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“ACCESS CONTROL SYSTEM USING NFC, ARDIUNO AND RASPERRY PI”

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# ABSTRACT

Attendance management is important to every single form of organization from a business to school checking the attendance of students or employees it can decide whether an organization will be successful in the future. Managing student attendance during class or lecture periods has become a difficult challenge for professors this project gives the ability to compute the attendance without the need of time waste going through all the students.

The concept of access control using Arduino & RFID technology is that to control the attendance of students automatically. Whenever person (he is having RFID card) comes near to the Reader reads the data from his NFC tag. This data is sent to the Raspberry pi, which is picked up by the database and compared to already existing values, then this information is passed on a web page displayed by the professor or the system administrator to check if the student is attending or not.

All of this is hosted on a single portable machine such as the raspberry pi having an efficient Web-based application for attendance management system is designed to track student's activity in the class. This application takes attendance electronically and the records of the attendance are storing in a database.

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# Chapter 1

# Introduction

The current method of product tracking within supply chains is the barcode, but RFID tags provides some simple, but fundamental, advantages. Firstly, barcodes are usually printed on paper labels or packaging, and are therefore prone to damage. Secondly although barcodes can provide inventory data to the level of product category, they cannot provide additional data such as ‘sell by ‘dates; this type of extra functionality has the potential to be developed further for things like recording attendance, where, for example, RFID tags embedded in uniforms may, in the future, be able to provide a seamless experience for the student while entering the school knowing that their attendance is recorded at the moment. Also, because RFID systems use radio frequencies to communicate, they can identify an object without a line of sight. This means that RFID tags can be identified while they are attached to items or inside backpacks.

One of such uses of RFID is NFC technology evolved from radio frequency identification (RFID) technology and is more fine-tuned. NFC is capable of both one-way and two-way communication, meaning it can act as both a reader and a tag. This allows NFC to be used for more complex interactions such as peer-to-peer (P2P) data sharing as well as card emulation.

Recording absence at school or university having many students in a classroom is a difficult task and time-consuming. Moreover, the process takes much time, and many efforts are spent by the staff of the department to complete the attendance rates for each student. So, in many institutions and academic organizations, attendance is a very important criteria which is used for various purposes. These purposes include record keeping and assessment of students which in some instance can determine if a student is allowed to take an exam or even in some extreme cases if their attendance is low enough, they can be dropped from the class altogether so its very important that the attendance is record in a objective manner.

# Methodology

This project is applied/descriptive research. It is a project in which a review of primary studies and raspberry pi projects and is carried out with the aim of summarizing the existing information and creating a system in our case is about attendance control as an instrument to carry out this research we are using the different resources offered by both internet and the raspberry pi foundation which offers lots of useful information about the usage of pins and internals.

I choose this type of methodology because of in descriptive research you can’t always accurately replicate or explain all the steps necessary to create the system and design that’s why the applied methodology comes strong not only following the steps necessary to describe the system but making it creates a feed loopback in which describing the steps to take to replicate the project and making it makes it makes it more accurate. As for procedures taken to ensure good quality, we can highlight the next steps:

1º Search of relevant information in websites.

2º Differential search of websites contents in step one with official documentation in Raspberry pi Foundation (such as components voltages and behavior).

3º Test steps in a controlled environment such as a virtual machine.

4º If step three works replicate same steps in raspberry pi and documented.

The limitations of the research come with the sample of website used and the bias the may have in regards of steps taken that some people may consider not necessary, another limitation is budget much of the problems that this projects can be solved with bigger budgets that can allow for better RFID readers or better NFC tags that can be more customized and suited better for a high school.

# Justification and objectives.

I choose this project for the knowledge I would acquire designing and making it as for the possibilities that opens in the future in regards of possible work opportunities in the RFID community as understanding the subject brings lots of potential knowledge that can be used to administer the control system of a business even if doesn’t use all the same exact components.

Through this project, to proceed to do applied, cross-sectional and descriptive study of the RFID standards and creation of an access control system, therefore these will be our objectives:

* **General**
* Analyze the current standards of RFID and modules compatible with a raspberry pi with the creation of an access control system.
* Minimal parts required to create and access control system and with minimal.
* **Specifics**
* Analysis of the current RFID technologies.
* Implementation of a confirmation system and website for attendance checking.
* Implementation of a MYSQL database as for record keeping and backend for the website.
* Analyze cybersecurity risk and risk tolerance of the system.
* Analyze the cost per unit and components availability.

