Class Attendance System using Active RFID: A Review

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Abstract —The rapid growth of Information and Communication Technology field has made medium of information retrieval more advanced and complex. As the RFID has gained a lot of attention nowadays, the use of RFIDin a wide range application has been successfully developed. Thus, this paper describes a brief introduction to application of attendance system and reviews some application of attendance system and techniques of data retrieval such as smart card, biometrics, barcode and RFID itself. This ongoing research would be applicable in collecting student attendance in classroom using active RFID technology.

Keywords: *Active RFID, attendance system, databases*

INTRODUCTION

Attendance system is one of the most important things to ensure students attend for the particular lectures. Some universities regulate class attendance as compulsory to each student who registered for a particular course. Normally, in Malaysian university, students are required to attend the class not less than 80% per semester otherwise student will be barred from taking any examinations. Currently, the practice in taking attendance in class is using paper-based method which instructor or lecturer required to pass by the attendance sheet before begin the lecture while students required to initials the attendance sheet. These methods requires more time when the scale of the class is large.

Thus, the current practice can be further improved using active RFID technology which attendance can be collected without human intervention during lecture session. The proposed system is aims to simplify the process of collecting class attendance whereby the RFID reader automatically triggered the tags and verify the triggered data in databases.

ACTIVE RFID TECHNOLOGY

Active RFID is a technology that uses a radio wave to identify a physical object automatically where an active RFID tags have an on-board power source from battery, solar and electronics to perform specific tasks. It has an onboard power supply to transmit it data to a reader [1]. Generally, active RFID transponder have significantly greater read range than passive RFID that have less read range due to it does not have an internal power source [2].

Figure 1 illustrates the typically RFID tags consists of an embedded microchip to a radio antenna mounted on a substrate which can store up to 2 kilobytes of data.

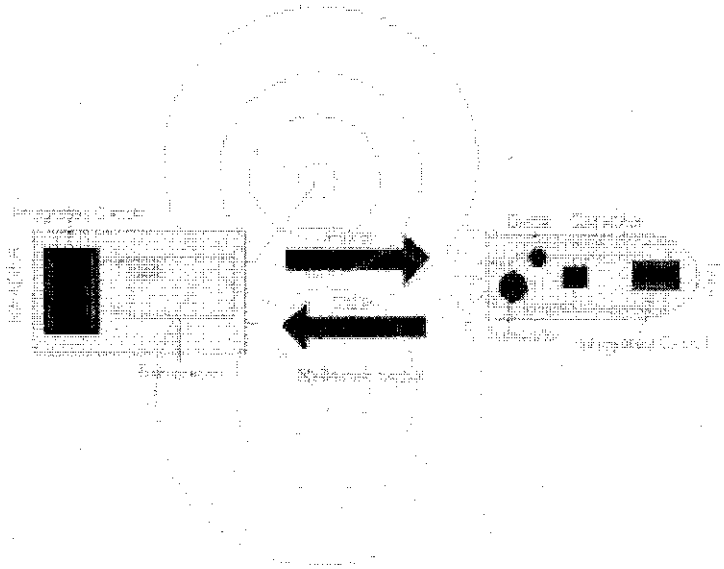

Figure 1: A Schematic of Power and Data Flow in a UHF RFID System

BLOCK DIAGRAM

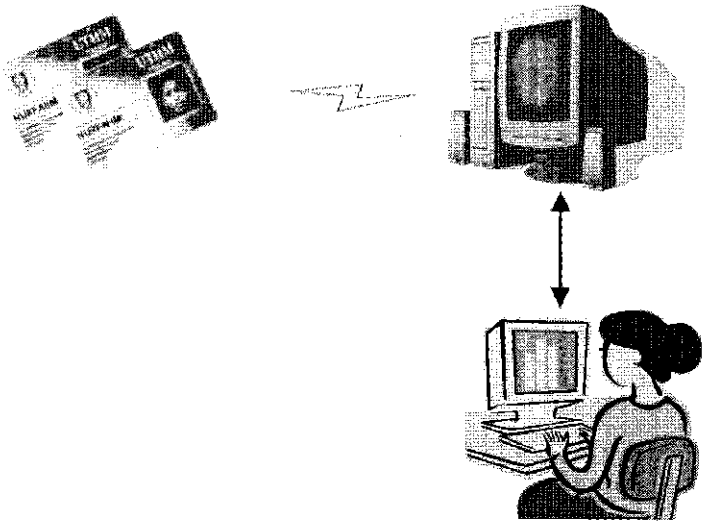

Figure 2: Overall Block Diagram

Figure 1 illustrate an overall view of the system which The RFID reader will detect the information that consists on matrix card from each students which the data will send from RFID tag to reader by using wireless connection. Then, the data will be sent to central computer. All the information will store in database and compare with the data that already in database. This is done to identify the status of the attendance. Finally, the administrator and lecturers can access and update the data in the database.

