

OBJECTS IDENTIFICATION AND TRACEABILITY USING RFID

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RESUMEN

La identificación de entidades permite que se puedan encontrar problemas en un proceso a través del rastreo de esas entidades que presenten inconsistencias, permitiendo que se tomen acciones inmediatas para corregir las causas de estas.

Para remediar lo mencionado se desarrolló un sistema básico de lectura RFID que se puede implementar en diferentes procesos para la identificación y trazabilidad de personas y/u objetos. Utilizando para esto las tarjetas SparkFun RFID USB reader, SparkFun RFID breakout y otros sistemas embebidos.

Además, se desarrolló un sistema para conectarse a una base de datos para realizar altas, bajas, cambios y consultas de información, todo esto mediante el ID único de cada tarjeta RFID.

Palabras Clave: RFID, SQL, Atom.

ABSTRACT

The identification of entities allows problems to be found in a process through the tracking of those entities that present inconsistencies, allowing immediate actions to be taken to correct their causes.

To remedy the above, a basic RFID reading system was developed that can be implemented in different processes for the identification and traceability of people and/or objects. Using for that, SparkFun RFID USB reader cards, SparkFun RFID breakout cards and other embedded systems.

In addition, a system was developed to connect to a database to carry out registrations, cancellations, changes, and queries of information, all this through the unique ID of each RFID card.

Keywords: RFID, SQL, Atom.

1. INTRODUCTION

Identification is uniquely recognizing an entity; this can be individually or in batches of entities. In its basic form it allows to recognize different objects through a unique identification, and to be able to locate the object through a tracking system that implements traceability, so you can know the position of the object in time and verify its origin and even its location history [1]. Traceability can be seen from two perspectives, the internal one allows to monitor the movements within the individual process and the chain one that allows to keep the products monitored in multiple processes that can be from different manufacturers [2].

All the data acquired on the objects can be stored in databases, which allows to handle the information in a practical and organized way in addition to validating the data through a unique ID for each batch or objects. This allows them to be able to find problems in a process through the tracking of objects that presented failures, causing immediate action to be taken to correct the causes of these.

To achieve these purposes, embedded systems can be used in conjunction with various computing platforms to process the information acquired.

The use of RFID technology gives the ease of making the identification without the need for visual or physical contact, in addition to the possibility of modifying the information registered in the identification achieving greater control over the characteristics of the object.

Several works have been developed in the field of identification, below, some of them are cited.

Nirmalendu (2017) describes in a simple way the applications of RFID systems in a library, for example, the management of information, inventory, and the circulation of books through the library. Finally, it is concluded that the use of this technology is already applied in libraries, improving efficiency, and granting the possibility of self-service for the handling of book requests [3].

Agnihotri (2017) presented the possibility of implementing RFID technology in the taking of attendance in a school by creating records in databases according to the different readings that are made. The result obtained with the implementation of the RFID system shows that 98% less is required with RFID identification compared to manual identification and 90% less than using barcodes. With which it demonstrates the improvement in efficiency for this type of applications making use of RFID technology and the system has a very wide scalability and adaptability to different systems [4].

Farshid (2018) proposes the use of a system that uses micro-controllers, readers, and RFID tags to obtain the trains position in the subway, identify the location through an internal database and control the speed automatically. Finally, it concludes that the proposed system is effective in reducing accidents in public transport, but it is applicable to many other

environments and one of its great advantages is that it is simple in both software and hardware [5].

Feng (2016) found that with the implementation of RFID technology it is possible to make inventory control more stable because lost objects can be recovered instantly, although it is also mentioned that the implementation has no effect if the objects can be recovered in time through a physical audit [6].

Azlan (2019) tries to address supply chain issues in the textile industry through RFID identification, finding that this technology contributed to improving supply chain operations and maintenance by having a positive effect on performance. This helps to study practices that help solve problems in the industry [7].

Navodya (2019) says that RFID technology is one of the areas of industrial digitalization bringing benefits to the visibility of goods, employee productivity and theft mitigation among others. It focuses on the application and sustainability of this technology in the apparel industry through recent RFID integrations that offer innovative solutions to business models, sales concepts, and traceability in the supply chain [8].

