INTELLIGENT FINGERPRINT-BASED ACCESS SYSTEM WITH CAMERA

Marina Daniela **SAS**
Technical University of Cluj-Napoca, Department of Electrical, Electronic and Computer Engineering
sas.marina8@gmail.com

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Abstract: *The paper presents a theoretical study and a practical realization of a system for access based on the imprint of a room and keeping track of people who are unauthorized. The assembly is done on a small scale (at the model level). For the practical realization we used the FPM10A fingerprint reader module, the Arduino AT Mega 2560 control unit equipped with the AT mega2560 microprocessor and an ESP32Cam camera equipped with the ESP32 microprocessor. The role of the fingerprint reader will be to check and recognize the fingerprints already stored in his memory, to the people who will want you to enter the rooms. The role of the camera will be to take a picture of the person whose fingerprint is not recognized. To view the allowed or not allowed access status, we mounted the 1.8" TFT LCD display. For the power supply of the assembly I used a 12V source that supplied my electromagnetic lock and from this source with the help of a low voltage converter you could power your Arduino board and ESP32Cam board, these being necessarily supplied at 5V voltage. The advantage of this application is that it secures the entrance to a room and can keep track of remote unauthorized persons who have tried to enter the room.*

1. INTRODUCTION

In recent years the technology has evolved a lot being used in various fields of activity to simplify and make people's work easier to ensure better home comfort, jobs and other areas.

One of the areas in which technology has evolved a lot is the field of access system of a room, of a property. This term access control actually refers to restricting the entry into certain rooms only of authorized persons.

In the past, this access control secured a space or property performed by a person (guard, receptionist), by certain mechanical means, such as locks, keys or access based on a card.

This control of conditional access by an individual would mean how that the person will decide who can have the right in the room or when he is allowed to. From the point of view of Historically, this access was often made on the basis of keys, which was owned only by triage staff for access.

Thanks to technology, which has evolved in recent years, access control in spaces has become a control based on an electronic system aimed at better security of access restriction unauthorized persons.

In order to replace those mechanical keys, the electronic access control will be based on accreditation based on the presence, when the person receives the access consent, the door will be opened. When the person's access is denied, the door will remain blocked and your access attempt may be registered.

This presence-based system could monitor your door with an alarm when the door it is open or held too long after it has been opened.

2. DESIGN AND IMPLEMENTATION

In this paper, I will represent the practical part of the proposed topic. For to highlight this aspect I will present the hardware connection diagrams of the different components and the software part, both contributing to the proper functioning of the chosen works.

2.1 The chosen theme of the fingerprint access system

This paper is entitled “Intelligent Fingerprint Access System with camera”, presents the realization of a secure access system based on fingerprint with use of a camera. (seems to be using the fingerprint camera).

The main feature of this system is the ability to have a system as much as possible well secured, when the person who wants to enter the room is not the fingerprint is recognized, the camera will take a picture of it, save it on a card, and from this card you will be able to view the picture with the help of the web interface created by Esp32.

2.2 Schematics of the fingerprint access system

Figure 1 shows the block diagram of the system, in which we also highlighted connection to the user of the ESP32Cam development board.