RELATED WORK

This section reviews of attendance system implementation some RFID application by the previous research. In early edition of wireless communication systems, there are a few technology have been successfully applied in attendance system such as biometrics, bar code, smart card and etc. RFID nowadays has taken a concern in providing wireless communications with security features as well as improved the previous technology such as the communication done in wireless, fast, and easy to operate.

4.1 Biometric

Biometric technology is a one of method that have widely used to recognize a person identity based on the biological and behavioural characteristic, which reliably distinguishes one person from another, used to recognize the identity, or verify the claimed identity of an enrolee' and enrolled into a template and store in a system database [3],[4].

There are many type of biometrics recognition technology that exist today and the fingerprint is one of widely used biometrics satisfying uniqueness and permanency [3],[4],[5],[7], hand geometry, voice, retina, iris [3],[7] and face recognition [3],[5]. The use of biometric system for authentication has been applied by Wu [6] where biometrics systems operate in either positive recognition or negative recognition. Generally, positive recognition must perform in verification mode and negative recognition must perform in identification mode. For these Biometrics-based network authentication systems, they have

five subsystems: data collection, signal process, matcher, storage and transmission. In conjunction of Wu [6], Gil et al. [4] developed an Access Control System that utilizing high level security fingerprint to verify user to gain access to property or service. It indicates data the use of fingerprint can improve the security from token based security method.

The application of attendance system using biometric system has been demonstrated by Simao, Fonseca and Santos [8] with integration with wireless communications. However, the weaknesses of the system has been discovered by Zhang et al. [9] by introducing palmprint which developed an attendance system to record the employee attendance including elderly people which may not provide clear fingerprint due to problematic skins. An online system captures palmprint images using a palmprint capture sensor that is directly connected to a computer for real-time processing. An offline palmprint identification system usually processes previously captured palmprint images, which are often obtained from inked palmprints that were digitized by a digital scanner. Meanwhile, a similar project has been implemented by Kadry and Smaili [27] which applied wireless iris recognition attendance management system. This system mainly used for employee identification.

Due to the biometric system is suitable for highly secured systems. It is not suitable to apply for the attendance system for students due to requires a time to record the attendance during lecture time.

4.2 Barcode

Barcode technology is a method of identification which is used to retrieve in a shape of symbol generally in bar, vertical, space, square and dots which have different width with each one [2][10]. A reader or scanners are required to identify the data that represent by each barcode by using light beam and scan directly to barcode. During scanning process, a scanner measured intensity of reflected light at black and white region. A black region will absorb the light meanwhile white region will reflected it.

There are several types of code bar scanner [2]:
Pen Reader
Laser Reader
Charge Coupled Device (CCD) Reader
Camera Reader

Based on Gao, Prakash and Jagatesan [10], the barcodes stored data in the form of parallel lines in different widths, and they are known as 1D barcodes, and could only encode numbers. The method to arranging the bars and spaces of barcodes are called symbology which is barcode symbology refers to the protocol that defines a standard for arranging the bars and spaces that comprise a particular type of barcode, such as UPC-A and EAN. It defines the technical details of a particular barcode type, including the width of bars, character set, and method of encoding, checksum specifications and others

Hebert et al. [11] designed a DNA barcode to identifying birds. Short DNA sequences from a standardized region of the genome provide a DNA barcode for identifying species. Compiling a public library of DNA barcodes linked to named specimens could provide a new

master key for identifying species, one whose power will rise with increased taxon coverage and with faster and cheaper sequencing.

Beside that, barcode technology also has been used with mobile phone [12] to carry more data that its ID counterpart. Previously, barcode has been used in attendance system which indicated by Susan, Mitchell, and Dudley [13] which used handheld barcode readers and the scanner to keep track of students' attendance at LEAD event.

Because of several disadvantage of barcode such as read range, data capacity and others, barcode technology is not suitable to implement for this project. This is because; to implement attendance record system for huge amount at wide area using barcode will take a long time.

4.3 Smart Cards

Smart card is built with variety of chip with a simple memory consisting of byte of information may have range from 1K up to 64K of microcontroller or multi-application memory [14]. Smart card are used as individual identification, building access and network access are part of a multi-tiered program that is in the final stages of rolling out. The data in smart card can be read when a physical contact has with a reader.

Smart card has been used in a wide range of application such as to store operation history, medical record or telemetry [15] as well as student identification in most organization with a multipurpose of use [28].