Martínez (2018) presents a tool for the intensive care unit, a key service, and special characteristics, which informs and tracks the admissions, care plans, vital follow-up, prescription process and administration of medications of the patients of this service. To achieve this, it is critical that innovative and cutting-edge technologies, such as RFID technology, are implemented, which is now being implemented in various environments, bringing a range of benefits to the tasks for which it is employed [9].

The present work focuses on the design of an RFID card reading system for the identification and management of information related to both people and objects that are part of a group or inventory. The objective is to access the information of people or objects registered in a database, also to register entries or exits to different areas. The above through a unique RFID identifier assigned to your ID card.

2. RFID

The following are the 2 RFID readers that were used.

2.1 Sparkfun RFID USB Reader

The SparkFun USB RFID reader is an easy-to-use USB-to-serial base drive for the ID-3LA, ID-12LA, and ID-20LA readers. Only one reader is connected to the card and a miniUSB cable. Any terminal program is opened at 9600bps, then the 125kHz ID tag is scanned and a unique 32-bit ID is displayed on the screen. The unit is based on an FTDI chip and has a reading LED and a buzzer [10].

This card has the following features:

- a) A buzzer.
- b) An LED indicator.
- c) 2mm sockets.
- d) One USB mini-B connector.
- e) An FTDI232RL module to convert the TTL serial signal to USB.

2.2 RFID ID-12LA (125kHz)

The ID-12LA is a very easy to use RFID reader module from ID Innovations, which has a built-in antenna. Turning on the module operates a 125 kHz card and results in a serial chain output containing the card's unique ID [10].

The characteristics of this sensor are as follows:

- a) 2.8 - 5V supply
- b) 125kHz read frequency
- c) EM4001 64-bit RFID tag compatible
- d) 9600bps TTL and RS232 output
- e) Magnetic stripe emulation output
- f) 120mm read range
- g) 25x26mm

3. METHODOLOGY

The following describes the connections of the hardware and software used.

3.1 Connection schemes

During the development of the system, connections between the embedded systems and Arduino were used to make the prototype, next the necessary connections are detailed.

For the SparkFun RFID UDB reader module, Vcc and GND of the module were connected to the respective 5v and GND of a Mega Arduino, to power it. For communication between them, the digital pin 19 was connected (RX1). The connection scheme can be seen in Figure 1.

For the Sparkfun RFID breakout, the same connection was used as with the aforementioned module. Figure 2 shows connection scheme for this case.

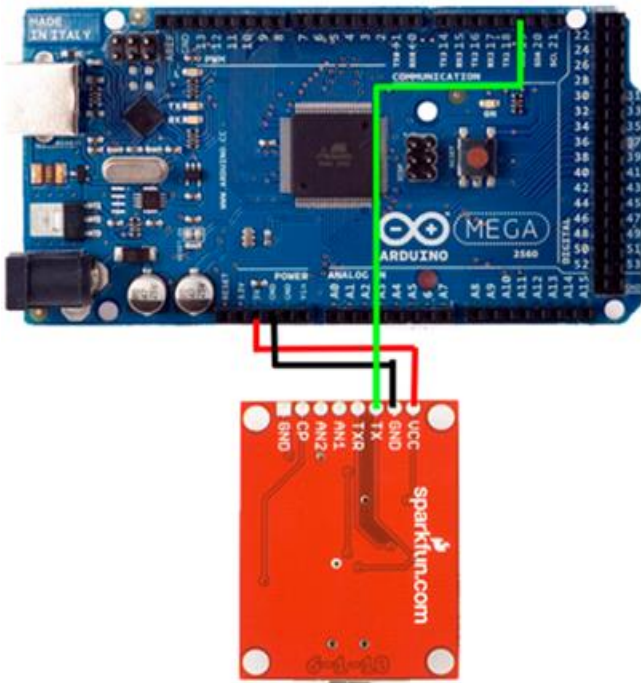


Fig. 1 Connecting Arduino with Sparkfun RFID USB Reader.

For the XBEE pro implementation, the previous connections were maintained by adding a serial connection between Arduino and XBEE on Arduino digital ports 0 and 1, with XBEE TX and RX ports. In addition, the XBEE must be connected with GND and Arduino 5V. Figure 3 shows the connection scheme. For the information receiver, only XBEE RX and TX are changed to Arduino ports 18 and 19.

