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Structural and Behavioral Models of RFID-based Students Attendance System Using Model-View-Controller Pattern

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ABSTRACT

A student attendance management system is needed by higher education institution due to the fact that the students' attendance are one of the critical factors which decide their academic achievement. The practice of managing the attendance based on the signatures collected on papers is considered inefficient. This paper presents a set of structural and behavioral models which can be implemented as a student attendance management system which utilizes RFID technology. The ability of RFID tags to promptly deliver accurate authentication information should improve the students attendance management process efficiency. The structural and behavioral models presented in this paper are using UML class diagram and sequence diagram notations. The models are developed based on the technical architecture of model-view-controller (MVC) pattern.

Keywords: *structural model, class diagram, behavioral model, sequence diagram, RFID.*

1.Introduction

Students' academic achievement is one of the main excellence factors of any higher education institutions. Many researches have concluded that students' attendance are one of the most dominant factors that can decide their academic achievement. Students who attend classes more regularly tend to demonstrate better academic performance[5]. Students who generally do well in academic examinations are those who regularly attend their classes in punctual and proper way[4]. Another study has also stated that student's attendance was a better predictor of academic grade than any other factors[7].

Institutions which still use paper-based procedures are considered as inefficient, not only in attendance recording process but also in their efforts to produce various kinds of administrative reports. That practice will also require the institution management board to establish a good quality filing system to store the attendance records[8]. This indicates the urgency for a more efficient way of tackling the difficulties.

RFID (Radio Frequency Identification) is an automated identification and data collection technology which recently gains more attention because of its low cost and advanced uses[1]. RFID combines radio frequency and microchip technologies as identification, monitoring, and security system. RFID technology uses small chips called RFID tags which can store and transmit information to an RFID scanner device. It can be used both for retrieving and writing data on to RFID tags without physical contact with the scanner device[6]. The benefit of RFID technology in providing accurate data in shorter time will likely improve the efficiency of any systems which implement the technology[2].

2.Method

The object-oriented analysis and design approaches are most associated with a phased development methodology. The primary difference between a traditional approach like structured design and an object-oriented approach is how a problem is decomposed[3].

UML (Unified Modeling Language) is made up of a variety of modeling techniques, dealing with various aspects of the system development. This research uses following process which is adopted from the principles of object-oriented analysis and design approach and based on UML notations:

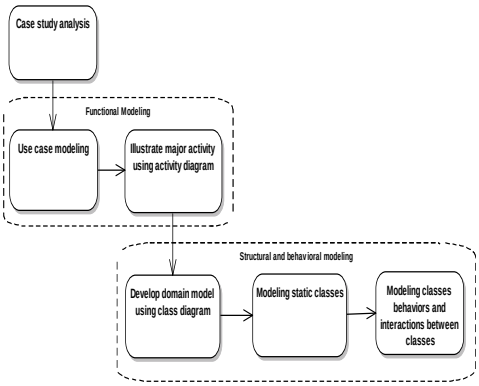

Figure 1: System analysis and design process

The first step after case study analysis is producing functional models based on identified business process and its functional requirements. The next step is producing structural and behavior models. In this step, class diagram notation is used to develop a domain model. Domain model are the representation of potential business objects which later can be converted as systems classes. Static classes are then developed based on domain models. Classes behaviors and any interactions that could possibly happened between classes are then presented by using sequence diagram.

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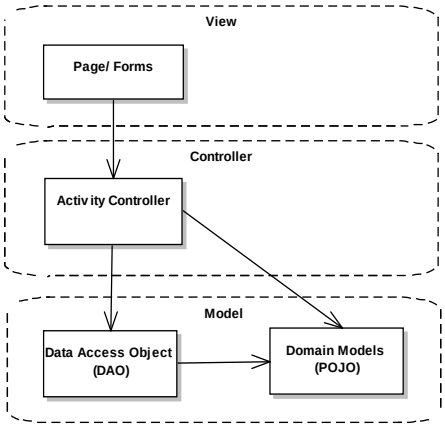


Figure 2: Model-View-Controller (MVC) technical architecture

3.Results

A functional model for student attendance system is represented by use cases models which describe the system's functions from the users' point of view. Functional model creation involves four sub-steps[11]: identifying actors and use cases, creating a use case model, creating the use case description, and analysis of the use cases.