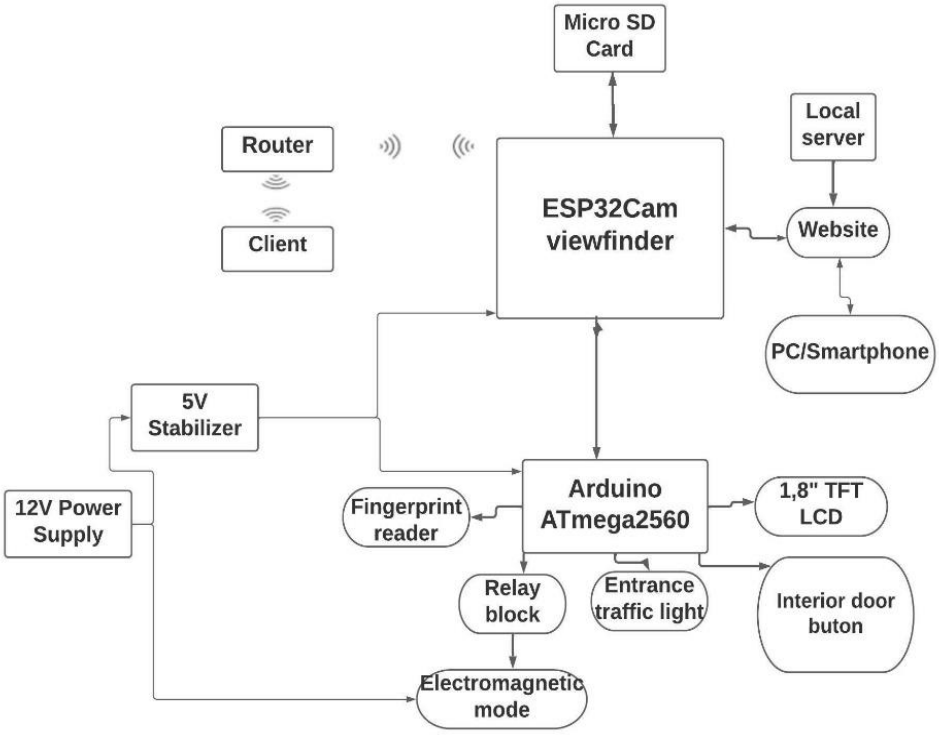

Fig. 1. Block diagram of the camera-based access system

To understand the operating stages of this project, we made a diagram with the functional blocks in which we highlighted and the connections between them. The stages of the block diagram represent the operation of the project presented as follows:

- ✓ the Arduino microcontroller took your data from the fingerprint reader, sent it to you decode then sends you the command of the relay block where it gave you the control of the electromagnetic yale to open or remain closed depending on the degree of resemblance of the fingerprint to the stored one.
- ✓ the LCD will retrieve your data from the Arduino when it recognizes you or not fingerprint and display certain messages
- ✓ the input traffic light also takes the data from the microcontroller, it will signal visually whether access is allowed or not
- ✓ the button on the interior door took over your data and activated the yala in inside the room
- ✓ Arduino microcontrols transmit data to the ESP32Cam microcontroller
- ✓ ESP32Cam takes over and sends you data to the micro SD card, and then all this data will be transmitted to the web interface via the WI FI connection
- ✓ The block diagram of this system we mentioned above, being represented in *figure 2*, in which we also represented the connection with the user of the board ESP32Cam development.

Figure 2 shows the electrical diagram of the access system.

