The Development of a Web-Based Attendance System with RFID for Higher Education Institution in Binus University

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Abstract. This study focuses on the development of a web-based attendance system with RFID in a Indonesian higher education institution. The development of this system is motivated due to the fact that the students' attendance records are one of the important elements that reflect their academic achievements. However, the current manual practice implemented is causing such a hassle. Empowering the usage of the new RFID based student card, a new web based-attendance system has been built to cater the recording and reporting of not just the student's' attendances, but also the lecturer's and taught topics in the class. The development of this system is inspired by the senior management. And the system can be easily accessed through the learning management system and can generate a report in real time, This paper will discuss in details the development until the maintaining phase of the system. Result achieved is the innovation of developing the system proved reliable to support related business processes and empowered the intention to maximize the usage of the RFID card. Considered as a successful implementation, this paper will give an input for others who want to implement a similar system.

1 Introduction

Considered as one of the biggest private university in Indonesia, Binus has been in the higher education sector for more than 30 years. And like any other university, all of the on campus transaction like borrowing books and student services required the students to show their specific ID card, which is called Binusian Card. Basically it is to show the staff their student number and to make sure the one who is holding the card is the rightful owner whose picture is on the card.

Previously the card used barcode to make it easier to input the 10 digits that form the student number into any kind of system used in the university. But in 2008, the university partnered with one of the well-known private bank, BCA, to use their technology called Flazz Card as Binusian card. The Flazz Card uses Radio Frequency Identification (RFID) chip that can be used as cash replacement. So, now the card as shown in figure 1, not only functions as an identity inside the campus, but also as a mean of payment [1].

Fig. 1. Binusian Flazz Card.

1.1. Binusian Card with RFID

While since 2000 the university also had the experience of integrating learning management system (LMS) as a critical part of their day to day teaching, learning, and administrative processes. They even developed their own LMS called Binus Maya in 2005 which can be accessed through the internet. Empowering the LMS usage, over time BINUS University reengineered many of the previous paper based administrative process to be integrated to Binus Maya, http://binusmaya.binus.ac.id/.

The management then came up with the idea of using the new RFID based card as an input to record the student's attendance. Previously the process rely heavily to the attendance paper form where each student signed it when they do attend the class. And then the academic operational staff must input it to a desktop application for

every class transaction done. With over 200 classroom, 6 class sessions every day, And with 40 to 70 students in one class session, making it a very hectic and prone to inaccuracy process to do. However, this process is important because only students who attend most of the class as ruled by the university can take the exams.

This paper will discuss in details the development until the maintaining phase of the web-based attendance system using the new RFID based card. Although the use of RFID systems in educational institutions is not new, it is intended to show how the use of it came to solve daily problems in our university.

2 Related Theories

Student attendance has strong correlation with understanding the course. The poor student attendance is usually followed by the lack of their understanding of the course and it impact to their academic achievement in the end [2]. Most educational institutions' administrators are concerned about student irregular attendance [3].Therefore; student attendance record system is needed by the higher education institution. Traditional approach with paper and pen becomes difficult for the management to regularly update the attendance record and manually calculate the percentage of class attendance [4]. The more number of students and the more number of schedules means it is more difficult to maintain and manage the attendance records.

For this reason, the automation of student attendance records is needed by academic institution, for example using biometric systems such as fingerprint system. By using biometric systems such as fingerprint, recording student attendance became faster and more accurate than recording with paper manually. This biometric approach also has disadvantage like students queuing to put their finger into fingerprint reader [5].

Another solution for automation of student attendance record system is by using Radio Frequency Identification (RFID) technology. RFID enables wireless data collection by readers from electronic tags attached to or embedded in objects, for identification and other purposes. RFID systems involve software, network and database components that enable information to flow from tags to the organization's information infrastructure where it is processed and stored [6]. A real time system is implemented in conjunction with RFID hardware to record students' attendance at class. RFID is a technology that allows for a tag affixed on identity card to communicate wirelessly with a reader, in order for the tag's identifier to be retrieved [7]. Students only need to place their ID card on the reader and their attendance time will be recorded immediately in database real-time, it more accurate than conventional [8].

An RFID-based Auto-ID system is made up of a unique identification number, which is assigned to a particular item, an identity tag, which is attached to the item with a chip capable of storing a unique identification number, networked RFID readers, and data processing systems that are capable of collecting signals from multiple tags at high speeds and of preprocessing this data, and one or more networked databases that store the product information [9].

