

Authenticity Access and Temperature Monitoring of Students to the Public System of the Puerto Rico Department of Education

*Javier González Hernández
Master in Computer Sciences
Alfredo Cruz, PhD
Computer Sciences Department
Polytechnic University of Puerto Rico*

Abstract – *This project consists of creating a system to authenticate and monitor students' temperature at the entrance of a school. The system will have a student's ID barcode scanner, temperature measurement, hand washing, and access lighting system. With that system, the school administration and nursing will have access to the database and authenticity of the student at the entrance of the school and have a daily tracking of the student's temperature. Also, this system is to prevent the entry of students who are not authorized to enter the school campus or other people who incorrectly use the access to the school by posing as a student where they are not really students and have access to the school to commit any act of violence or malice against the students or computer information systems of the schools of the Puerto Rico Department of Education.*

Key terms – *Arduino, Integrated Development Environment (IDE), Light Emitter Diode (LED), Liquid Cristal Display (LCD)*

INTRODUCTION

Authenticity and security in the schools of Puerto Rico are a topic of great importance for students, parents, and school administration. Therefore, the main objective of the project is to implement an Authenticity and Temperature Monitoring system in schools of Puerto Rico. Since today schools need secure systems to be able to guarantee the safety of students and to be able to maintain a secure environment of information systems, preventing unauthorized persons from entering and having access to the school.

By the General Regulations for Students and Compulsory Attendance of the Puerto Rico Department of Education [1], the safety of each student is the responsibility of the school, and each school must provide an environment that is safe and conducive to a safe learning environment.

But in the face of the new challenges that have been unleashed during these years as a result of the COVID-19 pandemic, the schools of the Puerto Rico public system lack a robust system of student authenticity and continuous monitoring of student's information. Because admission to the school must comply with the protocols established by the Department of Health of Puerto Rico [2].

The project consists of two parts, the first part is the development of a student database system that contains their personal information for its authenticity in the school. Then an identification card will be designed that will contain the bar code of the Student Information System Number, that is unique for each student in the information system registry of the Puerto Rico Department of Education. The system will be connected to a barcode reader that will read the code and authenticate it with the database system created in Microsoft Access software.

The second part of the project consists of the design of a temperature monitoring system through a configuration with an Arduino system. This allows the student's temperature to be taken and determine if it meets the parameters established by the Puerto Rico Department of Health. This will consist of a C++ programming for the IDE of the Arduino Microcontroller to indicate by LCD and LED light if it meets or does not meet the temperature required by the Department of Health of Puerto Rico.

The project explores the processes of system design, software installation, database configuration, and the codes used in the Arduino software.

Background

Taking advantage of the new challenges of this new era of access control and temperature monitoring due to the COVID-19 pandemic [1] it is important to develop an Authenticity and Temperature monitoring system. Today's students are already used to this new access control system and therefore its implementation is easier since they have created awareness of what access control is. Therefore, this benefits us to be able to carry out authenticity controls and to be able to complement a safer and calm environment within the schools of the Puerto Rico Department of Education.

Goals

In addition, this project has as its goal and purpose other development opportunities in the integration of the school community in the development of the Authenticity and Temperature Monitoring project. This provides integration with the basic subjects of the Education System of the Department of Education, since it can involve the participation of students in the design and analysis of the information obtained from the authenticity system of access to the school campus. Where Science Technology Engineer and Math strategies will be used for each student to participate in the project. The integration of the project in different subjects would be the following. In the Physical Science course, the students would use the Arduino system for the installation of the barcode systems, temperature sensors, and access lighting, in the Computers course, the students would write the C++ programming code, in the Chemical Science course, the students would create the Hand Sanitizer used for disinfection, in the Mathematics course, the students would work with the database to calculate statistics and graph developments according to the progress of the implementation of the project, in the Spanish course, the students would write the instructions and surveys developed for the project, and in the English

course the students would use the translation of information from instructions or resources necessary for the development and implementation of the project.

Research Questions

The following questions are part of the development of the project.

- Why is it important to establish an Authenticity system in the school?
- Is it important to monitor temperature during the COVID-19 pandemic?
- What happens if the student does not pass the Authenticity barcode scan or temperature measurement?
- Does the Authenticity system help in the security of the school's information system?
- How is this system acceptable for the parents?