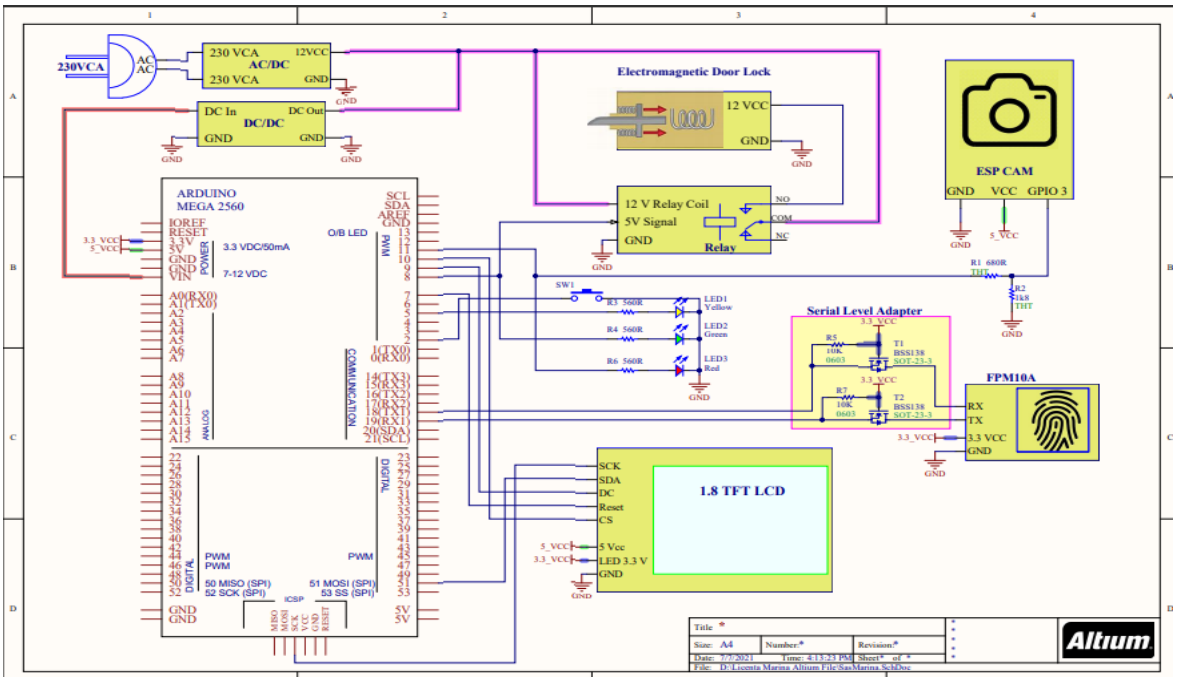

Fig. 2. Wiring diagram of the fingerprint access system

Figure 2 above shows the wiring diagram of the access system to understand how to design the access system, this diagram shows the connections from an electrical point of view.

This system is powered by a 12V source, it will supply you with the electromagnetic yala that will be controlled from the Arduino microcontroller via the relay block. The Arduino board will also be powered from this source by a low voltage converter that will convert your voltage from 12V to 5V so that it can be powered.

The fingerprint reader communicated to you via a logic level converter to the Arduino board, because it is powered at 3.6V, and from the Arduino board we can only supply 3.3V or 5V.

The LCD will communicate with the Arduino board via the pins dedicated to SPI communication, and it will be powered from the Arduino board.

The input traffic light is connected to the digital pins so that it can indicate the state in which the fingerprint reader has recognized the fingerprint or not, or it is in the fingerprint verification state, it is also powered by the development board.

The button is connected to a digital pin to be able to open the yala from the inside, this button on the Arduino board is also connected to ground.

The operating algorithm of this access system is presented in *figure 3*, the software being carried out in the following order:

Start:

• When the access system is powered on, microcontroller pin assignment operations are performed, thus establishing their role as output pins and how to write them (LOW or HIGH).

Fingerprint is expected:

• When the project is powered on, the fingerprint reader will wait for you until the user brings your finger close so that the fingerprint can be checked.

Fingerprint check:

• After the user puts their finger on the fingerprint reader, it will start comparing the user's fingerprint with the previously stored fingerprints, the result of the comparison will give the diagnosis whether or not it is valid.

Green LED / Red LED

• The green LED or the red LED are used to indicate when the fingerprint is recognized by the reader or when the fingerprint is not recognized by the reader.

LCD message:

• After the fingerprint is checked and the indicator lights have been turned on depending on whether the fingerprint is valid or invalid, a message will appear on the screen, consisting of "Access allowed" or "Access not allowed".

Picture taken:

• If the fingerprint is not recognized by the fingerprint reader, the camera will take a picture of that person, save the picture to a Micro SD card, and then the picture can be viewed using the WEB interface.

