Design of an RFID based Students/Employee Attendance System

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ABSTRACT:
The record of student attendance in most universities is done by calling the roll. This kind of calling is not only waste of class time, but also cannot be a true reflection of the real student attendance. The use of an alternative new system is becoming a mandate to manage students and staff attendance. The Radio Frequency Identification is the technology which will be applied as infrastructure in the indoor environment to enable the college administration to get the advantages and to improve the university's monitoring framework, taking into considerations some factors such as time saving, reliability, efficient and easy to control. This paper automates those outline and execution of a students'/employees'/lecturers' attendance management system using hardware and software in Al-Nahrain University in Iraq-Baghdad. This system is named Al-Nahrain University Student Employee Attendance Management System (AUSEAMS). This system initially uses a web based database coupled with RFID tagging system with acquire finish framework purpose the place the majority of the data may be manipulated. Preliminary simulation results of the proposed system confirm the validity of the system.

KEYWORDS: RFID Technology, Attendance System, Tags and Readers, Classrooms.

1. INTRODUCTION
RFID is a technology that uses communication through radio waves to transfer data between a reader and an electronic tag attached to an entity for the purpose of identification, tracking and surveillance [1]. This technology is used as a medium for many tasks and activities such as managing supply chains, parking lot access and control, tracking and traceability, health care industry such as patient tracking, product authentication, transient carrier labeling animal and specimen identification and ticketing such as baggage-passenger tracking [2, 3]. RFID technology offers several key benefits such as no line of sight necessity, robustness, speed, and bidirectional communication, reliability in tough environments, bulk detection, and superior data capabilities [1]. In monitoring applications of the university, the use of RFID technology enables the university management to avoid attendance records from loss, misplacement and damages. This technology also will save money, time and decreases work endeavors in dealing with the participation records. Universities bring progressively turned into great mindful of the fact that making methods more efficient and less time consuming, RFID Might

assistance on accelerate those techniques and Along these lines diminish the lead time in a few separate zones such as parking, attendance and others [4, 5].

The suggested application is RFID Attendance Management System be applied in Al-Nahrain University, to record the attendance of students, employees and lecturers, whereby each person is uniquely identified by an RFID transponder. This unique identifier can be used to retrieve all the staff's records from a centralized database to improve attendance system, reduce human errors, and the most important thing is to save the valuable lecture time. The rest of this paper is organized as follows. The essential RFID components reviewed in section two. Section three review RFID attendance system. AUSEAMS architecture and structure are introduced in sections four and five respectively. Design and preliminary simulation results are presented in section six. Finally, conclusions are listed in section seven.

2. ESSENTIAL RFID COMPONENTS
RFID is an innovation that is utilized to gather data consequently by radio recurrence information correspondence between a mobile object and an RFID reader [6]. An RFID framework comprises of

different parts that are associated with each other by a dedicated communication path as delineated in Figure 1. The individual parts are coordinated into the framework to actualize the advantages of RFID solution [7]. The list of components is as follows:
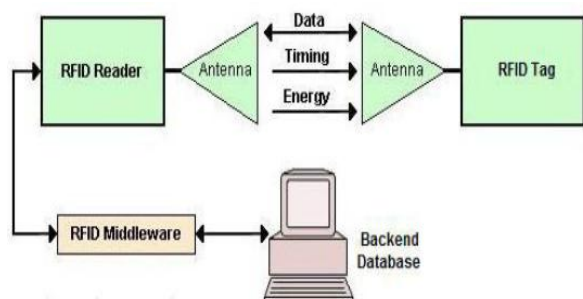

Fig. 1. Essential Components of an RFID system

A. Tags: An item that is appended to any product and uses a unique sequence of characters to define it. Tags also known as the transponder which is derived from the terms of the transmitter and it comprises of a chip and the antenna [8, 9].

B. Antenna: It is responsible for the transmission of information between the reader and tag using radio waves [8]. An antenna must be tuned to the same frequency band of the radio system to which it is connected; otherwise, the reception and the transmission will be impaired [2].

C. Reader: A scanning device that uses the antenna to realize the tags those are in its vicinity. It transmits signals at a certain frequency to the tag and listens for the tag's response. The tag detects this energy and sends back a response that contains the tag's serial number and possibly other information as well [7, 8].

D. Middleware: The widespread board selection of RFID requires minimal efforts of tags and readers, as well as suitable systems administration framework, such a supporting RFID base regularly involves a part frequently alluded to as RFID middleware [9]. It is a correspondence interface to translate and handle information being nourished by the readers into the data. It considers every significant port of correspondence and a product application to speak to this data [7].

E. Backend Database: A vault of data, which is designed specifically for the application. The database stores records of information particular to individual labels [7].

