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Design and Implementation of a System Access Control by RFID

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Abstract— **We present the design and implementation of a system access control using radio frequency identification (RFID) controlled by Arduino platform. The proposed system consists of a radio frequency reader (RC522), a set passive tags (identification cards), microcontroller Arduino MEGA, and graphical user interface (GUI) implemented in Matlab®. Through a GUI, it is possible to take control of access to the building and check the assistance; using identification cards, the user is able to access information of authorized personal. With this system is possible supervise, manage and report all personnel access.**

Keywords— Arduino, GUI, Matlab®, RFID, tags

I. INTRODUCTION

Radio frequency identification (RFID) has been very popular in the last years due to the relative reduction of prices in the market, the increase in their capabilities and advantages compared to other technologies for self-identification [1-2].

RFID technology can revolutionize people's lives through their various applications. This technology are used at library book or bookstore tracking, building access control, pallet tracking, airline baggage tracking and pharmaceutical items tracking. Also, RFID is used for automatizing various process ranging from industrial sector and home control [3]. To be involved in the chain of production and distribution of plants, animals, food, medicine will generate great benefits such as: specification of the production line, and verification of the quality of the products, development of an automatic inventory when the products enter the warehouse of the shops. The benefits are also included within the activities of daily living. The development of refrigerators with RFID technology will not only identify the moment in which a product is about to expire but also in the case of require its supply, the user will be informed of this condition. The washing machines, for example, they will identify the wash cycle that corresponds to a particular type of clothing. The applications of this technology are promising, however, is still in the process of evolution and developed.

RFIDs have a longer life span, are reusable, robust even in harsh environments, can store more data, and even measure environmental factors such as temperature, harder to counterfeit and can be scanned without line of sight. RFID is a wireless technology communications that can be used to develop the system access control. This technology uses a radio signals to transfer data in the identification, administration, categorization and storage. RFID systems are fast, reliable and require no physical signs or contact between them. The use of this technology is very wide and applied in different sectors such as: automotive industry, market place, security systems, hospital control access and medicines control, administration of products in a warehouse and home control [4-7].

RFID technology is widely used for better service of access control, trust and security. When a user makes a request to access a specific property through a personal identification card (tag), an access control mechanism will evaluate the request by permissions previously entered in a database: the request might be denied if that person does not have the authorization to enter or it is not in the database

Satisfying the needs of a teachers and students to check events and be identified through a cost effective solution coupled with a system that allows the statistics of inputs and outputs to the locations of all the staff working on it without a manual print time recorder. We present an access control for specifying and enforcing access control and restriction at the main university building area, which should only be accessed by a small group of staff. A key advantage of our system is that access control decisions (access denied or not) depend on the permission set to the person on the basis of data captured and updated, so the decision does not require processing. The system is user-friendly to display the information on a GUI.

Some RFID systems consist in tags, RFID readers, computer terminals, optical networks, computer servers and site controllers. And the minimal system of RFID includes RFID tags, readers and microcontroller or field programming gate array (FPGA) or application specific -integrated circuit (ASIC) [2, 8]. Depending upon the source of electrical energy, RFID tags are classified as either active or passive. The active tags use a battery for powering the circuit on the tag and transmit the tag information upon the reader request. However, these tags are very expensive and seldom used. Moreover, passive tags get energy from the reader to power their circuit. These tags are very cost-effective and hence most of the applications use them.

Tags can contain more information than a simple ID. They can incorporate additional read-only or read-write memory, which a reader can then further interact with. Read-only

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memory might contain additional product details that don't need to be read every time a tag is interrogated but are available when required. Tag memory can also be used to enable tags to store self-describing information. Although a tag's unique ID can be used to recover its records in an online database, communication with the database might not always be possible.

This paper is organized as follows, in section 2, we describe the system access control composed of a RFID reader, identification cards, microcontroller and GUI. Next, in section 3, the results of the system access control are described. Finally, we present the conclusions and future avenues of research in section 4.

II. System Description

RFID system access control consists of four components tag, reader, microcontroller and computer containing the GUI, as shown in Fig. 1. The reader reads the tag and transmits it to the computer for authentication. The information is processed and upon verification, access is granted. The system works at High Frequency (13.56 MHz), the reader and tags communicate using a protocol defined at ISO/IEC 14443-3 it describes polling for proximity cards entering the field of a reader, the byte format and framing and timing used during the initial phase of communication between reader and tags; the initial request and answer to request command content, methods to detect and communicate with one tag among several tags (anti-collision) and other parameters required to initialize communications between a card and a reader [9-11].