The structural and behavioral modeling are developed based on Model-View-Controller (MVC) design pattern. The premise behind MVC pattern is that the application models are divided into three distinct areas[10]:

- **Model**: This is an object representation of the data, usually read from database.
- **View**: This is the boundary between the computer and the user, usually refers to the GUI (graphical user interface) form or web page.
- **Controller**: This is the connector between Model and View components. When a request is received by the system, the controller fetches the data from the model, decides which view to show the user, and hands the requisite data to the view.

In addition to MVC pattern explained above, the structural and behavioral models presented in this paper are also utilize Data Access Object (DAO) classes. A Data Access Object (DAO) provides an abstraction from the underlying database. A DAO class includes "finder" methods that access the database and return instances of domain classes

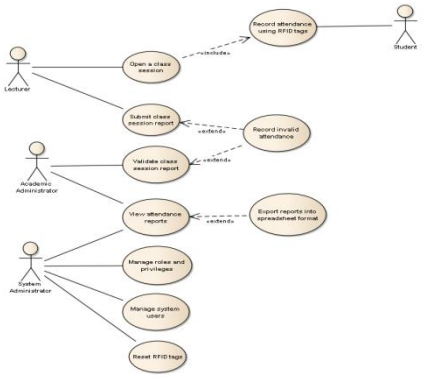


Figure 3: Attendance management system Use-Case Model

The identified main actors based on the business process analysis are lecturers, students, and academic administrators[9]. Additional actor is introduced to deal with administrative tasks of the proposed system, such as system users and privileges management.

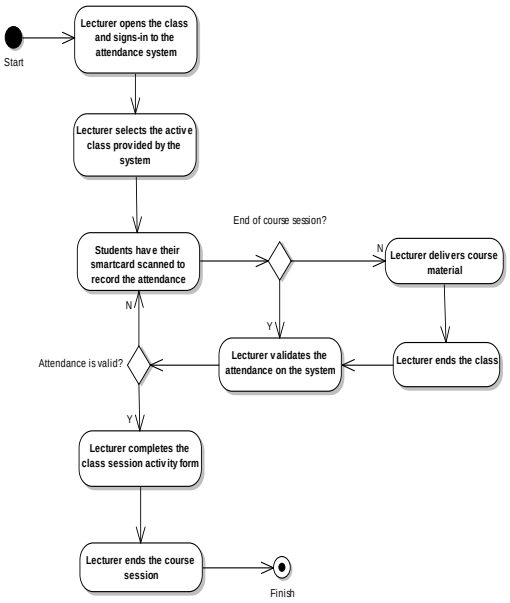


Figure 4: Activity model of the designed attendance recording process

Figure 4 above illustrates the designed process of student attendance management system which is proposed in this paper. Lecturers can use the system to begin the class and initiates the attendance recording process. Students can then use their own RFID tags to record their attendance to the system. At the end of the session, lecturers validate the attendance record and close the session by providing activity details into the system.

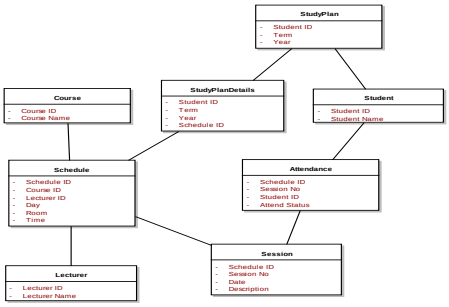


Figure 5: Domain model of student attendance management system

The functional model which is produced previously is then analyzed to develop the domain model of the system which is presented in Figure 5. The domain model consisted a number of classes related to the student attendance management process. The next step is to produce a set of static classes based on the domain models and MVC architectural pattern.

