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Students Record System using Radio Frequency Technique

Purnima Singh[1], Archana Gautam.[2] Km. Jyotsana[3], Diksha Srivastav[4],Aditya Kumar Singh[5]
[1-5] Dept of Electronics & communication Engineering, Buddha Institute of Technology, Gorakhpur, U.P., India
Email id-singh.purnima94@gmail.com

Abstract- In recent years, there have been rise in the number of applications based on Radio Frequency Identification (RFID) systems and have been successfully applied to different areas as diverse as transportation, health-care, agriculture, and hospitality industry to name a few. RFID technology facilitates automatic wireless identification using electronic passive and active tags with suitable readers. In this paper, an attempt is made to solve recurrent lecture attendance monitoring problem in developing countries using RFID technology. The application of RFID to student attendance monitoring as developed and deployed in this study is capable of eliminating time wasted during manual collection of attendance and an opportunity for the educational administrators to capture face-to-face classroom statistics for allocation of appropriate attendance scores and for further managerial decisions

Keywords— RFID: Radio Frequency Identification, RFID-tag, RFID-reader, attendance control system, GSM.

I. INTRODUCTION

RFID, which stands for Radio Frequency Identification, is an automatic identification technology used for retrieving from or storing data on to RFID Tags without any physical contact [1]. 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. A tag can either be passively activated by an RFID reader or it can actively transmit RF signals to the reader [3]. The RFID reader, through its antenna, reads the information stored on these tags when it's in its vicinity. The reader, whose effective range is based on its operational frequency, is designed to operate at a certain frequency.

The operational frequency of the reader ranges from 125 KHz – 2.4 GHz [5]. The Middleware encompasses all those components that are responsible for the transmission of germane information from the reader to the backend management systems [8]. The Middleware can include hardware components like cables and connectivity ports and software component like filter that monitor network performance of the system [2, 9]. The Backend database stores individual tag identifiers to uniquely identify the roles of each tag. The database stores record entries pertaining to individual tags and its role in the system application. 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 [4, 6]. Although, the cost of incorporating this technology has restricted its outreach, the technology promises to have untapped potential [10, 11].

1 Radio Detection and Ranging is a communication medium to subliminally detect objects that are miles away, invisible to the naked eye.
2 It defines the guidelines of how key identifiers must be encoded on the tag to define industry based standardization.

II. EVOLUTION OF RFID

The success of RFID technology primarily centers on the advent of radio technology [12]. 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). This technology is used for vehicle tracking and goods, courier services and luggage handling[18]. Other applications include animal tracking, secure toll payments, inventory management systems, access control mechanism.

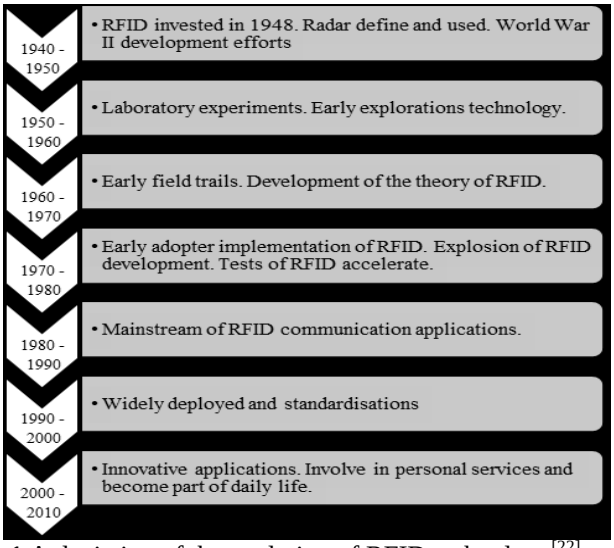

Fig. 1 A depiction of the evolution of RFID technology[22]

III. Building blocks of an RFID System

Various components of an RFID system that are connected to one another by a dedicated communication path (see figure 2). The individual components are integrated into the system to implement the benefits of RFID solution [15].