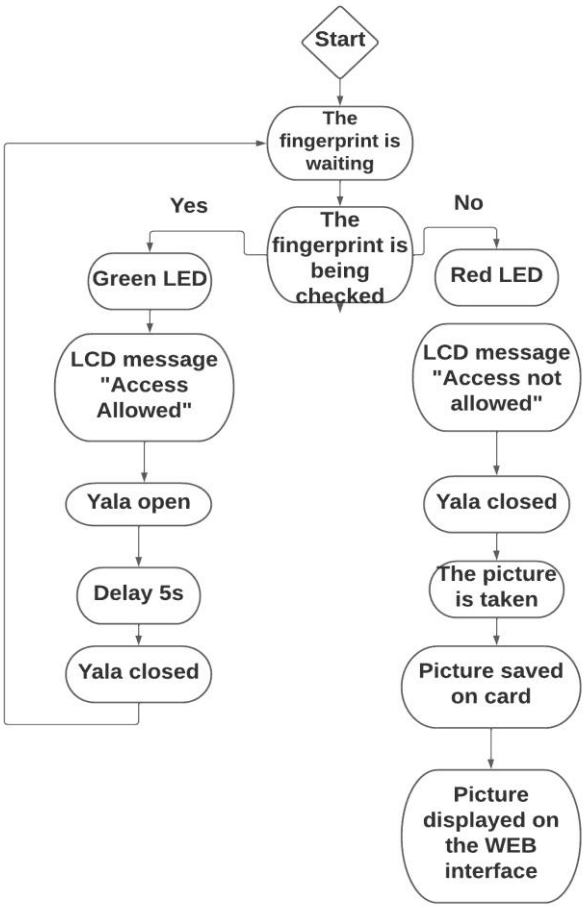

Fig. 3. Logic of the fingerprint access system

3 HARDWARE IMPLEMENTATION

Interfacing the FPM10A fingerprint reader with the Arduino AT Mega2560 development board is useful because the board has dedicated pins for serial communication, and the module uses the same communication interface. In order to work, I only had to identify the dedicated pins for the serial communication of the board and make the direct connection with the module pins, according to the diagram shown in *figure 4*, the power supply of the module is also provided by the Arduino AT Mega2560.

In order to be able to communicate the hardware of the Arduino board with the fingerprint reader module, we connected the serial communication module, RX to digital pin 18, and the reader's TX pin to digital pin 19, these development board pins being dedicated to serial communications.

This fingerprint reader is powered at 3.6V, and on the Arduino board we have 3.3V and 5V power pins respectively, and in order to be able to power this module from the Arduino board we used a logic level converter with I2C. *Figure 4* shows the connection mode of the module with the development board.