# Chapter 2

# Equipment, components and implementation

The equipment needed for this project may change depending on the objectives of the user but for the project to work we are going to need at least these pieces of equipment:

1º Raspberry pi or Arduino board

For the project to work we need some type of small factor computer that can be programmed so it can hold the rest of the equipment and provide energy to the components, the small factor computer so it is space efficient making the implementation in a wide range of environments easy in our case we are using a raspberry pi and a bread board to accomplish the project.

2º RFID reader

There are lots of RFID readers in the market for different use cases but for this case we are using an NFC with low power and low range which cost around 4 euros, as for the implementation we are using an Arduino bread board and cables.

The reader uses its own antenna to communicate with the tag. When a reader broadcasts radio waves, all tags designated to respond to that frequency and within range will respond. A reader also has the capability to communicate with the tag without a direct line of sight, depending on the radio frequency.

Readers such as the one used in this project can process multiple items at once, allowing for increased read processing times. Readers are differentiated by their storage capacity, processing capability, and the frequencies they can read.

3º Resistor or potentiometer.

Resistor or potentiometers are needed in order of the confirmation system to function normally such as the case of my confirmation system that uses a LCD display, but any type of confirmation system or additional parts may need to use resistors to limit or regulate the electricity.

4º Confirmation system

A confirmation system is a form of check that the final user can see and know if the machine actually read his tag for the project, I decided that the best course of action is to use a LCD display but this part may change depending on the use case a simple led green and red could suffice in some cases.

5º Ethernet or Wi-Fi.

For the attendance system we require a front-end web as such we need to have ethernet or Wi-Fi so we can have a web server and have it reachable for the administrator or schoolteacher and see the attendance in real time.

The implementation of all these components with the raspberry pi is done primarily by python libraries as such it is a must to have python installed this are the packets required for the project to begin: build-essential python git 3-dev python3-pip python3-smbu.

6º Database

The database information about the tagged item. Information stored in the database includes the tag identifier, name of the student. The type of information housed in the database will vary by application. For instance, the data stored for a toll payment system will be different than the data stored for a high school like this.

# Chapter 3

# RFID technology

* 1. Definition of RFID technology

RFID stands for Radio Frequency Identification. it uses radio waves to automatically identify people or objects. RFID is an automated data-capture technology that can be used to electronically identify, track, and store information contained on a tag. A radio frequency reader scans the tag for data and sends the information to a database, which stores the data contained on the tag.

* 1. Components of a RFID system.

Radio frequency identification (RFID) is a technology that allows automatic identification and data capture by using radio frequencies. The salient features of this technology are that they permit the attachment of a unique identifier and other information – using a micro-chip – to any object, animal or even a person, and to read this information through a wireless device.

RFIDs are not just "electronic tags" or "electronic barcodes". When linked to databases and communications networks, such as the Internet, this technology provides a very powerful way of delivering new services and applications, in potentially any environment.

The main technology components of an RFID system are a tag, reader, and database. A radio frequency reader scans the tag for data and sends the information to a database, which stores the data contained on the tag.

* 1. RFID frequency and NFC

RFID tags and readers must be tuned into the same frequency to enable communications. RFID systems can use a variety of frequencies to communicate, but because radio waves work and act differently at different frequencies, a frequency for a specific RFID system is often dependant on its application. High frequency RFID systems (850 MHz to 950 MHz and 2.4 GHz to 2.5 GHz) offer transmission ranges of more than 90 feet, although wavelengths in the 2.4 GHz range are absorbed by water, which includes the human body, and therefore has limitations.

NFC is used as an access key to contents and for services such as cashless payment, ticketing, and access control. NFC operates in a frequency range 13.56 MHz and 14.00 MHz offers a data transmission rate of up to 424 kbit/s within approximately 10 centimeters.

* 1. RFID tag and classification of tags.

An RFID tag, or transponder, consists of a chip and an antenna. A chip can store a novel serial number or other information supported the tag’s kind of memory, which might be read-only, read-write, or write-once read-many. The tag is attached to or embedded in and object to be identified, like a product, case, or pallet, and may be scanned by mobile or stationary readers using radio wave:

Tags are classified into different types based on battery and memory such as passive tags, active tags, semi active tags, read only tags, read write tags and write once read many times tags.