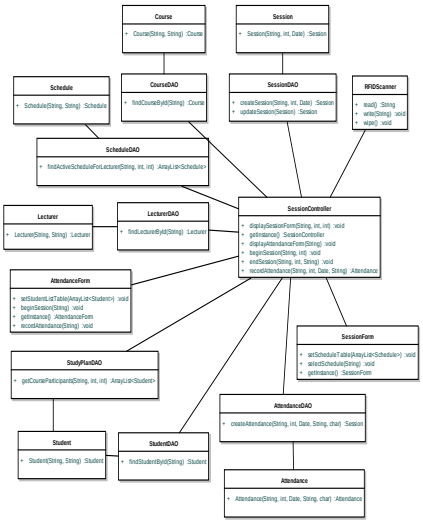


Figure 6: Static classes of student attendance management system

The static classes are presented in class diagram notation. Based on MVC pattern, the classes are classified into three distinct functions (model, view, and controller functions). The model classes consist of domain model classes and DAO classes. The domain classes are likely to be implemented into persistence objects, while the DAO classes handle any database-related functions of their respective domain model class.

A set of sequence diagrams are then produced after the static models are defined and classified by their respective functions. Sequence diagrams are used to illustrate behaviors of the classes and any interactions happened between them. The interactions are presented in the form of exchanging messages and procedure calls.

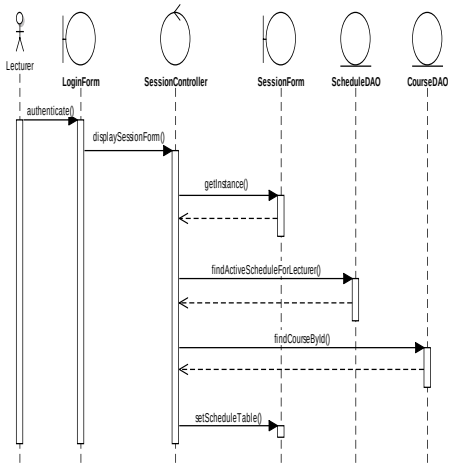
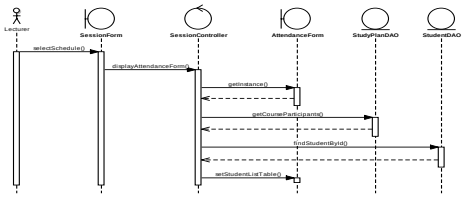


Figure 7: Sequence model of class schedule retrieval

The sequence model presented above illustrates the process that happened when the lecturer sign-in to the system. The system will retrieve any active class schedule which are associated with the lecturer. Any class schedule entries that are active in that term of year will be presented in the display and can be selected by the lecturer.



The sequence model presented above illustrates the process that is triggered when the lecturer select an available class which will be started soon. The system then retrieves any students records which are enrolled to the selected class. All of the students that associated with that class are displayed in the form and the attendance is ready to be recorded.

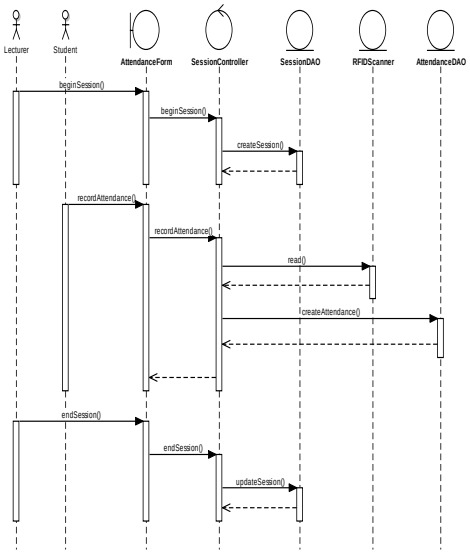


Figure 8: Sequence model of attendance recording

The sequence model presented above illustrates the fundamental process of the system. After the system displayed the participants list, the lecturer open the session and trigger the attendance recording process. After the session marked as open, the students can bring their RFID card near the scanner so the attendance can be recorded by the system. The RFIDScanner class can be developed as interface class and implemented based on any application programming interface (API) provided along with the RFID device.

4.Conclusion

The projected benefit of the proposed RFID-based attendance management system is to improve the efficiency of student attendance management process and also reduce the rate of errors in managing student's attendance records. The system is also aiming to help the academic administrators and management boards to provide any attendance reports based on certain set of criterias.

The set of structural and behavioral models presented in this article can be used as a blueprint to develop an RFID-based attendance management application system. The models can be implemented by using any programming language that endorse the object-oriented programming approach

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