Student Management System based on RFID Technology

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Abstract: Educational institutions’ administrators are concerned about student irregular attendance. Checking students‘ attendance is one of the important issues for universities, because many universities evaluate students‘ attendance while giving the final grade, professors consider their total number of appearances on classes during the whole semester. This brings to the idea of having some tool to control students’ attendance. However, Current manual way of taking student attendance is not an efficient way since there will be spent much of time for calling students names and putting marks like "presence" or "absence" if the class is a lecture class, and in this class at least 5 groups are presented. Moreover, some students may call his/her friend as "presence" even though this student is currently absent. After thinking all these issues, author of the following research paper decided to create a system that makes easier to check students’ attendance automatically. The system is based on RFID technology, and in this paper, details of this system are presented. The system can be easily accessed by the lecturers via the web and most importantly, the reports can be generated in real-time processing, thus, providing valuable information about the student.

Keyword: RFID-Radio Frequency Identification; RFID-tag; RFID-reader; LMS (Learning Management System), Student attendance control system, EPC (electronic product codes), Library Management System,

1. INTRODUCTION

Now-a-days, there are lots of colleges and Universities around the world and some of them consist of students up to thousands or more. To handle a large number of students may be a problem especially to get the attendance of the students. The manual process is that whenever a lecturer comes to class, he came with a register and manually takes attendance by calling roll-numbers. This manual process has some flaws because in a case where students can cheat by saying attendance of their friends, another problem is that the lecturer had to take care of the register and enter the attendance into the log (or) data-base, calculate the attendance percentage. This would be a big problem in the colleges and Universities. The suitable solution for this problem is by designing a system that will record attendance automatically. In this project, RFID system is used to record the numbers of student’s attendance automatically. The ID cards of the students is embedded with RFID tag which is read by a reader. This RFID system is interfaced to a database through a computer or some electronic circuits. This method is more effective to prevent problem encountered when getting attendance manually. The main components that the RFID technology consists are RFID Reader and RFID Tag.

RFID is a nascent technology, deeply rooted by its early developments in using radar 1 as a harbinger of adversary planes during World War II. A plethora of industries have leveraged the benefits of RFID technology for enhancements in sectors like military, sports, security, airline, animal farms, healthcare and other areas. Industry specific key applications of this technology include vehicle tracking, automated inventory management, animal monitoring, secure store checkouts, supply chain management, automatic payment, sport timing technologies, etc. This paper introduces the distinctive components of RFID technology and focuses on its core competencies: scalability and security. It will be then supplemented by a detailed synopsis of an investigation conducted to test the feasibility and practicality of RFID technology. Radio-frequency identification (RFID) is a technology that uses radio waves to transfer data from an electronic tag – called an RFID tag or label, which is attached to an object – through a reader for the purpose of identifying and tracking the object. An RFID system primarily comprises of RFID Tags, RFID Reader, Middleware and a Backend database. RFID Tags are uniquely and universally identified by an identification sequence, governed by the rubrics of EPC global Tag Data Standard2. Some RFID tags can be read from several meters away and beyond the line of sight of the reader. RFID systems have been widely used in many different application areas, such as: product tracking through manufacturing and assembly, control of inventory, parking lot access and control, container tracking, ID badges and access control, equipment tracking in hospitals, etc. Compared to other automatic identification technologies, such as optical barcode systems, RFID-technology has several advantages. The RFID system is interdependent on its core components to achieve maximum efficiency and optimum performance of the application. Due to its high degree of flexibility, the system can be easily adopted for an array of applications ranging from small scale inventory cabinets to multifarious and highly agile supply chain management systems.

An RFID tag should be chosen according to its intended use. Several frequencies are available, including LF, HF, UHF, and microwave. The frequencies may vary depending on the country in which the RFID tag is being
used. RFID technology was used as an automatic monitor of student classroom attendance. There was some research work done in Europe, in which proposed attendance management system extended with computer vision algorithms. They used real time face detection algorithms integrated on an existing Learning Management System (LMS), which automatically detects and registers student attending on a lecture.

2. EVOLUTION OF RFID:
The success of RFID technology primarily centers on the advent of radio technology. The developments in radio technology were a prerequisite to harness the essence of RFID technology. There is significant growth over the past couple of decades in this technology (see Figure 1). RFID technology is rife in modern industries that demand data integrity and high efficiency of the system. This technology is used for tracking vehicles and goods, courier services and luggage handling. Other applications include animal tracking, secure toll payments, inventory management systems, access control mechanisms, etc.