The passive RFID tags transmit information to the reader when it comes into the vicinity of an electromagnetic field generated by the reader. The phenomenon is based on Faraday's law of electromagnetic induction. The current flowing through the coil of interrogator produces a magnetic field which links to the transponder coil thereby producing a current in the are classified as either active or passive. The active tags use a battery transponder coil. The transponder coil then varies this current by changing the load on its antenna. This variation is actually the modulated signal (scheme is known as load modulation) which is received by the interrogator coil through mutual induction between the coils. The interrogator coil decodes this signal and passes it to the computer for further processing.

However, near-field communication has some physical limitations, because the range for which we can use magnetic induction approximates to $c/2\pi f$, where c is the speed of light and f is the frequency. Therefore, as the frequency of operation increases, the distance over which near-field coupling can operate decreases. Another limitation is the energy available for induction as a function of distance from the reader coil. The magnetic field drops off at a factor of $1/r^3$, where r is the separation of the tag and reader, along a centerline perpendicular to the coil's plane [12]. The maximum distance that can exist between tags and reader in our system is 15 centimeters.

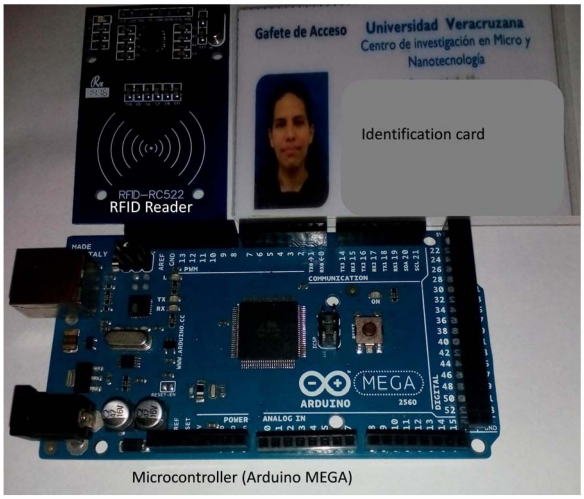

Fig. 1. Setup of RFID system.

The information obtained through the tags include a unique identification number and general information about the person. Once someone on the staff is identified, by the management system of RFID access updates its state in the database. In our case we have used the short for Proximity Integrated Circuit Card (PICC) because they have a longer life span, are reusable, robust even in harsh environments, can store more data and have dynamic updates. These tags which have undergone a process of printing the data of each element of staff authorized.

When multiple cards are crashing into each other within a reader's field, a collision occurs. All the tags has sending a response to the reader at the same time such that the reader cannot differentiate between cards. This crash need not be a physical touching between cards

To schedule a priority in the entry/exit, entry/entry or exit/exit an algorithm was developed in search of an optimal solution for when it happens 2 or more readings of tags at the same time selected who has priority over the other readings the access management system automatically checks your RFID database in regard to the current status of the person.

There was an automatic process of identification of the staff without any human interference. The program was developed using MATLAB which allows an array handling of the role of trace data, you can also interact with other programs written in different platforms.

The prototype of our system of management RFID-access was built on the basis of the RC522 which is a reading module of RFID, this element used as 3.3 volts supply voltage and is controlled through the serial peripheral interface (SPI) protocol, as well as the universal asynchronous receiver transmitter (UART) protocol, so it is compatible with any microcontroller, microprocessor, Arduino development or card. The RC522 use of advanced modulation and demodulation technique integrated completely integrated at 13.56Mhz all kinds of passive contactless communications techniques and protocols. The commercial tags compatible with this RFID module account with 64 blocks of memory where the reading is performed and/or writing, each block of

memory has the capacity to store up to 16 bytes. The serial number consists of 5 hexadecimal values.

To perform the task of detecting and reading RFID tags, in this case it is not required for the writing of the card, it is development in IDE Arduino a code for reading ID of each tag, subsequently codes will be printed tag-RFID through a terminal of the USB port (virtual COM4).

Matlab® can be used for a wide variety of applications such as: the processing of signals and images, control design, testing, mathematical modeling, financial analysis, the creation of GUI among others. This is a programming environment, is a tool for the resolution of problems of technical calculation because it is extremely powerful, one of its virtues is the communication with the Arduino in real time.

To program the microcontroller on a card, the Arduino Programming Language and the development environment is used. These applications can be downloaded for free from their website as well as the reference designs of the hardware which are available under open-source license [13]. The Arduino projects may be autonomous or can communicate with software running on a computer.

The flow chart describing the operation of system access control by RFID is shown in Fig. 6.