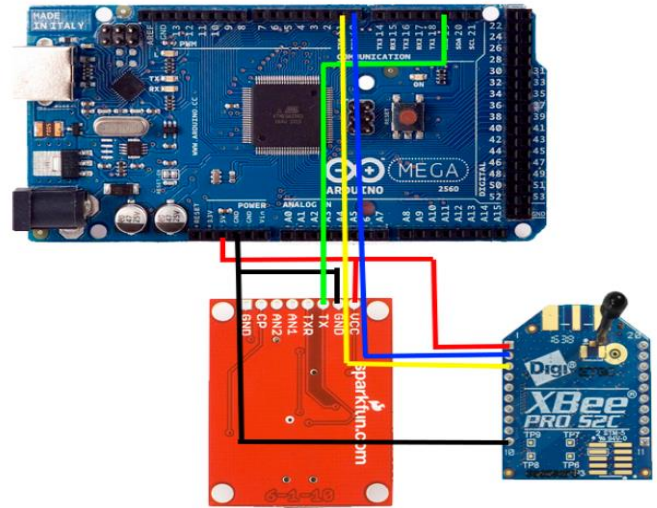


Fig 3. Implementation of XBEE as a wireless transmitter.

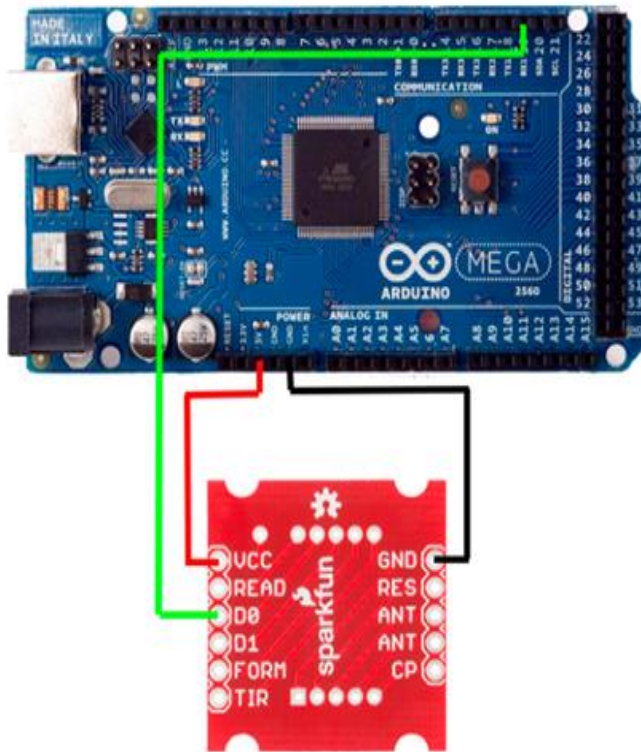


Fig 2. Arduino connection with Sparkfun RFID breakout.

3.2 Creating the database

For the management of RFID readings and the management of related information, a database was used by the functions that this offers, specifically a SQL database was used through the *phpMyAdmin*.

For the creation of the database the program *xampp* was first downloaded within which it is installed *phpMyAdmin*. In Figure 4 you can see the *web* page where it is downloaded.



Fig 4. Website to download xampp.

This leads to the database manager where you can create and manage the databases you need for the project; there you are assigned a name for the database.

Once created, a view of the database appears where the tables it contains are shown, in addition to the possibility of creating more tables, only a name is assigned to the table and the number of columns.

It also asks for the name, type, length, and default value, among other things. The necessary values are filled in and saved.

A view of the table and its contents is produced. Rows can be inserted from a document with the extension “.csv” going to the import option where it asks to select the file.

With this, the database is finished and the work for the connection of the database begins with an interface that reads the serial port to which it connects to an Arduino.

3.3 Serial port reading and database connection

For the connection between the Arduino and the database, a *webservice* was made that is responsible for reading the serial port and when it has a reading, a search is carried out in the database according to the RFID obtained. Finally, the search results are displayed in the database through a *web* page.

First a project was made in the *Atom* code editor within which some *add-ons* are installed for the operation of the project. Before you start with the programming is necessary to install *nodejs*. Figure 5 shows the page where *nodejs* can be downloaded



Fig 5. Page to download *nodejs*.

This program helps to run the programs in *JavaScript*. For the correct functioning of *nodejs* the operating system must be kept updated, in this case Windows 10.