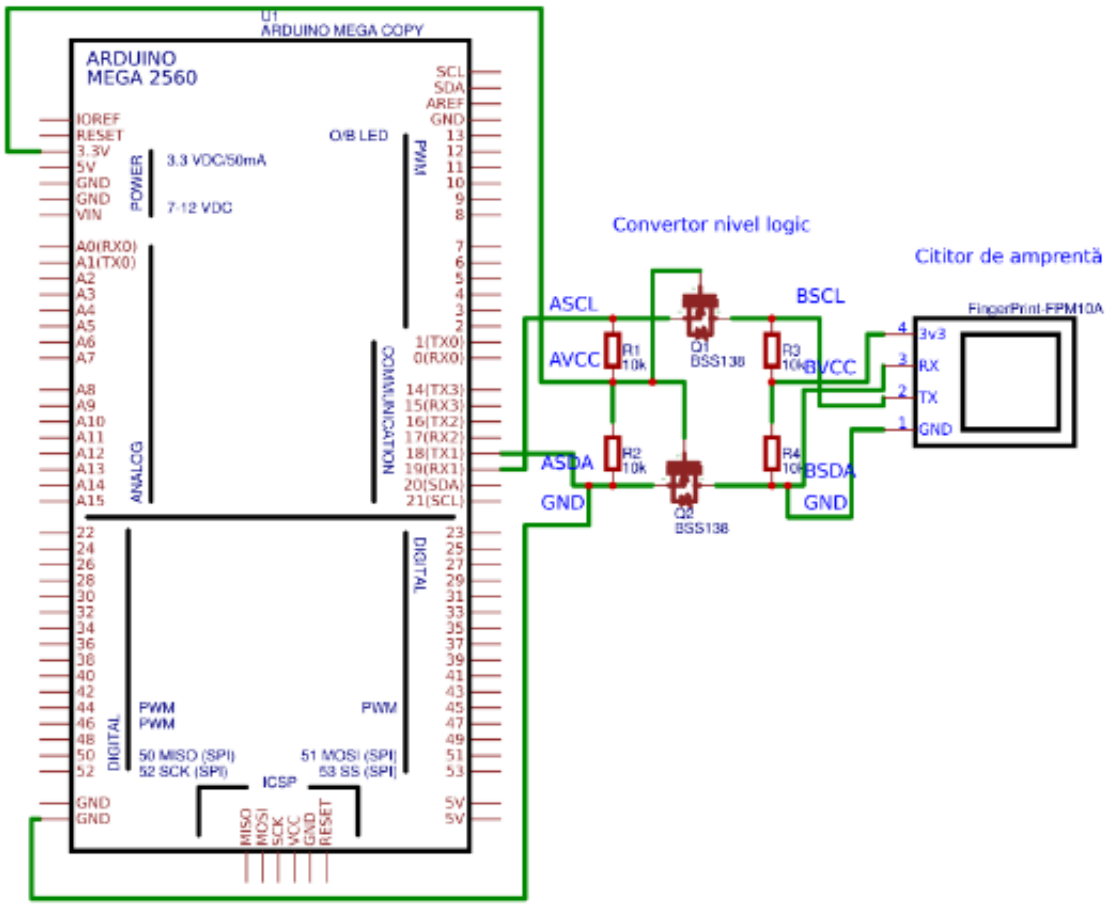

Fig. 4. Fingerprint reader connection diagram

And this time, the presence of dedicated pins for communication via the SPI protocol of the Arduino board proved to be useful, due to the simple interface between the LCD module and the board. For the pin that performs the function of "select chip" we chose the digital pin number 10, the other pins were connected according to the TFT library, already existing in the IDE, namely the MOSI pin (Master out slave in), to the digital pin 51 of the board Arduino and the MISO pin (Master in slave out) of the LCD mode, to the digital pin 52 of the Arduino board, as can be seen in *figure 5*. Power supply to the LCD mode was provided by the Arduino AT Mega development board.