Relevance and Significance

Student safety is important in a school. Therefore, it is important to establish authentication and temperature monitoring system. In [3], a similar system was established, and it implemented a barcode system to identify students. Also, [4] explains the importance of barcode systems and how it is used to ensure authenticity.

It is important to understand that today the Puerto Rico Department of Health has established safety protocols for school students. Therefore, with the security system, the implementation of the protocols is strengthened and a data system of the temperature monitoring of the students is maintained.

This makes the schools safe, and the Puerto Rico Department of Education has a robust Student Authenticity system and can provide a safe environment for students and school information systems avoiding any threat that may occur on a campus school.

Barriers and Issues

Before the implementation of the system, a Principal School approbation is needed to comply with the rules and public policy of the Puerto Rico Department of Education. The letter explains the

objective of the project and how it benefits the school with the implementation of this system. Because with that system the school can control the access of the students and avoid the entrance of any other person who wants to enter without authorization, and it is also a good system to protect the information system of the school that has a lot of personal information of the students.

In the case of public schools in Puerto Rico, the students are minors [1]. Therefore, an authorization process must be established because they will be photographed for the ID and it contains their personal information. Therefore, a universal permit will be designed that contains all the clauses that allow the implementation of the Authenticity and temperature measurement system [2].

With these permitting measures, we guarantee that the Authenticity System and Temperature Monitoring are safe and reliable. With the support of the parents or guardians of the students, the system is secure and meets the requirements of authenticity and protects the school campus and school information systems to prevent unauthorized students from accessing the school or the school's computer network.

Brief Review of the Literature

To do this project, different references related to projects, articles, regulations, and books are used to support the purpose of the development of this project. Regarding the entry of the students, they proposed a system to eliminate the possibility of human error, secure data, and attendance awareness among the students to have a backup of the information. [3]

[4] explains how to use an Arduino with a barcode and how it is implemented in a system to scan.

In the case of regulations, reference is made to those established by the Puerto Rico Department of Education. The rules established in Article III, Student right in Part 11 [1] say that their academic records, health profile, and other related documents of a confidential nature will be handled safely to protect them. COVID-19 protocols are also

established [2] where the temperature is taken, and handwashing hygiene is a fundamental principle. Teach children correct handwashing, and respiratory hygiene to provide adequate supplies.

For the implementation of the project and programming, [5] and [6] were used to carry out the programming of Arduino and its connections. In the case of the database, [7] was used to create a database based on Microsoft Access 2016.

PROCESS

This section covers all the requirements and processes for the development of the project Authenticity and Temperature Monitoring for students.

Project System Interfaces

In this part of the project, it will be shown how the flow diagram of the project process is. Figure 1 shows the process of Authenticity and Temperature Monitoring for students. The process begins with the creation of the Student Identification Card with the student's personal information, photo, and student barcode. Then the system scans the bar code and authenticates it with the database developed for the authenticity system. Once the student is authenticated, the temperature is taken and captured to comply with the protocols established by the Puerto Rico Department of Health. Where, at the end of the temperature measurement, a system for hand washing and an indicator light for safe access to the school campus will be activated.

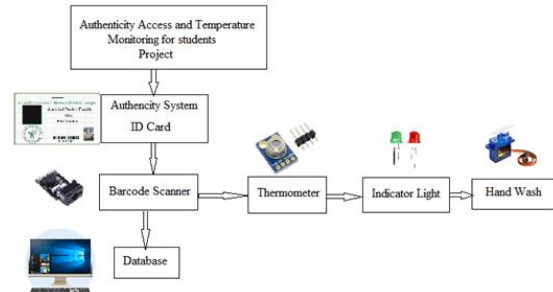


Figure 1
System Interface

Project Software Interface

The software interface used for this project is described in table 1 and contains the interaction with

the system. Table 1 consists of the Database System, which is the Microsoft Access 365 software that is authorized by the Puerto Rico Department of Education to use in their information systems. The ID Card Barcode is used with the CardPresso software to create the student Identification Card of the students. For the temperature monitoring, is used the Arduino IDE software to creates the code for the configuration of the IR Temperature sensor.