**Passive tags**

The simplest version of a tag is a passive tag. Passive tags do not contain their own power source. Passive tags can operate at low, high, ultrahigh, or microwave frequency. Depending on the storage capacity of the tag, additional data can be added. Under perfect conditions, the tags can be read from a range of about 3 to 6 meters.

**Active tags**

Active tags contain a power source and a transmitter. These tags have read/write capabilities and tag data can be rewritten and modified. Active tags can initiate communication and communicate over longer distances up to 200 meters, depending on the battery power. The relative expense of these tags makes them an option for use only where their high cost can be justified.

**Read only tags**

Read-only tags have minimal storage capacity (typically less than 64 bits) and contain permanently programmed data that cannot be altered. These tags primarily contain item identification information and have been used in libraries and video rental stores. Passive tags are typically read-only.

**Read write tags**

Not only they can store data, read-write tags can allow the data to be updated when needed. They have larger memory capacity and are more expensive than read-only tags. These tags are used in system where data may need to be altered throughout the tags life cycle, such as in passing down the tag to another student or erasing current student information.

**Write once read many times tags**

Write-once, read-many tag allows information to be stored once typically manufacturers, but does not allow subsequent alterations to the data. This tag provides the security features of a read-only tag while adding the functionality of read/write tags.

# Chapter 4

# LCD display circuit

Connecting the LCD to your Raspberry Pi is a pretty simple process to begin with we need connect our various components with the breadboard using this layout and pins.

* Pin 1 of LCD (Ground) to breadboard ground rail
* Pin 2 of LCD (VCC / 5V) to breadboard positive rail
* Pin 3 of LCD (V0) to middle wire of the potentiometer
* Pin 4 of LCD (RS) to GPIO4
* Pin 5 of LCD (RW) to breadboard ground rail
* Pin 6 of LCD (EN) to GPIO24
* Pin 11 of LCD (D4) to GPIO23
* Pin 12 of LCD (D5) to GPIO17
* Pin 13 of LCD (D6) to GPIO18
* Pin 14 of LCD (D7) to GPIO22
* Pin 15 of LCD (LED +) to breadboard positive rail
* Pin 16 of LCD (LED -) to breadboard ground rail

DIAGRAM

Interfaz de usuario gráfica, Diagrama

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I2C

One importer step before we use the LCD is to activate I2C in the raspberry pi GPIO is standard pins that can be used to turn devices on and off to use them correctly in our project we need to activate the I2C pins on the raspberry PI.

Texto

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I2C is a protocol, appropriate for short distance communications, and generally operate in the 3.3 or 5V range this will allow good connection between all the pieces of equipment.

CODE

Once the pin layout is finish, we need to start coding with it as such we are using a python library called Adafruit CharLCD we will clone the repository out of GitHub, in the library we will find different configurations for the project to work we will modify the pins according to the diagram.

To test that the diagram is working at this point with the lcd and potentiometer we can use this piece of code and see the results and if it displays. Texto

Descripción generada automáticamente

# Chapter 5

# RFID RC522 reader circuit.

Connecting the reader to our previous pieces of equipment is more difficult we procced following this pin set up:

* SDA connects to GPIO8 (Physical Pin 24)
* SCK connects to GPIO11 (Physical Pin 23)
* MOSI connects to GPIO10 (Physical Pin 19)
* MISO connects to GPIO9 (Physical Pin 21)
* GND connects to Breadboard Ground Rail.
* RST connects to GPIO25 (Physical Pin 22)
* 3.3v connects to 3v3 (Physical Pin 1)

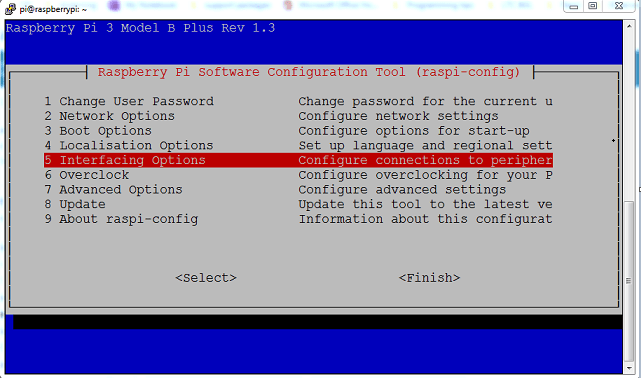
The complete diagram of the project is complete looks like this:

Imagen de la pantalla de un video juego

Descripción generada automáticamente con confianza media

# SPI

Before we procced with the coding we need to enable the SPI interface for the module of the NFC reader to work much like the I2C protocol is activated in the raspi-config



Once activated we need to reboot the raspberry before we procced, this interface allows us to transfer information from the NFC reader to the raspberry pi to use.