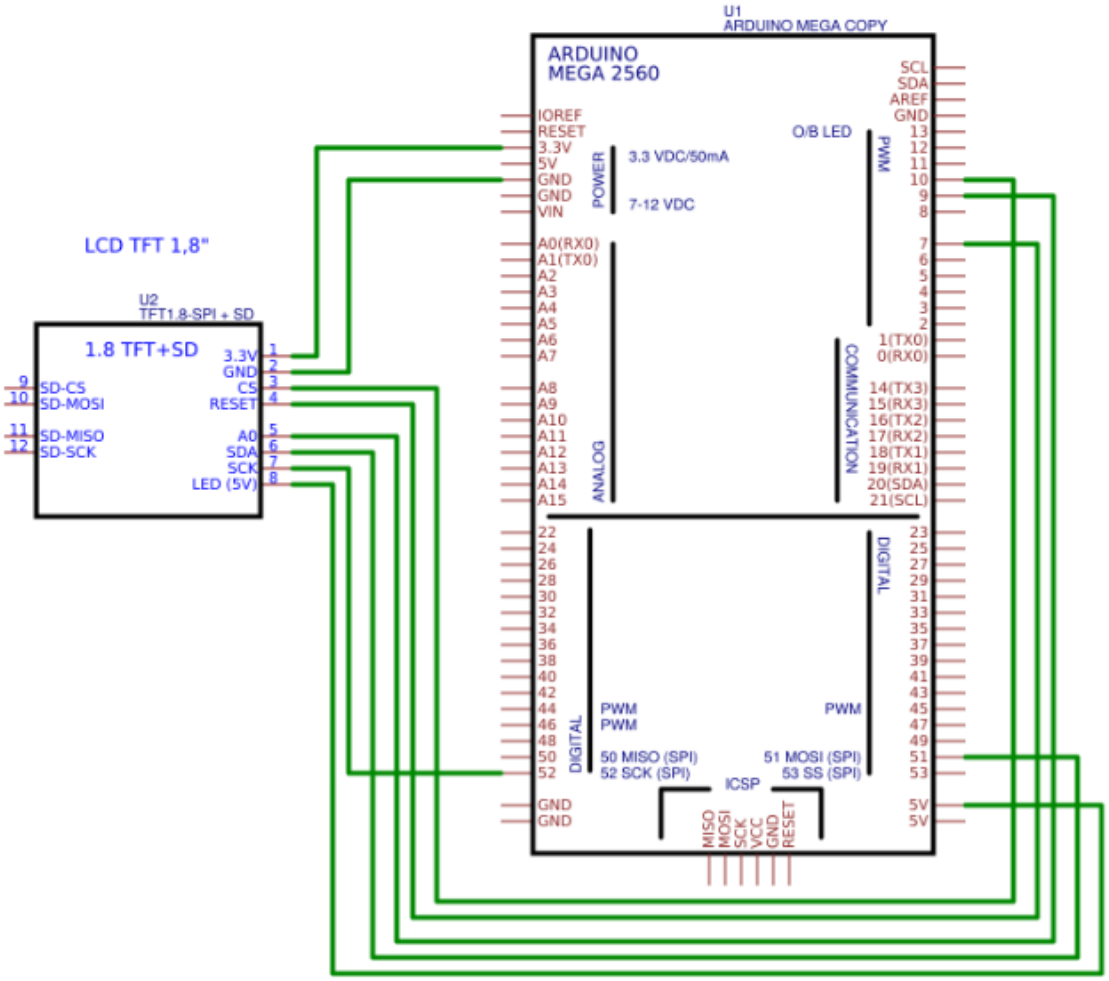

Fig 5. "TFT LCD connection module to Arduino board

The communication mode of these two boards is hardware, this communication is done through a GPIO that received a pulse from Arduino in LOW (0 logic) or HIGH (1 logic) mode when it had to take a picture.

Since the ESP works on 3.3V to power the GPIO pins, we did a level conversion using a voltage divider, this divider is made with the help of two resistors of different values, 1.8kΩ and 680Ω respectively.

