An IoT Braille display towards assisting visually impaired students in Mexico

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INTRODUCTION

According to the OMS, around 2,200 million people have a visual impairment and often have problems in the social and academic spheres.

Braille language is based on the use of raised dots on sheets (6 per letter of the alphabet), which makes it easier for the blind to detect by touching the letters and symbols of texts.

Technologies in braille writing for blind people are challenging to implement and adapt to any environment and country due to their high cost, especially if we talk about braille displays.

Braille displays

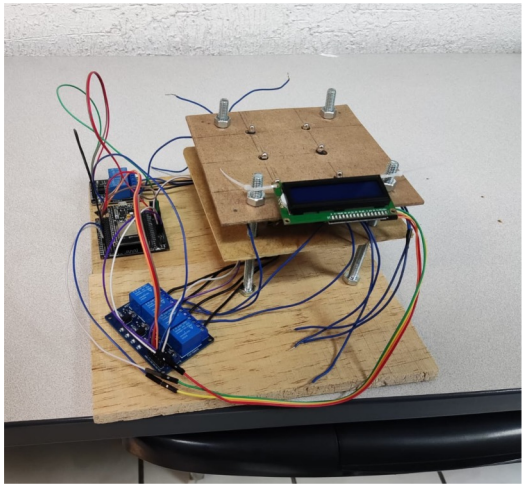
Braille displays are popular for their maximum usability, simple/practical design, and high interaction with devices.

However, costs are a strong limitation for those with low economic resources because it is difficult to access this technology.

Solution

Based on the main factors to implement more straightforward, cheaper, and more practical braille displays, it is proposed to develop an upgradeable Braille cell to address these challenges and build a device suitable for the local context. The device will be based on push-pull electromagnetic solenoids connected to an ESP-32 microcontroller board.

Each solenoid, when moved vertically, represents a braille dot that blind people can read from the device by touching it.



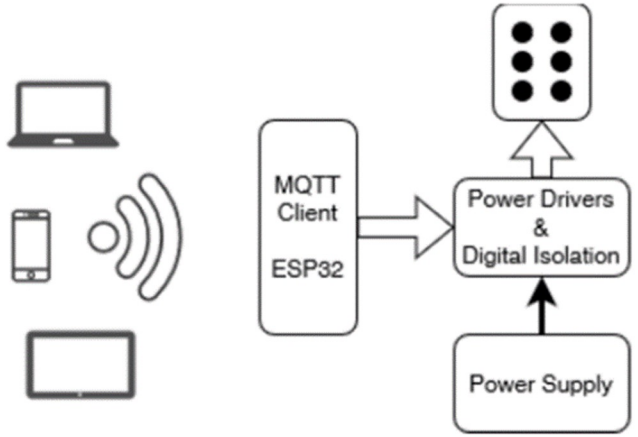
Methods

The methodology involved in our project was SCRUM because it uses an agile approach to develop systems based on software and hardware. It is based on rapid iterations with specific objectives.

System architecture

The architecture was designed based on the edge computing paradigm.

Allowing an almost real-time communication of the data emitted from a device with internet access almost instantly reading the information received.

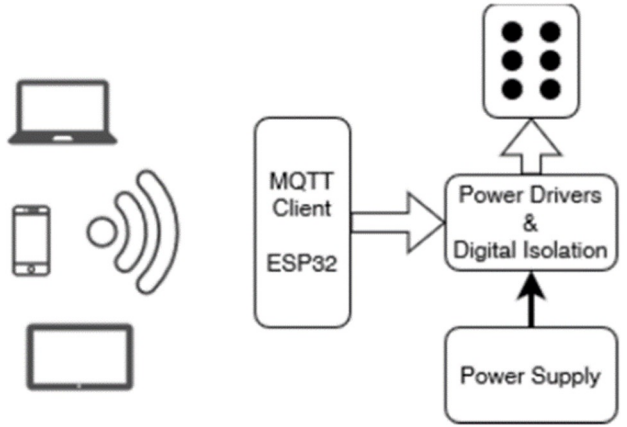


The IoT system architecture for the braille cell

Protocol Involved

Communication between the device and the content to be displayed in the Braille cell is carried out through the Message Queuing Telemetry Transport (MQTT) protocol.