Table 1
Software Interfaces

| Software Interface | Purpose |
|--------------------|--|
| Database System | The system uses Microsoft Access to store the data base of the student and for the authenticity of the students in the system. |
| ID Card Barcode | The system use the CardPresso Software to create the ID Card and the Barcode for the (Numero de SIE). |
| IDE Programming | The system uses an Arduino IDE C++ programming for the configuration of the temperature sensor and light indicators. |

Process Development Tools

This process shows the necessary tools that were needed for the development of the student's Authenticity and Temperature Monitoring project. It is divided into two parts: the part of Authenticity with the database and the part of monitoring the temperature of the students and indicators of access to the school campus.

ID Card Process

In this process, the cardPresso Software was used for the development of identification cards. As shown in figure 2, the identification card contains the School Name, Photo, Student Name, Grade, Occupational Workshop, School Logo, Barcode, and School Photo. With this identification card, the student is identified and authenticated every time it is necessary for the school. All, to prevent other people or students outside the school campus from having access to the school.



Figure 2
Student ID card with barcode

Microsoft Access Data Base System

The process of developing the student database for authenticity was done with Microsoft Access software. This database software was used since it is the one that is authorized to be used in the information systems of the Department of Education. Figure 3 shows how the database was developed and how it is accessed. The database consists of the SIE Number as the Primary Key since this is the data that will be used to scan the barcode. In addition, figure 3 shows all the content of the database. The content consists of SIE Number (Primary Key), Name (Short Text), Last name (Short Text), Date of Birth (Date/Time), Physical Address (Short Text), Telephone Number (Short Text), COVID 19 Vaccine (Short Text), Quantity of COVID 19 Vaccine (Number), and Occupational Workshop (ShortText).

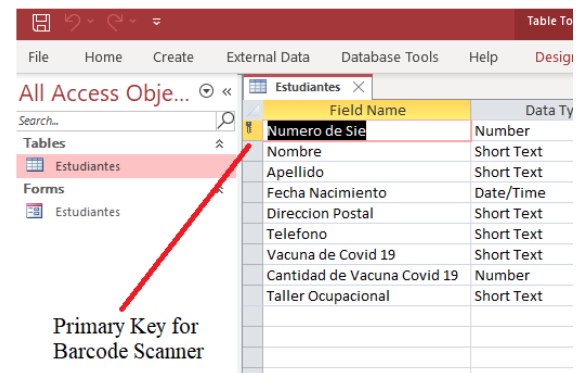


Figure 3
Microsoft Access database

Microsoft Access Data Base Form

In this part, the form is executed to be able to have access to the created database of the students. Figure 4 shows the student information, that will be

used for authenticity. Where you can search for the student using the SIE Number and verify their personal and school information. In addition, in figure 4 you can see the Find Record, First Record, Last Record, Next Record, Previous Record, Undo Record, Close Form, Delete Record and Save Record commands. Where in this form the school staff has the entire database of students to access, add or delete.

The screenshot shows a Microsoft Access form titled 'Estudiantes'. The form contains the following fields:

| | |
|-----------------------------|-------------------------------------|
| Numero de Sie | 24054246 |
| Nombre | Dante |
| Apellido | Bey Perez |
| Fecha Nacimiento | 8/23/2003 |
| Direccion Postal | Bo. Saltos Carr 445 Km 6.0 San Seba |
| Telefono | 787-503-9806 |
| Vacuna de Covid 19 | Si |
| Cantidad de Vacuna Covid 19 | 3 |
| Taller Ocupacional | Electronica |

At the bottom of the form, there are several buttons: Find Record, First Record, Last Record, Next Record, Close Form, Delete Record, and Save Record.

Figure 4
Microsoft Access database form

MDB ACCDB Access Viewer

The MDB ACCDB Access Viewer is a mobile application developed by Quiang Li. Figure 5 shows the application view on a cellphone. With this application, you can view and edit the Microsoft Access database on your iPhone or iPad natively. It easily Sorts, Paging, and Filter the database. This application must be downloaded from the app store or google play and installed on the cellphone.