The list of components is as follows:

- **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.
- **Reader** – a scanning device that uses the antenna to realize the tags that are in its vicinity. It transmits signals at a certain frequencies.
- **Middleware** – it is a communication interface to interpret and process data being fed by the readers into information. It takes into account all relevant ports of communication and a software application to represent this information.
- **Backend database** – a repository of information, which is designed specific to the application. The database stores records of data specific to individual tags

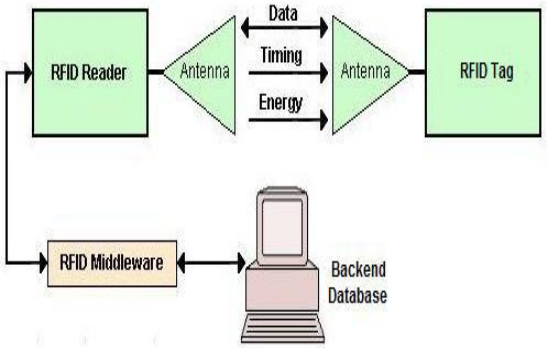

Fig. 2 Components of an RFID system

Tags

A tag consists of a microchip that stores a unique sequence identifier that is useful in identifying objects individually. The sequence is a numeric serial, which is stored in the RFID memory. The microchip includes minute circuitry and an embedded silicon chip [14, 18]. The tag memory can be permanent or re-writable, which can be re-programmed electronically by the reader multiple times. Tags are designed specific to its applications and environment. For example, paper-thin tags are attached to books in a library management system [12].

Tags are available in variety of shapes and sizes (see figure 3). Tags that are initiated by the reader are known as Passive tags, on the other hand those that do not require external initiation are called Active tags. A Semi-Passive tag exists, which has the features of both Active and Passive tags [21]. Each tag type has its distinct characteristics, which are discussed in table 1.

Tags are operable on Microwave (2.4 – 2.5 GHz), Ultra High Frequency (UHF) (860 – 1500 MHz), High Frequency (HF) (13.56 MHz) and Low Frequency (LF) (125 kHz) [22].

Features	Types of Tags		
	Passive	Active	Semi-passive
Read range	Short(up to 10m)	Long (up to 100 m)	Long (up to 100m)
Battery	No	Yes	Yes
Lifespan	Up to 20 years	Between 5 -10 years	Up to 10 years
Cost	Cheap	Very expansive	Expansive
Availability	Only in field of reader	Continuous	Only in field of reader
Storage	128 bytes read/write	128k bytes Read/write	128k bytes read/write
Application	EZ-Pass toll payment booths	Monitor the condition of fresh produce	Measurement of temperature periodically

Table 1. Features of different types of tags

Fig. 3 Different Types of RFID Tags

Antenna

The antenna is medium via which the tag and reader communicate with each other. It can activate a passive tag and transfer data by emitting wireless impulses that has electromagnetic properties [20]. The antenna comes in various designs (see figure 4). They come in following types: (1) Stick antennas, (2) Di-pole or multi-pole antennas, (3) Beam forming or phased-array element antennas, (4) Circular polarized, (5) Gate antennas, (6) Patch antennas, (7) Linear polarized, (8) Adaptive antennas, and (9) Omni directional antennas [19].

Reader

It is the most important part of the RFID system. It reads raw data input from the tag and transmits it to the Middleware for further processing [16]. The reader attempts to interrogate the tags at varying frequencies. It communicates by transmitting a beam of impulses, which encapsulate commands to the tag and waits for the tag's response [14]. The reader also consists of

built in anti-collision processes, which allows the reader to read multiple tags simultaneously [15]. The reader is connected to the computer for data processing via a USB cable or over a wireless connection. (see figure 4)

Fig 4. EM 18 RFID Reader

- **Middleware**

The middleware is an interface required to manage the flow of data from the reader and to transmit it efficiently to the backend database management systems [18]. The middleware monitors the number of tags present in the system and extracts relevant information from the readers [12]

- **Backend Database**

The backend database primarily deals with the storage of relevant information recorded by the reader and communicated by the middleware [16]. For example, the middleware in an automated security control system will store all tag readings taken by the reader in the database. This helps
create log entries for the system [19].

IV. SYSTEM DESIGN

For the implementation of RFID Based Student Attendance System with Notification to Parents Using GSM, the hardware and software are discussed below.

