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A Wireless Framework for Lecturers' Attendance System with Automatic Vehicle Identification (AVI) Technology

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Abstract: Automatic Vehicle Identification (AVI) technology is one type of Radio Frequency Identification (RFID) method which can be used to significantly improve the efficiency of lecturers' attendance system. It provides the capability of automatic data capture for attendance records using mobile device equipped in users' vehicle. The intent of this article is to propose a framework for automatic lecturers' attendance system using AVI technology. The first objective of this work involves gathering of requirements for Automatic Lecturers' Attendance System and to represent them using UML diagrams. The second objective is to put forward a framework that will provide guidelines for developing the system. A prototype has also been created as a pilot project.

Keywords: Automatic Vehicle Identification (AVI), Attendance System, Wireless Control, RFID

I. INTRODUCTION

The era of standard situated PCs is over; nowadays more and more people own multiple variety of computing appliances that can be easily transported. People prefer to use combination of mobile devices and information systems as a mechanism to provide automatic data capture. Automatic data capture plays significant role in information systems in various fields. It has gained great attention in recent years and is being gradually adopted and deployed in a wide area of applications that includes supply chain management, retail, anti-counterfeiting, security and healthcare [1] systems.

The most modern technology for automatic data capture is by utilizing the Radio Frequency Identification (RFID) system. This technology poses many new challenges on current data management systems. AVI data are time-dependent, dynamically changing, in large volumes, and carry implicit semantics. RFID uses radio frequency waves to transfer data between readers and mobile tagged object. This technology works automatically and is very fast. It also does not require line of sight or contact between readers and tagged objects [1]. According to Wigan [2], d

RFID has been used widely as Intelligent Vehicle Highway System (IVHS). The family of systems in this technology includes driver communications, automatic vehicle location (AVL), automatic vehicle identification (AVI), and vehicle characterization and behavior monitoring and automatic vehicle operation (AVO).

Among these several systems, the Automatic Vehicle Identification (AVI) system has great potential and similarities that can be effectively applied for development of automatic lecturers' attendance system at universities. Although the implementation of automatic lecturers' attendance system seems very easy to carry out, the most important aspect is in the design of information system which will record and manage information of the entire attendance system. The success of such computerized system depends on data operations design. Therefore, it is important to begin the lecturers' attendance system development by observing and investigating the system requirements and transform these requirements into a general framework.

This research is intended to investigate the requirements of Automatic Lecturers' Attendance System using AVI

technology. The requirements have been identified, modeled, and are represented in the form of framework for development of Automatic Lecturers' Attendance System. In order to acquire the requirements, methods have been applied such as observation, interview and literature research related to the currently implemented AVI systems. Universiti Utara Malaysia has been chosen as a case study for this research. The proposed framework is planned to assist and to provide guideline for development of lecturers' attendance system.

This paper is organized as follows: Section II is devoted to Radio Frequency Identification (RFID) and Automatic Vehicle Identification (AVI) systems. Requirement analysis is presented in Section III. Section IV present AVI frame work design and in Section V a discussion on the prototype testing to validate the frame work design is presented. The paper is concluded in Section VI.

Literature Survey

A. Radio Frequency Identification (RFID)

RFID systems are rapidly becoming the preferred technology for keeping tabs on people, pets, products, and vehicles. One reason for this is the capability of RFID system to track objects.

The benefit of RFID technology is its ability to transport information along significant distances and through a myriad of mediums. For instance, tags can be read through remotely and in harsh environmental conditions. This unique non-line-of-sight technology thus has an inherent advantage over the typical optical technologies used in such systems like barcodes. RFID tags can also be read in challenging circumstances at fast speeds, in most cases with response times less than 100 milliseconds. The read/write capability of an active RFID system is also a significant advantage in interactive applications [3]. By using RFID, we can reduce labor cost and human errors in certain applications. It can provide automatic data capture.

A well known British-owned retail store, Marks & Spencer, had tested the use of RFID in its food supply chain in 2002. Due to the success of these trials, the company had announced its plans to implement and roll out RFID in all its depots in 2004 and had deployed RFID enabled systems in their stores in 2005. Wal-Mart, one of the largest retailers in the world was working its way to implement the use of RFID in 2003. In 2005, it had first instructed its top 100 suppliers to place RFID tags on pallets and cases and a year later announced that this requirement would be extended to a further 200 suppliers [4].