Once you are inside *Atom* you install some plugins that serve for the development of the program. For this, 3 plugins are

installed within *Atom*: *atom-live-server*, *emmet*, and *platformio-ide-terminal*.

A folder named *RFID* is now created and opened from *Atom* to begin with the project's file structure.

Npm init --yes is written, which will add 2 configuration files in the project, which the names *package-lock.json* and *package.json* describing some features of the project.

Other necessary libraries are installed, this by means of the command “*npm i*” followed by the name of the libraries that you want to install separated between them by spaces, the complete command for this is:

```
npm i express ejs mysql body-parser socket.io serialport
```

Then click on *package.json* to add a line that indicates from which file you want the application to start when it runs. The command that was added is: “*start*”: “*node src/index.js*”.

It begins by programming in *index.js* the initial configuration of the application, in this a connection is made with *server.js* which gives the port on which the application works and connects with *students.js* which is the program that runs and the readings of both serial port and database are made. Finally, the port on which the application is located is displayed in the console.

Then it is passed to *server.js* to assign the port on which the application is displayed, in this case the one assigned by the server is used and if a port is not assigned on the server, then port 3000 is used. Then as a display engine is used *ejs*, this is assigned only to write the name of the file that you want to display without having to write the extension. Finally, you must change to the directory where the views are, or pages that are displayed in the *app* and the settings are exported in the *app*.

In the *connectionbd.js* file the connection is made to the database to call it only when it is needed and not have to write it in each part of the program, in addition to being able to make the database change easily. In this code only the *mysql* library is requested for the management of databases and the connection is made, granting the data of the database that was created, the database now is running from *phpMyAdmin*, the host is localhost, the name is the one that was given when creating it, the user will be *root* and the default password is blank.

In *alumnos.ejs* the part that is displayed in the *browser* (the graphical interface) was programmed using *HTML*, first the title of the page was written and the link for the connection with *bootstrap* was added, this helps in the definition of the styles to facilitate the design of the interface. Figure 6 shows this part of the code.

When an RFID tag is passed through the reader, the reader reads the ID and performs a search in the database according to the ID-SEP property and displays through a table the match that has been found in the database. This search screen was also developed for student management. Figure 12 shows the program with which the search results are sent in the interface.

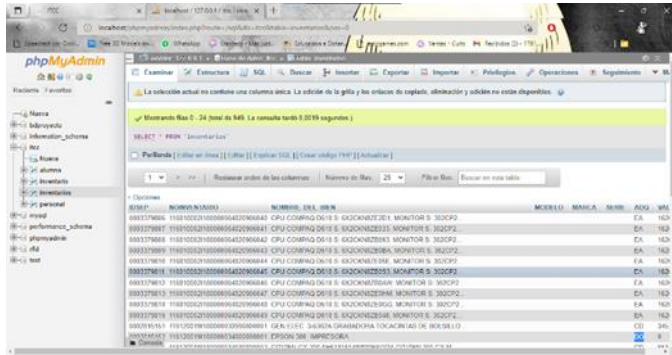


Fig 12. Code to send search results.

Figure 13 shows the result of a search in the inventory database, which shows that all the data of the object related to the search is printed on the screen.



Fig 13. The result of a search in the inventory table.

The data that appears is updated with each RFID reading showing the information related to RFID in the database, and through the form that appears at the top you can change the information stored in the database. In these cases, the examples show applications of RFID technology to a system related to students and inventories, the system can easily be updated for use in other areas, to be able to identify and track the entities through RFID, only by changing the database and making the necessary adjustments in the *web* application.

5. CONCLUSIONS

In this research, different possibilities of implementing an RFID system for different purposes were raised, such as the identification of people: students or teachers; the identification of objects to facilitate the management of inventories and thus be able to know if it is in existence and its last registered location.

To achieve these goals, it was necessary to collect information on the operation of embedded systems, on the alternatives they must achieve the connection with a database, should have been between different possibilities, as well as how to display the readings in a user interface.

It was possible to obtain a basic RFID system that handled information through a database, this system is the basis for creating more complex systems that can perform different tasks automatically, for example, attendance control or loan of materials in laboratories. The system can be improved in some aspects, for example, the visual or add functions that help a more intuitive use.

The research required interaction with different programming languages and platforms, in addition to working with specialized Arduino libraries to achieve the proper functioning of embedded systems.

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