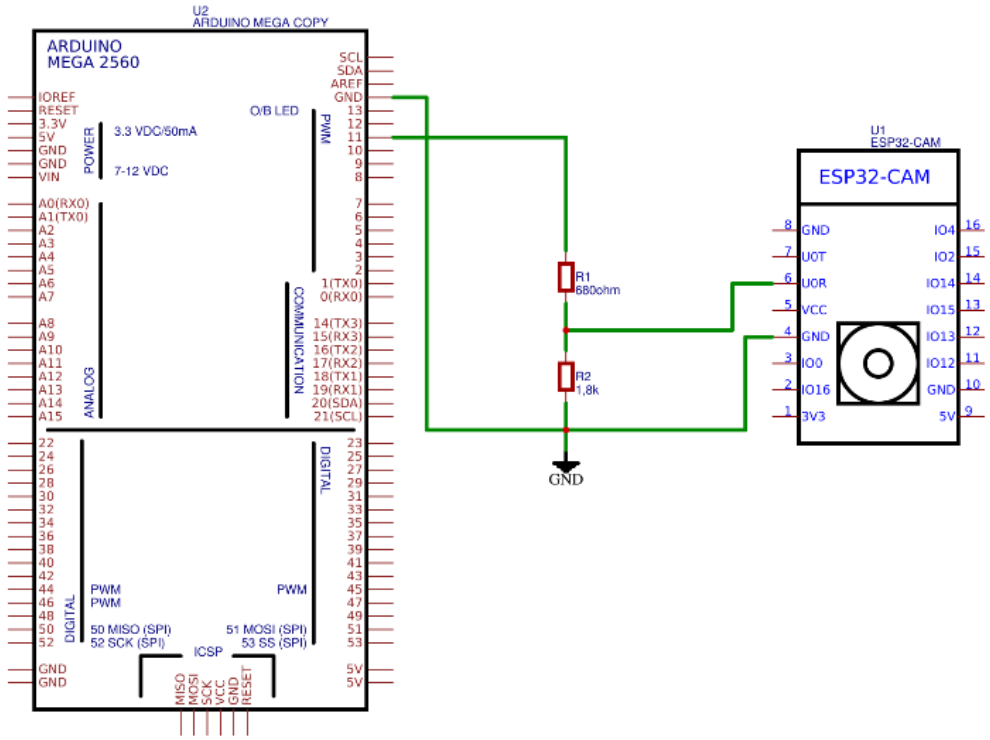

Fig. 6. How to connect the ESP32Cam board to the Arduino AT Mega2560 development board

In order to be able to program the electromagnetic yala module, we used a 2-channel relay to be able to communicate the yala with the Arduino development board.

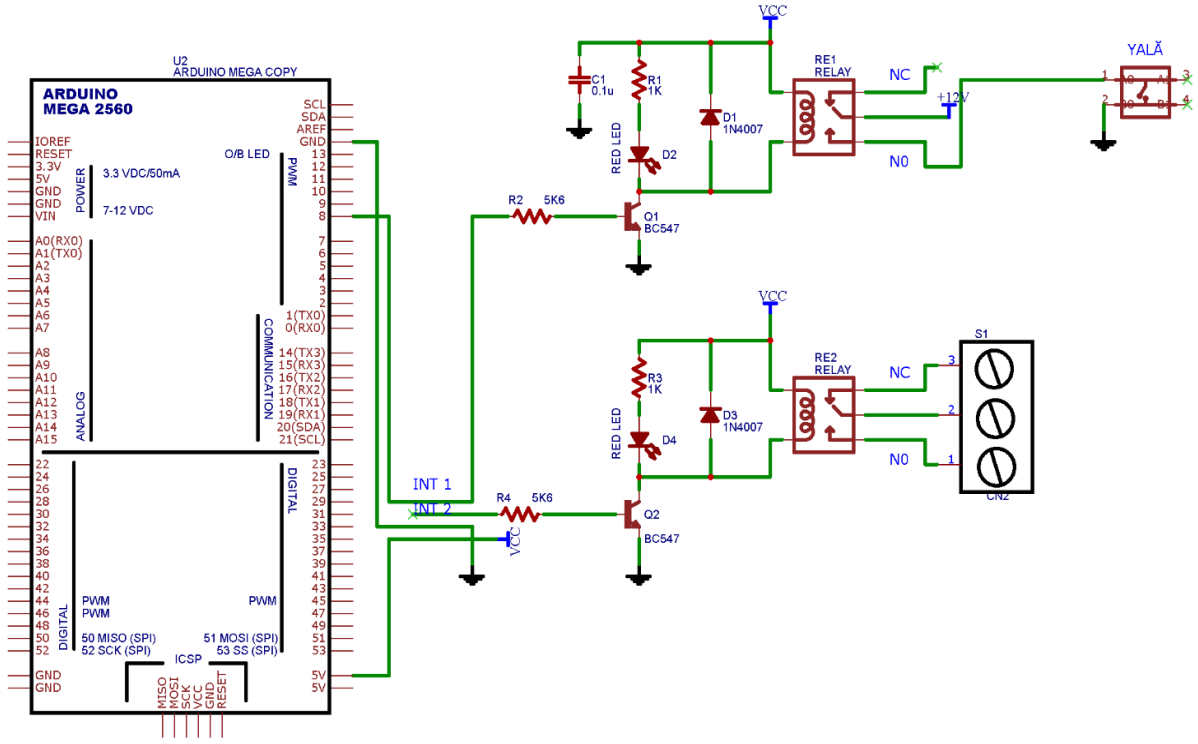

Fig.7. Connecting the yale module to the Arduino board

The Yala would have connected to the Arduino board with the relay, the Yale plus would have connected to the K1 connector on the relay, the Yala minus would have connected to the minus of the power supply, and the surplus would also have connected to the K1 connector.

