmesi, öğrencilerin kimlik numaralarını, adlarını, soyadlarını ve imzalarını içeren kâğıtlarla işlenir ancak bu yöntemin birçok dezavantajı vardır. Çoğunlukla, bazı öğrenciler derslere katılmayan arkadaşlarının yerine imza atarlar. Eğer, öğretim görevlileri sınıf mevcuduyla kâğıtlardaki imza sayısını karşılaştırmazsa, derste olmayan öğrenciler varmış gibi gözükebilir. Ayrıca, yoklama kâğıdı kaybolursa, öğretim görevlileri hangi öğrencinin derslere düzgün şekilde katılıp katılmadığına karar vermekte sorun yaşayabilir. Bu sebeplerden dolayı, sistemimizin geliştirilmesi gerekiyor. Sistemimiz, BLE Beacon cihazında var olan Düşük Enerjili Bluetooth sinyallerini yakalayıp, bu sinyalleri işleyerek hangi öğrencinin derste var olup olmadığına karar verebilecek, Android platformu üzerinde geliştirilecek bir telefon uygulaması geliştirmek üzerine tasarlanmıştır

Anahtar Kelimeler:

Düşük Enerjili Bluetooth (BLE), BLE Beacon, Android Studio, Yoklama Takip Sistemi, MSSQL, Java, EddyStone, Windows Ağ Servisleri, Android, BLE Sinyalleri.

1. Introduction

1.1. Problem Statement

During semester, not only lecturers but also students have some issues on tracking attendance in the traditional ways. First of the traditional ways is that an attendance paper is signed by a student and is transferred to other students until all of them signed it. Second way is a lecturer reads student names one by one from a student list and marks as attended if the student who the lecturer read name answers. These ways take too much time and can lead to mistakes. Additionally, losing the attendance paper causes crucial problems for students and lecturers and some illegal behaviors can occur on the part of students. For example, a student may sign attendance paper both for himself and for a friend of him. Thus, a student who do not attend the class may be seem like s/he attended the class. If we think about time is so important, we should avoid this time wasting and unreliable ways.

By the development of mobile phones, the features that mobile technologies and Bluetooth technologies are increased rapidly. One of the reason why we used mobile technologies in our project is its popularity. Consequently, almost all of the students have their mobile phones. Apart from this, with the help of BLE Beacons we can reach student information rapidly by using mobile phones. Goal of the project is tracking attendance as fast as possible and reporting attendance data for both students and lecturers. One of the problem about engineering is that BLE Beacon only sends Bluetooth signals within a range. In other worlds, BLE Beacon cannot receive a data from mobile devices. Therefore, we cannot reach any specific data by using Beacons. Another problem is that students can bring their phones to one of their friend who will attend the course. As a result, the student who brings phone to him/her friend can be marked as attended. Additionally, we should know which students take which courses and also which lecturers give the courses to determine student list of the classes.

1.2. Related Work

While we are doing our research, we found two interesting works which is called "LoCo: boosting for indoor location classification combining Wi-Fi and BLE" and "Bluetooth tracking of humans in an indoor environment". These two works guided us to understand how to implement our project.

The first work aims to create a new framework for indoor positioning to enhance the success of finding the location of someone in indoor places.

The tables below show the experimental results of the work. In Table 1, 55 locations are tried to estimate and 1181 scans are used. In Table 2, location number is increased to 56 and number of scans are 2294. Moreover, some methods are used in these experiments which are MAX, Redpin and Boosting. Boosting method is the method that is developed in this work [1].

Table 1 First Result of the Experiment

Method	RSSI data	Accuracy	Time (s)
MAX	BLE	0.757	0.00072
Redpin [6]	BLE	0.952	1.354
	Wi-Fi	0.913	3.054
	BLE + Wi-Fi	0.930	4.335
Boosting	BLE	0.937	0.00492
	Wi-Fi	0.943	0.00562
	BLE + Wi-Fi	**0.966**	0.00431

Table 2 Second Result of the Experiment

Method	RSSI data	Accuracy	Time (s)
MAX	BLE	0.629	0.00159
Redpin [6]	BLE	0.964	2.0835
	Wi-Fi	0.950	7.2236
	BLE + Wi-Fi	0.973	9.165
Boosting	BLE	0.965	0.00627
	Wi-Fi	0.956	0.00653
	BLE + Wi-Fi	**0.991**	0.00660

As it can be seen from the tables, Boosting method is more successful to find the locations more accurately and more rapidly.

Second work has an aim to develop a project which is about shopping mall visits collecting data of spatio-temporal behaviors of individuals to track humans in an indoor environment. Project owners tested their study on tracking of humans in a shopping mall visits in a shopping mall which is in Belgian and the duration of the study was three-weeks. 56 Bluetooth scanners were placed and during the study, analyzed collected data. As results of the experiment, it provided a real-life illustration of Bluetooth tracking in an indoor environment. The used methods were more useful than other tracking technologies like RFID,

GPS and Wi-Fi. Additionally, Bluetooth technologies has a low cost than others. Researches claims that Bluetooth technology is using MAC addresses and using MAC addresses cannot meet an identity of a person [2]. As a conclusion, Bluetooth tracking is a successful methodology to collect information through wireless Bluetooth signals about spatio-temporal behaviors of individuals [2].

1.3. Solution Statement

As we stated before, we will use BLE Beacons and Mobile technologies in our project. However, according to BLE Beacon working process, we cannot determine which phone is matches with a specific student because BLE Beacons just send Bluetooth signals within a range. To solve this problem, we will take phone numbers of the students that is used for a mobile phone and make this number unique. This phone number would not be written by a student but it would be taken automatically by the software side.

To avoid the problem that is about absent students can be marked as attended if he/she brings their phone to attended friends, we will add a feature that is named secure mode. This mode will work with momentary taken student photographs. Thus, lecturers can check student photographs to differentiate absent and attended students.

As we mentioned at the problem statement section, we should know student lists for the classes to find absent and attended students. To solve this problem, we will implement a feature that is named course assignment. All students and lecturers that is used this system as the attendance tracking should make course assignment. Therefore, student lists for courses would be created automatically and the system can check absent students.

2. Literature Search

2.1. BLE Beacon and Beacon Proximity Technologies

Following the position of someone or indicating the location of the buildings in indoor and outdoor places, Global Positioning System has been an only technology option for years. However, for the indoor positioning, GPS is not beneficial because it requires untainted signals from some satellites. Naturally, buildings cannot provide this requirement. Although we can detect the position of people in the meaning of coordinates, we cannot detect the position of them when they are inside the building while we are using the GPS technology.

Consequently, a new technology is produced called "Indoor Positioning System (IPS)". This technology provides tracking the people when they are inside. To be able to implement this technology, Bluetooth Low Energy (BLE) can be used for IPS. BLE signals are used for detecting the position of someone inside the building with a short-range wireless transmission to ensure low energy consumption and small sized devices [3]. For processing and implementing these signals, a device is produced that is called "BLE Beacon". BLE Beacon devices can be called as "super-small" computers with Bluetooth radios [4].

If we want to talk about importance of BLE technology, we must say that this technology can provide to secure the information between two devices while they are in close range. Additionally, BLE Beacons can offer a cost-effective solution for indoor positioning [5].

In lectures or offices, this technology can be used for attendance tracking easily by developing a simple application which will be in touch with both server and the mobile phones of the employees. By placing the several BLE Beacon devices to different parts of lecture halls or offices, students and employees can easily be tracked inside of the building. What we are trying to do in this project is students can be tracked by BLE Beacon to ensure a consistent attendance in lectures and decrease the instructors' workload on attendance tracking.

2.1.1. Eddystone

BLE Beacon technology can be implemented in different platforms such as Android and iOS. Google is created a platform called "Eddystone" that can easily work with Android and iOS technologies. Eddystone is one of the platforms of the Beacon devices that works with Google Proximity Beacon API. By using this platform, Beacons can be deployed to both fixed places such as apartments, schools etc. and movable objects such as cars, trains [5].

2.1.2. iBeacon

Nowadays, even the smartphones can be used as BLE Beacon device. Thus, the range of the BLE signals can be easily enhanced. In 2013, Apple Inc. introduced the iBeacon technology within the iOS7. iBeacon technology is one of the platforms of the Beacon devices [4][6]. If we want to talk about the benefits of this technology, we must say that iBeacon technology is a highly power-efficient solution for projects. Thus, the costs that can

be spent on the power and energy can be deased [7]. Additionally, this technology is built with compatibility and portability. This means that this technology can be used both in iOS and Android platforms. So, this feature can minimize the difficulties which can occur when the requirements of the project are changed during the project development.

2.1.3. AltBeacon

AltBeacon is known as a protocol specification and can be used for defining a message format for beacon advertisements and these advertisements can be transmitted by devices (also can be called as sources) to nearby devices (also can be called receivers). Likewise, in the other platforms or protocols, AltBeacon has its own requirements. This protocol's functionality is not limited with single-function devices, but can work as a feature with the devices that have Bluetooth Low Energy Signals and which have the requirements that are defined in Bluetooth Low Energy Specification 4.0 [8].

2.1.4. Web Services: Windows Communication Foundation

Today, desktop applications, mobile applications and web based applications become to run with the same data. In other words, same application data is used in different platforms at the same time. In multi-platform systems where you have accessed to the same resource, all these platforms accesses to data according to certain standards to protect data integrity. The name of the technology that provides these standards is web services [9].

From the past to present day, different service models have been developed for web service communication. Although Service-Oriented Architecture (SOA) is not new, one of the popular IT concepts of today must be Service-Oriented Architecture. One of the popular example of the web services is .NET. Before WCF (Windows Communication Foundation), .NET provides different opportunities to create services under .NET framework. Now, the latest programming model for creating and managing service oriented applications is WCF. Windows Communication Foundation is Microsoft's next step in building service oriented applications after .NET framework. WCF provides features to applications to communicate with each other in different platforms [10]. The WCF architecture includes SOAP, WebHTTP, DATA, RIA, Workflow service models. In this architecture, SOAP is appropriate in interoperability standards and is a service model that can communicate with some languages like Java. WebHTTP service model includes skills that provides Uniform Resource

Identifier (URI) based service operations with restful approaches. DATA service model is used when developers want to present data models within a restful interface. RIA is a middle layer service model that makes easy to be used and managed both client and server side of internet applications like Silverlight. Workflow service model is used for applications that has to be run in long term and requires continuity [11].

2.2.   Major Mobile Platforms

2.2.1. Android

Android is developed by Google. Google improved Android in November 2007. Android is an open source arena for software developers. Android is used Linux Kernel based and Java libraries. Android Studio is used for developing Android Application. Android Studio is better designer then other IDE. Developers use Android Studio for JetBrains Intellij Idea because JetBrains comforting good designs. Google provide own libraries reach Android Studio. Application development is easy. Android Studio provide writing code, publish and debugger is easier. Android is using SQL database from SQLite. SQLite is an Open Source Coded Database embedded in Android. The memory capacity required for operation is very small. SQLite is available on all Android devices. On Android, you do not need to install or configure anything to use the SQLite database [12][13][14].

2.2.2. iOS

iOS is developed by Apple. Apple improved IOS in 2007. [10] Applications for iOS are written in Swift. Learning Swift easy and it can powerful programming language. Programming language working different areas macOS, iOS, watchOS and tvOS. Developers use Swift for coding is safe, interactive and fun. Swift is an open source programming language. Swift 4 was developed in the open at Swift.org, with source code, a bug tracker, mailing lists, and regular development builds available for everyone [15].

3. Summary

3.1. Technology Used

Android Studio will be benefited to create the all aspects of the mobile application. Android Studio is the platform that provides the Software Development Kit (SDKs) and Application Programming Interface(API) to create a mobile application for the Android devices. As a scripting language in Android Studio, Java will be used because there is no other programming language that can be used in Android Studio This platform does not allow to build applications for the iOS or any other operating systems. Thus, developers which work with Android Studio can have chance to focus on the Android operating system entirely. Moreover, Android Studio provides implementing interfaces. Thus, there is no necessity to use any other software programs to create graphical interfaces. Additionally, developers have a chance to build applications for any version of Android operating system. Since the Android operating system ensures the idea that all applications that can run in the lower versions can run in the higher versions, developers have no concern to develop the applications for the lower versions of Android operating system.

Microsoft SQL Server Management Studio (SSMS) and MSSQL scripts for SSMS will be utilized for managing the database of the system. It is a free platform which is developed by Microsoft for creating and handling the databases. Additionally, it contains many features such as connection can be created with the scripting editors which decrease the workload of developers.

Scripting part of the project is transpired with using Java scripts. Java is one of the most used programming language all around the world. Moreover, Java includes all aspects of the object-oriented programming approach so that the developers can create much more systems that almost encapsulated from the outside of the system. Additionally, creating and handling the exceptions is easier than the other object-oriented programming languages. Besides, developers which work with the Java do not have to use any other software. Java ensures its own interface libraries and with these libraries, building user-driven and purposive interfaces is easy to develop.

4. Software Requirements Specification

4.1. Introduction

4.1.1. Purpose

The purpose of this paper is explaining the application which is called Attendance Tracking and Monitoring System with Using BLE Beacon. This application has aims of tracking students' attendance data on university lectures and monitoring it for both students and lecturers without using traditional way of taking attendance. Requirements of the project are mentioned in this paper. Moreover, it includes roles of the application and their proposed software functionalities. This document describes how students, teachers and admins interact with the application and explains how concerns of stakeholders are met.

4.1.2. Scope of Project

In most universities, tracking the attendance in lectures is processed by sheets that includes students' id numbers, names, surnames and signs but this method has many disadvantages. Mostly, students sign for their friends which do not attend to the lectures and if the lecturers do not count the class and compare the number of signs with the number of students in the class, students who not attend the lectures may be counted as they are in class. Additionally, if the attendance paper is lost, lecturer may have in trouble for deciding which student does not attend the lectures properly. Because of these reasons, our system has become necessary to develop.

The purpose of the project is designing and implementing the system that will be used for attendance tracking using BLE Beacon devices as hardware device and an application for mobile phones in Android platform and a web application as software. This project aims to enhance the quality of tracking the attendances on lectures and decrease the workload on lecturers. To be able to do that, students' phones and the system shall have an interaction. This interaction is going to be provided with BLE Beacon devices which are going to be placed in classes. To interpret this interaction, mobile and web application are going to be developed. A mobile application is going to be developed to decide which student is in the class and provide neat information for attendance status to the students. On the other hand, a web application is going to be developed for providing the three kinds of report; daily, weekly, and attendance % of each student in whole semester. There are three actors in this

system which are student, lecturer and admin and there are two modes in system which are regular and secure mode. Regular mode is related with the lectures that automatically tracks the attendances. Secure mode is related with the exams and it has a feature that students must take the picture of themselves and send it to the system. Our first type of actor is student and students shall register the system at the beginning of the semester, and choose the courses which they take. Additionally, students shall see total hours that they attend for each course and see the notifications from lecturers. Second type of actor is lecturer and lecturers also shall register to the system and enter the courses and the sections of the course which they give. Third type of actor is admin and admin shall re-organize the relation between students or lecturers and courses if it is necessary.

4.1.3. Glossary

Table 3 Glossary of SRS

Term	Definition
BLE Beacon	The device that sends Bluetooth signals with low energy.
Stakeholders	Any person or company who has rights on the project.
Software Development Lifecycle	Terminology that defines the phases of the software development.

4.1.4. Overview of Document

In first part of the document, we mentioned and discussed about the main aspects of the Tracking System. We described our problem and our solution that is created by us to solve this problem. The second part of the document describes the functionalities of the system in terms of the technical terminology to provide a specific information for developers. Second part also includes our development methodology while we are developing the system and the perspective of our system.

4.2. Overall Description

4.2.1. Product Perspective

Tracking Attendance System is the approach that has purpose of decreasing the workload of the lecturers while they are tracking the attendance in lectures and try to provide

a more secure attendance tracking for both students and lecturers. The project basically has two modes: Regular Mode and Secure Mode.

Regular mode has the features that automatically tracks the attendance with using Bluetooth Low Energy (BLE) signals and the mobile application that works with BLE signals. Regular mode is designed for tracking the attendance in the lectures. Secure mode has only feature that the students should take a picture of themselves and update to the system. Moreover, secure mode is designed for tracking the attendance in exams.

4.2.2. Development Methodology

We have planned to use Incremental Software Development Methodology (ISDM) to build our system. ISDM basically includes the following idea: Build every module of the system on the existing modules. In Software Development Lifecycle (SDL), there are four parts which are Requirements Specification, Design, Testing and Maintenance and most common issue in this cycle is managing the complexity of the project. Complexity usually occurs when there is a change in the Requirements Specification phase and if this change occurs in the later phases of project, re-organizing the existing project can be hard to handle. To be able to deal with this complexity, ISDM is beneficial because project is implemented module by module and if there is a change in one module, it is easier to interfere to the change. Thus, the approach of "Build one module to the existing modules" is the best way to interfere and handle the complexity in the projects' SDL. Moreover, ISDM provides the chance of dealing with and correcting the bugs and errors that can be occurred in every phase of SDL in the earlier phases. Thus, the product at the end can include less bugs and errors and with this kind of product, it is easier to attract the stakeholders.

4.2.3. User Characteristics

4.2.3.1. Student

4.2.3.1.1 Student must be a student at Çankaya University.

4.2.3.1.2 Student must take the related courses in the semester.

4.2.3.2.   Lecturer

4.2.3.2.1 Lecturer must be a lecturer at Çankaya University.

4.2.3.2.2 Lecturer must give the related courses in the semester.

4.2.3.2.3 Lecturer must know how to use the system.

4.2.3.3.   Admin

4.2.3.3.1 Admin must be employee at Çankaya University.

4.2.3.3.2 Admin must have knowledge of software maintenance process.

4.2.3.3.3 Admin must have enough authority to edit user data on the software.

4.2.3.3.4 Admin must have knowledge of Android platform.

4.3.   Requirements Specification

4.3.1. External Interface Requirements

4.3.1.1.1.   User interfaces

The user interface will be worked on mobile phones which has Android operating system version 5.1 or above.

4.3.1.1.2.   Hardware interfaces

Due to BLE Beacon is a Bluetooth Technology, our application will require working Bluetooth hardware on the mobile phones of students.

4.3.1.1.3.   Software interfaces

There are not any external software interface requirements.