2.1 COMPONENTS OF RFID:
An RFID system consists of various components that are connected to one another by a dedicated communication path (see Figure 2).

- **Tags** – an object that is attached to any product and uses a unique sequence of characters to define it. It comprises of a chip and the antenna.

- **Antenna** – it is responsible for the transmission of information between the reader and tag using radio waves.

- **RF Transceiver** - The RF transceiver is the source of the RF energy used to activate and power the passive RFID tags.

![Figure 1 Components of RFID System](image)

3. WHAT IS RFID?
RFID is short for Radio Frequency Identification. Generally a RFID system consists of 2 parts: A Reader, and one or more Transponders, also known as Tags. RFID systems evolved from barcode labels as a means to automatically identify and track products and people.

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![Figure 1 Evolution Of RFID](image)

3.1.1 TAGS:
An RFID tag is comprised of a microchip containing identifying information and an antenna that transmits this data wirelessly to a reader. At its most basic, the chip will contain a serialized identifier, or license plate number, that uniquely identifies that item, similar to the way many bar codes are used today. A key difference, however is that RFID tags have a higher data capacity than their bar code counterparts. This increases the options for the type of information that can be encoded on the tag, including the manufacturer, batch or lot number, weight, ownership, destination and history (such as the temperature range to which an item has been exposed). In fact, an unlimited list of other types of information can be stored on RFID tags, depending on application needs. An RFID tag can be placed on individual items, cases or pallets for identification purposes, as well as on fixed assets such as trailers, containers, totes, etc. Tags come in a variety of types, with a variety of capabilities. Key variables include: “Read-only” versus “read-write”.

There are three options in terms of how data can be encoded on tags: (1) Read-only tags contain data such as a serialized tracking number, which is pre-written onto them by the tag manufacturer or distributor. These are generally the least expensive tags because they cannot have any additional information included as they move throughout the supply chain. Any updates to that information would have to be maintained in the application software that tracks SKU movement and activity. (2) “Write once” tags enable a user to write data to the tag one time in production or distribution processes. Again, this may include a serial number, but perhaps other data such as a lot or batch number. (3) Full “read-write” tags allow new data to be written to the tag as needed—and even written over the original data. Examples for the latter capability might include the time and date of ownership transfer or updating the repair history of a fixed asset. While these are the most costly of the three tag types and are not practical for tracking inexpensive items, future standards for electronic product codes (EPC) appear to be headed in this direction.
3.1.2 ANTENNA:
The antenna emits radio signals to activate the tag and read and write data to it. Antennas are the conduits between the tag and the transceiver, which controls the system’s data acquisition and communication. Antennas are available in a variety of shapes and sizes; they can be built into a door frame to receive tag data from persons or things passing through the door, or mounted on an interstate tollbooth to monitor traffic passing by on a freeway. The electromagnetic field produced by an antenna can be constantly present when multiple tags are expected continually. If constant interrogation is not required, a sensor device can activate the field. Often the antenna is packaged with the transceiver and decoder to become a reader (a.k.a. interrogator), which can be configured either as a handheld or a fixed-mount device. The reader emits radio waves in ranges of anywhere from one inch to 100 feet or more, depending upon its power output and the radio frequency used. When an RFID tag passes through the electromagnetic zone, it detects the reader's activation signal. The reader decodes the data encoded in the tag's integrated circuit (silicon chip) and the data is passed to the host computer for processing.

3.1.3 RF TRANSCEIVER
The RF transceiver is the source of the RF energy used to activate and power the passive RFID tags. The RF transceiver may be enclosed in the same cabinet as the reader or it may be a separate piece of equipment. When provided as a separate piece of equipment, the transceiver is commonly referred to as an RF module. The RF transceiver controls and modulates the radio frequencies that the antenna transmits and receives. The transceiver filters and amplifies the backscatter signal from a passive RFID tag.

4. HOW RFID WORKS?
Shown below is a typical RFID system. In every RFID system the transponder Tags contain information. This information can be as little as a single binary bit, or be a large array of bits representing such things as an identity code, personal medical information, or literally any type of information that can be stored in digital binary format.

