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Automation of Time and Attendance using RFID Systems

Aysha Qaiser and Shoab A Khan
Bachelors of Software Engineering,Fatima Jinnah Women University, The Mall, Rawalpindi
aysha_800@yahoo.com
College of EME, NUST
kshoab@yahoo.com

Abstract: *This paper presents a novel concept to improve upon the processes in university environment using RFID technology. A system is implemented for the Automation of Time and Attendance using RFID Systems. The Students and Faculty members are provided with RFID devices/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 Log. Using the recorded information, this system is capable of (1) Marking Attendance (2) Marking Unauthorized Entry (3) Probation Analysis (4) Attendance Weightage Calculations (5) Submission of Warnings via Emails (6) SMS to Parents to keep them updated about their child's progress in the institute (7) A dedicated website for the availability of the processed data for the users of the system. The entire Processing is done without Human intervention. The system is comprehensive, effective and efficient, thus can help in automating the students' administration.*

1. INTRODUCTION

This paper focuses on implementing the Automation of Time and Attendance using the RFID System. Radio frequency (RF) refers to electromagnetic waves that have a wavelength suited for use in radio communication. Radio waves are classified by their frequencies, which are expressed in kilohertz, megahertz, or gigahertz. [1]. RFID is a flexible technology that's convenient and well suited for automatic operations. Its advantages aren't available with other identification technologies. RFID is a means of identifying a person or object using radio frequency transmission. Radio waves transfer data between an item to which an RFID device is attached and an RFID reader. This Technology overcomes the limitations of other automatic identification approaches that use light to communicate, (such as bar codes and infrared technology) because a tag may be hidden or invisible to the eye and can be used in a harsh or dirty environment. Readers can be set to remotely and automatically read without labor-intensive manual scanning of the object as in most bar code systems.

In a basic RFID System, an RFID Transponder will identify itself when it detects a signal from a compatible device, known as a Reader or Interrogator. The system is shown in Figure 1. Transponders or tags are attached to objects. Each tag carries with it information: a serial number, model number, color, place of assembly or any other imaginable data. When these Tags pass through a field generated by a compatible Reader, they transmit this information back to the Reader. In addition to this basic RFID Equipment, an RFID system includes Application-Specific Software.

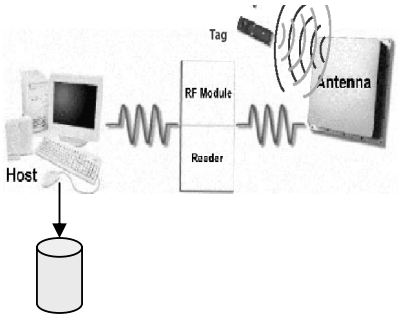

Figure 1: An RFID System

1.1 Frequency of RFID Systems

Radio frequencies of these systems range from very low frequency (VLF), which has a range of 10 to 30 kHz, to extremely high frequency (EHF), which has a range of 30 to 300 GHz.

These frequencies are grouped into four basic ranges and are give in Table 1

Table 1: RFID Frequencies

		Range	Uses
LF	Low Freq	30 kHz to 300 kHz	125 kHz
HF	High Freq	3 MHz to 30 MHz	13.56 MHz
VHF	Very High Freq	30 MHz to 300 MHz	Not used for RFID
UHF	Ultra High Freq	300 MHz to 3 GHz	866 MHz, 915 MHz

1.2 Why RFID Technology?

RFID is a very promising technology with significant impact. Following are the reasons for us to use this technology for students' administration application.

- No line of sight required.
- Tags can be read from significant distances
- Multiple tags can be read at the same time.
- Because tags must be enclosed, they are much more difficult to tamper.
- Many tags are read / write capable, rather than read only [2].

1.3 Read Range

An RFID system's "Read Range" is the distance an Interrogator (Reader) must be from the tag in order to read the information stored on its computer chip. It varies from a few centimeters to tens of meters, depending on frequency used, whether a tag is active or passive, and how directional the antenna is on the interrogator.