A. Hardware design

This system consists of automatic attendance system for both students and professor. While entering the class room both the student and professor have to mark their attendance using their RFID cards. This attendance will be forwarded to a central computer after processing it through the microcontroller where it will be stored. If a student is absent in the class then notification will be sent to his/her parents. The architecture of the system (see figure 5) consists of a tag attached on identity card to communicate wirelessly with a reader, in order to retrieve the tag‘s identity. RFID is used to take the attendance of the student. Student information is stored in the RFID tag and this information is read by the RFID reader. The ATMEGA16 microcontroller takes input from the RFID reader, processes it and sends it to both PC and the GSM module through MAX232 for storing the attendance and for sending SMS through the GSM module. Here, we can also use the PIC microcontroller easily but we are using ATMEGA16 microcontroller because the Atmel AVR.

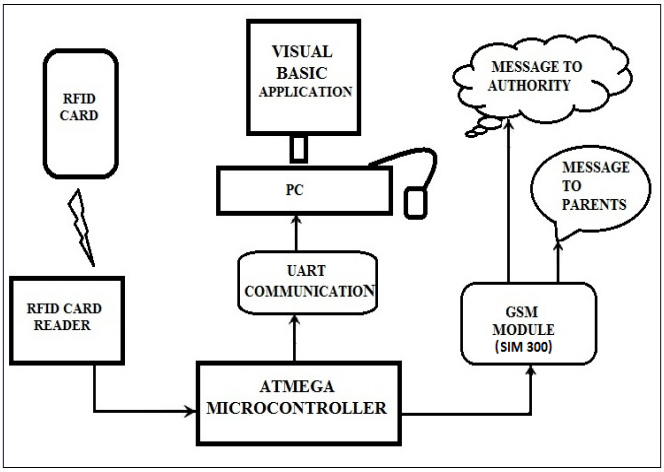

Fig. 5. Block diagram of the system

ATmega16 is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the ATmega16 achieves throughputs approaching 1MIPS per MHz allowing the system designed to optimize power consumption versus processing speed. This one is cost effective. The MAX232 IC is used to convert the TTL/CMOS logic levels to RS232 logic levels during serial communication of microcontrollers with PC. GSM (Global System for Mobile communications) is used to send SMS to student‘s parents about their absence in class. GSM SIM 300 is an open, digital cellular technology used for transmitting mobile voice and data services. GSM operates in the 900MHz and 1.8GHz bands. GSM supports data transfer speeds of up to 9.6 kbps, allowing the transmission of basic data services such as SMS.
The hardware of the system (see figure 6) consists of EM 18 RFID Reader, GSM SIM 300 module, Max 232 and ATMEGA 128 microcontroller with LCD.

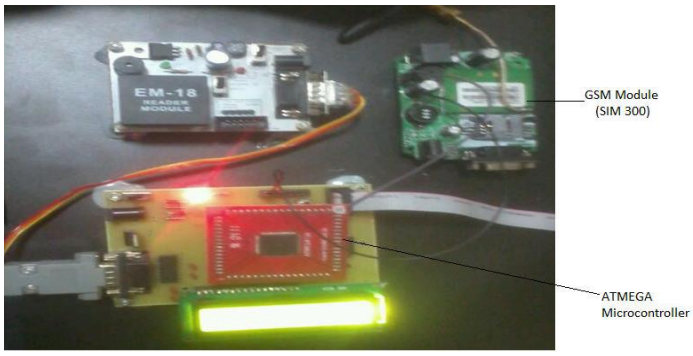

Fig. 6. Hardware of the system

When students scan their RFID tag to RFID reader, data will be transmitted to ATMEGA 128 microcontroller through Max232 and it will be displayed on LCD. Microcontroller sends the data to database in the PC for matching student details and information is stored in the database. After matching, PC sends notification to controller and it will be displayed on LCD **“present”.** After 10 minute, those students are absent, PC sends message through Max232 to microcontroller. Microcontroller sends the message to Parents through GSM.

B. Software Design

Direction flow of the program has been shown (see figure 7). ‘C’ sharp has been used for programming. The proposed system can be explained with the help of following steps.

Step 1-Initialise RFID Reader

Step 2-Initialise LCD

Step 3-Initialise UART

Step 4-Scan RFID tags

Step 5-Send scanned of RFID data to microcontroller

Step6-Using microcontroller perform the filtering operation to remove unwanted field and extract student‘s id.

Step 7-Search student tags id in permanent database with scanned RFID student’s tags.

Step7.1-Search student‘s id, if found go to step 8 else go to step 4.