4.3.1.1.4.   Communications interfaces

There are not any external communications interface requirements.

4.3.2. Functional Requirements

4.3.2.1.　Login System Use Case

Use Case:

- Login as Lecturer

- Login as Student

- Forgot Password

- Logout

Diagram:
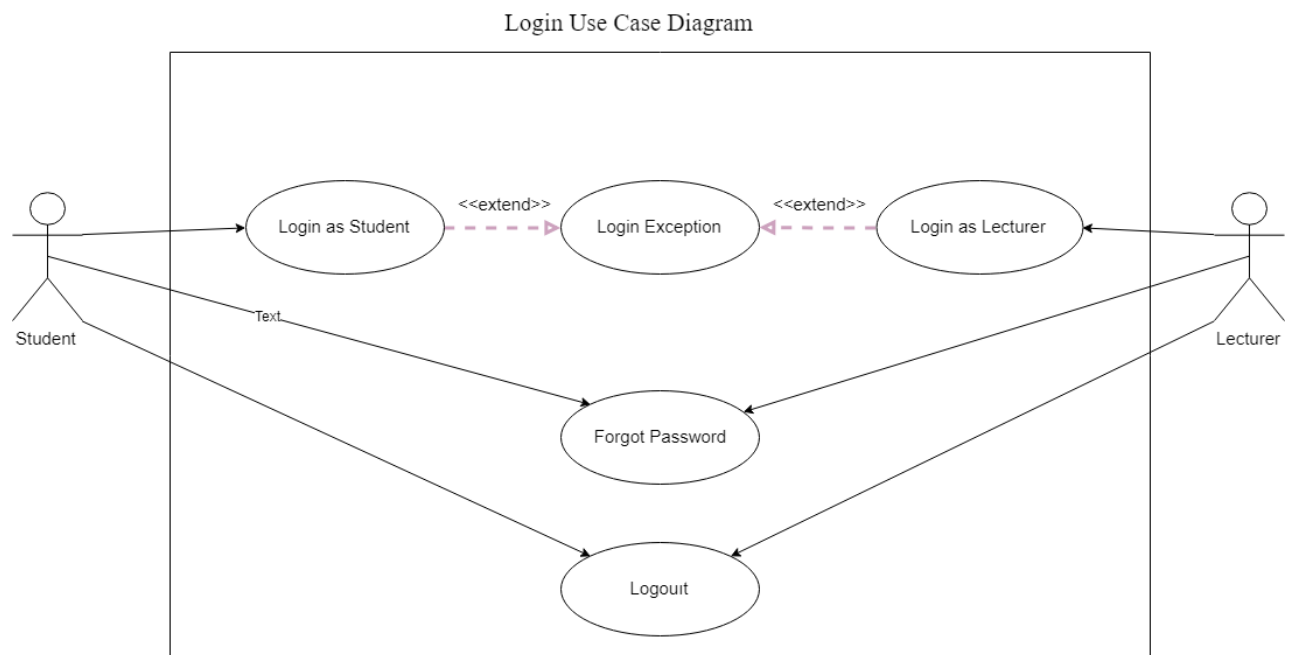
Figure 1 Login System's Use Case Diagram

Brief Description:

In Login System Use Case diagram (Fig.1) identifies the operations which can be used by whether admin, lecturer or student. Lecturers are able to use login as lecturer function. Students are able to use login as student and change password functions. Admins are able to use login as admin function. Apart from these, all students, lecturers and admins are able to use logout function.

Initial Step by Step Description:

1. Student shall login the system with appropriate id and password.
   1.1. If id or password is invalid, student should re-login.

2. Lecturer shall login the system with the e-mail and password.
   2.1. If a password is invalid for the lecturer e-mail, lecturer should re-login.

3. Both lecturer and student shall select the "Forgot Password" option

   3.1. If lecturer or student select change password button, the system shall ask the e-mail address that related with student's account.

   3.2. System shall send an e-mail to the address that is entered by lecturer or student. This e-mail shall include a link to change the password.

   3.3. Lecturer or student shall enter the new password twice from the window that shall open after a student clicks the link from the e-mail.

4. All lecturers and students shall log out from the system properly.

4.3.2.2.   Register System Use Case

Use Case:

- Register as Student
- Register as Lecturer

Diagram:

Registration System Use Case Diagram
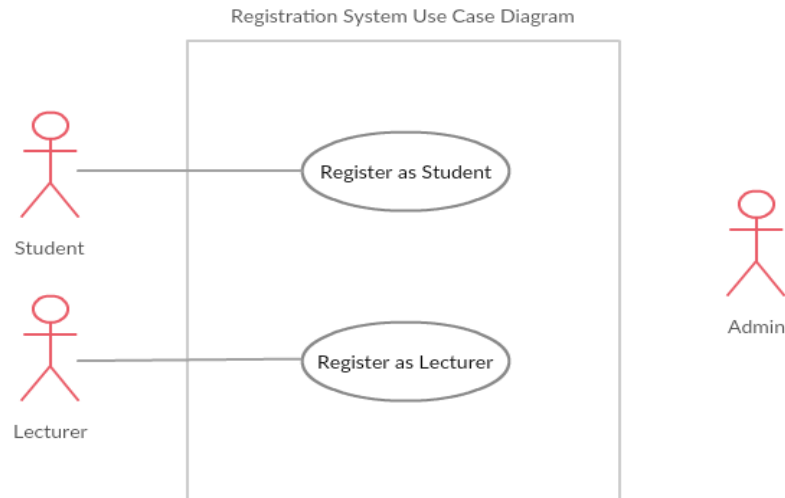
Figure 2 Registration System's Use Case Diagram

Brief Description:

In Registration Use Case diagram (Fig.2) shows that the functions which can be used by lecturers and students. Students are able to use the register as student function, lecturers are able to use register as lecturer function.

Initial Step by Step Description:

1. Student shall deactivate the "Lecturer Register" switch.

   1.1. Student shall enter the name as string, surname as string, id number with 9-digits integer.

   1.2. Student shall enter a password as string.

   1.3. Password shall contain at least 6 characters including at least one number, one upper case letter and at least one special character from the following special characters: ".", "-", "_", "!" and "*".

1.4. Student shall take a picture by pressing "Take Picture" button and after a register button is clicked, taken image shall be stored in database.

1.5. System shall detect the Bluetooth mac-address of the student and record it to the database

2. Lecturer shall active the "Lecturer Register" switch.

   2.1. Lecturer shall enter the name as string, surname as string, e-mail as string.

   2.2. Lecturer shall enter a password as string.

   2.3. Password shall contain at least 6 characters including at least one number, one upper case letter and at least one special character from the following special characters: ".", "- ", "_", "!" and "*".

   ### 4.3.2.3.   Regular Attendance Tracking Use Case

Use Case:

- Initiate Bluetooth Detection Service

- Detect BLE Signals

- Capture Time Log Entry

- Record Logs to Database

Diagram:

Regular Attendance Tracking
Use Case Diagram
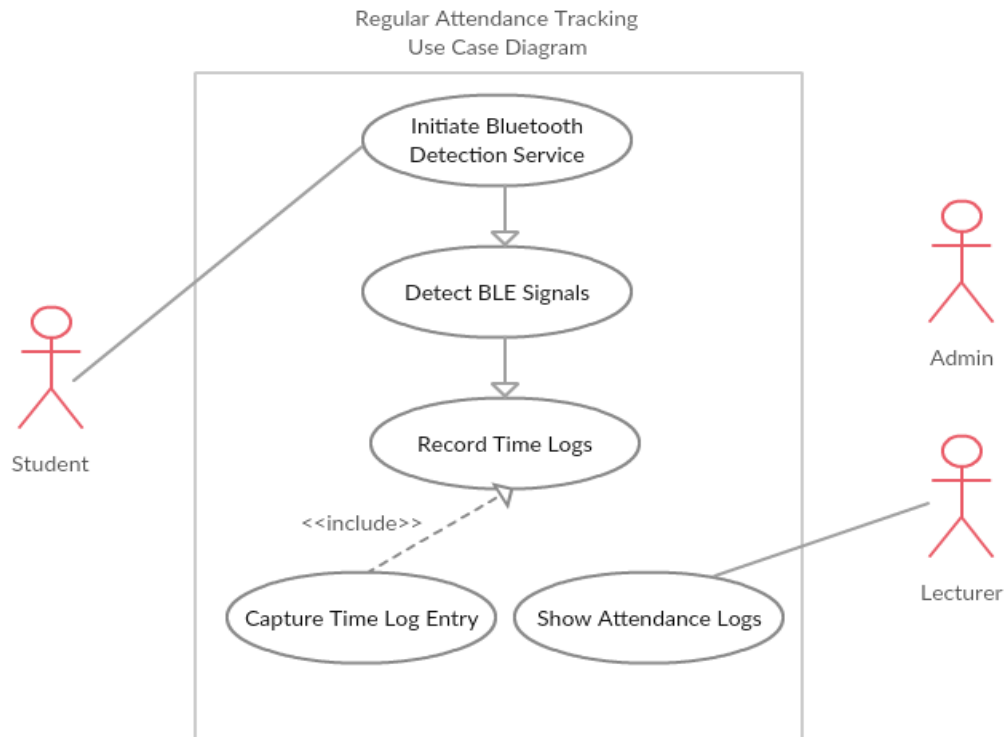
Figure 3 Use Case Diagram of Regular Attendance Tracking

Brief Description:

In Regular Attendance Tracking Use Case diagram (Fig.3) shows that the functions which can be used by students and lecturers. Students are able to use the Initiate Bluetooth Detection Service function and lecturers are able to use Show Attendance Logs function. All students and lecturers must be logged in into the system.

Initial Step by Step Description:

1. Student shall initiate Bluetooth detection service.
2. After Bluetooth detection service is initiated, the system detects BLE Beacon signals.
   2.1. Beacon shall send signals within range of thirty (30) meters square.

   2.2. Beacon shall send signals every sixty (60) seconds.

3. When the device detects, BLE Beacon signals,

   3.1. System shall capture time log entry and related student attributes.

   3.2. System shall record captured data on a database system.

   3.3. System shall decide whether the student should be marked as attended, nearly attended or absent according to the percentages that can be adjusted by lecturer from the application.

4. Lecturers are able to track students who are attending the class activity.

4.3.2.4. Secure Attendance Tracking Use Case

Use Case:

- Take Photograph
- Upload Photograph
- Show Photograph
- Take Attendance

Diagram:

Secure Attendance Tracking
Use Case Diagram

Take Photograph

Upload Photograph

Show Photograph

<<extend>>

Take Attendance

Student

Admin
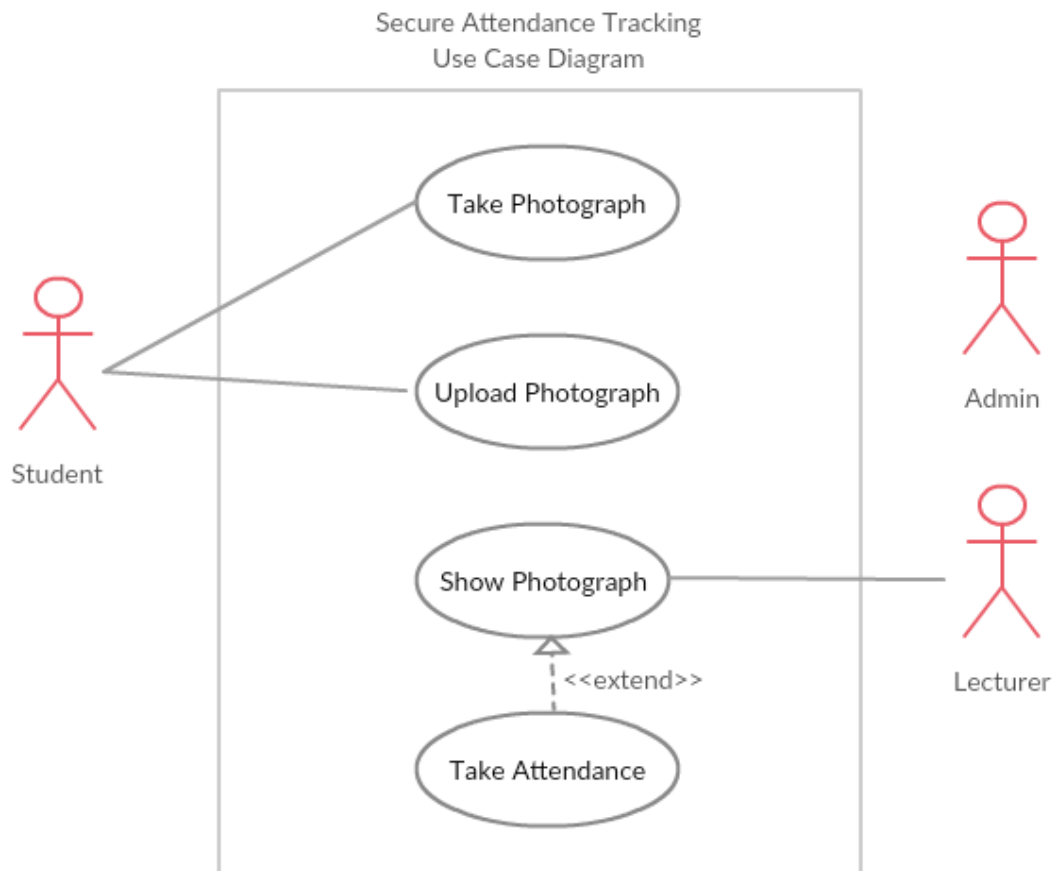
Lecturer

Figure 4 Use Case Diagram of Secure Attendance Tracking

Brief Description:

In Secure Attendance Tracking Use Case diagram (Fig.4) shows that the functions which can be used by students and lecturers. Students are able to use Take Photograph and Upload Photograph functions and lecturers are able to use Show Photograph and Take Attendance functions. All students and lecturers must be logged in into the system.

Initial Step by Step Description:

1. Student shall take a photograph of him/her face.
2. After he/she takes the photograph, taken photograph shall be uploaded to the server.

3. Lecturer shall check if the photograph is matches with the student.

4. If the lecturer agrees, he/she can mark the student as in the class.

4.3.2.5.   Reporting Attendance Use Case

Use Case:

- Select Course

- Show Report for Each Lecture

- Show Percentage for Each Student

- Show Report for Each Day

Diagram:
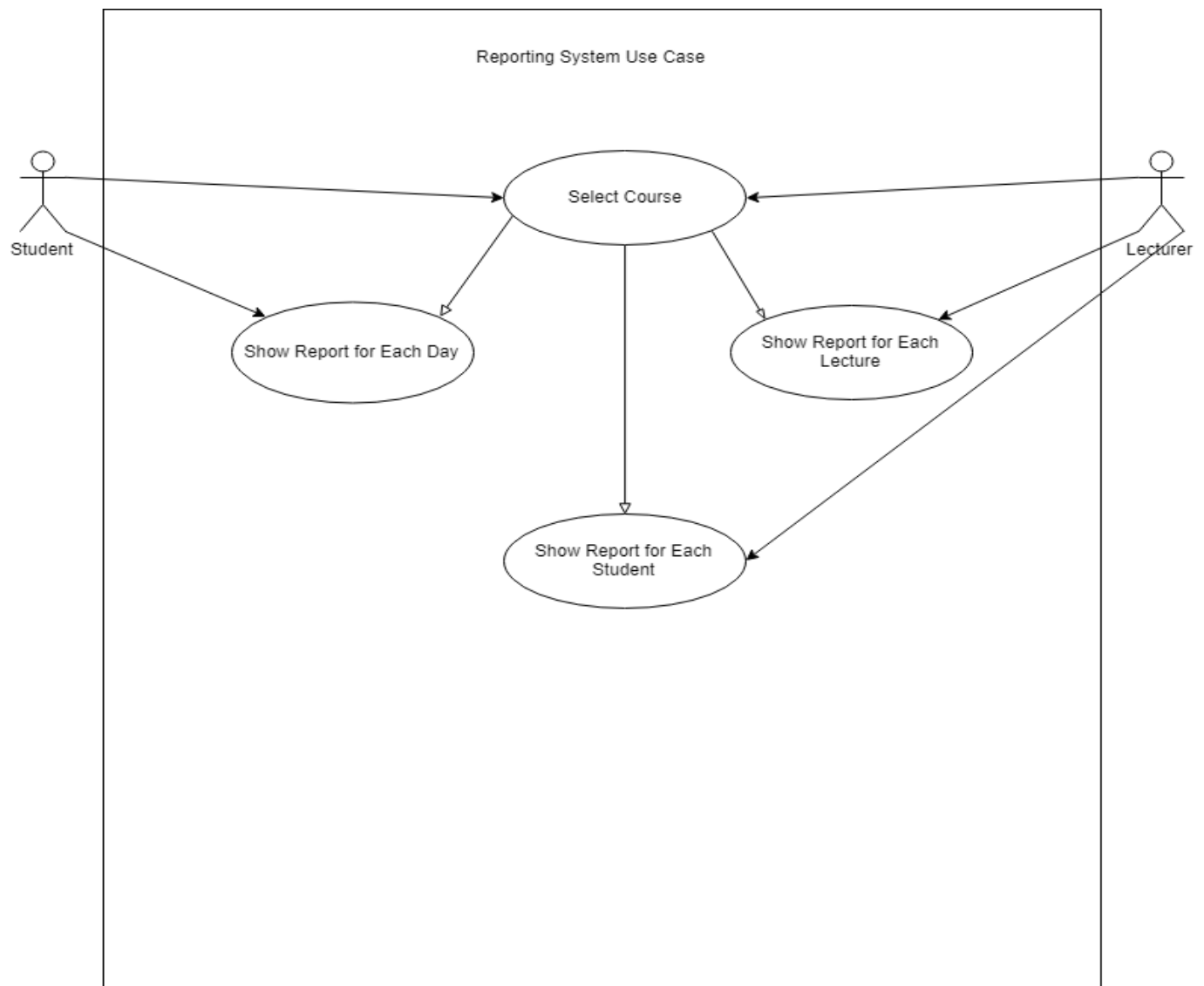
Figure 5 Use Case Diagram of Reporting Attendance

Brief Description:

In Reporting Attendance Use Case diagram (Fig.5) shows that the functions which can be used by lecturers and students. Lecturers are able to use the following functions: Show Report for Each Lecture, Show Percentage of Each Student. Students are able to use the following function: Show Report for Each Day. All lecturers and students must be logged into the system.

