Design of an Electronic Student Identification System
Using RFID

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Abstract—This project is based on designing of student identification system using RFID i.e. Radio Frequency Identification which is to fulfill broad range of purposes, least being an electronic student identification system focuses on academic and monitoring purposes, more also to address the problem when using the paper as student attendance such as cheating. The work provided the alternative way of interfacing a tag and a reader to get code of student’s card (tag) to compare with the database in Access, which is developed using Visual Basic 6.0 to make the database easier to access. When a student swipes his card on the reader, his information like student’s name, registration number, level, sex, and date of birth will show on interface if the code matched with database.

Index Terms—Tag, Reader, Student Identification System, Antenna, Carrier Frequency.

I. INTRODUCTION

RFID, its application, standardization, and innovation are constantly changing. Its adoption sis still relatively new and hence there is many features of the technology that are not well understood by the general populace. Developments in RFID technology continue to yield larger memory capacities, wider reading ranges, and faster processing. It is highly unlikely that the technology will ultimately replace bar code – even with the inevitable reduction in raw materials coupled with economies of scale, the integrated circuit in an RF tag will never be as cost-effective as a bar code label. RFID is a radio frequency identification, in which an object ("tag") is applied to or incorporated into a product, animal, or a person to facilitate identification and tracking using radio waves [1].

A moment’s thought about radio broadcasts or mobile telephones and one can readily appreciate the benefits of wireless communication. Extend those benefits to communication of data, to and from portable low cost data carriers, and one is close to appreciating the nature and potential of radio frequency identification (RFID). RFID is an area of automatic identification that has quietly been gaining momentum in recent years and is now being seen as a radical means of enhancing data handling processes, complimentary in many ways to other data capture technologies such as bar coding. A range of devices and associated systems are available to satisfy even broader range applications. Despite this diversity, the principles upon which they are based are quite straightforward, even though the technology and technicalities concerning the way in which they operate can be quite sophisticated. Just as one need not know the technicalities of a mobile phone or personal computer to use it, it is not necessary to know the technicalities to understand the principles, considerations and potential for using RFID. However, a little technical appreciation can provide advantage in determining system requirements and in talking to consultants and suppliers [2]-[3].

A consortium of companies formed the Auto-ID Center for continued research into the nature and use of radio frequency identification, which brought an idea of how to identify and track their assets. The vision underlying automatic identification is the creation of an “Internet of Objects” [4].

The EPC was developed at MIT’s Auto-ID Center in 2000 and is a modern-day replacement for the Universal Product Code (UPC). A tag’s embedded EPC number is unique to that tag. The EPC protocol is universal to all EPC-compliant systems and serves two specific functions;

Telling how data is to be segregated and stored on the tag and determining how the tags and readers communicate, which is called the interface protocol [5].

Wal-Mart, like other large retailers, had more pragmatic issues at hand when they established an RFID requirement for their supplies. Under Wal-Marts mandate, each supplier is required to identify their products not by bar codes, but through EPCs that are automatically broadcast by RFID tags as new products arrive at the retailer’s warehouse, distribution, center, or store [6].

A system requires, in addition to tags, a means of reading or interrogating the tags and some means of communicating the data to a host computer or information management system. A system will also include a facility for entering or interrogating the tags and some means of communicating across the air interface. By considering the data flow requirements and in talking to consultants and suppliers [2]-[3], it is possible to grasp most of the important issues that influence the effective application of RFID. However, it is useful to begin by briefly considering the manner in

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which wireless communication is achieved, as the techniques involved have an important bearing upon the design of the system components [8].

Communication of data between tags and a reader is by wireless communication. Two methods distinguish and categorize RFID systems, one based upon propagating electromagnetic waves. Coupling is via ‘antenna’ structures forming an integral feature in both tags and readers. While the term antenna is generally considered more appropriate for propagating systems, it is also loosely applied to inductive systems [9].

To transfer data efficiently via the air interface that separates the two communicating components requires the data to be superimposed upon a rhythmically varying (sinusoidal) field or carrier wave. They are essentially based upon changing the value of one of the primary features of an alternating sinusoidal source, its amplitude, frequency or phase in accordance with the data carrying bit stream. On can distinguish amplitude shift keying (ASK), frequency shift keying (FSK) and phase shift keying (PSK). In addition to non-contact data transfer data transfer, wireless transfer; wireless communication can also allow non-line-of-sight communication. However, with very high frequency systems, more directionality is evident and can be tailored to needs through appropriate antenna design [10].