Step8-Compare detected student’s tag, id’s, date and time with class time table and if match found then go to step 9 else go to step 4.

Step9- Check person type and mark the presence.

Step10- Repeat step 4 to step 9 for all row of RFID data.

Step 11- After 10 min check for present student and if student is absent then send massage to parents that your child is absent.

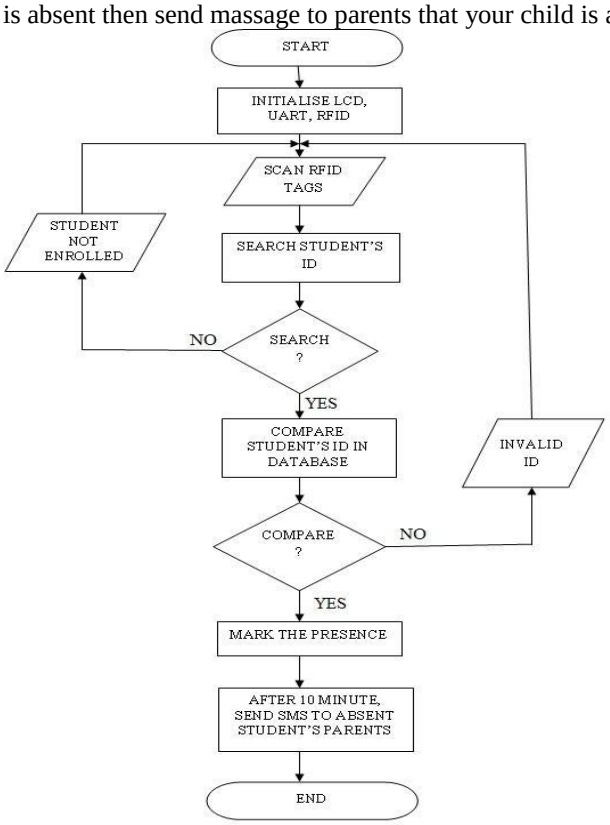

Fig. 7. Directional flow of the system

Following screens are designed in Visual Basic (VB). The database has been prepared by entering the user‘s name and password in the login page (see figure 8).

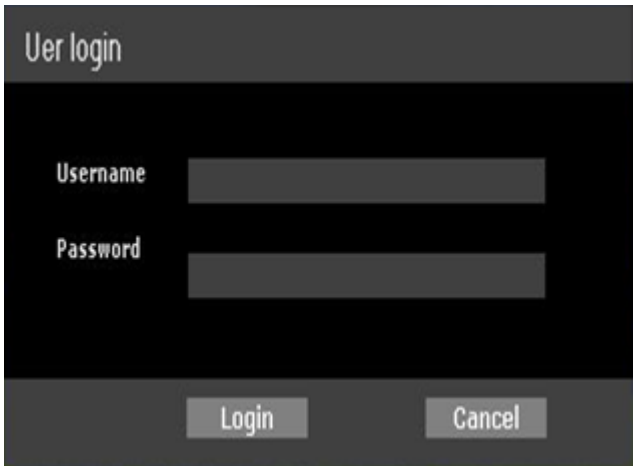

Fig. 8. Login page

The student database has been prepared by entering the student‘s ID, name, department etc. in the student information entry form (see figure 9).

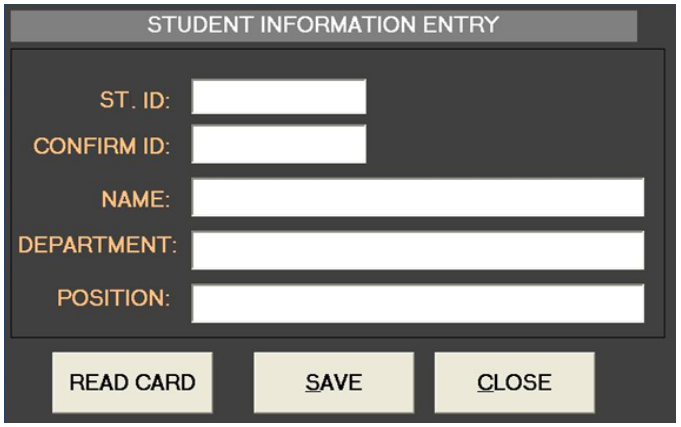

Fig.9. Student information form

Display window of the students shows the student‘s ID, name, Roll no., department etc. in the student information display window (see figure 10).

