The development of Student Attendance System using RFID and Internet of Things (IoT) technology

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Abstract. The attendance of students in the classroom is reflecting their academic performance, the Department of Informatics Engineering in the Universitas Sebelas Maret used a manual way to record student attendance. The manual way is using papers to record student attendance and lecture activities, it may suffer to human error, because attendee can manipulate their presence and the departments can't monitor them. Radio Frequency Identification (RFID) can be applied to identify various things, because it has unique information codes saved in a special chip called tags. RFID can be applied to developed an attendance system prototype. The term of Internet of Things (IoT) can be described as an embedded system with internet data exchange, by using this technology we can monitored and controlled the devices, also we can integrate the database. The aim of this research is to measure the data speed of the prototype of RFID attendance system, the prototype has function to stored, process, and record the student attendance in the Department of Informatics Engineering.

1. Introduction
Recording the presence of students is one of the important factors to show their achievement in learning process. In addition, in-depth and detailed information about the students presence can determine achievement, productivity or progress of the institution in general[1]. Generally, the institution records the student's presence using a conventional recording tool by paper. Some of students often manipulate their attendance data, if a continuous monitoring is not done properly. Moreover the tradional way take’s time consuming and prone of error [1],[2],[3]. Therefore to avoid this problem, we can use Information and Communication Technology (ICT) to create autonomous systems to record students attendance with their presence in the course subjects[4].

In recent years, Student Attendance have been developed by using a various things such as magnetic stripe, RFID, barcode scanner, QR scanner, biometric and Computer Vision. Pireva on his research, proposed using RFID to create a management systems for student attendance [5]. The paper shows that the systems has presented a good solution web application using RFID technology for attending student classes. However the paper is mentioned that the systems need improvement which can send annaucement via bluetooth thus the students will know immediately their attendance has been recorded successfully. Meanwhile Kishore, etc proposed their research using Computer Vision technologies to develop an IoT based student’s attendance systems [2]. According to their paper, they used a face recognition on Raberry Pi to represent the student’s attendance. Sutar, etc in the research
built a smart attendance system using RFID and IoT, but in their works they used SMS Gateway to report the student attendance [6].

This paper proposed using a RFID to record the students' attendance and IoT as an infrastructure to handle the microcontroller and the management systems. Student’s use the RFID to tags on the reader which consist of Arduino Uno and Ethernet Shield, the information sent to the management system and recorded to the database. The system checked the information and calculate them to it’s course schedule. Furthermore in this research we propose to build a feature with automatic email send to each students to check their availability in the class.

2. Experimental
2.1. System Architecture
The term of Internet of Things or usually abbreviated IoT was proposed in 1999 by Kevin Ashton, which firstly describe a RFID identify the number of objects to a reader through wireless then send the information via internet as the base of it’s communication network [7]. Atabekov also stated that nowadays IoT became a new network paradigm which allows various physical entities in the world connect each other. In the other word we can conclude that IoT consist of specific purpose computer added with internet as their communication network.

This research built an IoT based on Arduino Uno and Wiznet Ethernet Shield, in addition Mifare RFC522 is used to read RFID tags and then sent the information to the management system via internet communication. The Management system’s is custommaly built with a several functions such as student management, lecturer management, course management, schedule management, course log data, sent recap of presence via email, etc. The general architecture of the systems is describe in figure 1 bellow:

![Figure 1. General architecture of the system](image)

The development of management systems is using XAMPP as the bundled software that consist of an Apache Web Server to distribute the web file, PHP for the language programming, MySQL as a database engine and phpmyadmin as a database management systems. Here we use Yii Framework for the language framework that much more stabil than other framework. Based on figure 1, in bref we can explanations about the process, RFID tags is for representing student’s attendance read by the RFID, and the server had an independent job to get the University course schedule and public email
server, meanwhile the web based attendance system used to display the student attendance and course log data.

2.2. Implementation
The hardware system is shown in figure 2, it is consist of Arduino Uno as the mainboard which we put the programming code in, it is mixed with the Wiznet Ethernet Shield to communicate and sent the information through internet communication network. Meanwhile the Mifare RFC522 is used to read the student’s tags and by using the ethernet shield we can use it’s library that contains of Client and Server Class to sent and receive the information to the host server.

![Schematic of the students attendance systems hardware](image)

**Figure 2.** Schematic of the students attendance systems hardware

The software management system contains of several functions that designed and operated to handle backend process such as user management, lecturer management, course log data management, synchronizing course schedule, sent the presence recapitulation to email, etc. Generally the operation is show in figure 3. First the server check te course schedule if true than activate the course log data so the lecturer and the students can tags their id. The systems would record the data to the database, and later it would analyze and sent the result to their email.

![Flowchart of the operational system](image)

**Figure 3.** Flowchart of the operational system

3. Results and Discussions
The testing scenario, there are 2 testing and that is a reading test for the hardware and an average speed test of whole system. In the reading test we used to determine the distance that covered by the hardware, in the reading test we get the result as shown in figure 4.
Figure 4 is describing distance (cm) in x-axis and reading probability in y-axis. This testing used 6 different RFID tags, tapped to the hardware and measured the probability. The picture illustrate that the tags can optimally read at 3-4 cm, above of it the hardware can not read.

Figure 5 is describing the average speed test of whole system, first the tags is read by hardware and then the information is send to the management system. Secondly, the managemenent system is record into the database and show them to user, so user can validate their presence in here. The test used 6 different tags and tapped to the hardware, furthermore it shown to the user. The above figure is show time (minute) in x-axis and speed of reading tags in y-axis. It illusrate the system can read the tags aproximately 9-12 times in 1 minute. The inteval of the system may have long interval, because it is set to avoid flooding on tags read.

4. Conclusion
The test shows that the hardware can read optimally at 3-4 cm when the tags tapped to it, and it shows the management system can read the tags within 9-12 times per minute. On the other hand, the system can handle to log the attendee, and it can manage the course log. The system can recap the presence of attendee and send them to their email privately.
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