# Code

Before we procced with the coding of the NFC reader we need to install a python library that will allows us to communicate the device with the rest of the components called mfrc522 which can be install using the pip installation manager for python as previously downloaded once it installed we can begin to code, to check that the installation of the module is correct I coded a simple test run that will tell me a if tag near the device has and id or text embedded and print out it.

import RPi.GPIO as GPIO

from mfrc522 import SimpleMFRC522

reader = SimpleMFRC522()

try:

id, text = reader.read()

print(id)

print(text)

finally:

GPIO.cleanup()

One problem this code present us is that the reader cant read certain id or text if they are encrypted which is the case for most bank cards and the NFC option in mobile devices but, its not the case for most tags used in control system in enterprise for the most part this tags are unencrypted which create a huge risk because they can be modified without any problem whatsoever for example to enter a gym or to open a door, it also creates a huge counterfeit problem without encryption everyone can dump all the information a tag has a create a counterfeit for malicious purposes.

# Chapter 6

# NFC cybersecurity tag problems

Like previously mentioned NFC tags present problems and risk that need be addressed such as the type of card that we are using which is a write-read card once we have write all the code necessary to create our system is done we can convert our tag to a read only tag but the problem relies in the lack of regulation and standards so its crucial that we stick to one type of tags their encryption and their methods. This creates a competitive market between companies but at the same time creates a risk environment for developers to circumvent this problem we have some solutions such as:

1. do not write data on NFC tag but instead save it locally (if data is limited to one device) or to a server/cloud.
2. when NFC Tag is read get its ID and find proper data via proper source (local or cloud DB)
3. Rely on the pre-programmed id created by the manufacturer to use in programs (i.e., to match the ID against some form of database)

In the project we are using MIFARE which provide communication encryption and shared-key based mutual authentication with this approach, cloning could be prevented by protecting certain data on the tag with a secret password. However, if an attacker can find out that secret password, nothing prevents the attacker from creating a clone of the tag. Many modern access control systems and closed-loop payment systems use such an approach.

Yet the problem also relies in the coding language their built upon such as Java Card technology, so they contain a microcontroller that executes some custom application software. Most modern EMV-based credit cards use this type of mechanism to prevent cloning.

By design, NFC is a short-range technology. This means that the two parties in a data exchange need to be in immediate physical proximity to one another. It is possible that even within the short range, there could be some form of man-in-the-middle attack. This type of attack is also sometimes referred to as RFID skimming in the, as it can apply to both longer-range RFID as well as NFC-based data exchanges.

Another risk that NFC-based payments can be exposed to is that of session replay attack. In a session replay attack, the information used to execute one transaction in a session is then "replayed" a second time to defraud a user with a second transaction. Session replay attacks are not unique to NFC but can still have negative consequences.

# Chapter 7

# RFID Attendance System Database.

Before we must first prepare and set up the MYSQL database. This database is where we will be keeping track of each RFID cards attendance and who owns that RFID card, to do that we will install MySQL-server using the apt packet manager and run the secure installation.

These are the steps I took to create the database and all the tables and their relations:

1º CREATE DATABASE attendancesystem;

2º CREATE USER 'attendanceadmin'@'localhost' IDENTIFIED BY '';

3º GRANT ALL PRIVILEGES ON attendancesystem.\* TO 'attendanceadmin'@'localhost';

4º create table attendance (

id INT UNSIGNED NOT NULL AUTO\_INCREMENT UNIQUE,

user\_id INT UNSIGNED NOT NULL,

clock\_in TIMESTAMP NOT NULL DEFAULT CURRENT\_TIMESTAMP,

PRIMARY KEY ( id )

);

5º create table users(

id INT UNSIGNED NOT NULL AUTO\_INCREMENT UNIQUE,

rfid\_uid VARCHAR(255) NOT NULL,

name VARCHAR(255) NOT NULL,

created TIMESTAMP NOT NULL DEFAULT CURRENT\_TIMESTAMP,

PRIMARY KEY ( id )

);

For the attendance table, we are holding three pieces of data for each recorded RFID tap which can be described as:

* id – This is an integer that is used to keep track of the current row and increases automatically.
* user\_id – This is a integer, and we utilize this to join the attendance with a user in our users table that has the same id.
* clock\_in – This variable stores a SQL timestamp. This timestamp is used to track when the user taps their RFID card onto the RFID reader.