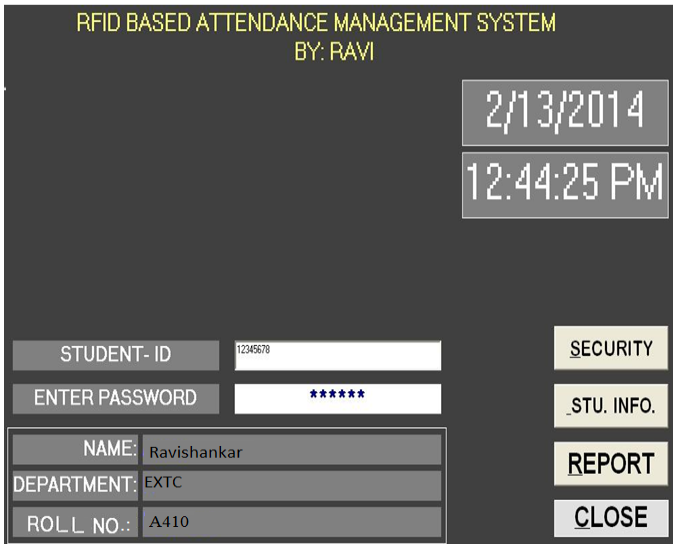

Fig 10. Student information display window

V. Results

The research was conducted on a sample of 60 students, enrolled in a particular course. The implementation of RFID technology has definitely quickened the entire of process of recording attendance. The traditional method of recording attendance involves individual manual entry; an arduous and a time consuming process. On average, based on experiment, the total time taken to record the attendance of a class of 60 students by manual entry method took approximately 10 minutes. This implies that approximately 10 seconds per student was required to record their attendance. This time duration includes visual and written authentication, after which the teacher records the attendance. In comparison (see figure 11), the total time taken for recording the attendance of 60 students using barcode and RFID technology is 120 seconds and 12 seconds respectively (see table 2). Based on the relationship obtained, a projection for a batch of 100 students is also forecasted.

Method	**Total number of students**			
	1	**10**	**60**	**100**
Manual Entry	10 seconds	100 seconds	600 seconds	1000 seconds
Bar Code	2 seconds	20 seconds	120 seconds	200 seconds
RFID technology	0.2 seconds	2 seconds	12 seconds	20 seconds

Table 2: Results of the Study

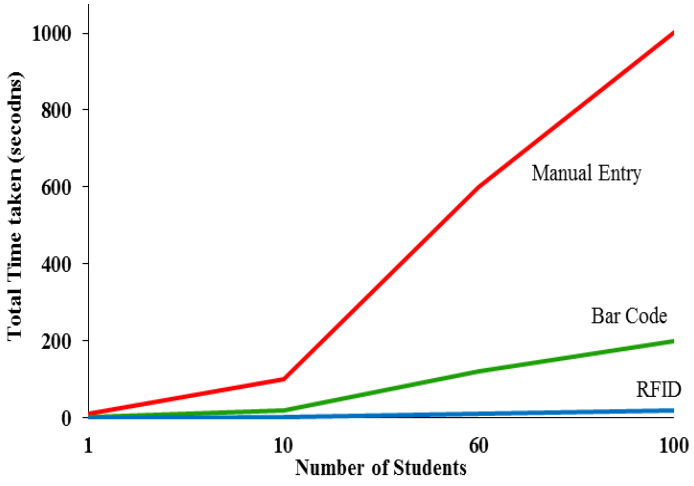

Fig .11 A line graph showing the comparison of total time taken to record the attendance of students

As shown in table 2, 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. Therefore, labour cost is reduced to perform the value added functions.

VI. Conclusion

The study has identified and explained the key benefits of RFID technology. RFID will open doors to a pool of applications from a plethora of industries [8]. Although the focal challenge to thwart the adoption is its investment cost, RFID technology provides an ocean of lucrative business opportunities that could convince several firms adopt it [14]. 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. The last part of the paper highlights one of the numerous practical implementations of RFID technology. RFID technology definitely promises an increased effectiveness and improved efficiency for business processes [22]. In the long run, with reducing unit tag and reader costs, several businesses will be able to leverage the benefits of RFID technology.

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