The Arduino relay will communicate in reverse logic mode, if we give a LOW to the relay it will open the yala, and if we give it a HIGH it will not open the yala.

The pins connected from the relay to the Arduino are as follows, the INT 1 pin from the relay is connected to the digital pin 8 of the Arduino board, the relay module will be powered from 5V from the Arduino board.

To obtain the 5V voltage from the actual 12V power supply of this assembly, I needed to use an LM2596 low voltage converter. It is used to power the Arduino AT Mega 2560 board at a voltage of 5V, connecting it as shown in *figure 8*.

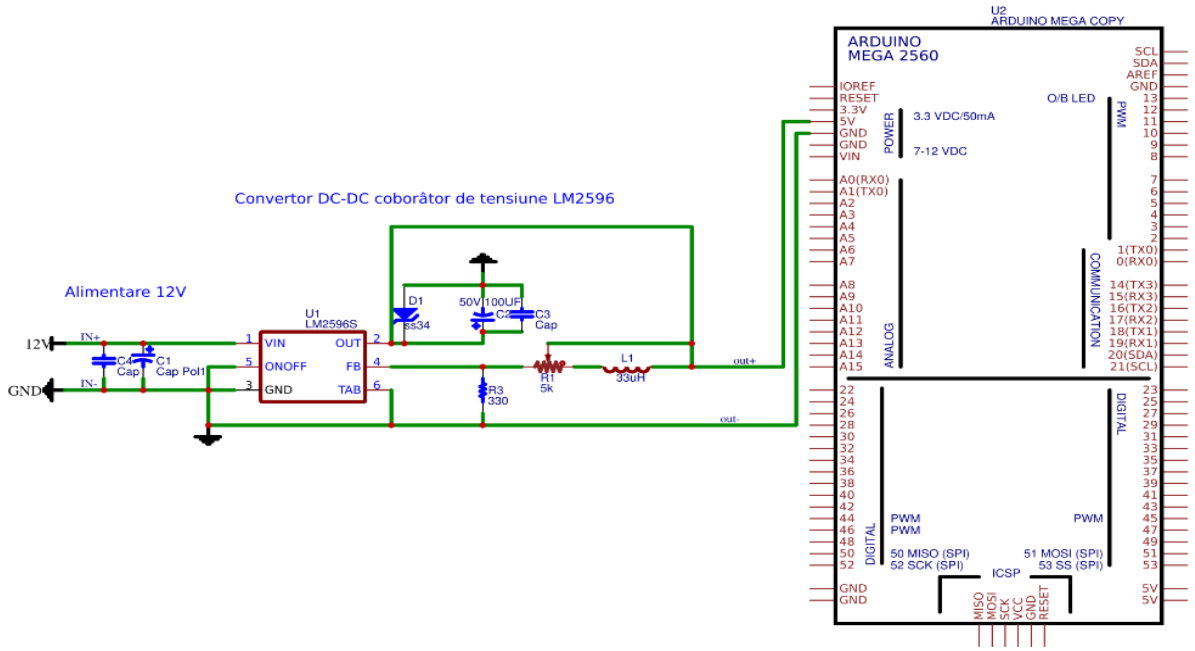

Fig. 8. Connecting the Voltage Converter to the Arduino Board

4. CONCLUSIONS

- Following the layout of this system, the web interface and the code, the camera-based fingerprint access system and the web interface work to the desired standards.
- After executing the code, the web interface displays the settings required by creating this job, and the camera-based fingerprint access system meets the desired requirements.

- The model can be implemented on a normal scale so that it can be used on a normal large scale for an entrance door, involving changing the power supply module with an appropriate module.
- It is possible to change the code to store more pictures on the card when people who tried to enter the room were not recognized.
- You can implement email notification or create an application that can be used remotely to view pictures taken by the camera.
- During this project I also encountered the problem of screen communication with the ESP32 module for displaying the picture on the screen, as a solution to the problem I went to create the web interface, the screen later mounting on the Arduino AT Mega2560 development board.

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