Figure 5
MDB ACCDB Access Viewer

This application is used to reinforce the authenticity of students remotely since it can be accessed by school security personnel and verify that students are those who are enrolled in school, and it is not a stranger that it is being done pass as a student at the school.

Arduino IDE Programming

The Arduino program uses the C++ language to configure the operation of the thermometer to be able to take the temperature of the students and to be able to determine if it complies with the body temperature levels established by the protocols of the Department of Health of Puerto Rico in the public schools of Puerto Rico. Figure 6 shows the C++ code used to connect the thermometer to the Arduino microcontroller and its Arduino Software 1.8.19. The code consists of the configuration of the LCD and the library of the temperature sensor.

```
File Edit Sketch Tools Help
Projecto_con_Sensor___Luces_y_Servo_Marzo1
#include <Wire.h>
#include <Adafruit_MLX90614.h>
#include <LiquidCrystal.h>

LiquidCrystal lcd(7, 8, 9, 10, 11, 12);
Adafruit_MLX90614 mlx = Adafruit_MLX90614();

void setup() {
  pinMode(4, OUTPUT);
  digitalWrite(4, LOW);
  pinMode(3, OUTPUT);
  digitalWrite(3, LOW);
  Serial.begin(9600);

  Serial.println("Adafruit MLX90614 test");

  mlx.begin();
  lcd.begin(16, 2);
}

void loop() {
  // Display Temperature in C
  lcd.setCursor(0, 0);
  lcd.print("Temp      C ");
}
```

Figure 6
Arduino IDE Programming

METHODOLOGY & DESIGN

For this project, the development of the Authenticity and Temperature Monitoring system for students is one of great security for any school campus. It has the necessary information to be able to identify and authenticate any student in the school at any time. This helps to control student access and

prevent anyone from outside the school campus from attempting to enter by posing as a student. Therefore, the system is one of easy access and management for school personnel, since by simply using a barcode system they can access the student's information and ensure that this is the one that is authorized to be on the school campus.

Design

The design of the system consists of the implementation of the barcode system in the search for student information for its authenticity. Where, through the database created in Microsoft Access, school personnel can access the student's information and authenticate her identity. In the design of the Form in the database, there are command buttons for searching for students, adding new students, and deleting students who are no longer part of the school campus. Figure 7 shows how the student can be accessed by scanning the barcode of the student's SIE number. The barcode system scans the student ID and when the scanning process is completed, all student information that is stored in the system can be accessed. Since the SIE number is unique for each student enrolled in a public school of the Puerto Rico Department of Education.

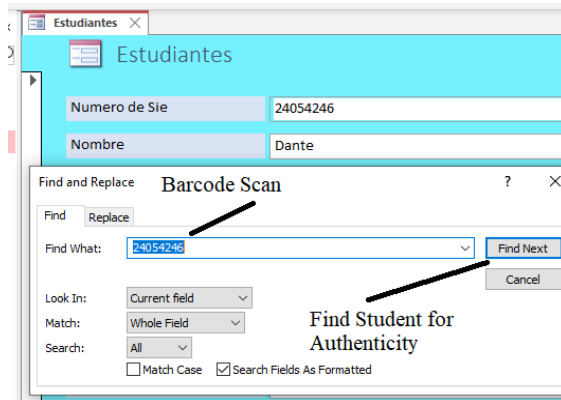


Figure 7
Find the Student for Authenticity

Temperature Monitor Design

In this part of the project, the Arduino microcontroller will be programmed to take the temperature of the students. Figure 8 shows the

Arduino microcontroller and how it is connected to the LCD which indicates the student's temperature. This temperature must be within the parameters established by the Puerto Rico Department of Health and must not exceed 37.8 degrees Celsius.



Figure 8
Temperature Monitor Design

With the Arduino Programming, it is also implemented a light LED system to determine if the student meets the temperature of fewer than 37.8 degrees Celsius and if they do not meet less than the temperature, the system will turn on a red light indicating that they did not pass the temperature test.