For the users table, we are holding four pieces of data for each user that we add.

* id – This is an integer that is used to keep track of the current user and increases automatically.
* rfid\_uid – This variable is used to store the UID that is captured when an RFID card is tapped on the RFID reader.
* name – This variable stores the name of the person who owns the RFID card.
* created – We use this variable to keep track of when the user was created.

# Chapter 8

# Recording a User in the Attendance System.

To continue the project, we need to install a library. Since I’m using python in the project, we need to find a way to create a connection between the database and the front end in order to do that we will install mysql-connector-python using the pip3 packet manager once installed we can begin creating the python scripts that will record our users into the database for record and attending purposes.

Firstly, we begin putting the environment we are going to use, much like a bash script we need to tell the script the environment using this phrase at the start of the document.

#!/usr/bin/env python

The we need to import the time library  so that we can put the script to sleep, so things don’t occur instantly.

import time

We require the GPIO library so that we can run the cleanup function when the script ends so we need to import it either.

import RPi.GPIO as GPIO

The SimpleMFRC522 library is used to make it easy to talk with our RFID reader.

from mfrc522 import SimpleMFRC522

We utilize the MySQL connector so that we can talk with the database that we set up earlier.

import mysql.connector

Finally, we load in the Adafruit library for talking with LCDs. This library simplifies the process of communicating with our 16×2 display significantly.

import Adafruit\_CharLCD as LCD

This are all the libraries need for the project with the exception of the LCD library if the confirmation system for the attendee is just a led in that case no library is required as the GPIO library is just enough to do that, as for the db connector uses a syntax very similar to a php connector like the ones that we have been seeing all year in IAW class.

db = mysql.connector.connect (

host="localhost",

user="attendanceadmin",

passwd="",

database="attendancesystem"

)

The object created by the connector is stored in the “db” variable so that we can interact with the database easily.

Using the cursor object from our database connection we can interact with the database and to execute SQL queries.

cursor = db.cursor()

Now we prepare the SimpleMFRC522 library by instantiating it to our reader object. This library will allow us to easily talk with the RC522 later in the script to read input from the reader.

reader = SimpleMFRC522()

This line prepares the CharLCD library for the 16×2 display. For this function, we pass in all the required pin numbers, number of rows and column so the script utilices it correctly.

lcd = LCD.Adafruit\_CharLCD(4, 24, 23, 17, 18, 22, 16, 2, 4);

This block of code is the start of our user creation logic. We will be wrapping the entirety of our logic first in a “try:” statement.

We also wrap our logic in a while True loop. This loop will ensure that the code below will run indefinitely so that the end user can register multiple users in succession.

try:

while True:

lcd.clear()

lcd.message('Place Card to\nregister')

id, text = reader.read()

In this section, we use the cursor to execute our first bit of SQL. In this SQL statement we are simply searching our “users” table to see if any rows have a matching RFID UID to the ID we retrieved when reading the RFID card.

cursor.execute("SELECT id FROM users WHERE rfid\_uid="+str(id))

cursor.fetchone()

We start in this section by checking how many rows were returned by our last SQL call. If the SQL call returns any rows, we need to prompt the user whether they want to overwrite the already existing user.

Inside the if statement we proceed to clear the LCD screen and display the message “Overwrite existing user?” and provide a prompt in the command line for the user to respond either Y to overwrite or anything else to cancel.

Once the input function has received the input, we then check to see if the first character of the returned data is equal to ‘Y‘or ‘y‘. If the first character does equal what we expect we then clear the LCD again. Next, we display a message “Overwriting user” for one second. Lastly, we build the SQL query to update the existing entry with the new name that we specify in the next step. We do this process instead of deleting the old entry and re-adding it.

if cursor.rowcount >= 1:

lcd.clear()

lcd.message("Overwrite\nexisting user?")

overwrite = input("Overwite (Y/N)? ")

if overwrite[0] == 'Y' or overwrite[0] == 'y':

lcd.clear()

lcd.message("Overwriting user.")

time.sleep(1)

sql\_insert = "UPDATE users SET name = %s WHERE rfid\_uid=%s"

else:

continue;

else:

sql\_insert = "INSERT INTO users (name, rfid\_uid) VALUES (%s, %s)"

Our final segment of code is quite simple and wraps everything up. We start by clearing the LCD again and prompting the user on the LCD that they need to enter a new name. Meanwhile on the console, the text “Name:” should appear as we utilize “input” to await the user’s input. Once a user has input a name into the console and pressed enter, we then proceed to utilize the cursor object to execute the query that we formed in the previous section of code.