Initial Step by Step Description:

1. Lecturer shall click on the "Reports" fragment button from the welcome page.
2. A calendar view shall be displayed and lecturer shall select the course from the list of courses that s/he gives.
3. Lecturer shall select a day that is marked by blue color meaning that lecturer has a lecture on that day.

   3.1. If lecturer selects a day,

       3.1.1. A list of courses on that day shall be displayed with the buttons "Show" and "Cancel".

           3.1.1.1. If lecturer selects one of the "Show" button for a lecture,

               3.1.1.1.1. A list of students should be displayed such that the attended students' rows shall be filled with green, nearly attended students' rows shall be filled with yellow and absent students' rows shall be filled with red.

               3.1.1.1.2. All rows shall contain the photo, student number, name and surname of each student that takes course.

                   3.1.1.1.2.1. If lecturer clicks one of the students' row, total attendance percentages such as attended, nearly attended and absent percentages of that student shall be displayed.

           3.1.1.2. If lecturer selects one of the "Cancel" button for a lecture,

               3.1.1.2.1. A warning that warns the lecturer for cancelling the course shall be displayed.

3.1.1.2.1.1.   If lecturer selects "Cancel Lecture" button, status of this lecture shall be set to the "0" in the database and lecture shall not be seen after that operation.

4. Students shall click on "Reports" fragment button from the welcome page.

5. A calendar view shall be displayed with the colors that identifies the attendance status for the student on that day.

   5.1. In calendar view, if student does not attend any of the lecture on that day, that day's field shall be filled with red.

   5.2. If student attends at least one lecture on that day, that day's field shall be filled with yellow

   5.3. If student attends every lecture on that day, that day's field shall be filled with green.

6. Student shall click on the day's field and see the his/her attendance status on every lecture that s/he takes on that day.

4.3.2.6.   Course Assignment

Use Case:

- Upload Excel File
- Save

Diagram:

Course Assignment Use Case
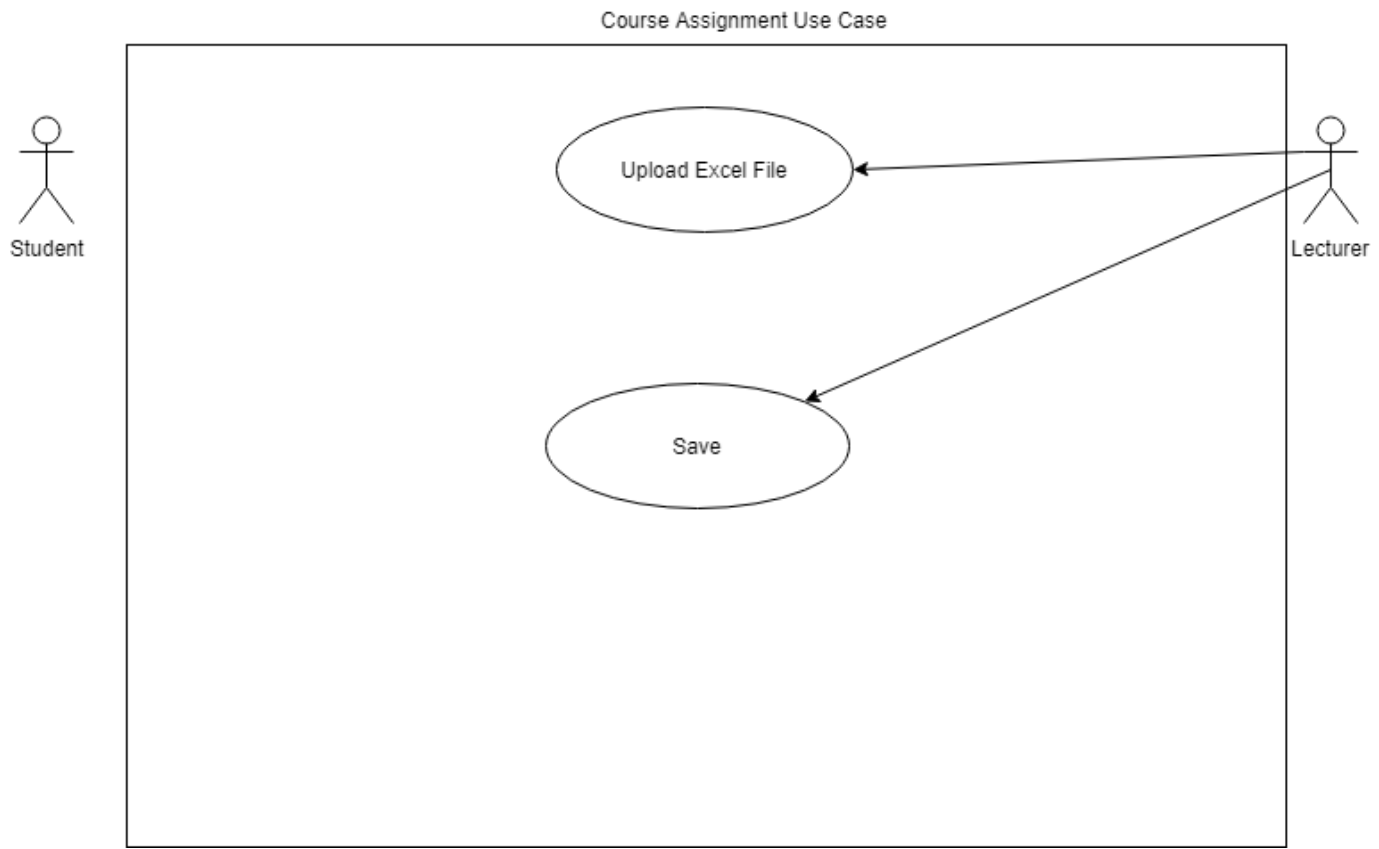
Figure 6 Use Case Diagram of Course Assignment for Lecturers

Brief Description:

In Course Assignment for Lecturers Use Case diagram (figure no) shows that lecturers should upload an excel file that contains the list of students that takes the course. Lecturers are able to use following functions: Upload Excel File, Save.

Initial Step by Step Description:

1. Lecturer shall select "Upload a Student List" button from the web-panel's interface.
2. System shall display an upload image filed so that lecturer can select the XML file from his/her computer.
3. Lecturer shall select the courses from the list with ticking the checkboxes of each course.
4. After selection is finished, lecturer shall press on the "Save" button.

5. After button is pressed, system shall parse the course code from the file and make a relationship between this course code and the lecturer that uploads the file by saving the id of the course that is already stored in database and the lecturer id to the given_courses table of database.

6. System shall also parse the school id of each student that is in the list and takes the user id of his/her from the database. Then, system shall update the database with user id of each student and the course id of the course to identify who takes the course that is already parsed from the file that the lecturer gives.

4.3.2.7. Administration System Use Case(Yeni Diagram)

Use Case:

- Delete Student Account
- Delete Lecturer Account
- Search Student
- Search Lecturer
- Delete Admin
- Create New Admin
- Add Lecture Hour
- Search Course
- Add Course

Diagram:

Administration System Use Case
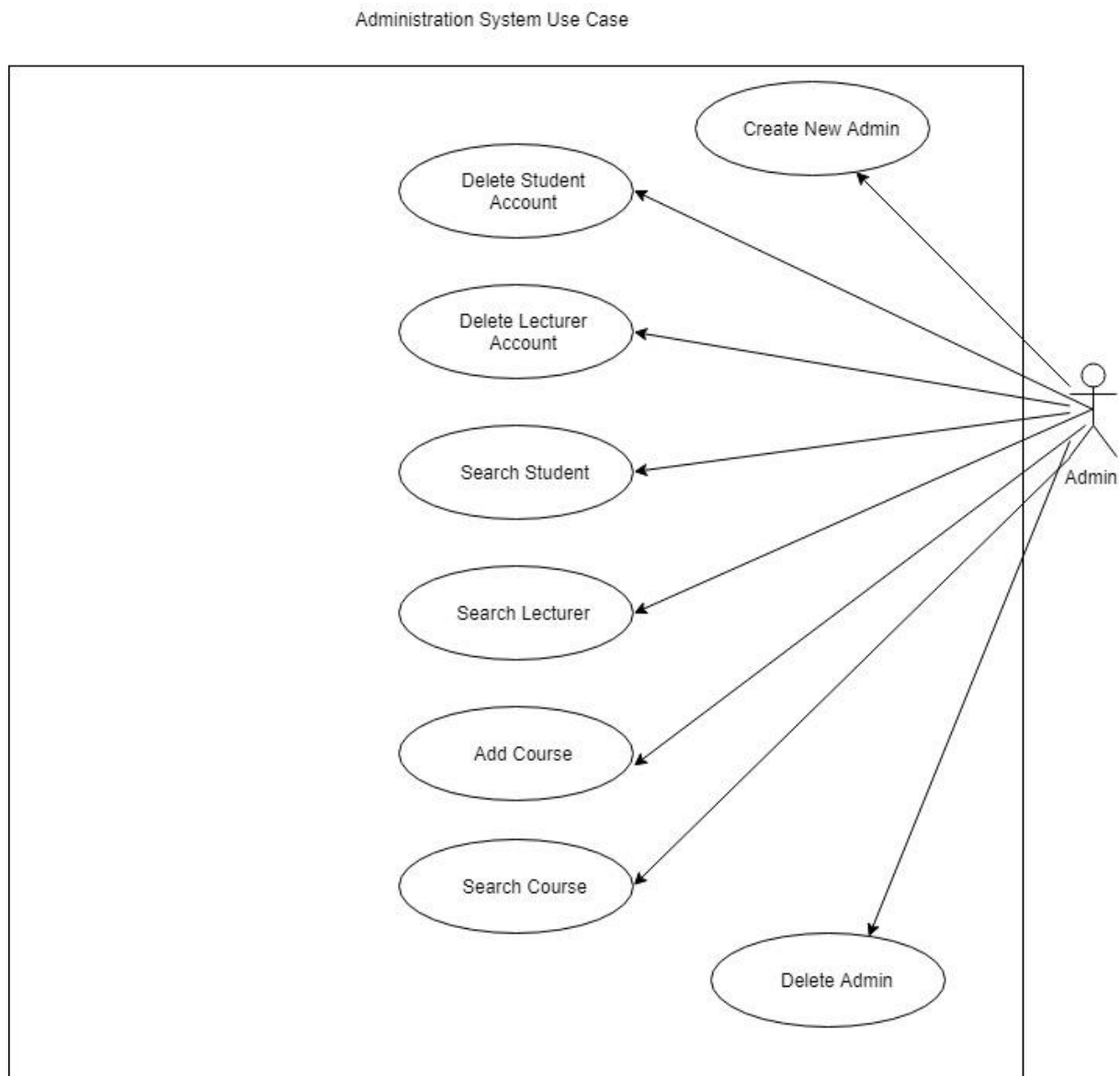
Figure 7 Use Case Diagram of Administration System

Brief Description:

In Administration System Use Case diagram (Fig.8) shows that admins are able to use following functions: Delete Student, Delete Lecturer, Delete Admin, Create New Admin, Change Admins' Attributes. Each admin must be logged in into the system with their usernames and passwords before using these functions.

Initial Step by Step Description:

1. System shall display a menu-based interface when admin logins to the system.

2. Admin shall select the option from the menu-based interface by clicking the buttons.

    2.1. If admin selects Manage Student Attributes,

        2.1.1. System shall display a search box and admin can search the student by student ID or student name or surname.

        2.1.2. System shall also display a list of students that their phone number could not be recorded at the registration and admin can select the student to manage attributes.

        2.1.3. A list of students that is related with searched value shall be displayed.

        2.1.4. After a student is selected, admin can manage attributes of the student.

            2.1.4.1. Admin can delete relationship between the student and a course or section.

            2.1.4.2. Admin can update relationship between the student and a course or section.

            2.1.4.3. Admin can add a relationship of courses or sections for students.

            2.1.4.4. Admin can delete the student information from the system.

    2.2. If admin selects Manage Lecturer,

        2.2.1. System shall display a search box and admin can search the lecturer by lecturer name or department.

        2.2.2. A list of lecturers that is related with searched value shall be displayed.

        2.2.3. After a lecturer is selected, admin can manage attributes of the lecturer.

            2.2.3.1. Admin can add a relationship of courses and sections for the lecturer.

2.2.3.2. Admin can delete relationship between the lecturer and a course or section that is given by the lecturer.

2.2.3.3. Admin can update relationship between the lecturer and a course or section.

2.2.3.4. Admin can delete the lecturer from the system with a required validation code.

2.3. If admin selects Delete Admin,

2.3.1. System shall display a list of admins and admin can select and delete admin that is wanted to be deleted with a validation code.

2.4. If admin selects Create New Admin,

2.4.1. System shall display an interface that includes the following text fields: Name, Surname, E-mail Address, Username, and Password.

2.4.1.1. Name, surname and e-mail address attributes must be a string.

2.4.1.2. Username attribute must be string a unique name and without starting with a number or special character.

2.4.1.3. Password attribute must be string including one number, one upper-case letter and one special character from the fallowing special characters: ".", "- ", "_", "!" and "*".

4.3.2.8.   Web Panel for Lecturer

<u>**Use Case:**</u>

- Upload a Student List

- Attendance Reports

- Change Password

Diagram:
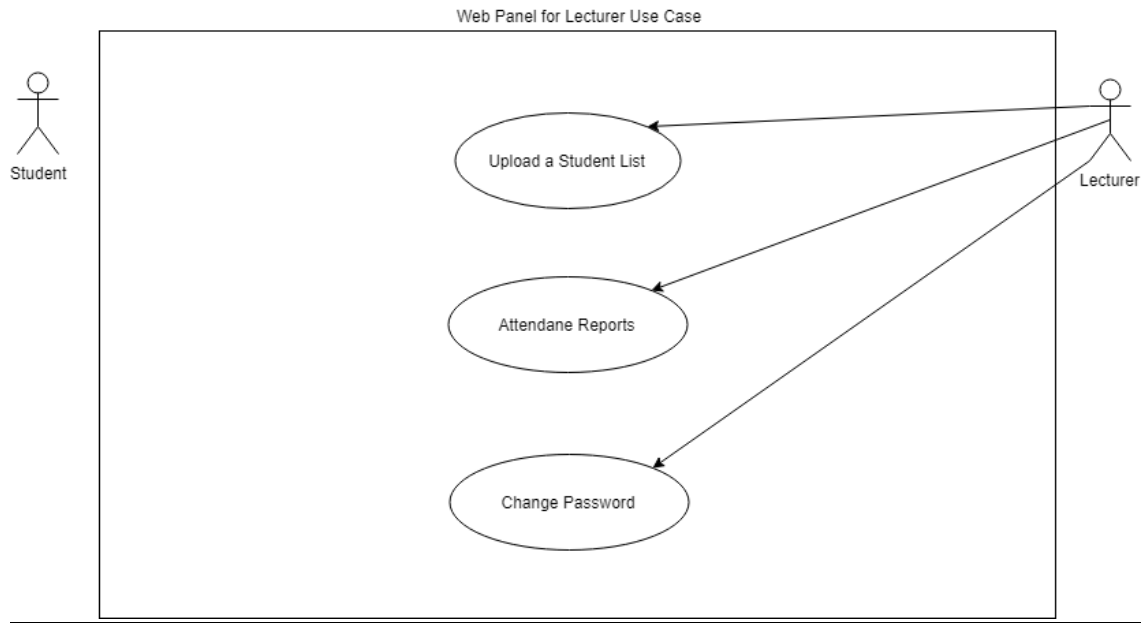
Figure 8 Web Panel for Lecturer Use Case Diagram

Brief Description:

In Web Panel for Lecturers Use Case diagram (Fig.9) shows that admins are able to use following functions: Home, Upload a Student List, Attendance Reports, Change Password, Logout. Each admin must be logged in into the system with their usernames and passwords before using these functions.

Initial Step by Step Description:

1. Lecturers shall login to the system from the URL www.attendancesystem.xyz/panel with their e-mails and password that are already registered into the system.

2. Lecturer shall upload a student list of the course that s/he gives by clicking the "Upload a Student List" button from the top of the interface.

   2.1. Lecturer shall select "Browse" button from the interface and selects the Excel file which lecturer wants to upload.

   2.2. After selecting, lecturer shall press "Save" button.

2.2.1. Lecturer shall see the list of the students which are parsed from the file.

2.2.2. Lecturer shall press on the "Save" button from the opened window that has the list of the students.

3. Lecturer shall see the attendance reports of the lectures that s/he gives by clicking the "Attendance Reports" button from the top of the interface.

3.1. Lecturer shall select a course by clicking on it from the calendar view that includes the given courses by lecturer on the course's date.

3.1.1. After lecturer selects the course, lecturer shall see the photo, student number, name, surname and attended time for each student that is registered for this course on the grid view.

3.1.1.1. If a student does not attend to the course, row of this student shall be red.

3.1.1.2. If a student does not fully attend to the course, row of this student shall be yellow.

3.1.1.3. If a student attends to the course fully, row of this student shall be green.

3.1.2. Lecturer shall mark a not attended student as attended by clicking the "Mark as Attended" button from the last column of this student's row.

4. Lecturer shall change his/her password by clicking the "Change Password" button from the top of the interface.

4.1. Lecturer shall enter his/her old password once and new password twice to the appropriate fields and click the "Save" button.

4.2. System shall update the lecturer's password with the new password if password in the "Old password" matches with the existing password and the password in the "New password" field matches with the password in the "Re-enter new password" field.

4.3.3. Software System Attributes

4.3.3.1.   Scalability

- All actors of the system must be warned when there is a change in the system.

4.3.3.2.   Adaptability

- Every corrected data that is entered by users must be saved in Database System in the appropriate tables of database.

4.3.3.3.   Usability

- When the users such as students or lecturers enters their attributes wrong, an error message should be displayed that explains the reason why the users failed.

4.3.3.4.   Performance

- Appearance time of the interfaces should not be more than 2 seconds.

4.3.3.5.   Portability

- Tracking System must for every BLE Beacon device that the lecturers have.
- Tracking System is designed for the devices with Android version 5.1 and above, so Tracking System must work properly with the possible new versions of Android platform.