3. RFID ATTENDANCE SYSTEMS
Education has always paid more attention for the development of society. Academic administration is very important in education, as accurate and fast data for each student's current academic state and performance is required by guardians, faculty and administration for taking decisions [10]. The RFID attendance system should be used in quickly expanding academic campuses which is an automatic embedded system for taking attendance of registered students and employee in a particular university [11, 10]. Universities should try using RFID technology, which has speedily gained more attention recently because of its existing low price and advances in other computing areas that open up more application regions to improve their student quality [12, 13]. Each RFID card has a unique ID, these cards are assigned to students and employees of the university. When students enter their classrooms, RFID readers will read these tags, then identify the students from their particular RFID tags and send logs to be stored in a centralized database in order to generate reports and statistics [14, 15]. RFID devices and software must be supported by a sophisticated software architecture that enables the collection and distribution of location based information in near real time.

4. AUSEAMS ARCHITECTURE
The main goal of this project is to automate the whole system of students'/employees'/lecturers' attendance and tracking by using the RFID technology, also lecture table and marks table for all students can be obtained using AUSEAMS website. The components of the proposed system are readers (ELA816B), passive tags and client-server applications program to connect RFID devices to main database to deal with the enormous information gotten from RFID readers in real time what's more, make use of the availability of web services that uses the same database system as a common source of information. The students, lecturers and employees are given one of a kind RFID recognizable proof cards which contain embedded tags to empower the readers to identify them as they pass through the reader interrogation field. These readers are installed in all departments, offices, classrooms, laboratories or any other possible locations to be reached within the university campus. The proposed design is shown in Figure 2, and can be divided in two groups. The first group consists of server for RFID, database (DB) and a web services. The RFID readers are connected to RFID server which is represent the host computer and it is responsible for establishing communication with readers, handling and managing the received data from readers in real time. Once it receives the read data, and providing the latter is correct, this server inserts a new attendance record in the DB Server. The DB Server stores and handles all the information related to the university such as basic information, attendance-absence, vacations records, lecture marks table for students and also RFID readers information.
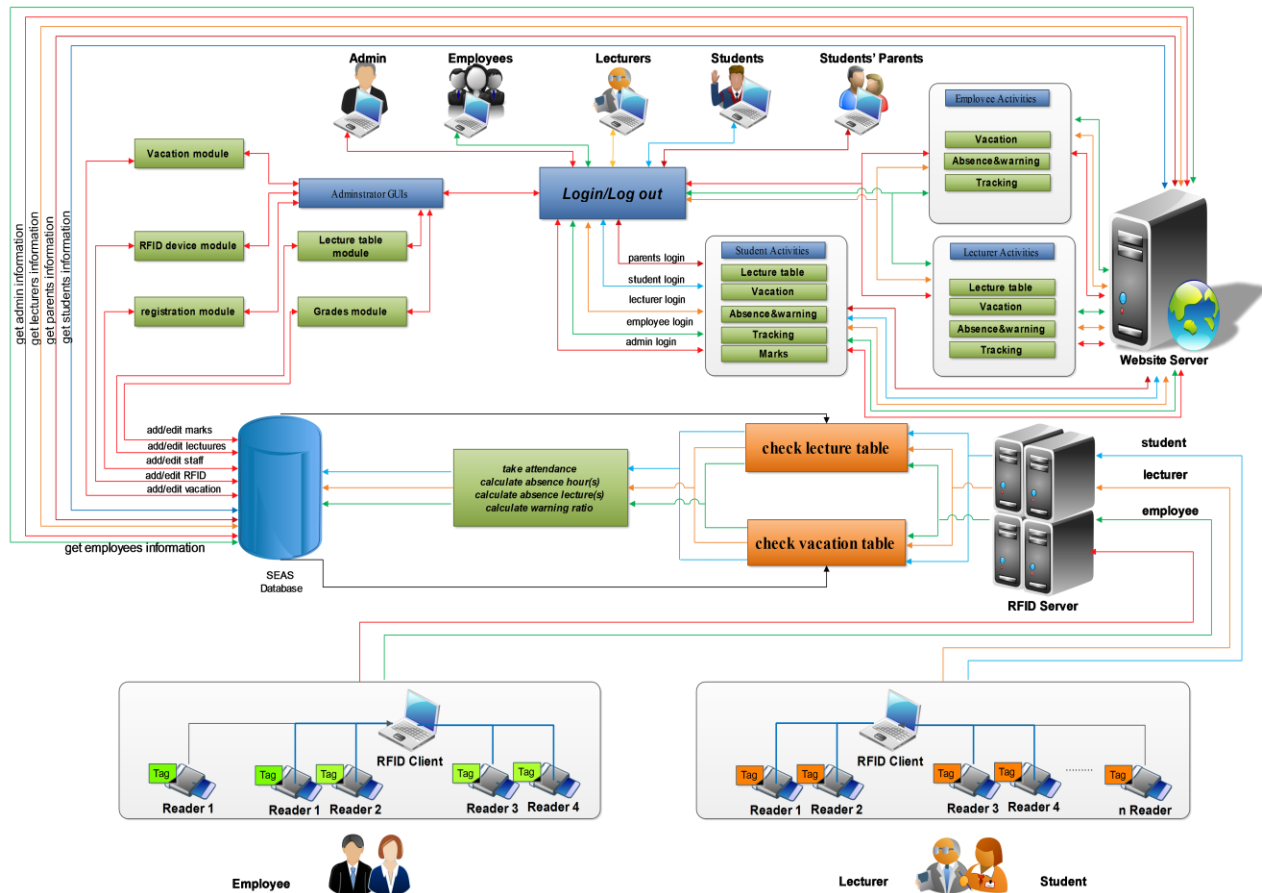
Fig. 2. AUSEAMS architecture

