Automated Employee Attendance and Tracking System Using RFID in Mobile Phones

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Abstract: This paper describes the design of an RFID Employee Attendance And Tracking System. It is designed to track a moving employee inside the organization using RFID technology in mobile phones. The proposed system has hardware and software components. The hardware architecture consists of an RFID active tag, RFID tag reader and database server. The database server are located in the master station. The tag readers are distributed around the open area. The tags are programmed with employee's profiles and are integrated in employee's mobile. Communication between the tag reader and the server is done via wireless LANs. The software architecture consists of a communication driver that handles all communication functions done at the master station, an Application Programming Interface (API) that handles and analyzes the data, a friendly GUI and a database that saves all the attendance information.

Keywords: *Radio Frequency Identification (RFID), RFID object tracking, Wireless system, Tracking Algorithm*.

I.INTRODUCTION

RFID gained a great interest in industry and academia. This interest has led to the use of RFID technology in a variety of applications such as factory automations and integrations ,B2B and B2C networks, smart parking lot access, material tracking information systems , libraries management system hospital management systems, Pharmaceutical manufacturing. The basic architecture of an RFID system consists of a tag that includes an antenna and a chip, a reader equipped with antenna and a transceiver.
It also has a workstation to host the Middleware and database. This proposed architecture is cost efficient in comparison with the other tracking systems. The objective of this project is to design and implement an RFID-based reliable and efficient solution to automate and track employee inside the organization. The system allows users (e.g. security officers)to monitor the position of "tagged employee" from a sufficiently large distance by implementing an application that reveals the position of an employee at anytime and anywhere in the coverage area.

II. SYSTEM FUNCTIONAL REQUIREMENTS

The system functional requirements are described according to their priority. The priority value (high, medium, or low) will be indicated at the end of each requirement description between round brackets.

A. Hardware Requirements (High Priority)

- The system requires the usage of RF (Radio Frequency) active readers.
- The reader requires an omni-directional antenna that provides a circular coverage area of at least 30 meters, or uni-directional antenna that provides a straight coverage area of 100 meters.
- The system requires the usage of RF active Reader able to communicate with the main station.
- 3different communication mediums: serial cable, LAN cable, and WLAN antenna.
- The system requires the usage of RF active Tags.

- RFID tags are powered by built in battery.

B. Readings and Measurements (High Priority)

The system shall be able to provide the user with the following information, at any time, when required:

- Reader ID and Tag ID, detected at anytime by any reader.

C. Detecting the Employee (High Priority)

The system shall be able to detect the employee if s/he is in the coverage area of a reader.

D. Interface Requirements (High Priority)

- The system shall have an Application Programming Interface that will open the serial port between the reader and the PC.
- The system shall have an Application Programming Interface that will enable readers and will enable tags.
- The system shall contain a graphical user Interface that will allow the user to monitor the covered area

E. Adding new user (High priority)

- The user shall be able to specify the new user's name, his middle name, last name, age and his ID number.
- The system shall be able to assign a new tag number to the new user from the pool of unassigned tag numbers.

F. Deleting user (High priority)

- The system shall be able to delete a user from the system by specifying his tag number.

G. Display Employee's location (High priority)

- The system shall be able to state whether the Employee is in the coverage area of one of the readers or not.

H. Tracing route (Low priority)

- The system shall be able to show the route taken by the employee by plotting the last detected positions and connecting them.

III. SYSTEM DESIGN

Our proposed system consists of three main modules namely the RFID reader module, Data Reporter module and Database module. Those modules are integrated together in order to allow its full functionality. Each module carries its own functions and special features.

A. RFID Reader and Tag

RFID reader is the device capable of reading and retrieving information stored inside the RFID tags. There are two types of RFID reader, which are the active and passive RFID readers. Active RFID reader can detect an active RFID tag while passive RFID reader can only detect passive RFID tag at a few centimeters away from the reader. The RFID reader being used in the system is a low cost reader for reading passive RFID tags. It operates at 0~ 400C temperatures, 20~80% of humidity, 125 kHz frequency and 12V power supply. The effective detection range of the reader is around 5-8cm. Each RFID tag has a unique serial number or ID. There are three types of RFID tags which are active, semi-passive and passive.