5. Software Design Description

5.1. Introduction

5.1.1. Purpose

The purpose of this Software Design Document is providing the details of project titled as "Attendance Tracking System with Using BLE Beacon".

The target audience is university students at Çankaya University. The application will provide opportunity to track course attendances of each students and report system for both lecturers and students. We aim to provide a mobile environment and take attendance with using BLE Beacon.

The purpose of Attendance Tracking System project is to design and implement an easy to use mobile phone tracking system that is the ascertaining of the position or location of a mobile phone stationary for both lecturers and monitoring system. Attendance Tracking System will include two tracking modes which are regular and secure. In regular mode, students will log in to the system and after giving necessary permission for Bluetooth detection services, their phones will interact with the BLE Beacon continuously. If the student is in range that is prearranged, the system takes attendance for the student as attended in the class activity. In secure mode, students will be able to take and upload their face photographs and lecturers will be able to see them for taking attendance.

In order to better comprehension, this SDD includes various diagrams such as UML diagram of project, activity diagram and block diagram.

5.1.2. Scope

This document includes brief and complete description about the design of project which is named as Attendance Tracking System using BLE Beacon.

Android Studio is benefited to create the all aspects of the mobile application. Android Studio is the platform that provides the Software Development Kit (SDKs) and Application Programming Interface(API) to create a mobile application for the Android devices. As a scripting language in Android Studio, Java will be used because there is no other programming language that can be used in Android Studio This platform does not allow to build applications for the iOS or any other operating systems. Thus, developers which work

with Android Studio can have chance to focus on the Android operating system entirely. Moreover, Android Studio provides implementing interfaces. Thus, there is no necessity to use any other software programs to create graphical interfaces. Additionally, developers have a chance to build applications for any version of Android operating system. Since the Android operating system ensures the idea that all applications that can run in the lower versions can run in the higher versions, developers have no concern to develop the applications for the lower versions of Android operating system.

Microsoft SQL Server Management Studio (SSMS) is utilized for managing the database of the system. It is a free platform which is developed by Microsoft for creating and handling the databases. Additionally, it contains many features such as connection can be created with the scripting editors which decrease the workload of developers.

Scripting part of the project is transpired with using Java scripts. Java is one of the most used programming language all around the world. Moreover, Java includes all aspects of the object-oriented programming approach so that the developers can create much more systems that almost encapsulated from the outside of the system. Additionally, creating and handling the exceptions is easier than the other object-oriented programming languages. Besides, developers which work with the Java do not have to use any other software. Java ensures its own interface libraries and with these libraries, building user-driven and purposive interfaces is easy to develop.

5.1.3. Glossary

Table 4 Glossary of SDD

Term	Definition
BLE Beacon	The device that sends Bluetooth signals with low energy
Block Diagram	The type of schema which the components in the system are displayed in blocks.
SDD	Software Design Document.
UML Diagram	It is a modelling language which is used in Software Engineering.

5.1.4. Overview of Document

Contents of the remaining chapters are explained below.

Section 5.2 is Architectural Design which ensures brief information about the development phase of the project. This section also contains class diagram of the system and the architecture design. Architecture design contains following attributes which identifies following terminologies: Actors, pre-conditions, post-conditions, basic sequences, exceptions and priorities of each module of system.

Section 5.3 contains an Activity Diagram which explains the basic sequence of the system while system is working.

Section 5.4 includes a Database Diagram which shows how the information of each actor will be stored and how the relationships between actors are created in the backside of the system.

Section 5.5 is Use Case Realization. This section's purpose is providing a brief explanation about components of the system. To be able to do that, Section 3 contains a block diagram of the system which is created according to the Software Requirements Specification document.

5.2. Architecture Design

5.2.1. Project Design Approach

We have planned to use Incremental Software Development Methodology (ISDM) to build our system. ISDM basically includes the following idea: Build every module of the system on the existing modules. In Software Development Lifecycle (SDL), there are four parts which are Requirements Specification, Design, Testing and Maintenance and most common issue in this cycle is managing the complexity of the project. Complexity usually occurs when there is a change in the Requirements Specification phase and if this change occurs in the later phases of project, re-organizing the existing project can be hard to handle. To be able to deal with this complexity, ISDM is beneficial because project is implemented module by module and if there is a change in one module, it is easier to interfere to the change. Thus, the approach of "Build one module to the existing modules" is the best way to

interfere and handle the complexity in the projects' SDL. Moreover, ISDM provides the chance of dealing with and correcting the bugs and errors that can be occurred in every phase of SDL in the earlier phases. Thus, the product at the end can include less bugs and errors and with this kind of product, it is easier to attract the stakeholders.

5.2.1.1.   Class Diagram
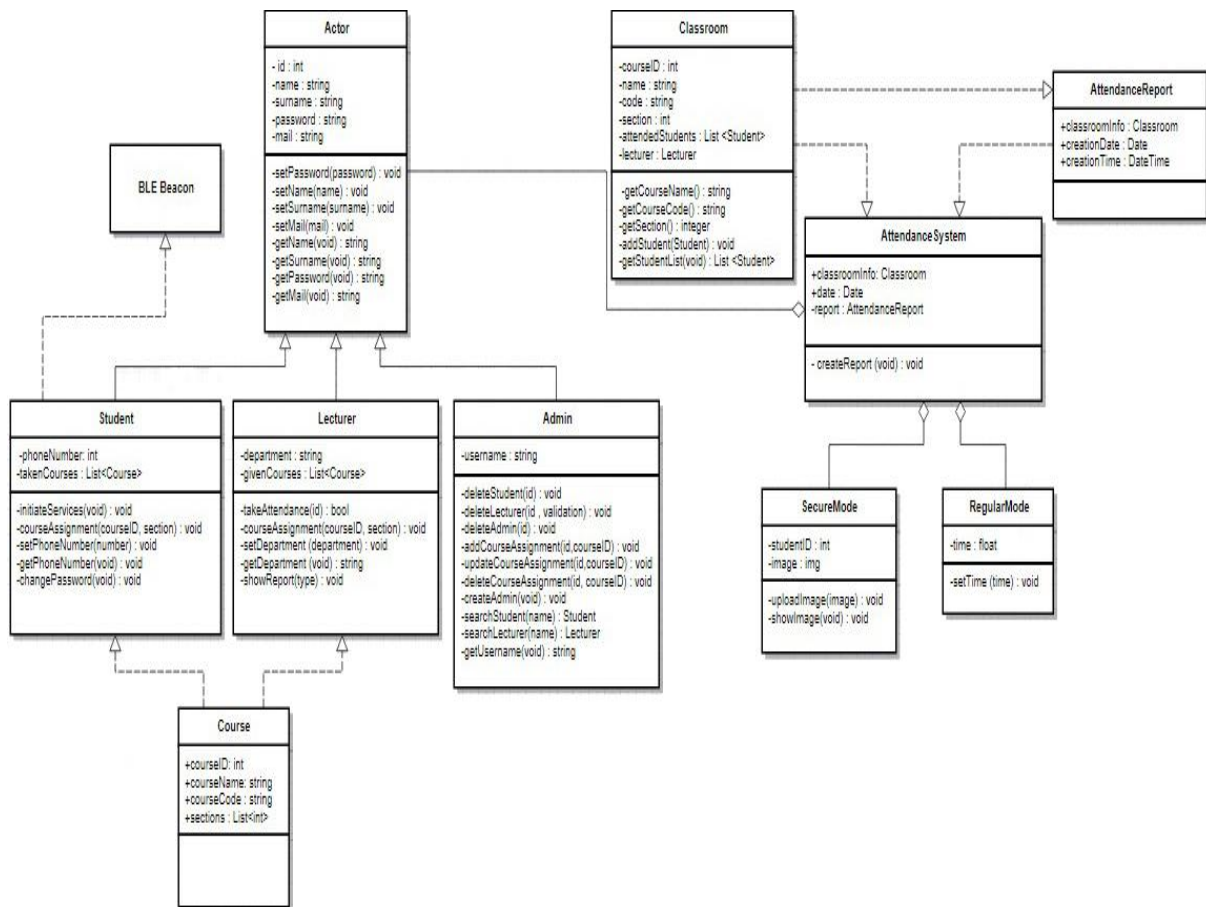
Figure 9 Class Diagram of Attendance Tracking System

Figure 9 shows information about connection and relationships between the classes within the system. AttendanceSystem is the main class which contains other components of the other actors. It is responsible for taking attendance in the classroom either within regular or secure mode. Also, it is responsible for connections between other classes. Actor class represents all the users who use the system. Student class represents all students that are taking and attending courses and there will be interaction between Student and BLE Beacon device. Lecturer class describes all lecturers that are giving courses and want to take

attendance with Attendance Tracking System. Admin class is for actor which manages and maintains the system. Course class includes data that is about courses such as course code, course name and sections related with the course. Classroom class represents a class where the attendance system works. AttendanceReport class describes an attendance report of a classroom. RegularMode is for the mode that is works with BLE Beacon. SecureMode represents the attendance mode which is based on photographs of the students.

5.3. Architecture Design of Attendance Tracking System

5.3.1. Profile Management

Summary: This system is used by student, lecturer and admin. Student, lecturer and admin can login the system, register, and update personal information and logout from the system. Also, admin can delete an account, edit course assignments of other accounts and add a new admin.

Actor: Student, Lecturer, Admin

Precondition: User must run the program.

Basic Sequence:

1. User must register if s/he does not have any account.
2. User shall login to the system by entering his/her mail address and password.
3. User can update his/her personal information by selecting profile button from main menu.
4. Admin can delete a user from the system by selecting delete user button from administration menu.
5. Admin can edit a user's course assignment by selecting edit course assignment button from administration menu.
6. Admin can define a new admin to the system by selecting add new admin button from administration menu.
7. User can logout from the system by selecting exit button.

Exception: Database error can be occurred.

Post Conditions: None

Priority: Low

5.3.2. Course Assignment

Summary: Student and lecturer can make assignment for a course. Student must be taking the course and lecturer must be giving the course in the semester.

Actor: Student, Lecturer

Precondition: User must be logged into the system.

Basic Sequence:

1. User can select a course from the course list.
2. User can select a section for the course from the section list.
3. User can make assignment by selecting save button from the interface.

Exception: Database error can be occurred.

Post Conditions: None

Priority: Low

5.3.3. Regular Attendance Tracking System

Summary: Student can be marked as attended to a course activity by using BLE Beacon. Lecturer can track attendance information of all students in the current classroom.

Actor: Student, Lecturer

Preconditions: User must be logged into the system. Student must initiate Bluetooth detection service of his/her mobile phone.

Basic Sequence:

1. Mobile phone of the student catch Bluetooth signal that is sent by BLE Beacon.
2. Received time of the signal is logged into the system with related student.
3. If the student data is saved properly at least 40 minutes continuously, the system marks the student as attended class activity.

4. If the student data lost in 40 minutes, the system asks related lecturer to decide whether the student is attended or not.

5. Lecturer can see a list of students in the class by selecting current classroom button.

Exception: Database error can be occurred. BLE Beacon can have no power. Student can have an issue on Bluetooth service on his/her mobile phone.

Post Conditions: None.

Priority: High

5.3.4. Secure Attendance Tracking System

Summary: Secure attendance tracking mode is used for exams for courses, to prevent students who attends exams for a different student. Student should take and upload his/her photograph to the server. Lecturer can check the photograph of the student and mark him/her as attended to the exam process.

Actor: Student, Lecturer

Preconditions: User must be logged into the system. Student should have a camera on his/her mobile phone.

Basic Sequence:

1. Student can take his/her face photograph by selecting take photo button from the interface.
2. Student can upload the face photograph by selecting upload photo button from the interface.
3. Lecturer can see uploaded photographs by selecting current classroom button from the interface.
4. Lecturer can mark students as attended if the student and his/her photograph is properly matching by selecting approve buttons near the list of students in the current classroom.

Exception: Database error can be occurred. There can be a connection error between student's phone and the server. Student can have an issue with his/her camera.

Post Conditions: None.

Priority: High

5.3.5. Reporting System

Summary: Student can trace his/her attendance information to the courses on whole semester. Moreover, lecturer can trace daily, weekly, monthly or yearly attendance information of the all students for the course which lecturer gives.

Actor: Student, Lecturer

Preconditions: User must be logged into the system.

Basic Sequence:

1. Student can see only his/her attendance information on courses by selection course name from the reporting menu.
2. Lecturer can see attendance report of students for a specific course by selecting course name from the reporting menu.
3. Lecturer can select a day from a reporting view, after selecting, lecturer can select a lecture on that day from the pop-up window.
4. Lecturer can see a student's attendance report for a specific course that is given by the lecturer by pressing on the student from the student list.

Exception: Database error can be occurred.

Post Conditions: None

Priority: Medium

5.4. Activity Diagram
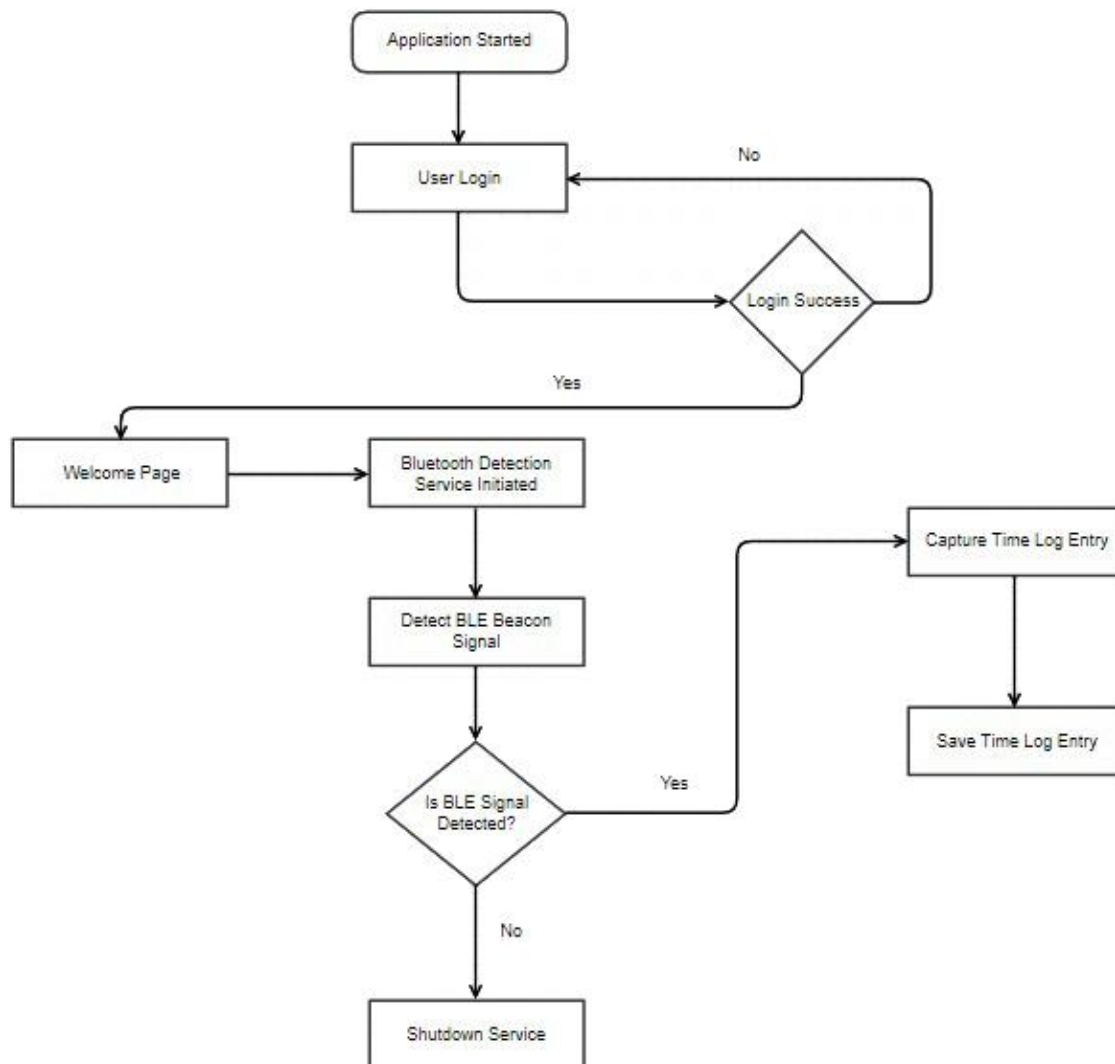
Figure 10 Activity Diagram of Attendance Tracking System

Figure 10 shows how the regular attendance tracking system works as an activity diagram. After student log into the system will be shown to the student. The student shall initiate the Bluetooth detection service on his/her mobile phone for tracking attendance information with BLE Beacon. After that, the application shall detect Bluetooth signal that BLE Beacon sends. If the signal received properly, the application will capture current time log entry and save in the database with the related student ID number. This process will repeat itself during the class activity every 60 seconds. If the signal is not received properly, the system shall shutdown service.

5.5.   Database Diagram
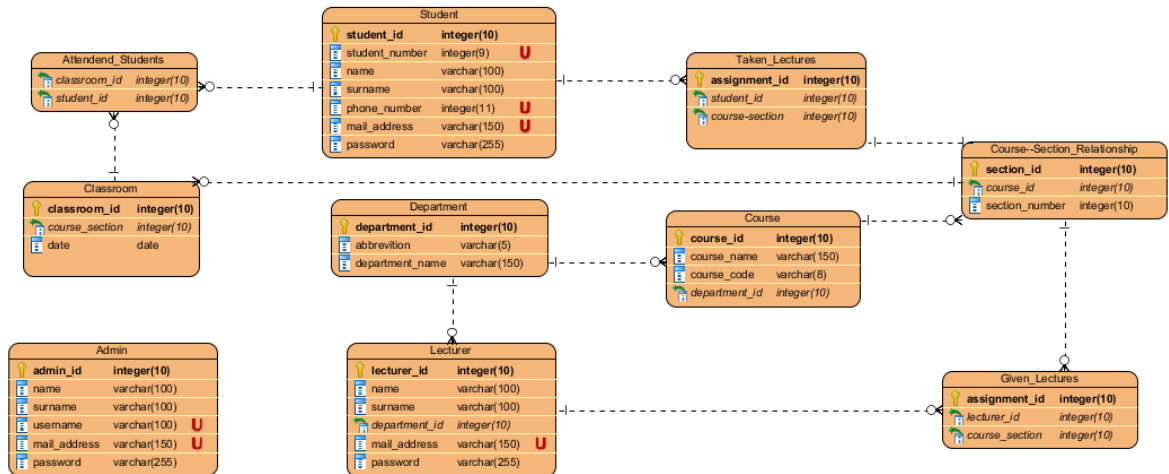
Figure 11 Database Diagram of Attendance Tracking System

Figure 11 shows the database diagram of Attendance Tracking System. Admin, Lecturer and Student tables store actor information related with the statue in the system. Department table represents departments in the university and is consisted of department name and abbreviation of the department like CENG, ECE etc. Course table is consisted of course name, course code and includes information of related department with course. Course-Section_Relationship table stores sections of the courses. Taken_Lectures is represents taken courses of the students. When a student makes a course assignment this table will be used to match a student with a course and section. Given_Lectures table stores information of given courses by a lecturer. Similarly, with Taken_Lectures, when a lecturer makes a course assignment, this table will be used to store assignment data for lecturers. Classroom table is used to store general information of a classroom environment for a course. Attended_Students stores students who are attended to classroom activity. Thus, we can capture attended student list and also we can easily find absent students.