A web administrations server gives some web strategies to serve AUSEAMS clients. To get a data, this server will query the DB Server to get attendance records, students' information records, lecture's information, and other related information. The second group is made up of numbers of RFID readers installed in the university that are implemented using number of ELA816B RFID card readers and also simulated using client-server sockets as an RFID middleware to permit the virtual creation of an RFID-based scenario while being certain that the product made for this reason will keep running as in this present reality. The bridge between these two groups is presented by the LAN of the university in which all RFID readers are connected to it. The RFID server is additionally associated with the LAN to empower correspondence between them.

5. AUSEAMS STRECTURE
The AUSEAMS project is divided into two implemented parts: software and hardware. The software part is programmed using (Microsoft Visual Studio 2012 Program) that works in (Microsoft .NET Framework 4.0) Environment and the large database system is designed by (MySQL Database Server version: 5.5.24). The website uses (PHP scripting

language ver. 5.3.13, CSS and HTML), and the web server uses (Apache web server ver. 2.2.22) using Wamp Server Version 2.2 program. These applications are installed on a PC with windows 7 (or any other version used as Server PC to install the AUSEAMS Server Program). It also which contains a database, web server and wireless gateway. For the client a PC with windows 7 is used (or any other version used as client PC to install the AUSEAMS client program) connected physically with RFID card reader to send readings information through wireless gateway, MySQL connector 5.2.7.msi is used to connect the client to the MySQL Database Server.

The hardware part of AUSEAMS consists of ELA816B/BJ RFID 125kHz card readers and its own tags, USB to Serial Convertor (to interface with the RFID reader) and PL-2303 Win 7 USB drivers to work with RFID, and AC to DC Adapter to run the RFID device.

5.1 . Software Part
The RFID reader module is simulated using VB.net client and server sockets. It is important to understand that this virtual environment permits utilizing the real protocol of the RFID readers and tags. A socket is one

endpoint which makes correspondence between two projects that are running over a system or running on the same machine. Sockets are used to represent the connectivity between RFID client and RFID server. The socket is bound to both an IP address and port number so that the TCP layer can distinguish the application. Figure 3 demonstrates the association in the middle of client and server on particular port [16].
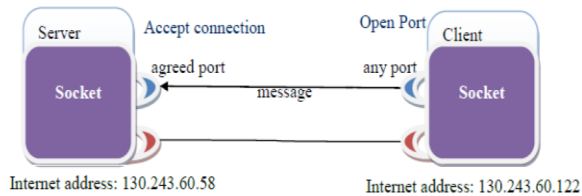

Fig. 3. Client and Server Socket ports

A socket creates a new connection with its endpoint. It uses listen/read for willing to accept the connection, send/write to send or write over the connection after the connection is established and end uses for releasing the connection [16]. Figure 4 shows the socket process on layers. After writing the code for socket, which works on the presentation layer, the application layer does not know anything how socket works. Sockets reside on the session layer. The session layer is sandwiched between the application-oriented upper layers and the real-time data communication lower layers [16].
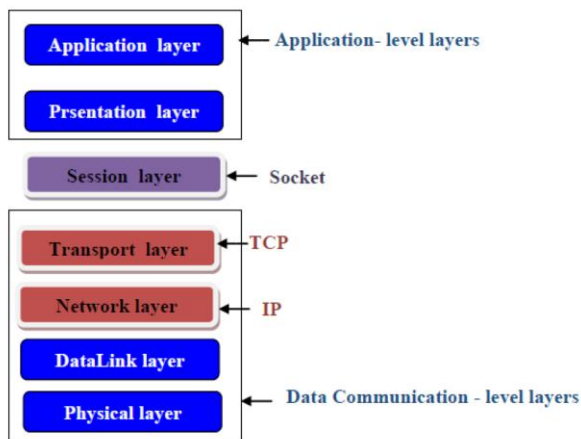

Fig. 4. OSI layers (Socket, TCP/IP)