A. Automatic Vehicle Identification (AVI)

AVI technology has become one of the most widely used applications of RFID. AVI allows toll agencies, parking operators, gated communities, fleet operators, and airports to identify a vehicle for revenue collection or simple and secure access control [5]. When vehicles equipped with AVI tags pass by AVI reader, the readers contact the AVI data processing system to report the tag read information. According to Arafeh and Rakha [6], the primary application of Automatic Vehicle Identification (AVI) has been applied to an electronic toll collection system.

AVI technology has a great potential to be used as a new mechanism for keeping and tracking attendance. The automatic data capture provides convenience to users to record their attendance. The implementation of the AVI technology requires the use of tags and reader to capture data automatically which will be connected to the data processing system.

II. REQUIREMENT ANALYSIS

The requirements which have been acquired are presented in the form of Unified Modeling Language (UML). The UML diagrams include Use Case diagram, Activity diagram, Sequence diagram, Collaboration diagrams and Class diagram.

A. *Case Diagram*

A use case diagram represents a set of use cases and actors, and the relationships among them. This system consists of eight use cases which are described below

Detect Tag: This use case describes the process of how reader detects the tag.

Read Tag: This use case describes the process of how reader gets data from tag and read this data.

Encrypt Data: This use case describes the process of a reader encrypts data.

Send to Database: This use case describes how the data is transferred from reader to database.

Decrypt Data: This use case describes how the data will be decrypted when the reader detects tag.

Login: This use case is activated by user. It enables them to log in the system by filing the user ID and name on the box provided.

Generate Report: This use case is activated by Administrator. It allows the administrator to generate report.

View report: This use case describes the process of lecturer view reports.

The Use Case diagram for Automatic Lecturer's Attendance System is depicted in Figure 1. There are four actors interacts with the system which are reader, database, admin and lecturer.

The Activity diagrams, Sequence Diagram, Collaboration Diagram and Class Diagram have also been created using Rational Rose software. However, all the diagrams will not be discussed here.

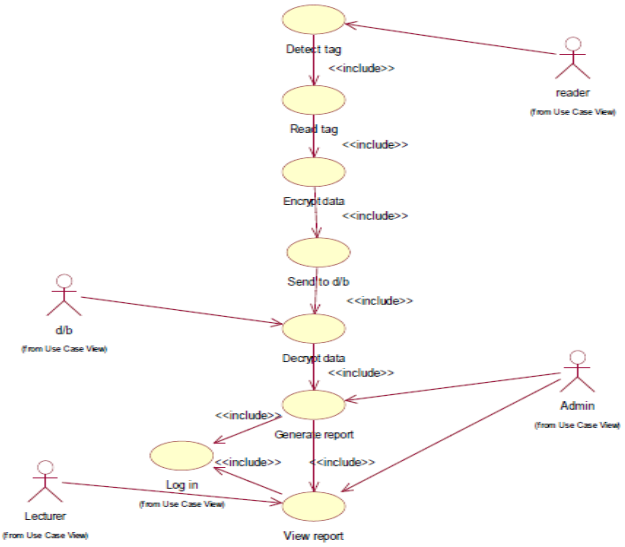

Fig. 1: Use Case Diagram for Automatic Lecturer' Attendance System

III. FRAME WORK DESIGN

A. AVI Frame Work Design

The Automatic Lecturers' Attendance System is a kind of system which combines the mobile devices and also a data processing system. The devices used for this system include tag and reader, database and server. The Ultra-high Frequency (UHF) readers should be mounted at the main entrance and passive tags should be attached to lecturer's car. A unique ID number is written to each tag and associated with the name of the lecturer to whom it is issued. As the lecturer drives through the reader range at the main entrance, the reader sends the tags' unique ID numbers and name of lecturer to a central server. The server will collect the tag data from the controller and send to database.

Figure 2 shows the proposed framework. The framework consists of four components and they are tags, readers, controller and server.