The value of RFID technology for managing business supply chains has only been recognized in recent years. The business press has since proclaimed that RFID marks a commercial innovation with the potential to soon replace barcode technology in the supply chains of numerous industries [10]. The RFID technology can often reduce or eliminate manual labor requirements. So overall, it provides faster processes, less inventory, less efforts, and better quality which provide direct cost savings [11]. To measure the value of an RFID investment, we have to understand the elements of the business and customer-related benefits as well as the costs, comprehensively [12].

3 Materials and Methods

The web-based attendance system was built with Prototype Model Approach, which consist of :

1. Preliminary User Requirements
2. Specifications Design Implementation Testing
3. Demonstration to User
4. Refinements to System Requirements
5. System Requirements Document

Fig. 2. Prototype Model

3.1. Prototype Model Approach

Prototype Model places more effort in creating the actual application instead of concentrating on documentation. This way, the application could be released in advance. Prototyping requires more user involvement and allows them to see and interact with a prototype allowing them to provide better and more complete feedback and specifications.

The presence of the prototype being examined by the user and their feedback is used to improve the application. The final product is more likely to user and developer agreement. It starts with an initial planning and ends with deployment with the cyclic interactions in between. Easier to test and debug during a smaller iteration. Easier to manage risk because risky pieces are identified and handled during its iteration [13].

Prototyping is the rapid development and testing of working models. It is an interactive, iterative process used during the design phase. It also makes development faster and easier, especially when end user requirements are hard to define and has enlarged the role of business stakeholders [14].

4 Results and Discussion

Below are the results and discussion derived from each phases of the prototyping as can be seen in section 3.

In the first phase which is the preliminary user requirement phase, we conduct the feasibility study to determine whether a new or improved system is a feasible solution to understand the business problems or the opportunities [15]. In this phase several meetings was held with the senior management and process owner to discuss how the current process works and problems that arose. And then how the new process could solves the problems. The results of these meetings were used to compare the users' preferences between the manual process and the proposed web-based system. From this, we then moved to the second phase.

In the second phase, we analyzed the requirements and develop the web-based attendance system design that covers user interface, data, and process according to the stakeholder's priorities. The design also will be constructed in logical and physical view. Here, the scope has also been identified. The system will only be used for all bachelor students in the regular program, could be accessed through the LMS, and could be integrated with the current backend system. The development of the new system then began. Along the way the system then was demonstrated to get approval for the process designed from the management. The approved process can be seen on Figure 3.
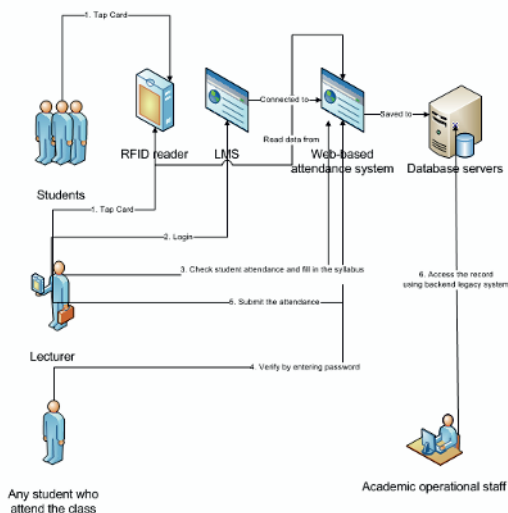
As seen, not only the system records the student's attendance, but also the lecturers. However, the system enable the lecturer to correct the student attendance based on the real condition e.g. student come but didn't bring their ID Card. The system is also being used to record progress of learning material taught on the class. Because it also required the lecturer to fill in which topics that have been discussed at that time. This was previously done on paper based forms.

As soon as all the readers (Figure 4) installed in all classrooms, the implementation process could begin. A radio-frequency identification system uses tags,or labels attached to the Binusian card to be identified. Two-way radio transmitter-receivers called readers (Figure 4) send a signal to the tag and read its response. The readers generally transmit their observations to a computer system running RFID software. The tag's information is stored electronically in a non-volatile memory. The RFID tag includes a small RF transmitter and receiver. An RFID reader transmits an encoded radio signal to interrogate the tag. The tag receives the message and responds with its identification information (Student ID). Student ID and their tapping time is recorded in database and using by the web for lecturer open the web to mark student attendance. [16]

Since some students and lecturers were still scheduled to get their new RFID based card, parallel conversion approach was used. With old and new process are run simultaneously until everyone is satisfied that the new system functions correctly and the old one is no longer needed [14]. Meaning the students still need to sign the attendance paper form and tap in their card. And since it is common to have the least class transaction in the compact semester, we decided that it was the best time for the first implementation. The first socialization was given to students and lecturers scheduled for the compact semester.