Shown is a RFID transceiver that communicates with a Tag. There are two types of tags: Active Tags and Passive Tags. Active tags have its own source of power where as Passive tags have no power source of their own and instead derive power from the incident electromagnetic field. Commonly the heart of each tag is a microchip. When the Tag enters the generated RF field it is able to draw enough power from the field to access its internal memory and transmit its stored information. When the transponder Tag draws power in this way the resultant interaction of the RF fields causes the voltage at the transceiver antenna to drop in value. This effect is utilized by the Tag to communicate its information to the reader. The Tag is able to control the amount of power drawn from the field and by doing so it can modulate the voltage sensed at the transceiver according to the bit pattern it wishes to transmit.

5. KEY BENEFITS OF RFID
RFID-enabled systems help companies cut costs, improve customer service, reduce labor, increase accuracy, and improve production throughput. Other benefits of RFID technology are as listed below:

- **No line-of-sight contact necessary**
  - The major advantage of all kinds of RFID system is that they work contactlessly and require no line of sight.

- **Robust system**
  - Transponders can be read through a whole number of substances, e.g. snow, fog, ice, paint, dirt, and in difficult constructional scenarios where barcodes or other optical reading technologies would be no use at all.

- **Speed of an RFID system**
  - RFID transponders can be read at remarkable speed even in difficult conditions, and in most cases respond in less than 100 milliseconds.

- **Bidirectional communication**
  - The reading/writing capability of an active RFID system is also a significant advantage in interactive
applications, e.g. when tracking products in process or maintenance jobs.

- **Reliability in tough environments**
  - In difficult external conditions RFID has the advantage of being able to communicate contactlessly and without direct line-of-sight contact with the data medium. Where the transponder is doesn't matter either -- it can be read through substances like dust, paint or ice.

- **Bulk detection**
  - Active and passive systems working at HF and UHF frequencies detect a number of transponders in the field. This property is called bulk capability. In practical terms it means that every data medium needn't be scanned singly, but is automatically detected during a read operation.

### 6. COMPARISON BETWEEN RFID AND BARCODE

<table>
<thead>
<tr>
<th></th>
<th>RFID</th>
<th>Barcode</th>
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<tbody>
<tr>
<td><strong>Line of Site</strong></td>
<td>Not required (in most cases)</td>
<td>Required</td>
</tr>
<tr>
<td><strong>Read Range</strong></td>
<td>Passive UHF RFID:</td>
<td>Several inches up to several feet</td>
</tr>
<tr>
<td></td>
<td>- Up to 40 feet (fixed readers)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Up to 20 feet (handheld readers)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Active RFID:</td>
<td></td>
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<tr>
<td></td>
<td>- Up to 100's of feet or more</td>
<td></td>
</tr>
<tr>
<td><strong>Read Rate</strong></td>
<td>10’s, 100’s or 1000’s simultaneously</td>
<td>Only one at a time</td>
</tr>
<tr>
<td><strong>Identification</strong></td>
<td>Can uniquely identify each item/asset tagged.</td>
<td>Most barcodes only identify the type of item (UPC Code) but not uniquely.</td>
</tr>
<tr>
<td><strong>Read/Write</strong></td>
<td>Many RFID tags are Read/Write</td>
<td>Read only</td>
</tr>
<tr>
<td><strong>Technology</strong></td>
<td>RF (Radio Frequency)</td>
<td>Optical (Laser)</td>
</tr>
<tr>
<td><strong>Interference</strong></td>
<td>Like the TSA (Transportation Security</td>
<td>Obstructed barcodes cannot be read (dirt covering)</td>
</tr>
<tr>
<td></td>
<td>Administration)</td>
<td></td>
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### 7. COMPARISON BETWEEN RFID AND NFC

<table>
<thead>
<tr>
<th></th>
<th>RFID</th>
<th>NFC</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RFID uses radio frequencies for communication</strong></td>
<td>NFC is a subset of RFID</td>
<td></td>
</tr>
<tr>
<td><strong>RFID is capable of accepting and transmitting beyond a few meters</strong></td>
<td>NFC is restricted to within 4 inches</td>
<td></td>
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<tr>
<td><strong>RFID has a wide range of uses</strong></td>
<td>NFC is usually used in cases where security is needed</td>
<td></td>
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<tr>
<td><strong>RFID waves are either passive or active</strong></td>
<td>NFC are usually passive</td>
<td></td>
</tr>
<tr>
<td><strong>RFID can be used in any frequency or standard that are being used</strong></td>
<td>NFC requires 13.56 MHz frequency</td>
<td></td>
</tr>
<tr>
<td><strong>RFID can be used for applications like animal tracking, vehicle tracking</strong></td>
<td>NFC is appropriate for the reliable applications like mobile payments</td>
<td></td>
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### 8. SYSTEM ARCHITECTURE AND ITS WORKING PRINCIPLES