5.6. Use case realizations

Attendance Tracking System
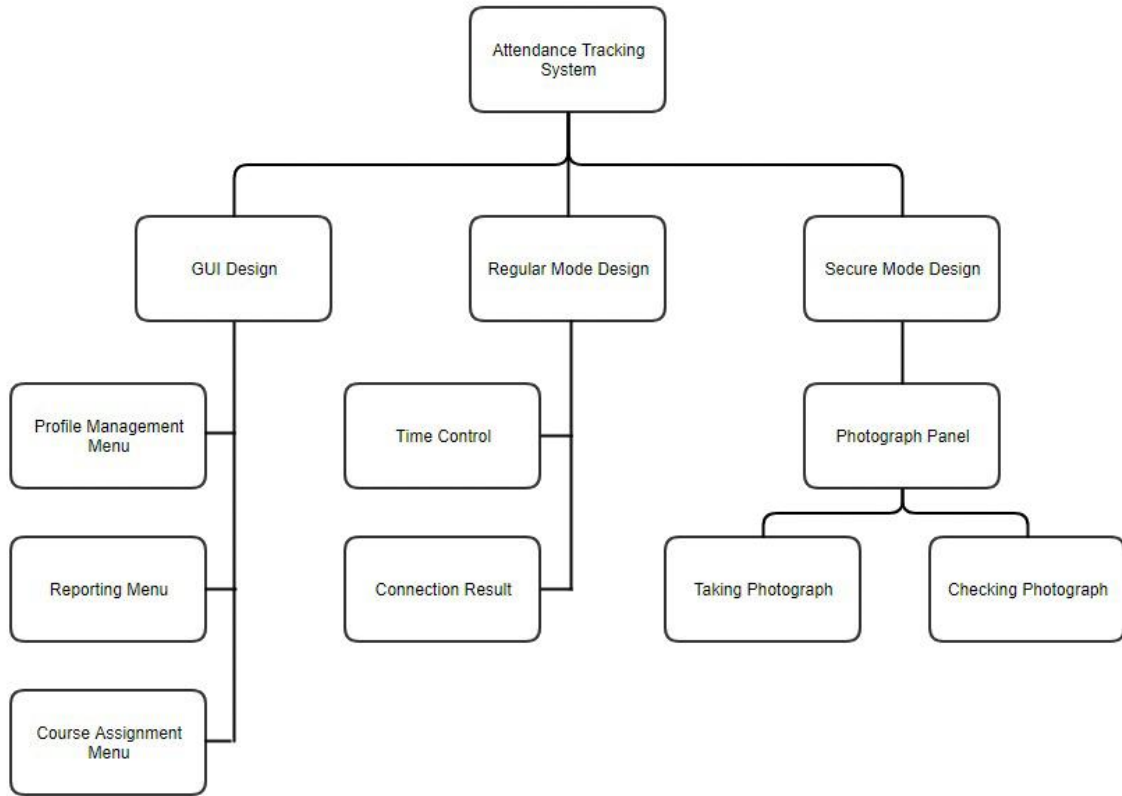
Figure 12 Components of Attendance Tracking System

5.6.1. Brief Description of Figure 12

Components of the Attendance Tracking System are identified in *Figure 12*. All systems of the project are shown in the block diagram in the figure. There are three main modules of the system which have their own sub-modules.

5.6.1.1. GUI Design

Creation purpose of the GUI design is providing the proper interaction between the user and the system. There are three sub-systems in GUI design and they are named as follows: Profile Management Menu, Reporting Menu and Course Assignment Menu.

In the Profile Management Menu model, admins, students and lecturers can update their accounts' attributes such as e-mail addresses. Admins can create a new admin, delete the user and change the course assignment for user from this menu.

In Reporting Menu model, attendance reports for each course can be reached and only students and lecturers can get these reports. Lecturer can see daily, weekly and a semester report for each course that s/he is assigned to. Also, lecturer can see the attendance report of a specific student who takes one of the lecturer courses. Student can see his/her attendance report for each course that s/he takes.

Course Assignment Menu model provides a selection-based interface for both lecturers and students. Lecturer can select the courses and the sections of the courses that s/he gives. Also, student can select the courses that s/he takes in the semester. All of this information shall be stored in the appropriate tables and attributes in the Database System.

5.6.1.2. Regular Mode Design

Creation purpose of this design is tracking the attendance with the BLE Beacon and the mobile application in the lectures. Regular Mode Design contains two sub-modules which are time control and connection result. In Time Control model, devices which detect the BLE signals are checked with the specific time amount whether they are still in range or not. According to results that consist of from this model, a decision is made in the Connection Result model. Users of the devices which stay in the range within the specified time period are counted as "Attended" by the system. If devices do not stay in the range within the same time period, users of that devices are counted as "Not attended" by the system.

5.6.1.3. Secure Mode Design

Secure Mode Design model created for the exams so that attendance in the exams can be tracked in more confidential way. This model has one sub-module which is named as "Photograph Panel" and this sub-module contains two sub-modules which are "Taking Photograph" and "Checking Photograph". In Taking Photograph module, students can take their photographs and upload these photographs to the system. Lecturers can see the taken photographs by students in the "Checking Photograph" module of the system.

6. Test Plan

6.1. INTRODUCTION

6.1.1. Version Control

Version No	Description of Changes	Date
1.0	First Version	April 23, 2018
1.1	Second Version	May 12, 2018
1.2	Third Version	May 17, 2018

6.1.2. Overview

Our three modes which are Regular and Secure Attendance Tracking System and Reporting System and all interfaces will be tested.

6.1.3. Scope

This document gives a brief description about what will be our test cases when we are testing our system.

6.1.4. Terminology

Acronym	Definition
GUI	Graphical User Interface
RM	Regular Mode
SM	Secure Mode
RS	Reporting System

6.2. FEATURES TO BE TESTED

This section provides a brief description about our components that will be tested during and after the development.

6.2.1. Graphical User Interface (GUI)

This feature mainly contains all the buttons, check boxes and similar interface attributes that ease the usage of our application

6.2.2. Regular Mode Attendance Tracking System (RM)

This feature mainly contains the attendance tracking with the Beacon device and updating the attendance status of each student.

6.2.3. Secure Mode Attendance Tracking System (SM)

This feature is designed with the idea that attendances can be tracked more secure in the exams. Students should take and upload the pictures to be marked as attended.

6.2.4. Reporting System(RS)

This feature provides attendance reports of each lecture for both student and lecturer with their own needs.

6.3.   ITEM PASS/FAIL CRITERIA

6.3.1. Exit Criteria

- 100% of the test cases are executed
- 95% of the test cases passed
- All High, Medium and Low Priority test cases passed

6.4.   REFERENCES

[1] Group17_SRS_V0.6, December 10, 2017
[2] Group17_SDD_V0.7, December 31, 2017

6.5. TEST DESIGN SPECIFICATIONS

6.5.1. Graphical User Interfaces

6.5.1.1. Subfeatures to be tested

6.5.1.1.1. Login Page Button (GUI.LGNP_BTN)

All participants have to login to the system. After selecting "Login" button, login interface shall be shown.

6.5.1.1.2. Register Page Button (GUI.RGSP_BTN)

Register interface shall be displayed with selecting "Register" button.

6.5.1.1.3. Student Login Button (GUI.SLGN_BTN)

Student must login by a valid student ID number and password for using the system.

6.5.1.1.4. Lecturer Login Button (GUI.LLGN_BTN)

Lecturer must login by a valid e-mail address and password for tracking and monitoring attendance information of students.

6.5.1.1.5. Admin Login Button (GUI.ALGN_BTN)

Admin must login by a valid username and password for managing the both lecturers' and students' account.

6.5.1.1.6. Logout Button (GUI.LOUT_BTN)

All participants should be logged out successfully after selecting the "Logout" button.

6.5.1.1.7. Reports Button (GUI.SR_BTN)

After selecting "Reports" button from the navigation bar which should be placed the middle of the toolbar that is placed bottom of the welcome page, reporting interface shall be appeared.

6.5.1.1.8. Settings Button (GUI.SB_BTN)

After selecting "Settings" button from the navigation bar which should be placed right-top-side of the welcome page, settings panel should be appeared.

6.5.1.1.9. Beacon Configuration Button (GUI.INITS_BTN)

After selecting "Beacon Configuration" button, Bluetooth Detection Services shall be initiated for the regular attendance tracking mode.

6.5.1.1.10. Change Password Button (GUI.CP_BTN)

After selecting "Change Password" button, an interface which includes one text box for old password and two text box for the new password should be appeared and an e-mail which includes a random generated code should be sent the participant's e-mail.

6.5.1.1.11. Delete Student Button (GUI.DS_BTN)

Admin can delete a student by selecting "Delete Student" button.

6.5.1.1.12. Delete Lecturer Button (GUI.DL_BTN)

Admin can delete a lecturer by entering validation code and selecting "Delete Lecturer" button.

6.5.1.1.13. Show List of Students Button (GUI.SLS_BTN)

After selecting "Show List of Students" button, a list of registered students shall be displayed.

6.5.1.1.14. Search Student Button (GUI.SS_BTN)

After selecting "Search Student" button, a text box should be displayed and all results that includes the searching parameter should be displayed.

6.5.1.1.15. Search Lecturer Button (GUI.SL_BTN)

After selecting "Search Lecturer" button, a text box should be displayed and all results that includes the searching parameter should be displayed.

6.5.1.1.16. Add Admin Button (GUI.AD_BTN)

Admin can create a new admin record with selecting "Add Admin" from the administration menu.

6.5.1.1.17. Delete Admin Button (GUI.DA_BTN)

Admin can delete admin from the system with selecting "Delete Admin" from the administration menu.

6.5.1.2.   Test Cases

TC ID	Requirements	Priority	Scenario Description
GUI.LGNP_BTN.01	3.2.1	H	Select "Login" button. After the selection, login interface will be displayed.

TC ID	Requirements	Priority	Scenario Description
GUI.RGSP_BTN.01	3.2.2	H	Select "Register" button. After the selection, register interface will be displayed.

TC ID	Requirements	Priority	Scenario Description
GUI.SLGN_BTN.01	3.2.1	L	Enter a valid student ID number and password.
GUI.SLGN_BTN.02	3.2.1	L	Enter an invalid student ID number or password.

TC ID	Requirements	Priority	Scenario Description
GUI.LLGN_BTN.01	3.2.1	L	Enter a valid lecturer e-mail address and password.
GUI.LLGN_BTN.02	3.2.1	L	Enter an invalid lecturer e-mail address or password.

TC ID	Requirements	Priority	Scenario Description
GUI.ALGN_BTN.01	3.2.1	L	Enter a valid admin username and password.
GUI.ALGN_BTN.02	3.2.1	L	Enter an invalid admin username or password.

TC ID	Requirements	Priority	Scenario Description
GUI.LOUT_BTN.01	3.2.1	M	Select "Logout" button. After the selection, actor will logout from the system and main interface will be displayed.

TC ID	Requirements	Priority	Scenario Description
GUI.SR_BTN.01	3.2.5	H	Select "Show Report" button. After the selection, report interface will be shown.

TC ID	Requirements	Priority	Scenario Description
GUI.SB_BTN.01	3.2.1	M	Select "Settings" button. After the selection, an editable panel that contains information of the actor who logged in to the system will be displayed.

TC ID	Requirements	Priority	Scenario Description
GUI.INITS_BTN.01	3.2.3	H	Give permission to the system to access Bluetooth Services of the mobile device.
GUI.INITS_BTN.02	3.2.3	H	Select "Initiate Services" button. After the selection, Bluetooth Detection Service of the mobile phone will be initiated for the Regular Mode.

TC ID	Requirements	Priority	Scenario Description
GUI.CP_BTN.01	3.2.1	M	Select "Change Password" button. After the selection, the password of the logged in to the system will be changed.

TC ID	Requirements	Priority	Scenario Description
GUI.DS_BTN.01	3.2.8	L	Delete one of the student by entering a valid student ID number.

TC ID	Requirements	Priority	Scenario Description
GUI.DL_BTN.01	3.2.8	L	Delete one of the lecturer by entering a valid lecturer name, surname and validation code.

TC ID	Requirements	Priority	Scenario Description
GUI.SLS_BTN.01	3.2.8	L	A list of the registered students will be displayed.

TC ID	Requirements	Priority	Scenario Description
GUI.SS_BTN.01	3.2.8	L	Search and display a registered student by entering a valid student ID number or name and surname.

TC ID	Requirements	Priority	Scenario Description
GUI.SL_BTN.01	3.2.8	L	Search and display a registered lecturer by entering a valid e-mail address or name and surname.

TC ID	Requirements	Priority	Scenario Description
GUI.ACA_BTN.01	3.2.8	M	Select course and section to add a relationship with found actor.

TC ID	Requirements	Priority	Scenario Description
GUI.UCA_BTN.01	3.2.8	M	Update a course and section relationship with the found actor.

TC ID	Requirements	Priority	Scenario Description
GUI.DCA_BTN.01	3.2.8	M	Delete a course and section relationship with the found actor.

TC ID	Requirements	Priority	Scenario Description
GUI.AD_BTN.01	3.2.8	L	Select "Add Admin" button. After selecting, new admin information will be registered to the system.

TC ID	Requirements	Priority	Scenario Description
GUI.DA_BTN.01	3.2.8	L	Select "Delete Admin" button. After selecting, delete the admin record from the system.

6.5.2. Regular Mode Attendance Tracking System (RM)

6.5.2.1.   Subfeatures to be tested

6.5.2.1.1. Scan Beacon (RM.SCANB)

The system shall scan nearby beacons on background. For that reason mobile device should have Bluetooth Services and Bluetooth Detection Services on that mobile device must be initialized before scanning.

6.5.2.1.2. Capture Time Log Entry (RM.CTLE)

In regular mode, if there is an interaction between the mobile device of the student and beacon, system shall store record of time log entries to decide whether the student is attended to the class activity or not.

6.5.2.1.3. Show Attendance Log (RM.SAL)

Lecturer can see list of the attended and absent students in the current class.

6.5.2.2.   Test Cases

TC ID	Requirements	Priority	Scenario Description
RM.SCANB.01	3.2.3	H	Do not give necessary permissions to the application
RM.SCANB.02	3.2.3	H	Give permission to the system for accessing Bluetooth Detection Services
RM.SCANB.03	3.2.3	H	Scan nearby beacons in the classroom continuously.
RM.CTLE.01	3.2.3	H	If there is a connection between the mobile device and the beacon, capture time log entries.
RM.CTLE.02	3.2.3	H	Store capture time log entries on the database.

TC ID	Requirements	Priority	Scenario Description
(RM.SAL.01	3.2.3	M	After selecting "Show Attendence Log" button, a list of attended and absent students shall be displayed.

6.5.3. Secure Mode Attendance Tracking System (SM)

6.5.3.1. Subfeatures to be tested

6.5.3.1.1. Take Image (SM.TI)

Student's phone camera shall be opened and student shall be able to take a photograph of himself with selecting "Take Image" button.

6.5.3.1.2. Upload Image (SM.UI)

Students can upload image to the remote server, if he/she took image already.

6.5.3.1.3. Show Image (SM.SI)

Lecturer can see uploaded images which are on the remote server as a list of images.

6.5.3.1.4. Take Attendance (SM.TA)

Lecturer can mark the student as attended the class activity by checking checkboxes near the images. If the lecturer do not mark the student as attended, student shall be absent for that class.

6.5.3.2. Test Cases

TC ID	Requirements	Priority	Scenario Description
SM.TI.01	3.2.4	H	Give permission to the application for accessing the camera of the mobile device and then select "Take Image" button.
SM.TI.02	3.2.4	H	Take a face photograph. After taking, the location of the photograph will be recorded.
SM.UI.01	3.2.4	H	Select "Upload Image" button. If there is not any taken photograph, a dialog message should be appearred.
SM.UI.02	3.2.4	H	If there is taken photograph, it will be uploaded remote server properly.

TC ID	Requirements	Priority	Scenario Description
SM.SI.01	3.2.4	H	Select "Show Images" button. After selecting, all uploaded images will be listed from the remote server.
SM.TA.01	3.2.4	H	Students will be marked as attended and recorded on the database with selecting the checkboxes near the images. Otherwise, they will be marked as absent.

6.5.4. Reporting System (RS)

6.5.4.1.　Subfeatures to be tested

6.5.4.1.1.　Select Course (RS.SC)

Student or lecturer can select a course from a dropdown list of courses that has a relationship with the participant who logged in to the system.

6.5.4.1.2.　Show Daily Report (RS.SDR)

After selecting "Show Daily Report", an appropriate interface that should include the check box to input the date. According to the selected check boxes displayed report shall be changed.

6.5.4.1.3.　Show Weekly Report (RS.SWR)

After selecting "Show Weekly Report", an appropriate interface that should include the check box to input the week. According to the selected check boxes displayed report shall be changed.

6.5.4.1.4.　Show Monthly Report (RS.SMR)

After selecting "Show Monthly Report", an appropriate interface that should include the check box to input the month. According to the selected check boxes displayed report shall be changed.

6.5.4.1.5.　Show Semester Report (RS.SR)

After selecting "Show Semester Report", a report should be generated for the whole semester related with the selected course.