5.2. Hardware Part
The RFID reader used in this system is the ELA816 card reader, which is a small range reader (typically 5-15 cm reading range). This reader operates at a frequency of 125 kHz. The ELA816 card reader is designed to provide access control; it is connected to an access controller, meaning it is positioned at main gates or at specific doors to allow authorized personnel to access. The ELA816 card reader will be used to operate

in a host based reader system. Once the RFID tag passes over the card reader, the reader will handle all the RF and digital functionality required in communicating with the RFID tag. Then the ELA816 card reader will pass the tag number to the host computer. The communication between the host and the reader is over a serial cable (RS- 232). Figure 5 shows the implemented connection between the RFID reader and the host computer using serial port through RS232 and the used RFID tags.
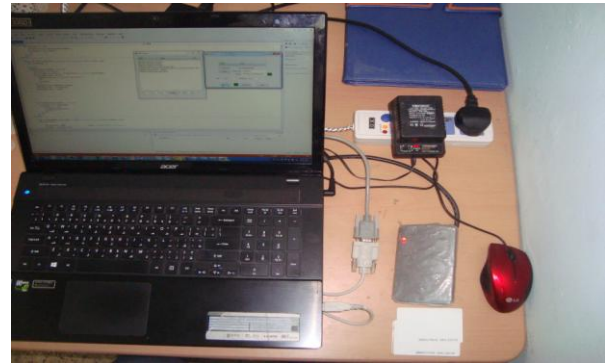

Fig. 5. Implementation of ELA816 RFID card reader

The primary function of the client side application is to communicate with the RFID tag from one side and with the server from the other side. Flow chart of Figure 6 illustrates the interfacing with multiple ELA816B RFID readers.
Once the RFID card passes over the reader, the application waits for a response. The application checks for errors, when the response arrives. If no errors are found, the application extracts the tag number from the response string and stores it. The application generates the Uniform Resource Locator (URL) from the tag number and sends it to the server over the network. The system incorporates a web-browser in which the results of the query can be viewed.
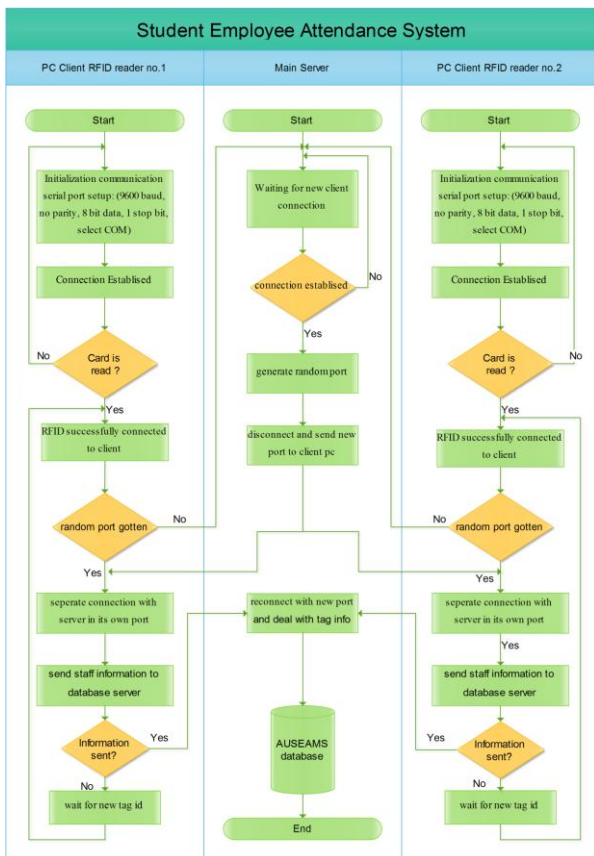
Fig. 6. Flowchart to illustrate the interfacing with multiple RFID card readers