The main difference between these RFID tags is that active and semi-passive RFID tags require internal battery while passive RFID tags do not use any internal battery. Adapted to our scope of work, the student cards being used to identify each individual student are the RFID cards that consist of passive RFID tag, which do not require internal battery. When such cards are passed through the field generated by a compatible Reader, they transmit information back to the Reader. This illustrates how data transmission is performed between an RFID reader and an employee mobile.

B. Data Reporter

Data Reporter is a component that fetches all logging data from the RFID reader such as the captured employee ID, time and date for every 30 minutes interval. The collected data are then passes to the server, which will record the data into the database. This component should always be kept up and running and needs to be automatically restarted each time the operating system reboots.

C. Data Collector

The role of the data collector is to continually listen to incoming data sent by the Data Reporter component. The received log data will then be inserted to the database for recording purpose.

E. Database

A database is defined as an organized collection of data and tailored to our system, our database is employed to mainly store the data captured by the RFID reader. In offering more features to the users, our system can manipulate the recorded student attendance record by querying the database for complex data retrieval. This includes automated operation, such as summarizing an individual employee attendance by calculating the attendance percentage for a particular course.

F. Graphical User Interface (GUI)

The GUI component of the system is purposely developed for friendly interaction with the users. Both types of users, namely the employee and the manager are given unique access to their individual member area, where the employee can access their personal information, while the manager can monitor their employee information. The developed GUI is in the form of dynamic web pages, which are database driven. This signifies that the information displayed on the web pages are constructed based on the data extracted from the database. The web pages are categorized into four modules, namely the User List, Log, Timetable and Attendance. The pages are developed using the Hypertext Preprocessor (PHP) scripting language and compatible with all major web browsers.

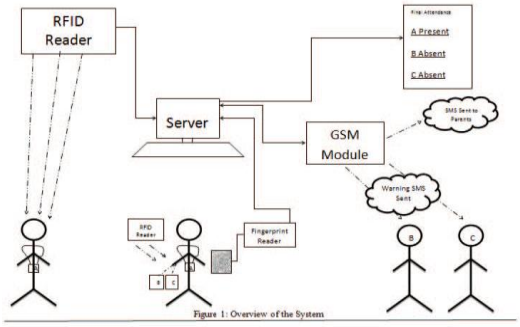


Figure 1: Overview of the System

IV. SYSTEM IMPLEMENTATION

Based on the system design presented earlier, the system implementation was carried out. The overall process flow of system implementation is illustrated in Figure 2, which composed of 5 main steps. The deployment of networked RFID readers is also illustrated.

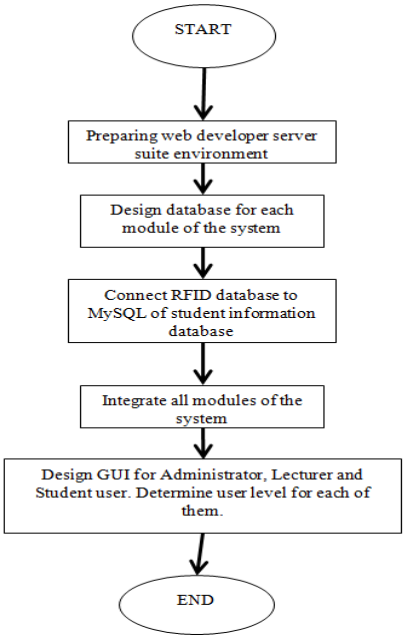
A. RFID System Device

The system employs RFID-Mifare terminals as the readers, which can be installed across all areas each denoting a specific venue. These readers are connected to a hub or a switch through RJ45 port or also known as LAN port.