- For Read/Write Tags, the read range is typically greater than the Write range.
- Low-frequency Tags are read from a foot (0.33 meter) or less.
- High-frequency Tags are read from about three feet (1 meter) and UHF tags are read from 10 to 20 feet.

1.4 RFID Vs Bar Code System

- RFID is similar in concept to bar coding.
- Bar code Systems use a Reader and Coded Labels that are attached to an item, while RFID uses a Reader and special RFID devices that are attached to an item.
- Bar code uses optical signals to transfer information from the Label to the Reader while RFID uses RF signals to transfer information from the RFID device to the Reader.

2. SYSTEM OVERVIEW

The proposed system a generic application design to automate and enhance the manual work of recording and reporting in real-time, the Time and Attendance System in Educational institutes. A Log is maintained in the Database, which contains timely information of the Tag's Enter/ Exit. From the log maintained, total Stay-In time of the Student in the class is calculated, if the time is equal to required time (criterion fixed by the University Administration), he/ she is marked "Present" else marked "Absent" in the Database. In addition to this attendance, 'Faculty Attendance' is also marked in the Database. The Unauthorized/ Unregistered entry of Student/ Faculty/ Administrator is also checked.

In order to aware the Parents/ Administration about Student/ Faculty Attendance, Warnings are generated and e-mailed showing their Absence / Presence information.

If the Faculty member remains absent for three classes his/her progress is also E-mailed to the head of the School Administration.

Student's Attendance weightage is also calculated in order to confirm their eligibility to sit in exam. For example if they are absent for three classes in a Particular Course they are sent on probation. The whole data compiled after marking Attendance can be used to deduce different information i.e. depicting behaviors of Faculty, Students etc from the Records.

3. SYSTEM BLOCK DIAGRAM

The system takes input from the HW. The RFID tag is read and a log is maintained in the database. The record is also forwarded for central processing and storage is depicted in Figure 2.

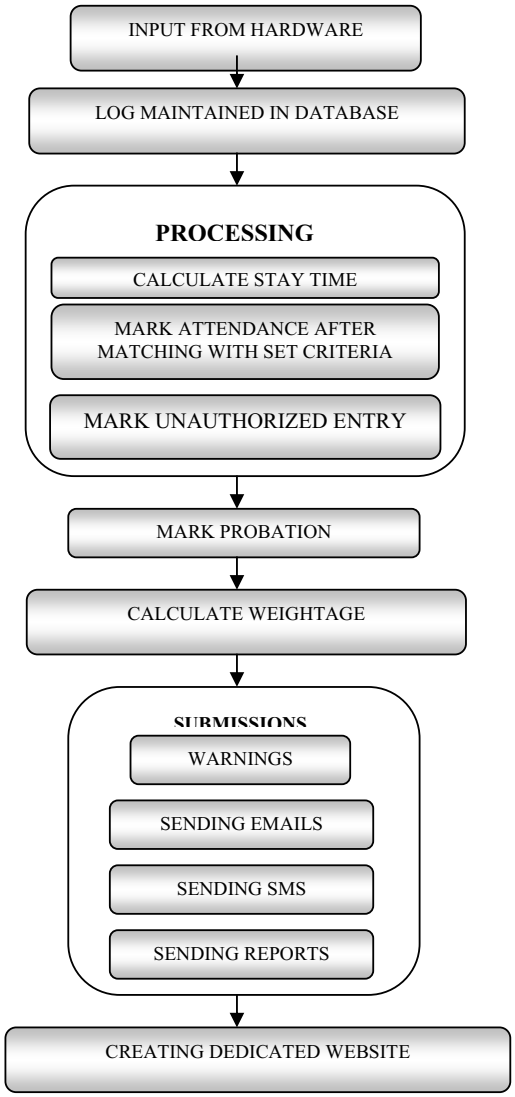

Figure 2: Block Diagram of the System

The reports and warnings are generated in users are informed via emails and SMS messages.