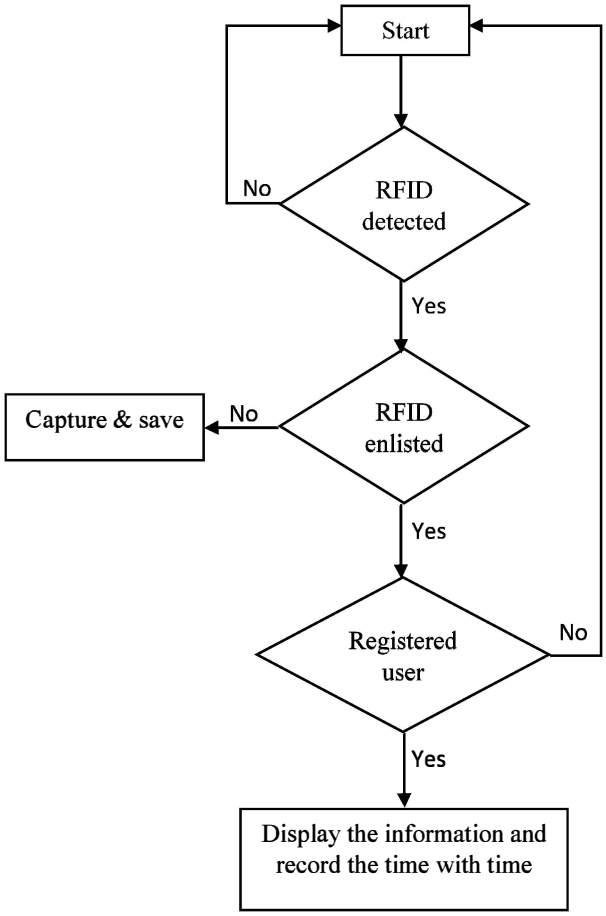

Fig. 2. Flow chart of a system access control.

III. RESULTS

In order to check the results of our system in Fig. 3, show the GUI implemented in Matlab® in this part it's possible to add and edit the information of the worker. Fig. 4 shows the result when the identification card doesn't exist in the database or when staff are not authorized to access. Fig. 5. Shows the personal information of the employee assigned to the ID number of the tag contained in the database, as well as a display of the day and time, allowed access

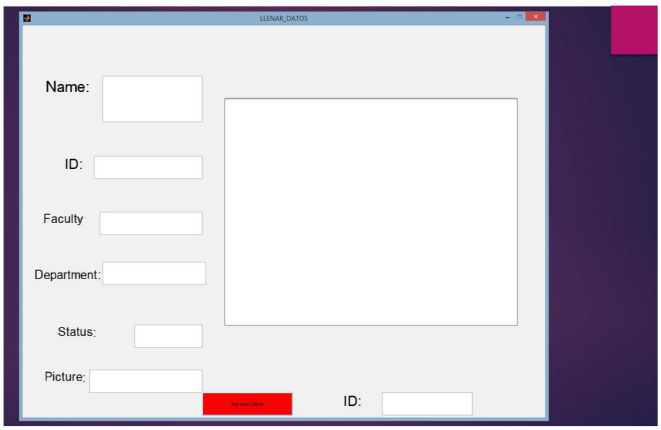

Fig. 3. Data editing in the GUI.

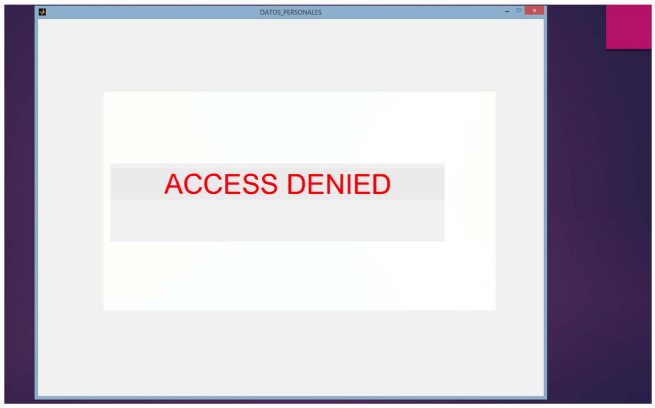

Fig. 4. The information not found in the database.

Fig. 5. GUI with the correct information.

IV. Conclusions

In this work we present a system access control by RFID which was achieved with success since this manages to give or deny access to the personal worker, which is reliable, low cost and is easy to operate.

The program design in Arduino had as its objective to manage communication between the reader and the tags acquiring the ID card number adhering to ISO/IEC 14443-3 protocol for the identification tags and avoid the collision when to read 2 or more cards and the same time, whereas the code in Matlab® focused on the related identification number entered through COM4 with an internal database system, or not allowing access to staff.

The valuation of the security and reliability of the system is joined to the low total cost, the project proved to be a solution to the problems of security and can be scalable to solve the problems of income to other buildings and the vehicular income.

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