6. SYSTEM DESIGN AND IMPLEMENTATION

The RFID card reader is successfully connected to the host computer; the data is gathered from the readers, after that passed to the RFID Server then these data will be passed to the database sever after filtering and correcting the information. DB server will manages the gathered information and maintains the attendance log. The main program workflow is illustrated in Figure 7 which represents the procedure of attendance that should be taken to the marked class contains all the functions that are used in attendance taking process including calculating stay-in time, set attendance, check weight, calculates warnings and check vacation. Next system specifications, and main website are discussed and some preliminary results will be shown in the next sections.
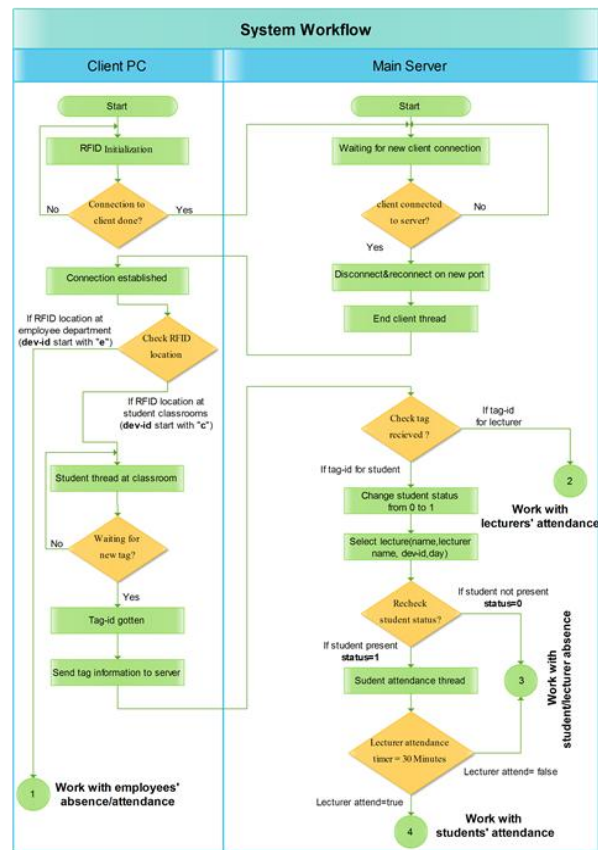

Fig. 7. AUSEAMS main program flowchart

6.1. Specifications

This system consist mainly of four major categories according to the uses of the system and can be notified as administrator level, students' (and their relatives), lecturer' and the final one is for employee' activities, and each one of these levels required a separate login form to access these facilities as shown in Figure 8 and include the following:
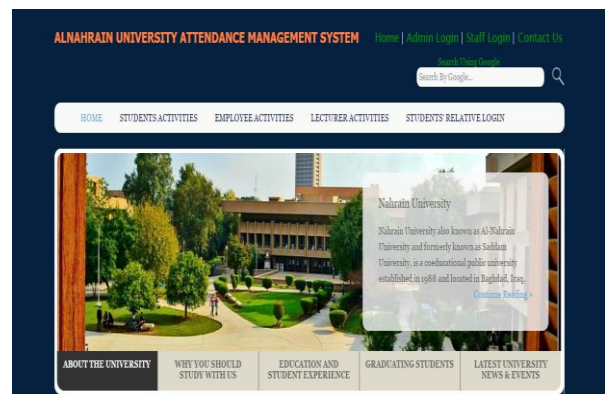

Fig. 8. AUSEAMS main program flowchart

Administrators: are predefined in the data base have to be at the top of system hierarchy so they can have access to all users and check attendance, absence,

grades and tracking of the staff at the lower level, also they can add new staff, vacation to database in two ways (remotely using a website or using the Admin GUI) and enabling them to control and manage RFID readers.

Students' Activities tab: this page represents all information required for the students and their attendance, absence, lecture tables, marks table, warning and some useful links.

Employees' Activities tab: this page represents all information required for the employees and their attendance, absence, vacation for each employee and warning ratio if absences reach a predefined ratio.

Lecturers' Activities tab: this page represents all information required for the lecturers and their attendance. Absence lecture must be given for each class, vacation for each lecturer and warning if absences reach a predefined rate.

6.2. Preliminary Results
In this section the main website tabs will be discussed. This system was designed and tested using both real and simulated RFID. The outcomes demonstrate that the framework works effectively in such a productive way, to the point that it can interface with readers and gather data continuously. Figure 9 demonstrates the administration main page.