Content

The content of information found in the database of the student information system has all the necessary tools to be able to identify and authenticate the student. In addition to the student's data, it also has information regarding vaccination against COVID -19. As shown in figure 9, in addition to the name and information of the student, there is a section that indicates whether the student has been vaccinated Yes, No or Ex. In the number of Vaccines section, the number of these is indicated. This helps to comply with the protocol established by the Puerto Rico Department of Education and the Puerto Rico Department of Education that all students be vaccinated against COVID-19.

| Estudiantes | |
|-----------------------------|---|
| Numero de Sie | 24054246 |
| Nombre | Dante |
| Apellido | Bey Perez |
| Fecha Nacimiento | 8/23/2003 |
| Direccion Postal | Bo. Saltos Carr 445 Km 6.0 San Sebastia |
| Telefono | 787-503-9806 |
| Vacuna de Covid 19 | Si COVID-19 Yes/NO /EX |
| Cantidad de Vacuna Covid 19 | 3 COVID-19 Vaccine Quantity |
| Taller Ocupacional | 0 1 2 3 |

Figure 9
COVID-19 vaccine identification

RESULTS

This part explains all the parts of the project and how they have been improved from the Idea Paper. The project is divided into two parts: the Authenticity system and the Student Temperature Monitoring system.

Identification Card

The Student ID card as shown in Figure 10 contains the student's basic information for the student to carry as a school ID and gain access to the school campus. The card contains their Photo, Name, Home-Room, Occupational Workshop, and Barcode. With this information visible always, school security personnel can identify and authenticate each student at any time during the day.

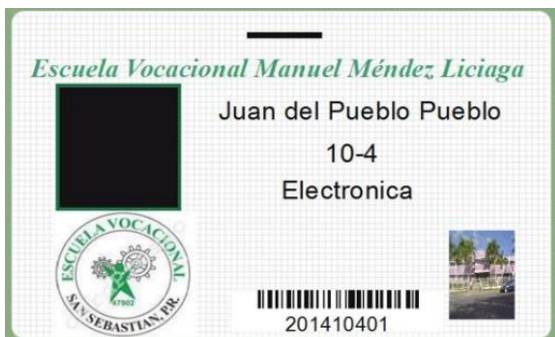


Figure 10
Student identification card

Microsoft Access Database Barcode Scanner

Student information is stored in a database created by Microsoft Access software. This data is accessible through a Form created so that school personnel can easily locate it using a barcode scanning system. The staff accesses the database using find the record as shown in Figure 7 above in the form of Microsoft Access and with this information they can authenticate the student. Figure 11 shows the GM65 1D 2D Barcode Scanner which is used to scan ID card barcodes. It has high efficiency and high-speed recognition and has become one of good efficiency.



Figure 11
GM65 1D 2D barcode Scanner

MDB ACCDB Access Viewer

With the MDB ACCDB Access Viewer the administrator personnel of the school can also access the Authenticity information of the student with a cellphone or tablet. The application is a good tool for the mobility of the person to another part of the school and identifies the student if this is not authenticated. Figure 12 shows how to access the application and the database information of the students. This application has the link to the real database of the system, and you can use the camera of the cellphone or tablet to scan the student's ID.

| Database | Choose | Estudiantes | | |
|---------------------|--------|-------------|-------------------|-----|
| Vocacional1-1.accdb | | Nombre | Apellido | Fec |
| Vocacional1.accdb | | Kenai | Barreto Perez | 200 |
| Vocacional.accdb | | Dante | Bey Perez | 200 |
| | | Ian | Colon Arce | 200 |
| | | Alexis | Gonzalez Roman | 200 |
| | | Javier | Hernandez Rive... | 200 |
| | | Christian | Illa Ruiz | 201 |
| | | Andres | Iehron Valentin | 200 |

Figure 12
MDB ACCDB Access viewer from student database

Also, it filters the database and shows only the student that the school personnel want to Authenticate. Figure 13 shows how the database is filtered by the (Numero de SIE) and only shows the student that is scanned by the barcode scanner or cellphone application.