6.5.4.1.6.　Report for Lecturer (RS.RFL)

After selecting "Report for Lecturer" button, a report that includes the information of courses that lecturer gives should be generated.

6.5.4.1.7.　Report for Student (RS.RFS)

After selecting "Report for Student" button, a report that includes the information of courses that student takes should be generated.

6.5.4.2.　Test Cases

TC ID	Requirements	Priority	Scenario Description
RS.SC.01	3.2.5	M	Select a course related with the participant logged in to the system from dropdown list.
RS.SDR.01	3.2.5	M	Select "Show Daily Report". After selecting, report interface will be displayed with a callender.
RS.SDR.02	3.2.5	M	Select check boxes on the calander to update the reporting table according to the selected check boxes.
RS.SWR.01	3.2.5	M	Select "Show Weekly Report". After selecting, report interface will be displayed with a callender.

TC ID	Requirements	Priority	Scenario Description
RS.SWR.02	3.2.5	M	Select check boxes on the calander to update the reporting table according to the selected check boxes.
RS.SMR.01	3.2.5	M	Select "Show Monthly Report". After Selecting, report interface will be displayed with a callender.
RS.SMR.02	3.2.5	M	Select check boxes on the calander to update the reporting table according to the selected check boxes.

TC ID	Requirements	Priority	Scenario Description
RS.RFL.01	3.2.5	H	Generate a report that includes attendance information of the courses that the lecturer gives.
RS.RFL.02	3.2.5	M	Generated report will be displayed on the report interface.

TC ID	Requirements	Priority	Scenario Description
RS.RFS.01	3.2.5	H	Generate a report that includes attendance information of the courses that the student takes.
RS.RFS.02	3.2.5	M	Generated report will be displayed on the report interface.

6.6. Detailed Test Cases

6.6.1. GUI.LGNP_BTN.01

TC_ID	GUI.LGNP_BTN.01
Purpose	Opens login interface correctly
Requirements	3.2.1
Priority	High
Estimated Time Needed	1 Minute

Dependency	Application is executed
Setup	Application should setup on the mobile phone
Procedure	[A01] Click "Login" button.
	[V01] Observe that the login interface that includes "Login as Lecturer" and "Login as Student" buttons.
Cleanup	Go back to the main page

6.6.2. GUI.RGSP_BTN.01

TC_ID	GUI.RGSP_BTN.01
Purpose	Opens registration interface correctly.
Requirements	3.2.2
Priority	High
Estimated Time Needed	1 Minute
Dependency	Application is executed
Setup	Application should setup on the mobile phone
Procedure	[A01] Click "Registration" button.
	[V01] Observe that the registration interface that includes "Lecturer" and "Student" radio buttons.
Cleanup	Go back to the main page

6.6.3. GUI.SLGN_BTN.01

TC_ID	GUI.SLGN_BTN.01
Purpose	Enter a valid student number and password.
Requirements	3.2.1
Priority	Low
Estimated Time Needed	2 Minute
Dependency	-
Setup	A student user should be created.
Procedure	[A01] Go to the Login page
	[A02] Enter a valid student number and password.
	[A03] Click on the "Login" button.
	[V01] Observe that login is successful and student page is displayed.
Cleanup	Logout

6.6.4. GUI.SLGN_BTN.02

TC_ID	GUI.SLGN_BTN.02
Purpose	Enter a invalid student number or password.
Requirements	3.2.1

Priority	Low
Estimated Time Needed	2 Minute
Dependency	-
Setup	A student user should be created.
Procedure	[A01] Go to the Login page.
	[A02] Enter an invalid student number or password.
	[A03] Click on the "Login" button.
	[V01] Observe that "Student number or password is invalid" message.
Cleanup	Close login interface

6.6.5. GUI.LLGN_BTN.01

TC_ID	GUI.LLGN_BTN.01
Purpose	Enter a valid e-mail and password.
Requirements	3.2.1
Priority	Low
Estimated Time Needed	2 Minute
Dependency	-
Setup	A lecturer user should be created.
Procedure	[A01] Go to the Login page.
	[A02] Enter a valid lecturer e-mail and password.
	[A03] Click on the "Login" button.
	[V01] Observe that login is successful and lecturer page is displayed.
Cleanup	Logout

6.6.6. GUI.LLGN_BTN.02

TC_ID	GUI.LLGN_BTN.02
Purpose	Enter an invalid e-mail or password.
Requirements	3.2.1
Priority	Low
Estimated Time Needed	2 Minute
Dependency	-
Setup	A lecturer user should be created.
Procedure	[A01] Go to the Login page.
	[A02] Enter an invalid lecturer e-mail or password.
	[A03] Click on the "Login" button.
	[V01] Observe that "E-mail or password is invalid" message appears.
Cleanup	Close login interface

6.6.7. GUIALGN_BTN.01

TC_ID	GUI.ALGN_BTN.01
Purpose	Enter a valid username and password.
Requirements	3.2.1
Priority	Low

Estimated Time Needed	2 Minute
Dependency	-
Setup	An admin user should be created.
Procedure	[A01] Go to the Login page.
	[A02] Enter a valid admin username and password.
	[A03] Click on the "Login" button.
	[V01] Observe that login is successful and admin panel appears.
Cleanup	Logout

6.6.8. GUI.ALGN_BTN.02

TC_ID	GUI.ALGN_BTN.02
Purpose	Enter an invalid username or password.
Requirements	3.2.1
Priority	Low
Estimated Time Needed	2 Minute
Dependency	-
Setup	An admin user should be created.
Procedure	[A01] Go to the Login page.
	[A02] Enter an invalid admin username or password.
	[A03] Click on the "Login" button.
	[V01] Observe that "Username or password is invalid" message appears.
Cleanup	Close login interface

6.6.9. GUI.LOUT_BTN.01

TC_ID	GUI.LOUT_BTN.01
Purpose	Terminate the session.
Requirements	3.2.1
Priority	Medium
Estimated Time Needed	1 Minute
Dependency	An actor should login the system.
Setup	One of the actor accounts should be created.
Procedure	[A01] Click on the "Logout" button.
	[V01] Observe that main interface appears.
Cleanup	Close the application

6.6.10. GUI.SR_BTN.01

TC_ID	GUI.SR_BTN.01
Purpose	Open report interface correctly.
Requirements	3.2.5
Priority	High
Estimated Time Needed	2 Minute
Dependency	A lecturer or student should login the system.
Setup	A lecturer or student account should be created.
Procedure	[A01] Go to the navigation menu from the left-side of the screen.

	[A02] Click "Show Report" button
	[V01] Observe that reporting interface appears.
Cleanup	Close report interface

6.6.11. GUI.SB_BTN.01

TC_ID	GUI.SB_BTN.01
Purpose	Open Settings Panel correctly.
Requirements	3.2.1
Priority	Medium
Estimated Time Needed	2 Minute
Dependency	A lecturer or student should login the system.
Setup	A lecturer or student account should be created.
Procedure	[A01] Go to the navigation menu from the left-side of the screen.
	[A02] Click "Settings" button
	[V01] Observe that settings panel appears with the information of the actor.
Cleanup	Close settings panel

6.6.12. GUI.INITS_BTN.01

TC_ID	GUI.INITS_BTN.01
Purpose	Taking permission from the student for accsessing Bluetooth Services.
Requirements	3.2.3
Priority	High
Estimated Time Needed	1 Minute
Dependency	Mobile device should have Bluetooth Service. Student login test cases should pass.
Setup	Login to the system as student.
Procedure	[A01] Click "Allow" button on the appeared permission dialog.
	[V01] Observe that the application can reach Bluetooth Services.
Cleanup	Disable Bluetooth Services

6.6.13. GUI.INITS_BTN.02

TC_ID	GUI.INITS_BTN.02
Purpose	Initiate Bluetooth Services to communicate with the beacons.
Requirements	3.2.3
Priority	High
Estimated Time Needed	1 Minute
Dependency	Mobile device should have Bluetooth Service. Student should allow the application to reach Bluetooth Services. Student login test cases should pass.
Setup	Login to the system as student and select Initiate Services button.
Procedure	[A01] Click "Allow" button on the appeared permission dialog.
	[V01] Observe that "Bluetooth services is running" message is displayed.
Cleanup	Disable Bluetooth Services

6.6.14. GUI.CAS_BTN.01

TC_ID	GUI.CAS_BTN.01
Purpose	Open course assignment interface correctly.
Requirements	3.2.6-3.2.7
Priority	High
Estimated Time Needed	2 Minute
Dependency	Student login or lecturer login test cases should pass.
Setup	Login to the system as student or lecturer. Courses and secitons are added to the database.
Procedure	[A01] Go to the navigation menu from the left-side of the screen.
	[A02] Click "Course Assignment" button.
	[V01] Observe that course assignment interface appears
Cleanup	Close course assignment interface

6.6.15. GUI.CP_BTN.01

TC_ID	GUI.CP_BTN.01
Purpose	Password change request of the participant who is logged in to the system
Requirements	3.2.1
Priority	Medium
Estimated Time Needed	1 Minute
Dependency	Student login or Lecturer login test cases should pass. Internet connection is required.
Setup	Login to the system as student or lecturer.
Procedure	[A01] Go to the navigation menu from the left-side of the screen.
	[A02] Click "Settings" button.
	[A03] Click "Change Password" button.
	[V01] Observe that "Change password link is send to your e-mail address" message is displayed.
Cleanup	Close the settings panel.

6.6.16. GUI.DS_BTN.01

TC_ID	GUI.CP_DS_BTN.01
Purpose	Delete student record from the database properly.
Requirements	3.2.8
Priority	Low
Estimated Time	2 Minute

Needed	
Dependency	Admin login test case should pass.
Setup	Login to the system as admin.
Procedure	[A01] Click "Delete Student" button from the administration menu.
	[A02] Enter a valid student ID number
	[A03] Click "Delete" button.
	[V01] Observe that "Student is deleted successfully from the database" message.
Cleanup	Close student deletion page

6.6.17. GUI.DL_BTN.01

TC_ID	GUI.DL_BTN.01
Purpose	Delete lecturer record from the database properly.
Requirements	3.2.8
Priority	Low
Estimated Time Needed	2 Minute
Dependency	Admin login test case should pass.
Setup	Login to the system as admin.
Procedure	[A01] Click "Delete Lecturer" button from the administration menu.
	[V01] Observe that lecturer deletion page is opened.
	[A02] Enter a valid lecturer name, surname and validation code.
	[A03] Click "Delete" button.
	[V01] Observe that "Lecturer is deleted successfully from the database" message.
Cleanup	Close lecturer deletion page

6.6.18. GUI.SLS_BTN.01

TC_ID	GUI.DL_BTN.01
Purpose	List registered students on the system.
Requirements	3.2.8
Priority	Low
Estimated Time Needed	1 Minute
Dependency	Admin login test case should pass.
Setup	Login to the system as admin.
Procedure	[A01] Click "Show List of Students" button from the administration menu.
	[V01] Observe that all of the registered students on the database is listed on the screen.
Cleanup	Go to administration panel

6.6.19. GUI.SS_BTN.01

TC_ID	GUI.SS_BTN.01
Purpose	Search and display a registered student on the system.
Requirements	3.2.8
Priority	Low
Estimated Time Needed	1 Minute

Dependency	Admin login test case should pass.
Setup	Login to the system as admin.
Procedure	[A01] Click "Search Student" button from the administration menu.
	[V01] Observe that search student page is opened.
	[A02] Enter a valid student ID number or student name and student surname.
	[V01] Observe that information of the related student on the database is displayed on the screen.
Cleanup	Close search student page

6.6.20. GUI.SL_BTN.01

TC_ID	GUI.SL_BTN.01
Purpose	Search and display a registered lecturer on the system.
Requirements	3.2.8
Priority	Low
Estimated Time Needed	1 Minute
Dependency	Admin login test case should pass.
Setup	Login to the system as admin.
Procedure	[A01] Click "Search Lecturer" button from the administration menu.
	[V01] Observe that search lecturer page is opened.
	[A02] Enter a valid lecturer e-mail or lecturer name and lecturer surname.
	[V01] Observe that information of the related lecturer on the database is displayed on the screen.
Cleanup	Close search lecturer page

6.6.21. GUI.ACA_BTN.01

TC_ID	GUI.ACA_BTN.01
Purpose	Add a course assignment to a student or a lecturer
Requirements	3.2.8
Priority	Medium
Estimated Time Needed	1 Minute
Dependency	Admin login, search student and search lecturer test cases should pass.
Setup	Login to the system as admin.
Procedure	[A01] Click "Course Assignment" button from the administration menu.
	[V01] Observe that course assignment panel is opened.
	[A02] Click "Add Course Assignment" button.
	[A03] Search a student or lecturer
	[A04] Select a course and section information from dropdown lists.
	[V01] Observe that "Course assignment is done successfully" message is displayed.
Cleanup	Close add course assignment page

6.6.22. GUI.UCA_BTN.01

TC_ID	GUI.UCA_BTN.01
Purpose	Update a course assignment of a student or a lecturer
Requirements	3.2.8
Priority	Medium
Estimated Time Needed	1 Minute
Dependency	Admin login, search student and search lecturer test cases should pass.
Setup	Login to the system as admin.
Procedure	[A01] Click "Course Assignment" button from the administration menu.
	[V01] Observe that course assignment panel is opened.
	[A02] Click "Update Course Assignment" button.
	[A03] Search a student or lecturer
	[V01] Observe that all course assignments of the searched participant is listed.
	[A05] Select a course assignment
	[A06] Select new course and section from dropdown lists.
	[V01] Observe that "Course assignment is updated" message is displayed.
Cleanup	Close update course assignment page

6.6.23. GUI.DCA_BTN.01

TC_ID	GUI.DCA_BTN.01
Purpose	Delete a course assignment of a student or a lecturer
Requirements	3.2.8
Priority	Medium
Estimated Time Needed	1 Minute
Dependency	Admin login, search student and search lecturer test cases should pass.
Setup	Login to the system as admin.
Procedure	[A01] Click "Course Assignment" button from the administration menu.
	[V01] Observe that course assignment panel is opened.
	[A02] Click "Delete Course Assignment" button.
	[A03] Search a student or lecturer
	[V01] Observe that all course assignments of the searched participant is listed.
	[A05] Select a course assignment
	[V01] Observe that "Course assignment is deleted" message is displayed.
Cleanup	Close delete course assignment page

6.6.24. GUI.AD_BTN.01

TC_ID	GUI.AD_BTN.01
Purpose	Create a new admin record for the system
Requirements	3.2.8
Priority	Low

Estimated Time Needed	1 Minute
Dependency	Admin login test case is passed.
Setup	Login to the system as admin.
Procedure	[A01] Click "Add Admin" button from the administration menu.
	[V01] Observe that create a new admin page is opened.
	[A02] Enter username, password, name, surname and e-mail address information.
	[V01] Observe that "A new admin is added successfully" message is displayed.
Cleanup	Close create a new admin page

6.6.25. GUI.DA_BTN.01

TC_ID	GUI.DA_BTN.01
Purpose	Delete an admin from the system
Requirements	3.2.8
Priority	Low
Estimated Time Needed	1 Minute
Dependency	Admin login test case is passed.
Setup	Login to the system as admin.
Procedure	[A01] Click "Delete Admin" button from the administration menu.
	[V01] Observe that delete admin page is opened and all the admins listed.
	[A02] Select an admin
	[V01] Observe that "Admin is deleted" message is displayed.
Cleanup	Close delete admin page

6.6.26. RM.SCANB.01

TC_ID	RM.SCANB.01
Purpose	Do not give any permission to the application
Requirements	3.2.3
Priority	H
Estimated Time Needed	1 Minute
Dependency	Student login test case passed.
Setup	Login to the system as student. "Initiate Service" button is selected.
Procedure	[A01] Disallow the application to reach Bluetooth Services of mobile device.
	[V01] Observe that the system informs the student about regular mode within in a message.
Cleanup	Go to welcome page

6.6.27. RM.SCANB.02

TC_ID	RM.SCANB.02
Purpose	Give permission to the system for accessing Bluetooth Services
Requirements	3.2.3
Priority	H
Estimated Time	1 Minute

Needed	
Dependency	Student login test case passed.
Setup	Login to the system as student. "Initiate Service" button is selected.
Procedure	[A01] Allow the application to reach Bluetooth Services of mobile device.
	[V01] Observe that "Bluetooth services is running" message is displayed.
Cleanup	Go to welcome page

6.6.28.   RM.SCANB.03

TC_ID	RM.SCANB.03
Purpose	Scan nearby beacons continuously
Requirements	3.2.3
Priority	H
Estimated Time Needed	40 Minute
Dependency	Student login test case passed. Bluetooth services is working.
Setup	Student should login the system.
Procedure	[A01] Scanner is working on background.
	[V01] Observe that "scanning" message is displayed on top of the welcome page.
Cleanup	Bluetooth services is switched off.

6.6.29.   RM.CTLE.01

TC_ID	RM.CTLE.01
Purpose	Caputering time log entry every 10 seconds.
Requirements	3.2.3
Priority	H
Estimated Time Needed	40 Minute
Dependency	Student login, Scan beacon test cases passed. Bluetooth services is running.
Setup	Student should login the system.
Procedure	[A01] Scanner is working on background.
	[A02] System should capture time log entry every 10 seconds if there is a connection with beacon.
	[V01] Latest captured time entry is displayed on the screen.
Cleanup	Exit

6.6.30.   RM.CTLE.02

TC_ID	RM.CTLE.02
Purpose	Store the captured time enry on the dabase
Requirements	3.2.3
Priority	H
Estimated Time Needed	40 Minute

Dependency	Student login, Scan beacon test cases passed. Bluetooth services is running.
Setup	Student should login the system.
Procedure	[A01] Scanner is working on background.
	[A02] System should capture time log entry every 10 seconds if there is a connection with beacon.
	[A03] Store time logs on the system.
	[V01] Observe that latest captured time entry is displayed on the screen.
Cleanup	Exit

6.6.31. RM.SAL.01

TC_ID	RM.SAL.01
Purpose	Show attendance logs of the classroom
Requirements	3.2.3
Priority	H
Estimated Time Needed	40 Minute
Dependency	Lecturer login, Scan beacon test cases passed. Bluetooth services is running.
Setup	Lecturer should login the system.
Procedure	[A01] "Show Attendance Log" button is selected.
	[V01] Observe that a list of absent and attended student list displayed.
Cleanup	Go to welcome page

6.6.32. SM.TI.01

TC_ID	SM.TI.01
Purpose	Open the camera
Requirements	3.2.4
Priority	H
Estimated Time Needed	2 Minute
Dependency	Student login test case should pass.
Setup	Login to the system as student.
Procedure	[A01] Give a permission to the application for using the camera and click "Take Image" button.
	[V01] Observe that the phone's camera is opened.
Cleanup	Logout from the system

6.6.33. SM.TI.02

TC_ID	SM.TI.02
Purpose	Take a picture
Requirements	3.2.4
Priority	H
Estimated Time Needed	2 Minute
Dependency	Open camera test case should pass.
Setup	Login to the system as student and select secure mode.
Procedure	[A01] Take a picture.