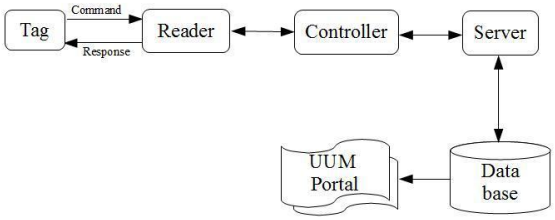

Fig. 2: AVI framework

The tag is an integrated circuit that will be imbedded in the lecturer's car. This research proposes to use passive tag, which does not need any battery. The reader is responsible for communicating with the tag through wireless channel using UHF and its wiring is connected to the controller. The controller will be a PC in the controller's room, which is connected to the reader and to the server through university network (ISLAN). The server (integration server) supports the functions of the controller. It also offers processed integration, including sophisticated, cross-university process-management.

The server (integration server) supports the functions of the controller. It also offers processed integration, including sophisticated, cross-university process-management.

A. Flow of the Process

Figure 3 shows the flow of the process. The process begins when the AVI reader sends signal via its antenna to collect the data from tag. Once the reader, tag and decryption key have been registered in the database, and the tag passed the reader, the following actions will occur

Step 1: The registration of the decryption key in database should be done manually.

Step 2: The ID registration for each tag is also done manually. These above two steps are compulsory in order to use the Automatic Lecturers' Attendance System.

Step 3: The reader will automatically send a signal to recognize the tag and to access its ID.

Step 4: Since the tag has been powered, it will send back "Response" command which is the tag identification number and the encrypted data to the reader.

Step 5: The response message from the tag will instruct the reader to send the data from reader to database.

Step 6: The system will then use the captured data to create lecturer's attendance list.

By following the above process we can easily create a lecturers' attendance system without any inconvenience to the users.

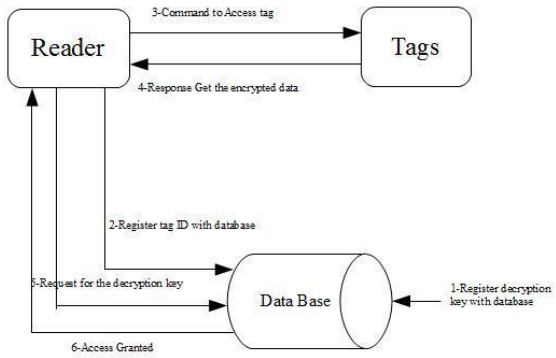

Fig. 3: Flow of the process

IV. PROTOTYPE DEVELOPMENT

A prototype of Automatic Lecturers' Attendance System has been developed to test the validity of the proposed framework following an object-oriented approach [7]. However, the real tag and reader were unable to be used due to cost of acquisition. To overcome this problem computer system has been used to simulate the functions of tag and reader. The prototype has been developed using Visual Basic as the programming language and Microsoft Access as it database. It shows how the reader captures the data automatically and then sends the data to the database

V. CONCLUSION

The proposed AVI framework which has been described in this research will be beneficial to UUM because the lecturers are able to access information is similar to the previous system. The prototype of automatic lecturer's attendance system that has been developed has the capability to test the framework. Despite all the advantages mentioned above, there are some threats that faced this system. The system will face some problems when it is applied on those lecturers who stay inside the campus. Since the system is mounted in the main gate, all the lecturers who stay inside the campus will have to go outside the main gate then to drive through it again so the system is activated, Furthermore, it is important to keep in mind that not all of them have their own vehicles.

The main limitations to the proposed framework are insufficient fund to buy the devices. Some lecturers have spouses working in the university, and come in single cars, if they went out with one car, will the two cards be read out, or should the lecturer bring along his tag?. If the spouse works outside, after sending the spouse, he/she goes out to campus, what happen to the data collected by AVI?.

The first objective of this research has been met through the gathering of requirements for Automatic Lecturers' Attendance System, and represented using UML diagrams. The second objective is to propose framework for Automatic Lecturers' Attendance System that will provide guidelines for developing such system. A prototype has also been developed to verify the proposed framework.

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