Our aim is to create a system with one server to which all PC’s are connected, so all data will be saved in one data base, making the monitoring of the information effortless. All classes must have a PC with a connected RFID-reader that can read student RFID-cards, as well as a Web camera that can take their photos. The camera is meant to prevent a student from giving his/her RFID-card to a classmate who attends the lecture, scanning the other student’s RFID-card to make it appear as if s/he had also attended.
When a student enters class, the RFID reader reads his/her student ID card, while the Web-camera simultaneously takes his/her photo and sends it to the PC. After some time, the professor submits all data for storage in a database.

This RFID system can also be implemented for Library Management System. When a student enters the library it scans the student ID same as attendance and only allows authenticated students in the library and when ever a student leaves the library it checks for the RFID tag. The architecture for library management system using RFID is shown in below figure.

When students enter the classroom, the RFID-reader automatically reads their RFID-cards(See Fig. 5) and the Web-camera takes their photos. These photos and ID’s are sent to the PC, where system will compare their information with information stored on the DBMS according to their ID’s that we have assigned to them. Finally, the professor will submit all the information collected, and the DBMS will have a record of who came and who failed to come to class on any given day.

In the case of a new student, when he/she enters the library, the RFID-reader automatically reads their RFID-cards and the Web-camera takes their photos. These photos and ID’s are sent to the PC, where system will compare their information with information stored on the DBMS according to their ID’s that we have assigned to them. If any inconsistency found, then system will turn alarm on. If the student is valid then he or she can search any book, if he/she wants to withdraw the book then using system and RFID tag, student can able withdraw it. Same way in case of book return, only student has to drop the book in its place, it will search the RFID tag and book is returned in his/her account automatically there is no need of any man power for book issue and return.

As and when new students enter gets admitted, using system their personal data, scanned photograph and RFID tag data has been saved into the system.

Professors will be able to use their free time to compare the photos of students who came to lessons with those in the Database, so taking attendance will no longer eat up lesson time. Use of RFID-cards, then, may help to solve attendance-taking problems and any and all related issues.

As shown in the below figure for library management, RFID card will be used for entry and exit checking in and from library, for book checking (availability) purpose and for book withdrawal and return purpose.

9. IMPLEMENTATION:
The primary aim of the research is to uniquely identify individual students based on their unique tag identifiers. The research should shower light on how scalable and efficient the system is. A systematic and serialized approach is required to solve this conundrum. The key characteristics of the application include:

- Perform automated attendance
- Generate report of attendees for a particular course
- Error free tag identifier detection
- Easy scalability to incorporate more records
- Integrity and security in data storage

When the professor arrives in class, he/she logs in and submits a password on the PC to our system, after which our system opens his/her page as shown in below figure.
Data being recorded can be easily exported to a Microsoft Excel file for report generation. The database can be easily scaled to incorporate more details about the student. Various reports in required formats can be generated using this data.

10. ADVANTAGES OF SYSTEM
The implementation of RFID technology will definitely quickened the entire of process of recording attendance and library management. Manual Process of attendance taking and book issue and return will be totally removed which will save man power requirement and it provides very authenticate output. compared with the time consumption in data entry for different technologies, RFID technology saves considerable amount of time and greatly improves the operation efficiency. Also with the adoption of this technology the process and product quality can be improved due to reduction in entry errors by manual human operations. Labour cost is reduced to perform the value added functions.

11. CONCLUSION
The authors we have consulted in our research have shown how a system relying on RFID - technology may be developed. This system is flexible, which means that it may be extended by adding more modules. The cards that have been employed for this specific system are RFID cards, and the algorithm used has shown stable and reliable results. These cards can be put to use at the university and may replace student ID cards. RFID technology continues to develop, and the time has come for us to avail ourselves of its promise and convenience. The main aim of this research has been to demonstrate potential uses of RFID-technology and build a system reliant on it.

The study has identified and explained the key benefits of RFID technology. The first part of the paper explains the evolution of RFID technology and the role of its individual components within the system. The second part of the paper discusses the feasibility of employing RFID technology and how it is benefactor of improved efficiency at lowered costs. RFID technology definitely promises an increased effectiveness and improved efficiency for business processes.

REFERENCES