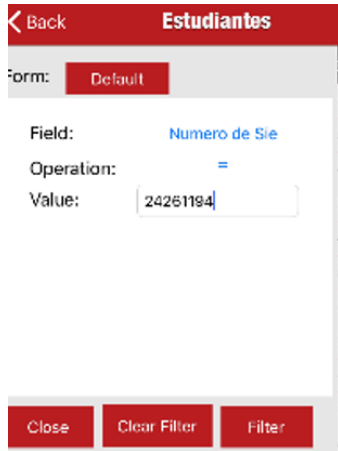


Figure 13

MDB ACCDB Access Viewer Filter by (Numero de SIE)

Temperature Monitoring

With the Arduino microcontroller and the use of the Thermometer GY-906 for Arduino, it was configured so that the student's temperature was illustrated on an LCD screen to determine if it complies with the temperature level accepted by the protocols established by the Puerto Rico Department of Health. Figure 14 illustrates the thermometer used. This thermometer is GY-906 a high precision infrared non-contact thermometer module with an I2C interface and 5V or 3.3V operation. Figure 15 shows its connection using the Arduino microcontroller. This connects the microcontroller with the thermometer and with the LCD to show the results of the temperature monitoring.



Figure 14

Thermometer GY-906

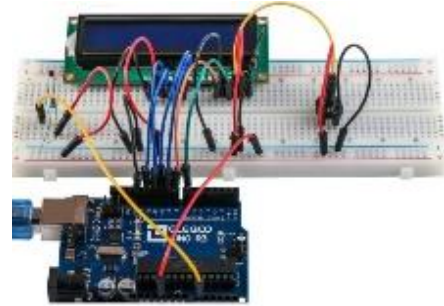


Figure 15

Arduino Connection Thermometer

Lighting Indicators

The Light Indicators complement the Temperature Monitoring it can turn green when the student temperature is under the parameters established by the Puerto Rico Health Department. And turn Red if the student exceeds 37.8 degrees Celsius. Figure 16 shows the code used in the Arduino IDE software to generate the parameters to turn the correspondent light according to the student temperature. The code consists of the LCD library, the thermometer library, and the C++ coding to be able to display the student's temperature and their permission to access the school.

```

Proyecto_con_Sensor___Luces_y_Servo_Marzo15
void loop() {
  // Display Temperature in C
  lcd.setCursor(0, 0);
  lcd.print("Temp      C ");

  lcd.setCursor(6, 0);
  lcd.print(mlx.readObjectTempC());
  {
    if (mlx.readObjectTempC() >= 37.8)
    {
      lcd.setCursor(0,2);
      lcd.print("NO Pass");
      digitalWrite(4, HIGH);
      digitalWrite(3, LOW);
    }
    else if (mlx.readObjectTempF() < 37.8)
    {

```

Figure 16

Arduino IDE Code Temperature and Light Indicators

Handwash

The handwash consists of a servo motor configuration that is activated when the student passes all the requirements at the entrance of the school. The students pass the Authenticity process and Temperature Monitor. Figure 17 shows the connection of the servo motor to be used for Handwash Dispenser. With this

system, once the student passes the temperature monitoring, the servo motor will activate, allowing a hand wash dispenser to be activated.

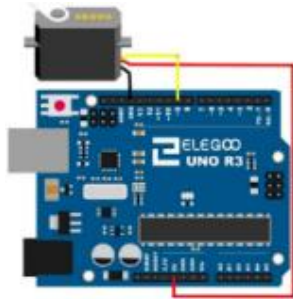


Figure 17
Servo motor connection for handwash dispenser

Tests Performed

The tests carried out consisted of creating identification cards, running the Microsoft Access program on the computer, and installing the temperature sensor. In the tests carried out, it was determined the approximate time for each process of authenticity and temperature scanning. This took about 5 seconds per student. During the process, the student was authenticated with the identification card scanning system, and then his temperature was taken, and it was determined if he complies with the body temperature allowed by the Puerto Rico Department of Health. Once the tests were carried out, the student flow went smoothly, achieving an approximate estimate of 5 seconds per student. With the determined time, it can be determined that its implementation fulfills the purpose of the authenticity of the student and the taking of this temperature. Given this time analysis, it is possible to determine the number of stations that would be needed in a school to be able to verify the authenticity and temperature monitoring. Table 2 shows that every 5 seconds a student can be authenticated. This means that in table 2 it is determined that for every 1 minute 12 students can be authenticated, every 10 minutes 120 students and 720 students in one hour. With this information, it can be established that 720 students can be authenticated with a station in one hour. But if the school wants to have a further advance in authenticity, 2 stations can be installed at the entrance of the school to speed up the process and avoid crowds at the entrance.