Fig. 3. Rich Picture of the New Process of Recording and Reporting Attendance

Fig. 4. RFID Reader

The real challenge actually started at the odd semester, as it had the most class transaction. Even before the semester started, socialization of the new system was conducted during the new student orientation and during the big meeting before class for all the lecturers. Socialization was also conducted for the senior students through the LMS and on class sessions.

Even though we had managed to improve the system on the first implementation, certain scenarios apparently are not covered in the original design. These scenarios was overlooked because it was rarely happened and only happened in certain conditions. And since the number of class transaction increased so many times compared to the compact semester, the initial prepared increase in server capacity was still not enough. This caused some technical issues and the system ran slow. Fortunately this was only a glitch to the day to day operation. Since the students were still signing the attendance paper form. We kept on monitoring the system performance and solved every new problems that arose. Then the system got updated almost an instance after the solution was discovered. Updates were done during the class breaks.

Even with many problems arise, strong management support enabled the new system being socialized appropriately to both students and lecturers and new servers added. The academic operational staffs were also continuously encouraged to use the new system. All of these efforts apparently managed to improve the system performance and lowering the user's resistance to use the new system.

In the end, after all of the students and lecturers got the new RFID based card. The attendance paper form was no longer needed to be used all the time. By that time the new system was also accepted as part of the business as usual in the university. The screenshots for the final version currently used can be seen below, on Figure 5 and Figure 6.
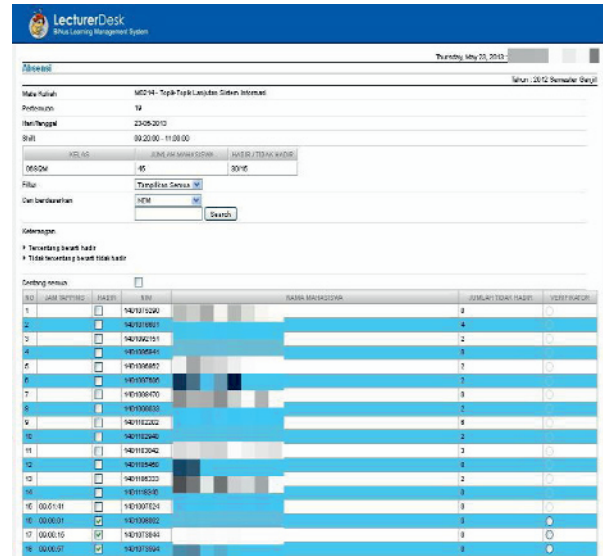

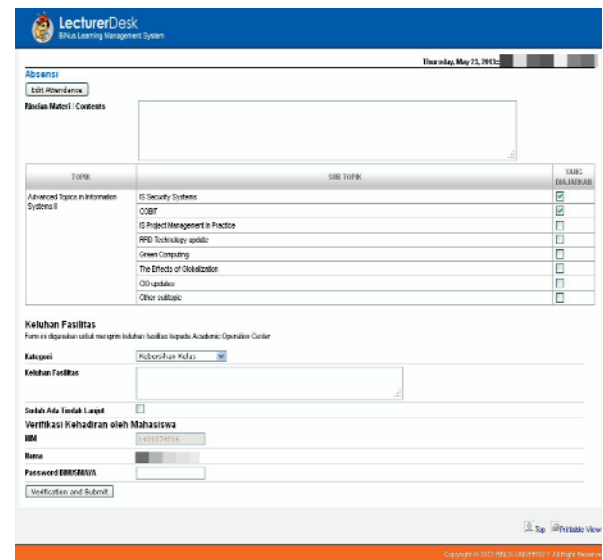**Fig. 5.** Web-based Attendance System Student List

Fig. 6. Web-based Attendance System Verification

5 Conclusions

The study has revealed that the system makes the process more efficient and time-saving. Since unless there is an electricity outage or system failure, there is no need for staff to input the student's attendance manually using the attendance paper form. The university also no longer has to save so many paper forms to support the regular internal and independent audit.

With such a large scale implementation, the decision to first try the system on compact semester where there were a few classes scheduled and using the parallel approach is appropriate. Management commitment also gives critical support to the success of the new system implementation. This is also makes the socialization process carried out appropriately to all of

stakeholders (students, lecturers, faculties, and academic operational staffs).

Now, with the new attendance process runs as business as usual, the implementation of the system is considered a success. The system is also far more stable and mature compared to when it is first used. The web-based attendance form is also being used as a way to capture any complaints from the lecturers related to the facilities inside the class, as shown on figure 6. So that, related staff can fix things right away for the next class session.

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