This page consists of four parts (student tab, lecturer tab, employee tab and final one is system management). Figure 10 shows an example of checking student absence in all lecture(s) using "absence lecture" tab by typing either tag-id or student name while Figure 11 shows an example of check student location or last seen for that student using "Student Tracking" tab in the administrator main page.
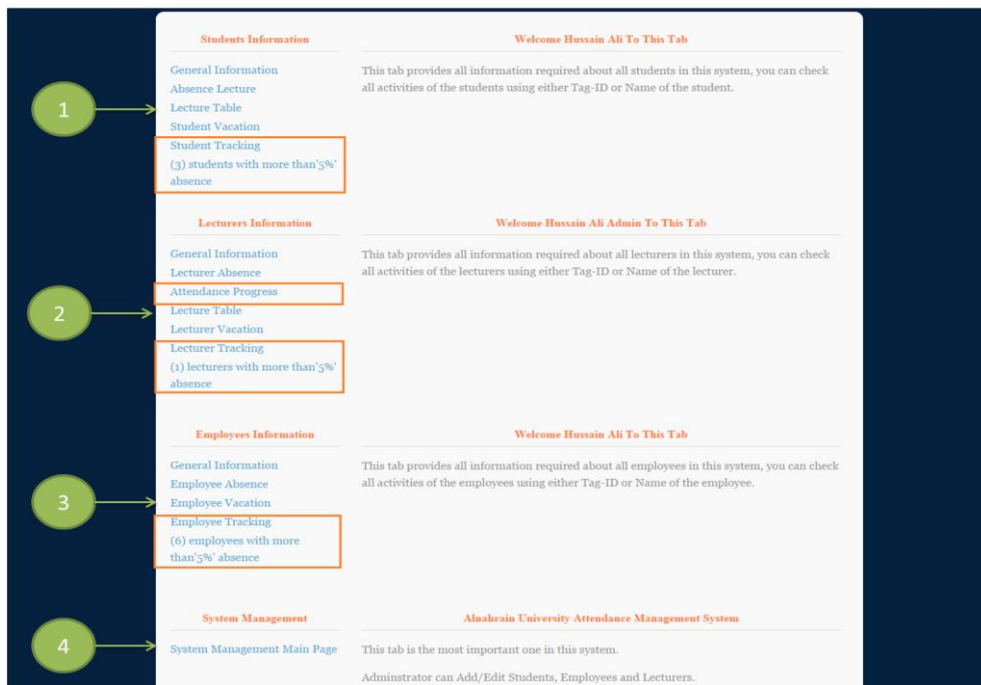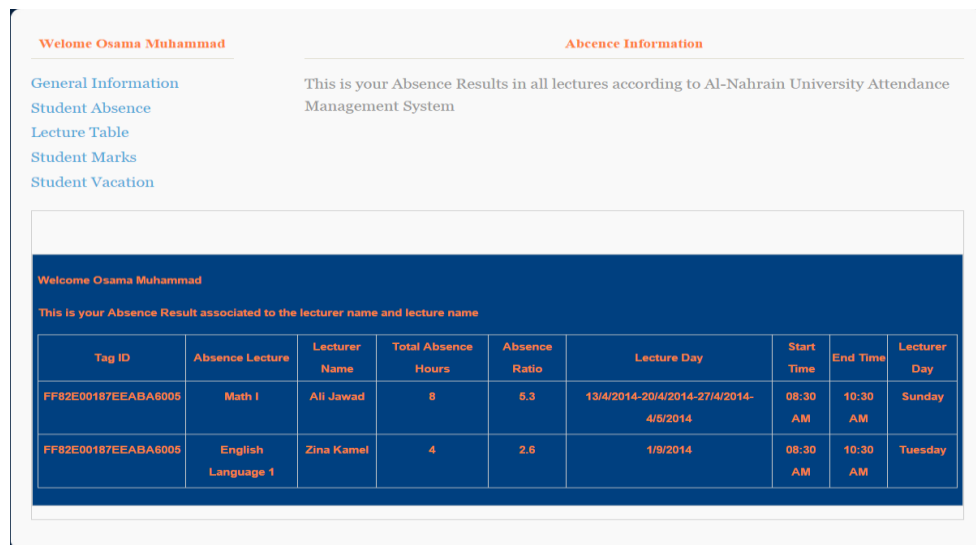
Fig. 9. Administrator main page

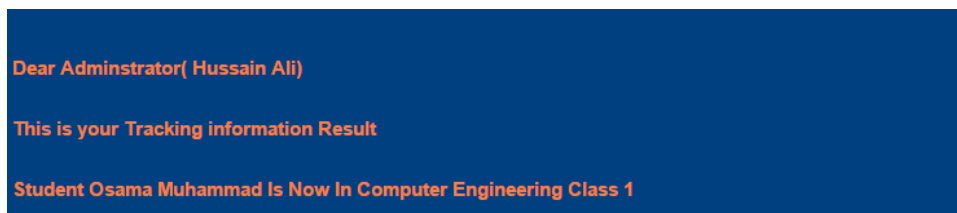**Fig. 10.** Student absence results

Fig. 11. Student tracking result

Administrator main page generates automatic counter to check if there are any student, employee or lecturer has an absence ratio more than 5% as shown in Figure 12, so the administrator can check all students, which they have a high absence ratio then he/she can email them and email students' relative such as (parents, brothers, sisters, etc.….).
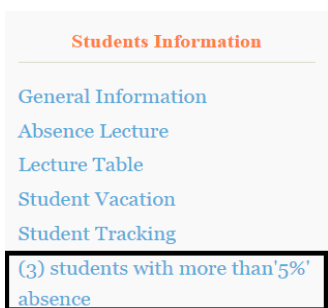
Fig. 12. Number of students with more than 5% absence

Now in lecturer form, the administrator can check attendance/absence, lecture table, tracking of all the lecturers in the university using lecturer information.

Figure 13 shows an example of lecturer attendance, absence and free time of a specific lecturer during working days in all the week while Figure 14 shows an example of checking the lecture tables of the

specific lecture using either search by lecturer tag-id or using lecturer name.