According to Halawani and Mohandes [29], smart card has been developed at campus environment as identity cards for students and employees for granted access to certain data, equipment and departments according to their status. Meanwhile, a similar project has been implemented by Mustafa and Kyng [30] which utilized MyKad Touch N Go features for student attendance in a web-based environment. This system could be accessed by teachers, headmaster and parents via internet and intranet facilities.

Because the smart card need physical contact to the reader before the data in the smart card can be transfer, the implemented attendance record system for huge amount at wide area using smart card will take a long time.

4.4 Radio Frequency Identification

Nowadays, the RFID technology has been widely used such as medical surgeries, animal identification, baggage handling, library services and real time location tracking [16]. According to Yoon, Chung and Lee [17], RFID is an automatic identification method, whereby identification data are stored in electronic devices, called RFID tags (transponders), and these data are retrieved by RFID readers (interrogators) using radio frequencies. RFID systems can be classified into two categories according to the tags' power supply: active RFID systems or passive RFID systems. In active RFID systems, tags are equipped with their own batteries, whereas tags in passive RFID systems do not have an internal power supply. Therefore, compared with passive RFID tags, active RFID tags enable a greater communication range. Table 1 shown differentiation between active and passive RFID.

Sabri et. al. [18] used RFID as a method to record the web-based attendance application to overcome the problem record the student's attendance. The system only

accepts from five different levels of accesses which are the Administrator, Lecturer, Student, University Administration and the Guest. Each user have own limited access according to the user level. For example, the Administrator has all the security clearance. Meanwhile other users have limited access to the system. The disadvantage of this system is unable to identify the student who late attending the class. Furthermore, Chen and Chang [19] also applied the active RFID and wireless GSM message to construct an active student attendance system that sends the message to parents' cellular phone informing whether their children are safely arrived in classroom at morning. Meanwhile, the system is also used to relieve the traffic congestion around kindergartens especially while the parents are driving cars to pick up their children after class at rush or on rainy days.

On the other hand, Qaiser and Khan [21] used RFID technology for the automation of time and attendance using RFID Systems. The students and faculty members are provided with RFID tags. When these tags pass through the reader generated interrogation field, they transmit information back to the reader, thereby identifying them. The RFID System makes it possible to monitor the movement of tagged users and record their real time data and pass it to processing system to maintain a system Log. Meanwhile, a similar project has been implemented by Herdawatie, Siti and Helmy [31] which is used to monitor boarding school students using RFID. The data will be sent online to the school management for monitoring purposes. However, Joseph and Yusuf have developed a similar student attendance system used RFID which is the information of student attendance will be sent to parents by using Short Message Service (SMS) [32].

Table 1: A Comparison of Passive and Active RFID

	Active RFID	Passive RFID
Tag Power Source	Internal to tag	Energy transferred from the reader via RF
Tag Battery	Yes	No
Availability of Tag Power	Continuous	Only within field of reader
Required Signal Strength from Reader to Tag	Low	High (must power the tag)
Available Signal Strength from Tag to Reader	High	Low
Communication Range	Long range (100m or more)	Short (3m or less)
Multi-Tag Collection	Collects 1000s of tags over a 7 acre region from a single reader Collects 20 tags moving at 100 mph	Collects hundreds of tags within 3 meters from a single reader Collects 20 tags moving at 3 mph2 or slower
Sensor Capability	Ability to continuously monitor and record sensor input; date/time stamp for sensor events.	Ability to read and transfer sensor values only when tag is powered by reader; no date/time stamp.
Data Storage	Large read/write data storage (128KB) with sophisticated data search and access capabilities available.	Small read/write data storage (e.g. 128 bytes)

Other than that, RFID technology also has been used to monitor a transportation system which is used to monitor the container tracking from Yokohama Port to Kobe Port with our active RFID Systems. The results show that our active RFID system has the capability to acquire a movement history and sensor data easily with low power consumption without GPS [20].

According to Ogata et. al. [22], the paper proposed basic support for ubiquitous learning (BSUL) environments as an extension of e-learning systems. For the attendance-taking module, every student has a RFID tag. When the student enters the classroom, the system reads the RFID tag and sends a message to a web service based on the simple object access protocol (SOAP), asking to update the system database. There have four different status for the students: attendance, absence, delay, and a fourth one called remote attendance, which means that the student is viewing the class through the streaming video source. The criteria for deciding whether a student is late or not, can be configured by the teacher in charge of each course. The teacher can view the records of each student's attendance during the course using the environment website, but the students can view only their own records.

TOOLS USED

There are several tools which have been selected to be used during the development.