We also create a tuple that’s passed into the execute function. This tuple contains the new name and the RFID card’s id. Both these values will automatically pass into our query strings on execution.

lcd.clear()

lcd.message('Enter new name')

new\_name = input("Name: ")

cursor.execute(sql\_insert, (new\_name, id))

db.commit()

lcd.clear()

lcd.message("User " + new\_name + "\nSaved")

time.sleep(2)

CODE

Texto

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# Chapter 9

# Recording Attendance and Web Front-End check .

This script will run in an infinite loop checking for any taps from an RFID chip. When someone taps their RFID chip, we will check that chip’s ID in the database using a similar structure as the other script.

#!/usr/bin/env python

import time

import RPi.GPIO as GPIO

from mfrc522 import SimpleMFRC522

import mysql.connector

import Adafruit\_CharLCD as LCD

db = mysql.connector.connect (

host="localhost",

user="attendanceadmin",

passwd="",

database="attendancesystem"

)

cursor = db.cursor()

reader = SimpleMFRC522()

lcd = LCD.Adafruit\_CharLCD(4, 24, 23, 17, 18, 22, 16, 2, 4);

try:

while True:

lcd.clear()

lcd.message('Place Card to\nrecord attendance')

id, text = reader.read()

Here we execute our first bit of SQL. This SQL statement grabs both the “id” and “name” from our “users” table where the user has the same RFID ID as the card that was tapped on the reader.

cursor.execute("SELECT id, name FROM users WHERE rfid\_uid="+str(id))

result = cursor.fetchone()

lcd.clear()

In this section, we first check to see if the last SQL request returned any rows. If it returned 0, then we display a message to the 16×2 display that the “User does not exist“otherwise we insert the user id a value into the database and then we clean the LCD with gpio.cleanup

if cursor.rowcount >= 1:

lcd.message("Welcome " + result[1])

cursor.execute("INSERT INTO attendance (user\_id) VALUES (%s)", (result[0],) )

db.commit()

else:

lcd.message("User does not exist.")

time.sleep(2)

finally:

GPIO.cleanup()

CODE

Texto

Descripción generada automáticamente

To proceed with the front-end web, we will need to install nginx and I have used a combination of php (using medoo) for its simplicity to connect with the database.

Then I used a combination of bootstraps examples from the official documentation for the most interesting part which are the php files we can look at the connector using medoo which is a lightweight framework and portable since it only uses one file .

Texto

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This is the that calculates the day month and year. This piece of code was used in the exam and exercise given to the class in IAW.

Texto

Descripción generada automáticamente

Lastly we have loop to echo the information already present in the database to be seen in the front end.

Texto

Descripción generada automáticamente

As for the rest of the code since is publicly available in the bootstrap webpage official documentation and examples is considered redundant to show it the webpage therefore looks like this.

Interfaz de usuario gráfica, Aplicación, Teams

Descripción generada automáticamente

Interfaz de usuario gráfica, Aplicación

Descripción generada automáticamente

Interfaz de usuario gráfica, Texto, Aplicación

Descripción generada automáticamente

# Chapter 10

# Discussion

Although the Access control system is a success, I can’t overlook some mayor problems that comes with the development of systems related to RFID where private-sector organizations involved in the development of RFID. Private-sector organizations that represent multiple industries can develop a standard for a specific application not using the standards giving by organizations this makes the development of a enterprise ready access control system very difficult not only that but National standards-setting organizations facility the development of nation standards within their own country. For example, the American National Standards Institute (ANSI) represents the United States to ISO and facilitates the development of U.S. standards. ANSI, as well as other national standards organizations, is involved in the development of RFID standards the Standardization Administration of China has established a National RFID Standards Working Group to draft and develop a national standard. This only exacerbates the dire problem that RFID systems have that is lack of standardization over RFID making difficult for Sysadmins such as myself to implement a system in a different country.