Erdem Ozyurt, of the University of Atilim undertook a Master Thesis in RFID Utilization for personal localization. Using transponders located inside of a building, he ran computer software that calculated the approximate location of a tag’s bearer using triangulation, by correlating the relative received signal strength (RSSI) from the various readers deployed [8].

Michael Silbermann undertook a research work in which he analyzed the security implications of contactless payment systems using RFID. Using Mifare cards, he was able to analyze some security flaws with cards based o that platform, MiRaFe, when used as monetary tokens. Related papers have been written in various schools beyond the shores of Nigeria [10].

The Department of Defence has always been a technology innovator through such groups as the Defence Advanced Research Projects Agency (DARPA) and others, but the technology impact has been mostly within its own secluded world. The information on the micro-chip can be read automatically, at a distance, by another wireless machine. A typical RFID system consists of RFID tag(s) and reader [11]-[12].

Each tag has a unique identifier and may also have other features such as memory to store additional data, environmental sensors, and security mechanisms. Tags are categorized into four types based on the power source for communication add other functionality: passive, active, semi-active and semi-passive [13].

A reader typically contains a radio frequency module (transmitter and receiver), a control unit and a coupling element to the transponder. RFID readers wirelessly communicate with the tags to identify the item connected to each tag or update additional information stored on the tag. Readers also measure parameters such as RSSI, phase and frequency [14].

II. DESIGN AND IMPLEMENTATION

The system is partitioned into two principal parts:

A. The hardware components

The hardware component comprises the RFID reader and its associated peripheral components. The system design was designed to effect automatic identity recognition and validation when an EM4001-capable card is brought in range of the ID-12 RFID scanner. The reader has an RS232 interface, running at 9600, and was interfaced with a USB port on the PC since the machine lacked a hardware legacy port. A PL2303-based converter cable kit affected the RS232-t-USB conversion. The driver installed for the virtual port to work, and was configured in the user interface at 9600, 8, N, 1. The user interface, developed in VB.Net was integrated with a prototype database with the following entries in each record set:

a. Name of card holder
b. Level of card holder
c. Registration Number of Card Holder
d. Gender of Card Holder
e. Date of Birth of Card Holder
f. Courses registered for by Card Holder
g. Passport Photograph of Card Holder in JPEG format.

Other entries can be added if the database design topology is amended, but for this application, the above entries were considered adequate.

The record entries were kept in .CSV text files located in folders individually addressable via the card digital ID.
Power for the reader was pulled from the USB port as the device places very little demand, loading-wise, on the USB port with its limited 0.5A maximum current sourcing capability. An LED glows whenever the serial cable is inserted into the USB, indicating power supply availability. A second LED glows whenever a card is read, giving a visual indication of the read process.

The PL2303 RxD line operates on 3.3V, with the ID-12 on +5V, therefore a simple 2:3 resistive attenuator was used to lower the voltage to within range of the PL2303’s. With the driver for the cable installed, the user is oblivious of the port assignment processes handled by the platforms’ operating systems.

Faraday’s law states a time –varying magnetic field through a surface bounded by a closed path induces a voltage around the loop. This fundamental principle has important consequences for operation of passive RFID devices. When the tag and reader antennas are within a proximity distance, the time-varying magnetic field, B, that is produced by a reader antenna coil induces a volateg in the tag antenna coil. The induced voltage in the coil causes a flow of current in the coil. The induced volate on the tag antenna coil is equal to the time rate of change of the magnetic flux, \( \varphi \).

\[
V = -N \frac{d\varphi}{dt}
\]  

(1)

Where \( N \) = Number of turns in the antenna coil  
\( \varphi \) = Magnetic flux through each turn  
The magnetic flux in equation 1, is the total magnetic field, B that is passing through the entire surface of the antenna coil, and found by;

\[
\varphi = \int B \cdot dS
\]  

(2)

Where \( B \) = Magnetic field  
\( S \) = Surface area of the coil  
Hence, the induced voltage, \( V_o \) for an unturned loop antenna is given by;

\[
V_o = 2\pi f NS B_o \cos \alpha
\]  

(3)

Where \( f \) = Frequency of the arrival signal  
\( N \) = Number of turns of coil in the loop  
\( S \) = Area of the loop in square meters (m\(^2\))  
\( B_o \) = Strength of the arrival signal  
\( \alpha \) = Angle of arrival of the signal

An RF signal can be radiated effectively if the linear dimension of the antenna is comparable with the wavelength of the operating frequency. In an RFID application utilizing the VLF (100-500 KHz) band, the wavelength of the operating frequency is few kilometers.