	[V01] Observe that "Photo is taken successfully. Photograph and its location records is saved." message is displayed.
Cleanup	Logout from the system

6.6.34. SM.UI.01

TC_ID	SM.UI.01
Purpose	Upload a picture
Requirements	3.2.4
Priority	H
Estimated Time Needed	2 Minute
Dependency	Login test case should pass.
Setup	Login to the system as student and select secure mode.
Procedure	[A01] Click "Upload Image" button.
	[V01] Observe that if there is no taken photograph, "You must take a photo first." message should displayed.
Cleanup	Logout from the system

6.6.35. SM.UI.02

TC_ID	SM.UI.01
Purpose	Upload a picture
Requirements	3.2.4
Priority	H
Estimated Time Needed	2 Minute
Dependency	Login test case should pass.
Setup	Login to the system as student and select secure mode.
Procedure	[A01] Click "Upload Image" button.
	[V01] Observe that if there is a taken photograph, "Your photograph is uploaded successfully." message should be displayed.
Cleanup	Logout from the system

6.6.36. SM.SI.01

TC_ID	SM.SI.01
Purpose	See the taken images.
Requirements	3.2.4
Priority	H
Estimated Time Needed	2 Minute
Dependency	Login lecturer test case should pass.
Setup	Login to the system as lecturer.
Procedure	[A01] Click "Show Images" button.
	[V01] Observe that all the taken images for appropriate lecture is displayed.
Cleanup	Logout from the system

6.6.37. SM.TA.01

TC_ID	SM.TA.01
Purpose	Take attendance corrertly
Requirements	3.2.4
Priority	H
Estimated Time Needed	2 Minute
Dependency	Show images test case should pass.
Setup	Login to the system as lecturer.
Procedure	[A01] Click the check boxes beside the photographs.
	[V01] Observe that for each student, "Student is marked as attended" message should be displayed.
Cleanup	Logout from the system

6.6.38. RS.SC.01

TC_ID	RS.SC.01
Purpose	Select a course from the dropdown list.
Requirements	3.2.5
Priority	Medium
Estimated Time Needed	2 Minutes
Dependency	Login test case should pass.
Setup	Login to the system either as a lecturer or as a student.
Procedure	[A01] Click the "Show Report" button from the navigation bar at the left-side of the screen.
	[V01] Observe that a dropdown list appears.
	[A02] Select a course from the dropdown list.
	[V01] Observe that an interface is displayed which including the reporting options.
Cleanup	Logout from the system

6.6.39. RS.SDR.01

TC_ID	RS.SDR.01
Purpose	Show daily report.
Requirements	3.2.5
Priority	Medium
Estimated Time Needed	2 Minutes
Dependency	Login test case should pass.
Setup	Login to the system either as a lecturer or as a student and click "Select Course" button from the reporting menu.
Procedure	[A01] Select a course from the dropdown list.
	[V01] Observe that an interface is displayed with a calendar.
Cleanup	Logout from the system

6.6.40. RS.SDR.02

TC_ID	RS.SDR.02
Purpose	Update the attendance table.

Requirements	3.2.5
Priority	Medium
Estimated Time Needed	2 Minutes
Dependency	Show daily report test case should pass
Setup	Login to the system either as a lecturer or as a student and click "Select Course" button from the reporting menu.
Procedure	[A01] Select a course from the dropdown list and select the check boxes for the date.
	[V01] Observe that an attendance report table is updated for the given date.
Cleanup	Logout from the system

6.6.41.   RS.SWR.01

TC_ID	RS.SWR.01
Purpose	Show weekly report.
Requirements	3.2.5
Priority	Medium
Estimated Time Needed	2 Minutes
Dependency	Login test case should pass
Setup	Login to the system either as a lecturer or as a student and click "Select Course" button from the reporting menu.
Procedure	[A01] Select a course from the dropdown list.
	[V01] Observe that an interface is displayed with a calendar.
Cleanup	Logout from the system

6.6.42.   RS.SWR.02

TC_ID	RS.SWR.02
Purpose	Update the attendance table.
Requirements	3.2.5
Priority	Medium
Estimated Time Needed	2 Minutes
Dependency	Show weekly report test case should pass
Setup	Login to the system either as a lecturer or as a student and click "Select Course" button from the reporting menu.
Procedure	[A01] Select a course from the dropdown list and select the check boxes for the date.
	[V01] Observe that an attendance report table is updated for the selected date from the check boxes.
Cleanup	Logout from the system

6.6.43.   RS.SMR.01

TC_ID	RS.SMR.01
Purpose	Show monthly report.
Requirements	3.2.5
Priority	Medium
Estimated Time Needed	2 Minutes
Dependency	Login test case should pass

Setup	Login to the system either as a lecturer or as a student and click "Select Course" button from the reporting menu.
Procedure	[A01] Select a course from the dropdown list.
	[V01] Observe that an interface is displayed with a calendar.
Cleanup	Logout from the system

6.6.44.   RS.SMR.02

TC_ID	RS.SMR.02
Purpose	Update the attendance table.
Requirements	3.2.5
Priority	Medium
Estimated Time Needed	2 Minutes
Dependency	Show monthly report test case should pass
Setup	Login to the system either as a lecturer or as a student and click "Select Course" button from the reporting menu.
Procedure	[A01] Select a course from the dropdown list and select the check boxes for the date.
	[V01] Observe that an attendance report table is updated for the selected date from the check boxes.
Cleanup	Logout from the system

6.6.45.   RS.RFL.01

TC_ID	RS.RFL.01
Purpose	Generate a report that includes the attendance information.
Requirements	3.2.5
Priority	High
Estimated Time Needed	4 Minutes
Dependency	A lecturer must be assigned for at least one course and at least one lecture's attendance must be tracked.
Setup	Login to the system as lecturer.
Procedure	[A01] Select a course from the dropdown list and select the check boxes for the date.
	[V01] Observe that "Report generated successfully" message is displayed.
Cleanup	Close report interface

6.6.46.   RS.RFL.02

TC_ID	RS.RFL.01
Purpose	Display generated report
Requirements	3.2.5

Priority	High
Estimated Time Needed	4 Minutes
Dependency	Generate report test case should pass.
Setup	Login to thte system as lecturer.
Procedure	[A01] Select a course from the dropdown list.
	[V01] Observe that a report that includes all the students' names, surnames, student IDs and the number of hours that each of student attended to the course.
Cleanup	Close report interface

6.6.47.   RS.RFS.01

TC_ID	RS.RFS.01
Purpose	Generate a report that includes the attendance information of the student.
Requirements	3.2.5
Priority	High
Estimated Time Needed	4 Minutes
Dependency	A student must be assigned for at least one course and at least one student's attendance must be tracked.
Setup	Login to the system as student.
Procedure	[A01] Select a course from the dropdown list
	[V01] Observe that "Report generated successfully" message is displayed
Cleanup	Close report interface

6.6.48.   RS.RFS.02

TC_ID	RS.RFS.02
Purpose	Display generated report
Requirements	3.2.5
Priority	High
Estimated Time Needed	4 Minutes
Dependency	Generate report test case should pass.
Setup	Login to thte system as student.
Procedure	[A01] Select a course from the dropdown list and select the check boxes for the date.
	[V01] Observe that a report that includes the number of hours that the student attended, absent and attended dates.
Cleanup	Close report interface

7. Test Results

7.1. Individual Test Result

TC ID	Priority	Date Run	Run By	Result	Explanation
GUI.LGNP_BTN.01	H	14.05.2018	Melihşah Akın	Pass	Login interface is displayed.
GUI.RGSP_BTN.01	H	14.05.2018	Melihşah Akın	Pass	Register interface is displayed.
GUI.SLGN_BTN.01	L	14.05.2018	Melihşah Akın	Pass	Login is successful. Student welcome page is displayed.
GUI.SLGN_BTN.02	L	14.05.2018	Melihşah Akın	Pass	Login is failed. Error message is displayed.
GUI.LLGN_BTN.01	L	14.05.2018	Melihşah Akın	Pass	Login is successful. Lecturer welcome page is displayed.
GUI.LLGN_BTN.02	L	14.05.2018	Melihşah Akın	Pass	Login is failed. Error message is displayed.
GUI.ALGN_BTN.01	L	14.05.2018	Melihşah Akın	Pass	Login is successful. Admin panel is displayed.
GUI.ALGN_BTN.02	L	14.05.2018	Melihşah Akın	Pass	Login is failed. Error message is displayed.
GUI.LOUT_BTN.01	M	14.05.2018	Melihşah Akın	Pass	User is logout from the system.
GUI.SR_BTN.01	M	14.05.2018	Melihşah Akın	Pass	Report interface is displayed.
GUI.SB_BTN.01	M	14.05.2018	Melihşah Akın	Pass	Settings panel is displayed.
GUI.INITS_BTN.01	H	14.05.2018	Melihşah Akın	Pass	Permission is asked at the beginning of the application.
GUI.CAS_BTN.01	H	14.05.2018	Melihşah Akın	Pass	Assignment interface is displayed.
GUI.INITS_BTN.02	H	14.05.2018	Melihşah Akın	Pass	Regular mode is initiated automatically.
GUI.CP_BTN.01	M	14.05.2018	Melihşah Akın	Pass	Password is changed.
GUI.DS_BTN.01	L	14.05.2018	Melihşah Akın	Pass	Student is deleted.
GUI.DL_BTN.01	L	14.05.2018	Melihşah Akın	Pass	Lecturer is deleted.
GUI.SLS_BTN.01	L	14.05.2018	Melihşah Akın	Pass	List of students is displayed.
GUI.SS_BTN.01	L	14.05.2018	Melihşah Akın	Pass	Searched student is displayed.
GUI.SL_BTN.01	L	14.05.2018	Melihşah Akın	Pass	Searched lecturer is displayed.
GUI.ACA_BTN.01	M	14.05.2018	Melihşah	Pass	Relationship is built

TC ID	Priority	Date Run	Run By	Result	Explanation
			Akın		successfully.
GUI.UCA_BTN.01	M	14.05.2018	Melihşah Akın	Pass	Relationship is updated successfully.
GUI.DCA_BTN.01	M	14.05.2018	Melihşah Akın	Pass	Relationship is deleted successfully.
GUI.AD_BTN.01	L	14.05.2018	Melihşah Akın	Pass	New admin is added.
GUI.DA_BTN.01	L	14.05.2018	Melihşah Akın	Pass	Admin is deleted.

TC ID	Priority	Date Run	Run By	Result	Explanation
RM.SCANB.01	H	14.05.2018	D. Mertcan Kökcür	Pass	Error message is displayed.
RM.SCANB.02	H	14.05.2018	D. Mertcan Kökcür	Pass	Permission is granted.
RM.SCANB.03	H	14.05.2018	D. Mertcan Kökcür	Pass	Scanning nearby beacons is successful.
RM.CTLE.01	H	14.05.2018	D. Mertcan Kökcür	Pass	Log entry is captured.
RM.CTLE.02	H	14.05.2018	D. Mertcan Kökcür	Pass	Duration is calculated end stored on database successfully.
RM.SAL.01	M	14.05.2018	D. Mertcan Kökcür	Pass	List of attended and absent students is displayed.

TC ID	Priority	Date Run	Run By	Result	Explanation
SM.TI.01	H	15.05.2018	D. Mertcan Kökcür	Pass	Permission to access camera is asked and camera view is displayed.
SM.TI.02	H	15.05.2018	D. Mertcan Kökcür	Pass	Photograph is taken.
SM.UI.01	H	15.05.2018	D. Mertcan Kökcür	Pass	Error message is displayed.
SM.UI.02	H	15.05.2018	D. Mertcan Kökcür	Pass	Taken photograph is uploaded successfully.
SM.SI.01	H	15.05.2018	D. Mertcan Kökcür	Pass	Taken photographs are displayed.
SM.TA.01	H	15.05.2018	D.	Pass	Student is marked as

TC ID	Priority	Date Run	Run By	Result	Explanation
			Mertcan Kökcür		attended.

TC ID	Priority	Date Run	Run By	Result	Explanation
RS.SC.01	M	16.05.2018	Berkan Gürel	Pass	Course list is displayed.
RS.SDR.01	M	16.05.2018	Berkan Gürel	Pass	Calendar is displayed.
RS.SDR.02	M	16.05.2018	Berkan Gürel	Pass	Daily report of the classroom is displayed.
RS.SWR.01	M	16.05.2018	Berkan Gürel	Pass	Calendar is displayed.
RS.SWR.02	M	16.05.2018	Berkan Gürel	Pass	Weekly report is displayed under the calendar.
RS.SMR.01	M	16.05.2018	Berkan Gürel	Pass	Calendar is displayed.
RS.SMR.02	M	16.05.2018	Berkan Gürel	Pass	Monthly report is displayed under the calendar.
RS.RFL.01	H	16.05.2018	Berkan Gürel	Pass	Report is generated.
RS.RFL.02	M	16.05.2018	Berkan Gürel	Pass	Generated report is displayed.
RS.RFS.01	H	16.05.2018	Berkan Gürel	Pass	Report is generated.
RS.RFS.02	M	16.05.2018	Berkan Gürel	Pass	Generated report is displayed.

7.2. Summary of Test Results

Priority	Number of TCs	Executed	Passed
H	18	18	18
M	17	17	17
L	13	13	13
Total	48	48	48

We have executed 49 test cases and also full of them are passed. Moreover, 35 of high and medium priority test cases are passed. As a result, exit criteria is met.

7.3. Exit Criteria

We have executed all test cases that we identified and 100% of them are passed. Also, 100% of high and medium priority test cases are passed. Software development activities are completed within the timeline. As a result, exit criteria is met.

8. Conclusions

This document contains an extensive information about the project that is named as "Design and Implementation of Attendance Tracking and Monitoring System using with BLE Beacon". In this project, we have aimed to create a new solution to the problem that we named as "Tracking the attendances in the courses". To be able to do that, we plan to use Bluetooth Low Energy (BLE) Beacon device which can be used by mobile application which is developed for it. Main purpose of selecting the BLE Beacon device is that BLE Beacon device provides the most beneficial indoor positioning estimation across all the indoor positioning devices.

We have made a lot of research about BLE Beacon device, its related technologies and similar works. We have researched the similar projects and tried to understand how the mobile application can be developed as working accurately with the BLE Beacon device. After the researches, we have decided the requirements that our project should meet. As a result of gathering these requirements, we have prepared the SRS document to specialize all requirements. After that, we have decided a developing plan for our product and this plan is explained in SDD document. Within these period, we have decided our development methodology that we want to use while we are developing the project.

In the light of all these information, we have discovered that there is no project that can be a solution to our problem despite of there are some related works about the indoor positioning. One of the advantages of our project is that to have a chance reducing the time that is wasted on tracking the attendance in the lectures by the attendance sheet. Because of the attendance will be tracked automatically in the lectures, there will be no time that will be wasted on tracking the attendance. Therefore, we claim that our project can be easily considered as time-effective. Secondly, handling the attendance of each course for both students and lecturers will be easy because our final product will have a reporting system such that lecturers can see daily, weekly and the report that contains the attendance of whole semester for each course that they give. Also, students can see their attendances in each course that they take in the semester. Thus, attendance in the lectures can be easily handled and lecturers and students will not experience any confusion on that subject.

9. Compilation & Installation Guide

In our project, we have both an Android application and a web panel for the lecturers. To see our web panel, you should go to this website: www.attendancesystem.xyz/panel

For our Android application, you can install it by choosing one of these options below.

9.1. Install with the file .apk file

You can download .apk file to your phone and install it by giving a permission to your phone to install .apk files so that our application can be installed to your phone.

Minimum System Requirements:

Android version 5.0 or more

9.2. Downloading the source codes and open the application from the Android Studio

Firstly, you must download and install the Android Studio tool from this link: https://developer.android.com/studio/

After installation of Android Studio tool is finished, you should download and unzip the latest version of our source code from the "Releases" tab in our Github repository.

Then, you should open Android Studio and follow these steps from the Android Studio window:

1. File->Open->Directory that our source codes are placed->Select the file that has an image of Android Studio near of it->Click "Open"

2. After our source codes are opened, click the "Run" button from the top of the Android Studio UI.

3. Make a connection between your Android phone and your computer with a USB cable.

4. Select your phone from the pop-up window that should occur after you click "Run" button.

5. After selecting your phone, Click "Run" button

6. After the application is opened in your phone you do not need to make a connection between your phone and your computer because it should be installed to your phone.

10. User Manual

WARNINGS ABOUT PRE-USE

1. Make sure that you have read the "Installation and Compilation Guide" from our GitHub repository.

2. Make sure that you have a BLE Beacon device if you want to track attendances in courses.

3. Make sure that you have a phone that has minimum Android 5.0 version.

4. If you want to run our application from our source codes, make sure that Android Studio is working properly on your computer.