Fig. 13. Lecturer attendance progress

Fig. 14. Lecture table result for all the week

All these facilities also available for the employees in this university so they can check their attendance, absence, and their vacations if they have any kind of approved vacation. The administrator can access to all university staff and check their activities inside the university. Vacations are very important in this system since each absence record will be recorded after checking vacation table to see if there is any approved vacation for that staff or not. AUSEAMS provides three types of vacations (one day, part of a day and longtime). Figure 15 shows the main page of the staff vacation accessed to it by the administrator and this page has multiple tabs such as the name of the student/employee, vacation date, vacation type, vacation start-end date (if the vacation is long or one day), vacation start-end hour (if the type of the selected vacation is a part of a day) and vacation note for any extra notes about that vacation. This system was

implemented using two main methods; the first one is by using two real ELA816 RFID card readers to connect two departments at the same time, which are computer engineering classroom 1 and computer engineering classroom 2, these RFID readers are successfully connected to client PC which is connected to the main server and all attendance and absence records are done successfully in these departments separately using client-server sockets with different port number for each department as shown in Figure16.
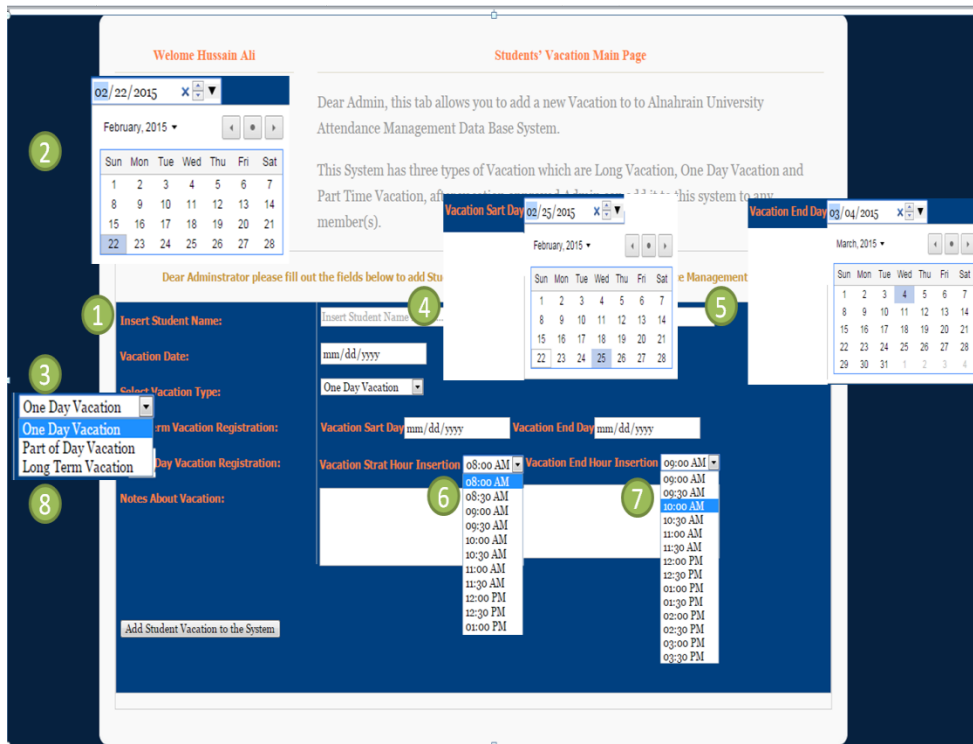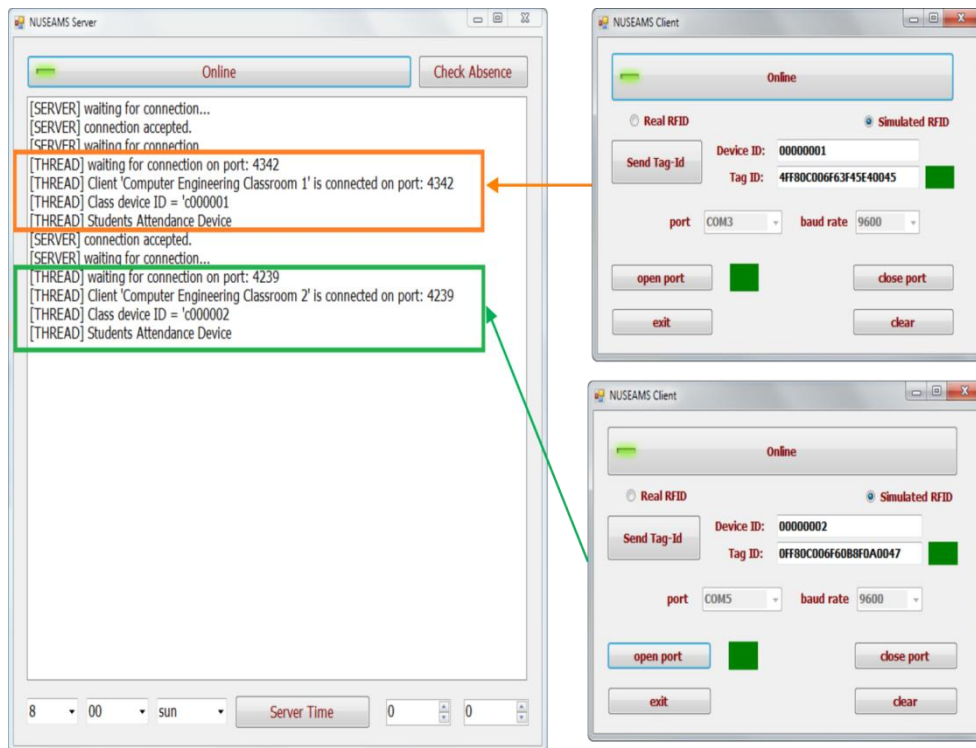
Fig. 15. Add vacation to the data base