5.1 Visual Basic 6.0

Visual Basic evolved from BASIC (Beginner's All-purpose Symbolic Instruction Code). BASIC was developed in the mid-1960s by Professors John Kemeny and Thomas Kurtz of Dartmouth College as a language for writing simple program. BASIC's primary purposed was to help people learn how to program. The widespread use of BASIC with various types of computers led to many enhancements to the language. With the development of the Microsoft Windows Graphic User Interface (GUI) in the late 1980s and the early 1990s, the natural evolution of BASIC was Visual Basic, which was created by Microsoft Corporation in 1991[26]. The use of Visual Basic in system development has been used a wide range of field such as in control system analysis which is as an interface for the system [23]. Visual Basic provides a visual environment to ease the user designing a friendly user interface system using object-based method such as forms, grid facility and command buttons.

5.2 Database

Microsoft Access is a relational database management application that is used to create and analyse a database which is a database is a collection of related data [24]. In a relational database, the most widely used database structure; data is organized in linked table. The tables are related or linked to one another by a common field.

Based on [25], database is a self-describing collection of integrated records. The records stored in a database consist of linked tables so that information is chaining each other. Microsoft Access has been used in designing database because this software is a relational database management system that store data safely and efficiently. Other than that; it allows the data to be viewed and modified easily at any time. It can create different

types of interface objects that allow working with the data in the databases become simple and efficient.

5.3 RFID Tag

RFID tag is a base of RFID system which it is an integrated circuit consist radio frequency circuit. RFID systems can be classified into two categories according to the tags power supply; active RFID systems or passive RFID systems. In active RFID systems, tags are equipped with their own batteries, whereas tags in passive RFID systems do not have an internal power supply. Active RFID have greater range communication compared to passive RFID.

5.4 RFID Reader

RFID readers are antenna that will receive a radio frequency from RFID tag before it sends to computer. The reader's microprocessor directly controls the RF transceiver in communicating with the tags and processes the entire task, such as the communications protocol and tags response data.

RFID reader and tag must follow the same standard to make a communication between reader and tag successfully. Reader's attitude that depends tags attitude are:

Power output and duty cycle.
Interface of project subsystem.
Antenna design and locations.

ON-GOING WORK

Implementing the attendance system using active RFID, the author uses Visual Basic integrating with SQL Server databases to develop the system. The system will be functioned as what it was design which is able to record the attendance of huge amount of students automatically. The information on matrix card will be sent by using radio frequency to RFID reader before it will send to central computer and stored in database. Attendance record can be view or access by lecturers and faculty through Graphic User Interface (GUI) that has been developed to facilitate the end user friendly used the system. An overall picture of the development process as illustrated in Figure 3.

As for a function expansion, there is a possibility to integrate with decision support system features to make the system for flexible and integrated with the policy makers to ensure the system can automatically recommend to barred the system.

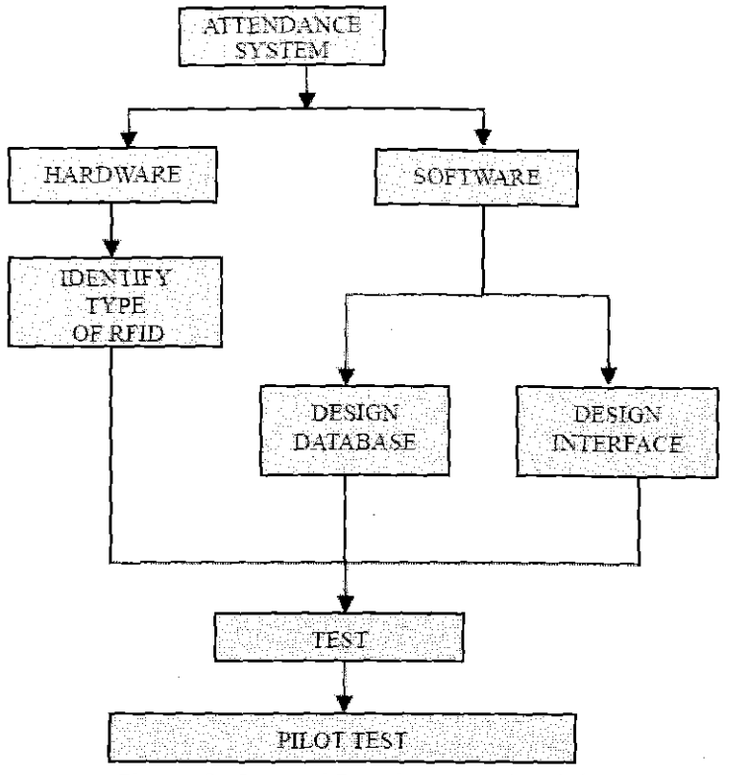

Figure 3: General Development Module

CONCLUSION

In this paper, a review on attendance system and some application of techniques such as biometric, barcode, smart card and RFID were discussed. The main aim of the review is to determine the suitability of choosing the right techniques as well as to discover the benefit of applying RFID in attendance systems.

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