5. Make sure that you have proper internet connection on your phone to use the system more accurately.

10.1. General Description of System
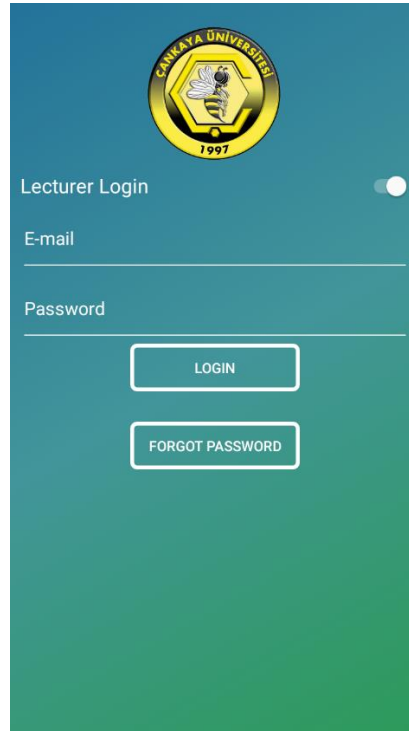
General purpose of this project is tracking the attendances in lectures in a more efficient and accurate way. To be able to do this, project includes two main components which are Android application and BLE Beacon device. Attendance Tracking process starts with capturing the signals from the Beacon device in the application. Additionally, application tries to check whether a signal is captured or not in 2.5 minutes cycles and saves this cycle times inside the phone. In a particular amount of time, system add these values up and sends them to the database to identify how many minutes student takes place in classroom.

10.2. How to Use

Our system can be used by both students and lecturers with their own needs. All users must be registered to the system to use the features of it.

10.2.1.　Lecturer Usage

10.2.1.1.　Login System

Figure.13: Login Page for Lecturer

Lecturers should login to the system by enabling the switch under the university logo from the window that is shown in Fig.1 with their e-mail addresses and passwords.

10.2.1.2. Welcome Page of Lecturer
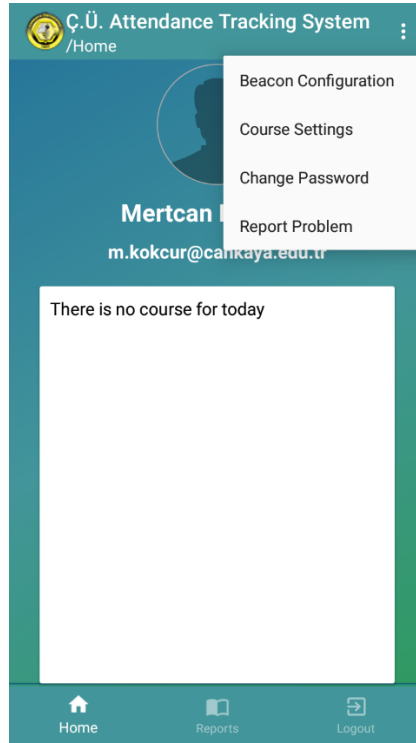
Figure.14: Welcome Page for Lecturer

In this window, there are several functionalities that lecturer can use which are Beacon Configuration, Course Settings, Change Password, Report Problem and Reports.

- **Beacon Configuration**
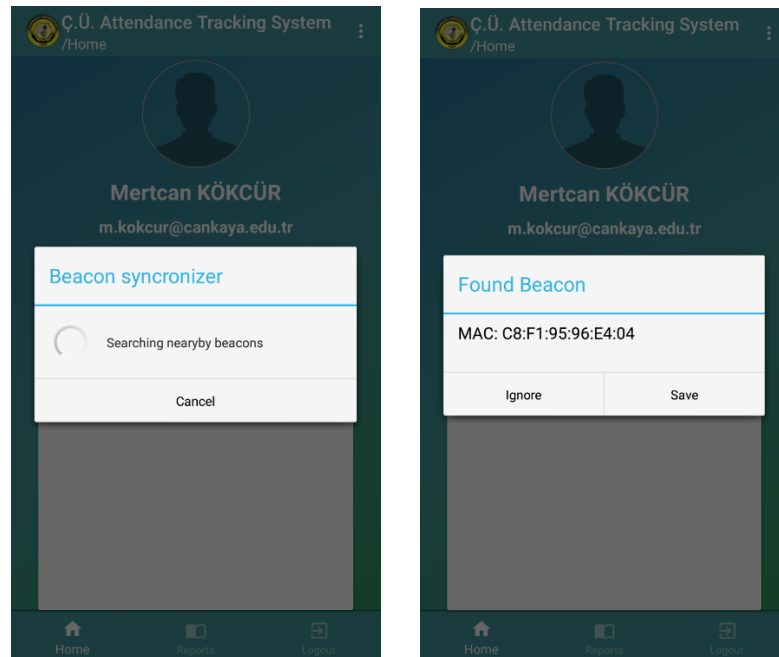
Figure 15 and Figure 16: Beacon Configuration Pop-Up

Lecturer can match his/her Beacon device with his/her account by selecting this option. After selecting this option, and pop-up is opened, system starts to search for the devices that broadcasts Bluetooth Low Energy signals and if system finds a device, prints its mac address to the screen so that lecturer can decide whether this mac address matches with his/her device and lecturer can press "Save" or "Cancel" button from this pop-up window. If lecturer press "Cancel" button for any device, this device will not appear on that screen until lecturer starts this process by choosing "Beacon Configuration" button.
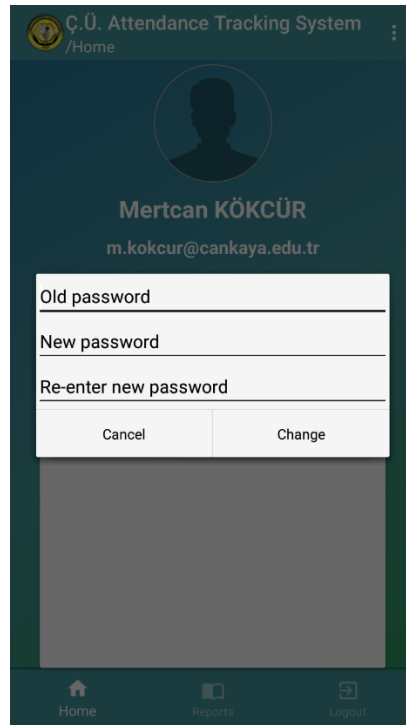
- **Course Settings**

Figure 17: Course Settings for Lecturer

Lecturer can select a course that s/he gives from the drop-down list and set "Nearly Attended" and "Fully Attended" percentages for that course in this window. These percentages will be used inside the system to identify the attendance status for each student who takes this course.

- **Change Password**
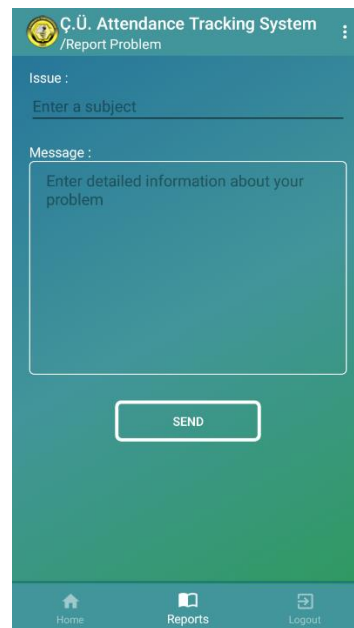
Figure 18: Change Password Pop-Up

Lecturer can change his/her password by selecting this option. When this option is selected, a pop-up window that includes one field for old and two fields for new password is opened and lecturer cam change his/her password by filling all the fields correctly.

- **Report Problem**

Figure 19: Report Problem Window

Lecturer can report any problem by selecting this option to the administrators. In this window, lecturer should enter the issue subject and detailed description about the problem.

• **Reports for Lecturer**

This filed is one of the most important and detailed part of the project. Because, all attendance information about the students is identified and shown in this part. So, there are some sub-parts inside this part.

A. Calendar View

Figure 20: Calendar View for Reporting

This is the main view field of the Reports section of lecturer. From this view, lecturer can select the dates that are filled with blue and after selecting it, list of the lectures on that day will be displayed.

a. List of Lectures Pop-Up
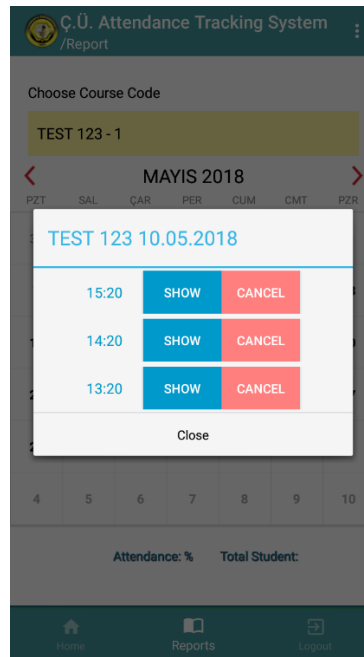
Figure 21: List of Lectures Pop-Up for Lecturer

In this pop-up, lecturer can see the reports of each lecture whose attendance is tracked by clicking the "Show" button and list-view which contains all the students that take this course with their attendance status for that lecture. If "Cancel" button is selected, this means that lecturer cancels this lecture's attendance and all the information about that lecture is deleted from both system and database.

b. List-View of Students
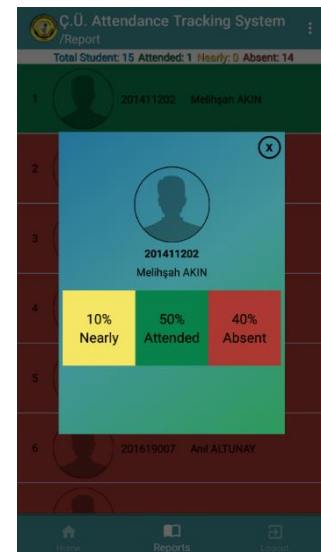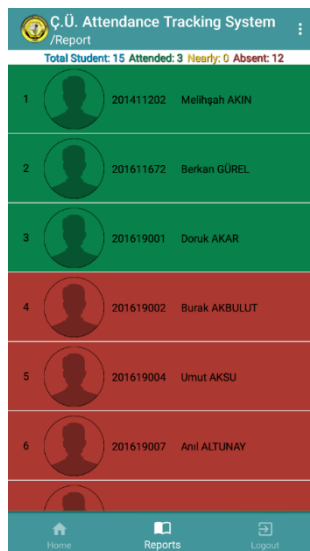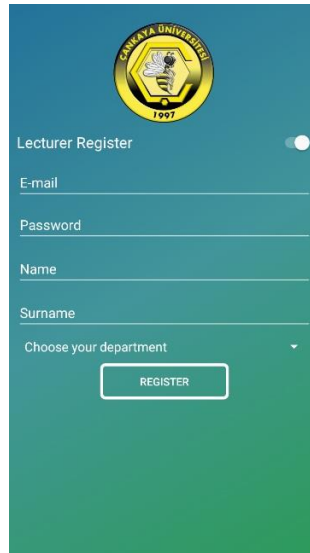
Figure 22: List of Students Pop-Up   Figure 23: Total Attendance for Specific Student

This view contains the students that take the course with their attendance status on selected lecture. Red field means that student is absent, green mark means that student is fully attended. There is no yellow field on that screen but yellow field means that student is nearly attended to the lecture. Also, lecturers can press on any student and see their total attendance status on the course.

10.2.1.3. Registration for Lecturer
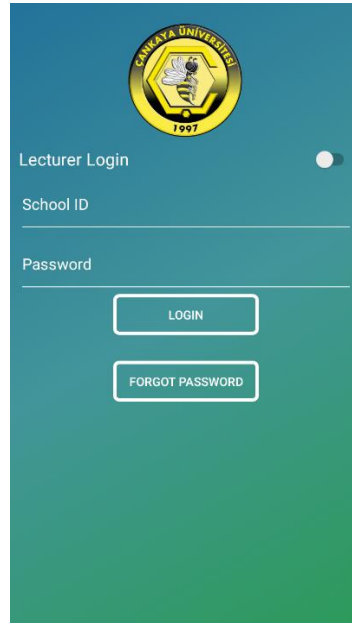
Figure 24: Registration for Lecturer

In this window, lecturer can register into the system with entering school e-mail address, password, name, surname and his/her department.

10.2.2.   Student Usage

10.2.2.1.   Login System
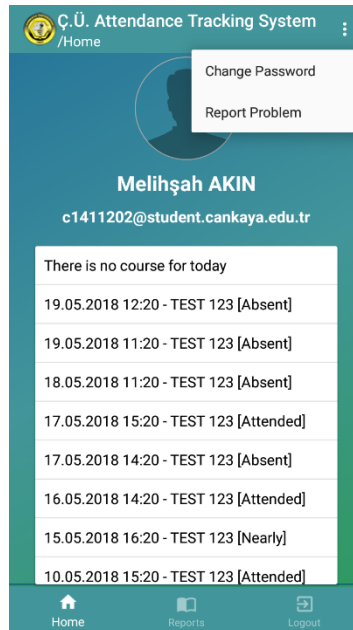
Figure 25: Login for Student

From this window, student can login into the system with entering his/her school id and password.

10.2.2.2.   Welcome Page

Figure 26: Welcome Page for Student

Student can see his/her attendance status on last 15 lectures from welcome page. Additionally, "Report Problem" and "Change Password" options have exactly same features that lecturer has. However, "Reports" feature of student is different according to students' needs.

- **Reports for Students**

Likewise, in the "Reports for Lecturer" feature, this feature has its sub-parts in it.
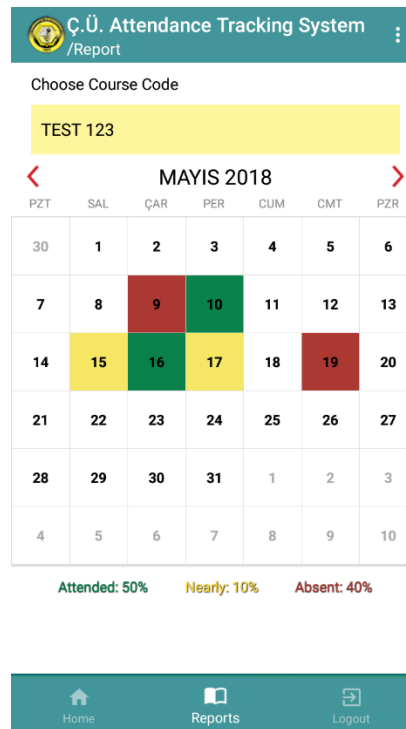
A. **Calendar View**

Figure 27: Calendar View for Students

Student can see his/her total attendance status on selected course at the bottom of this page. Additionally, s/he can see the partial attendance status on each day. Colors that fill the day-boxes on calendar view represent the meanings below:

- Green: Student fully attended every lecture on that day.
- Yellow: Student nearly or fully attended at least one lecture on that day.
- Red: Student did not attend any lecture on that day.

Additionally, student can see which lectures s/he attended on any day by pressing on the day that s/he wants to see.
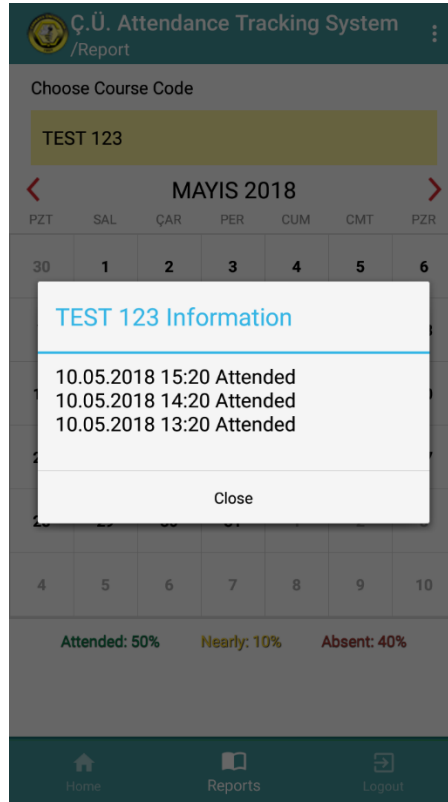
B. List of Lectures

Figure 28: List of Courses for Students

Student can see the date and attendance status of the selected course on selected date from this view.

Acknowledgement

References

[1]- Cooper, M., Biehl, J., Filby, G., & Kratz, S. (2016). LoCo: boosting for indoor location classification combining Wi-Fi and BLE. Personal and Ubiquitous Computing, 20(1), 83-96.

[2]- Oosterlinck, D., Benoit, D., Baecke, P. and Van de Weghe, N. (2017). Bluetooth tracking of humans in an indoor environment: An application to shopping mall visits. Applied Geography, 78, pp.55-65.

[3]- Subedi, S., Kwon, G. R., Shin, S., Hwang, S. S., & Pyun, J. Y. (2016, July). Beacon based indoor positioning system using weighted centroid localization approach. In Ubiquitous and Future Networks (ICUFN), 2016 Eighth International Conference on (pp. 1016-1019). IEEE.

[4]- Newman, N. (2014). Apple iBeacon technology briefing. Journal of Direct, Data and Digital Marketing Practice, 15 (3), 222-225.

[5]- "Google Eddystone™ and Platform Overview" Available at: https://developers.google.com/beacons/overview

[6]- Conte, G., De Marchi, M., Nacci, A. A., Rana, V., & Sciuto, D. (2014, November). BlueSentinel: a first approach using iBeacon for an energy efficient occupancy detection system. In BuildSys@ SenSys (pp. 11-19).

[7]- Zou, H., Jiang, H., Luo, Y., Zhu, J., Lu, X., & Xie, L. (2016). Bluedetect: An ibeacon-enabled scheme for accurate and energy-efficient indoor-outdoor detection and seamless location-based service. Sensors, 16(2), 268.

[8]-Altbeacon[Online]. Avaliable at: https://github.com/AltBeacon/spec

[9]- S. Klein, Professional WCF programming. Indianapolis, IN: Wiley Pub, 2007, pp. 3-37.

[10]- E. Newcomer and G. Lomow, Understanding SOA with web services. Upper Saddle River, NJ ; Munich [u.a.]: Addison-Wesley, 2007.

[11]- "What Is Windows Communication Foundation", Docs.microsoft.com, 2017. [Online]. Available: https://docs.microsoft.com/en-us/dotnet/framework/wcf/whats-wcf. [Accessed: 29-Oct- 2017].

[12]- Gronli, T. M., Hansen, J., Ghinea, G., & Younas, M. (2014, May). Mobile application platform heterogeneity: Android vs Windows Phone vs iOS vs Firefox OS. In Advanced Information Networking and Applications (AINA), 2014 IEEE 28th International Conference on (pp. 635-641). IEEE.

[13]- Android Studio The Official IDE for Android. (2017, October 25). Retrieved October 29, 2017, from https://developer.android.com/studio/index.html.

[14]- SQLite Home Page. (n.d.). Retrieved October 29, 2017, from https://www.sqlite.org/

[15]- Swift Apple Developer. (2017, November). Retwieved November 01,2017 from https://developer.apple.com/swift/