4. PRINCIPAL HARDWARE: RFID DEVICES AND READER

RFID reader is the fundamental component of the system. Reader is 'Plug and play' device. The RFID Readers are configured to the Server machine.

5. PRINCIPLE OF THE APPLICATION

The application consists of seven main modules, which are as follows:

5.1 Scanning Input from Hardware

Reader reads the ID of any tag which is with in its field. So, when the Tagged user passes the Reader generated field, it sends unique information, and real time data is stored in the Table 'Log' in the database.

Basically a Server program takes the Reader ID and then receives Tag ID's from the Client. On the basis of the Flag value it maintains real time data in the Log in the form of 'enter/ exits'.

5.2 Windows Service

To avoid Human Intervention in the System, Windows Service is created and used. Services enable us to create long-running executable applications that run in their own Windows session, which then has the ability to start automatically when the computer boots and also can be manually paused, stopped or even restarted. This makes services ideal for use on a server or whenever long-running functionality is needed. Three timers used are shown in Table II.

Timer	Hours
Attendance Timer	Set to a timer of 24 hours
Probation Timer	Set to a Timer of 1 week
Weightage Timer	Set to a Timer of 6 months.

Table II: Timers used

The services provided by the window service are as follows:

5.3 Marking Attendance and Un-authorized Entry

Attendance of Students against every Course is marked on the basis of calculated Stay-In time from the 'Enter/ Exits' in the Log. If there Stay-In time, matches with the required time, then Attendance is marked as 'Present'. Attendance of those students not attending/coming to class/institute is also marked as 'Absent'. Before marking attendance, duplicate record is checked in order to avoid redundancy.

The Unregistered Tagged Students attending the class are marked as Unauthorized. This is done in order to avoid congestion in labs/ Classrooms and distraction issues.

5.4 Probation Analysis

The entire Attendance record of the Student is checked, to check for the number of absentees in his /her record. If the absentees are more then the allowed in a particular course then the student is put On-Probation.

5 5. Weightage Calculations

The Weightage calculations are done for every Student in each of his Registered Courses in order to check his eligibility to sit in Exam.

5.6 Submission of Warnings

In the Probation Analysis when the Student/Faculty member is On-Probation, a Warning is inserted against his account. When the Student has Attendance Weightage less then required in some Course, a Warning containing Low Weightage information is inserted against his/her account.

5.7 Sending Emails

Whenever a Warning is submitted at Student account in case of On-Probation or in case of low Weightage, an e-mail containing the same Warning is sent to Student's Parent/Guardian. By doing this the system updates Parent about their Child's progress.

5.8 Sending SMS

For sending SMS, web service is used. Whenever the student is On-Probation or acquires a low Weightage. An SMS is sent to His Father/ Guardian to update him about his Child's Progress in case he is unable to check his email.

5.9 Sending Reports

System also automates the task of sending reports, in order to avoid any loss of information or misinformation.

As soon as the warning is submitted against any Tag ID, a report is generated and e-mailed to the Student and Parent for further verification. If the Student is On-Probation, Probation Report containing the entire Attendance record of the Student against particular Course is e-mailed to the Parent. In case of less Attendance weightage also Weightage report is generated and E-mailed.

5.10 Availability of Processed Data

A Dedicated Website is created for the availability and access of the compiled data depending on the roles. This application is available on the LAN and the Students, Faculty members and the Administrators need to login in to the system to access it. There is a different interface depending on the role of the user.

6. CONCLUSION

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 Classroom 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.

Most organizations are implementing RFID Systems and we hope that the result of this paper will also contribute towards its development in educational Institutes where issues like proxy, attendance, Weightage and probation are highly critical and also effect grades. The parents are always concerned about their children attending professional colleges. The system automatically generates SMS messages to inform parents if an issue requires their immediate attention and consideration.

REFERENCES

[1] RFID Overview: Introduction to Radio Frequency Identification by Intermec Technologies Corporation.

[2] Nadeem Raza, Viv Bradshaw, Matthew Hague, Microlise Systems Integration Limited. Applications of RFID Technology; IEEE Review, April 2004.