The induced voltage developed across the loop antenna coil is a function of the angle of the arrival signal. The induced voltage is maximized when the antenna coil is placed perpendicular to the direction of the upcoming signal where \( \alpha = 0 \).

The read range of RFID reader is a function of the number of turns (Ampere-turns) of a reader coil that has a specific radius is characterized by the equation 4;

\[
(NI) = \frac{2\pi(a^2+r^2)^{3/2}}{\mu a^2}
\]  

(4)

Where \( r \) = the read range  
\( a \) = the radius of the coil  
\( B_z \) = flux density

For a longer read range, its is instructive to consider increasing the radius of the coil. Hence,
\[ a = \sqrt{2}r \] (5)

The above result indicates that the optimum radius of loop for a reader antenna is 1.414 times the read range.

**B. The Software Component**

Various code blocks make up the operational base of the GUI. Code modularization was employed for greater abstraction from underlying detail, with the advantage of easier code base maintenance, and non-disruptive changes to the overall software makeup when modifications are made.

System operation was effected by the fusion of the hardware and software components descriptive of the system. Bringing EM4001-compatible cards in range of the reader elicited the designed for responses from the GUI as necessary.

### III. RESULTS

**Fig. 5:** The Launching outlook of the entire application

**Fig. 6:** User’s records when its associated registered card is ready by the scanner.

**Fig. 7:** Database creating using the flat record set topology

**Fig. 8:** The card registration page

**Fig. 9:** Software’s administrator log-in, and password changes

**Fig. 10:** The interface for setting the communication port

### IV. DISCUSSION OF RESULTS

‘Form 1’ is the gateway into the entire application. It handles login after due authorization. It also enforces communication port selection prior to launching the user interface.

‘Form 2’ is the displayed users’ records when its associated registered card is read by the scanner. The fields in the record sets are applied to the relevant display elements on this form proximally text boxes and an image frame holder. The search is launched without the requirement to have a tag/card in proximity to the reader.

‘Form 3’ handles database creating using the flat record set topology. Possible courses are added or removed from the course pool via this user interface. At card registration, the courses from this pool are pulled into the user’s record as required.

‘Form 4’ handles card registration. This user interface enables importing user’s picture from any medium, resizes it to match the software requirement, and also enables information relating to the user to be recorded in to the
user’s database that is automatically created on the system partition.

‘Form 5’ handles software’s administrator login, and password changes.

‘Form 6’ provides the administrator an interface for setting the communication port assigned to reader by the host operating system (Windows 7) to match the port address used by the software. Since the reader does not possess a means of identifying itself to the user application, manual port setting was used to effect communication between the user application and the reader.

V. CONCLUSION

The project work was realized in line with the design objectives spelt. The undertaking was therefore deemed feasible, operational, and satisfactory in performance. Lecturer needs to fill forms in an interface like student’s name, registration number, level, sex, and date of birth. This part is important because we need the information in this part to use I the next interface. After the reader was ready, process to get attendant will be started.

If the code were not match with database, it means that student was in the wrong class or not registered yet in that class. When this happen, lecturer can register that student by using registering form and the information of that student will be updated into database.

The software was tested exhaustively in line with its intended operational requirements. Errors generated during testing were eliminated by software refactoring and restructuring. Intentionally inserted errors were trapped to prevent errant software behavior. The software was deemed satisfactory in performance as it executed card reads, card ID loading, and automated database access without human interaction except that needed card registration.

This project will help lecturer taking the student attendance more easily and automatically. As the conclusion, RFID technology can be used in student attendance application.

VI. RECOMMENDATION

The user database can be mounted on a remote server; registration can also be on the remoter server, with only card authentication effected on client machines. This enables simultaneously access to the database by different clients without the database being distributed on the client machines. This implementation requires a server-client realization, and a network for realization. If these conditions are meant, i.e. a network is available, and a server located on the network, client machines can log on to the remote server and wirelessly downloaded card user data.

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