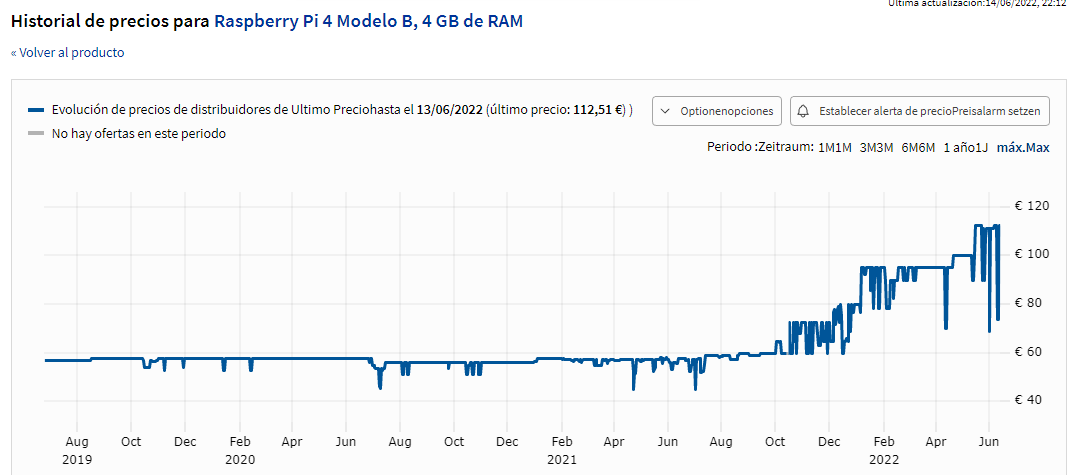
Another problem that comes with using RFID systems is that there is not much free and available information about it specially on Linux system much like the problem with the standards lack of regulations makes enterprises do proprietary solutions which not only makes the overall cost of project higher since you can only find their resources but also makes the communities that the RFID technologies such as home automatization, motorized access control system such as magnetic doors or even in some cases cars.

No amount of encryption can protect a student from losing or been robbed of a tag. If a tag is stolen, the thief could theoretically overwrite the tag with whatever they want creating what is called a data corruption attack in which you override the tag with junk data in order to saturate the database or using NFC exploits to start sending SQL statements to the database in order to create a backdoor (which is not that complicated if know where to look) and let’s face we are in a It focus High school is in the nature of some people to have malice in them and try to things they are not supposed to so having a device connected to a database is in itself a risk that some people may not take if the system is not being updated all time.

Availability of components and cost is another problem to address, since the start of the pandemic components such as Arduino kits and raspberry pi have been in a shortage and demand isn’t slowing down which ultimately makes the raspberry pi with all his models more expensive, is estimated that by 2025 more than 50m of raspberry pi will be on the market like this official graph from the raspberry pi foundation indicates.

Gráfico, Gráfico de líneas

Descripción generada automáticamente

As of cost several models have increased prices but with the shortage going don’t reflect the current prices of the raspberry pi, as of today there is not a single ACU available to the public there is high inflated raspberry pi going for models such as the 4b for 100 euros, so this in itself makes the cost of this project costly if its purpose is to be used in a enterprise level business.

As of today including shipping cost the project has costed me including the raspberry pi around 135 euros including all the components required for its function such as the Arduino breadboard and using a cheap RFID reader and the cheapest tags I could if bough in bulk per 125 students 50 euros (write many times and read many times bought using amazon prices, having a distributor would be cheaper ) so each card is approximately 2 euros knowing that some students will lose/break card it can quickly add up.

**Conclusion**

As for the conclusion of project analyzing all variables the cost, time invested, time to deploy and the availability of the components I don’t think it’s feasible at this moment for the High school to have this type of access control system based on a raspberry pi which has a design relatively small and easy enough to install even overlooking the portable and small factor there are too many variables that the market controls to be considered a reliable system to be deployed in all of the classrooms not counting on the fact that is another system that needs to be secured and monitored by the system administrator of the center and like previously stated the security of the device is also based on the components bought such as the quality of the reader and the type of tag which there is a shortage of and even with all of this problems I will do the project again for the knowledge that it provides and the opportunities that brings to know a whole new technologies even if I think is not enterprise or institutions ready project to be deployed.

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