B. MySQL Database

The Attendance system is connected directly to a MySQL database. In general, there are four main tables created to store the collected data.
A table called the Log table is used to store all users' logging data that include the check-in date and time.
It is paired with the employee ID. These data are initially captured by the Data Reporter component from the RFID reader, which are then submitted to the Data Collector, which is responsible in storing the data onto the database. The User table is another table in the database that is used to record the employees' details that include their profile information such as name, address, email, phone number and etc. Meanwhile the analyzed employees' attendance information is recorded in the Attendance database. A set of pre-defined SQL queries are written into common functions allowing easy data insertions, update and retrievals for displaying purpose

C. Web Graphical User Interface (GUI) Design



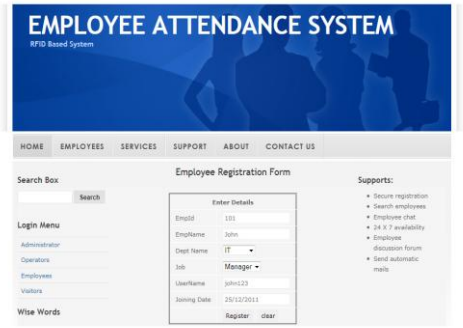
A user is allowed to enter the member area by logging in to the system via a login form. This type of authentication is important in order to prevent access by unauthorized users. The system grants access to 3 different types of users namely the Administrator, Manager and Employee. According to the user type, each user is given the specific level

of access. For instance, the Administrator level is given an access not only to view but to moderate and modify data in the system. In contrast, other user levels will be given only limited access to the system.

D.VRT Algorithm

Virtual Route Tracking (VRT) algorithm is designed to track persons and objects attached by RFID transponders moving in an RFID Reader Network. The RFID Reader Network herein consists of densely deployed RFID Readers (or RFID Interrogators), which are connected by short-range wireless technologies (such as ZigBee) in ad hoc mode. VRT algorithm is specifically designed to track mobile RFID transponders by using fixed RFID readers; therefore, tracking mobile RFID reader by using fixed RFID transponders is not in the scope of this paper. But in some RFID Networks, which are composed of both fixed and mobile readers, VRT algorithm is also effective merely by ignoring mobile RFID readers and using remaining fixed RFID readers to calculate. VRT algorithm selects a series of adjacent readers in the RFID Network to form a "Virtual Route" to realize tracking, and a combination of RFID reader ID, transponder ID and the time of interrogating, coined Tracking Vector (TV), is defined in this paper. Since the position of RFID transponder is located by RFID readers, the ideal performance of this algorithm is achieved in the condition that the distance between two readers is far greater than the interrogation range of RFID system. VRT algorithm can track tens and hundreds of transponders simultaneously, instead of only one each time.

The developed automated attendance and tracking system can be improved and upgraded further, e.g. by extending the system with new features and modules or by improving the layout with new display style. Better yet the system can be used to enhance further to offer another significant enhancement where the system can be extended to monitor the attendance record and view it globally across the World Wide Web. This improved technology also promises an increased effectiveness and improved efficiency. In the long run, with reducing unit tag and reader costs, several businesses will be able to leverage the benefits of the RFID technology.



V. CONCLUSION AND FUTURE WORK

Integration of RFID technology into mobile phones can bring about revolution. The major challenge in current era is the cost of RFID reader. RFID is an automated identification and data collection technology, leading to accelerated business processes and more accurate and timely data entry. The Paper proposed a novel usage of RFID Systems in Organization Automation. Experimental results proved that the Processing by the Windows Service was 100% exact and timely. There is no reason to wait to take advantage of RFID technology and its benefits. The technology is mature in many applications, highly functional and supported by current and emerging standards. RFID can be used to improve accuracy, speed and responsiveness. The developed Employee Attendance System using Radio Frequency Identification technology will significantly improve the current manual process of employee attendance recording and tracking system, especially in a corporate environment. The system promotes an automated approach in capturing the employee attendance, i.e. by having the employees enter the reader's range in the organization.
The captured employee attendance data are also processed and analyze automatically with less risk of data loss, compared to a manual filing approach. RFID systems provide automated responding signals to identify physical objects without the need for line-of-sight communication. The developed system can be improved and upgraded further, e.g. by extending the system with new features and modules or by improving the web-interface layout with new display style. Better yet the system can be enhanced further to offer another significant enhancement where the system can be extended to monitor employee attendance record.

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