Table 2
Students barcode scan and temperature monitoring time

| Students Scanned per Second | Number of Students per Minute | Number of Students Every 10 Minutes | Number of Students in an Hour (7:00 a.m. - 8:00 a.m.) |
|-----------------------------|-------------------------------|-------------------------------------|---|
| 1 student every 5 seconds | 12 students per minute | 120 students | 720 students |

Prototype

Figure 18 shows a prototype of how the stations will be in the school once all their parts are installed. This consists of an LCD screen that contains the database of the students of the information system of the Microsoft Access software where in addition the GM65 1D 2D Barcode Scanner is connected that will be used to scan the student identification card for its authenticity. In the system is also placed the Arduino microcontroller that contains the program codes for the use of the Infrared Thermometer GY-906. This system can be fixed or mobile according to the needs of the facilities of the school.

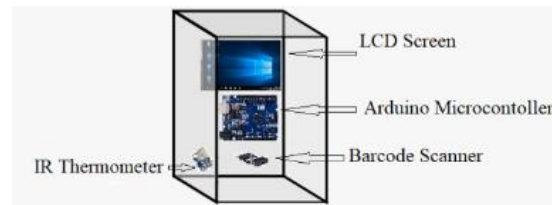


Figure 18
Authenticity and Temperature Monitor System

DISCUSSION

With the development of the Authenticity and Temperature Monitoring system for students, the Puerto Rico Department of Education will have a robust and secure system to be able to identify and keep school campuses safe. In addition, it has a student temperature monitoring system and will allow students to enter the school campus safely. The system has the necessary tools to prevent anyone who wishes to enter the school campus from pretending to be a student to violate student security or access information systems. Therefore, it is detected from the entrance of the school campus. That is why the Authenticity and Temperature Monitoring

system for students guarantees a safe environment and protection of the school's information systems.

FUTURE WORK

The Student Authenticity and Temperature Monitoring System can be expanded to other needs depending on the situation of each school. In the case of authenticity, more data can be added to the Microsoft Access database to obtain more accurate information about the student. But this requires other relationships in the database configuration that would entail other types of configurations in the system.

In the case of temperature monitoring and verification of COVID-19 vaccination, it is a section that is currently included due to the current reality of the COVID-19 pandemic, it can be improved or adapted as variants or needs continue to arise that require new measures to safeguard the health of students. Therefore, it is important to follow the protocols established by the Puerto Rico Department of Health and continue to see the new rules established by the Puerto Rico Department of Health and the Puerto Rico Department of Education.

CONCLUSION

The main purpose of the development of the Puerto Rico Department of Education Authenticity and Temperature Monitoring system is for students to meet basic authenticity and security needs in a school. It is important to see how this system was developed and adapted to the needs of the school. The system provides a useful security tool for the school administration of the Department of Education of Puerto Rico. This offers real identification through various methods. First, the school administration is in charge of entering the student's data into the database system designed for Microsoft Access. Second, they are using a unique ID card created at the school with a unique barcode for each student. Third, it has a system to authenticate the student at the school entrance by scanning the barcode on their identification card. Fourth, they have access through a mobile app that can also scan the student's barcode. This helps to strengthen school security since security personnel can

scan the student ID card from anywhere in the school and determine its authenticity.

In the second part of the project, the security protection measures against COVID-19 established by the Puerto Rico Department of Health are complied with, since the system provides an adjusted and programmed temperature monitoring system through the Arduino microcontroller according to the needs and protocols during the COVID-19 emergency. This also provides visual alerts through an LED light indicator to provide greater security at the school entrance. Considering that these measures may vary according to the guidelines given by the Puerto Rico Department of Education, we conclude that security and authenticity are issues of great importance and concern, as information systems continue to grow every day and cybersecurity is the key to protecting any place and system from any cyber threat.

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