Fig. 16. Two real RFID card readers connected to the server

The second approach was by using a simulation of RFID readers to test the efficiency of this system by dealing with multiple RFID readers at the same time and record attendances from these readers. Figure 17 shows an example of connecting eight readers in different locations for both students' classrooms and for employees' departments in Al-Nahrain University campus.
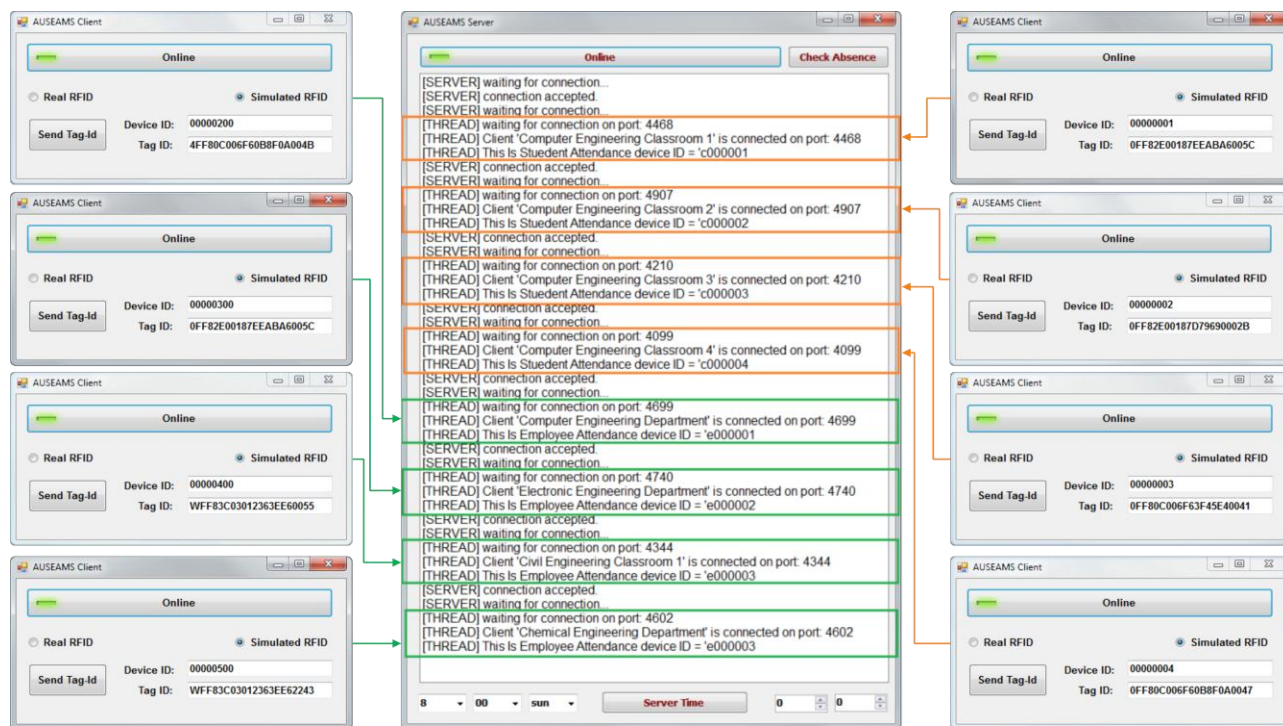
Fig. 17. Eight students and employees attendance devices connected to the main server

7. CONCLUSIONS

The proposed system successfully merges the technologies of the web-based database systems and RFID client-server technology at Al-Nahrain University in Baghdad to improve the management of attendance of all staff activities to reduce administrative errors and increase studying quality and performance. The preliminary results show that the system works successfully in real time. The system is efficient, flexible, comprehensive and can be adapted as an attendance system for any institution. The RFID tag provides a protected and strong strategy for holding the staff identifier. The web-based database allows for the centralization of all staff records. For future work, the security issues of the system has to be taken into consideration to make it resistant from any assault furthermore to couple the framework with other helpful innovations like biometrics or additional control equipment to provide cater for misuse and deceit.

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