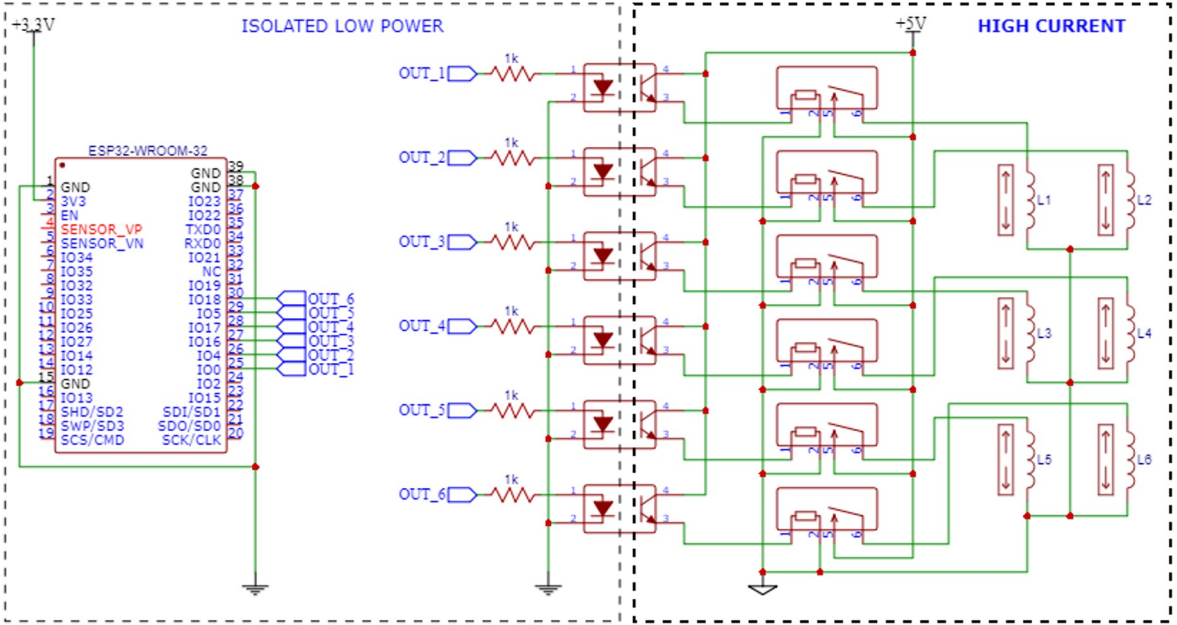
Using the publish and subscribe model.



The IoT system architecture for the braille cell.

Schematic Diagram

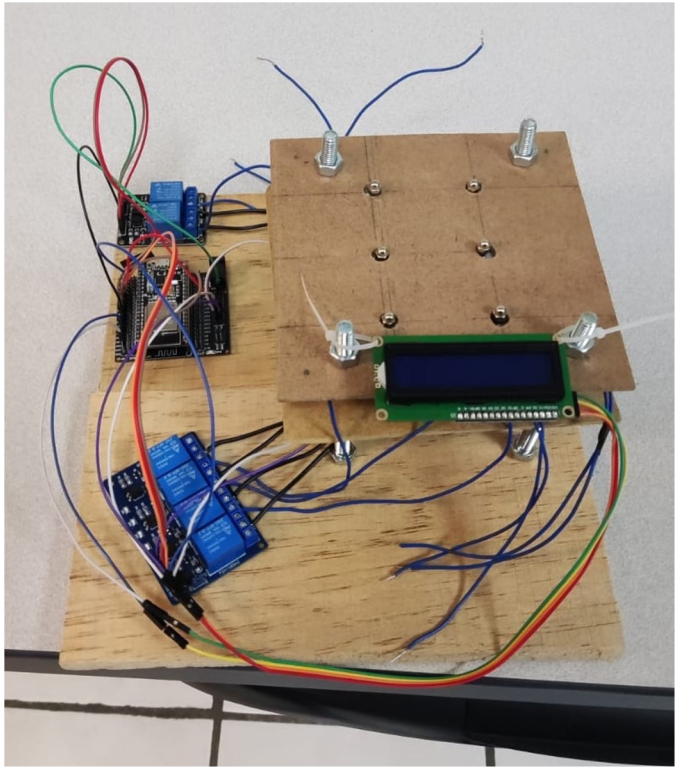
The schematic diagram presents two blocks separated according to their operating voltage and current: one low power and one high current.



Results

A Braille cell was built.

The structure was built with wood since it represents a lower cost than 3D printing. At the top is the cell in the form of a 2x3 matrix, whose pins are visible when they are in the active state, representing a Braille character.

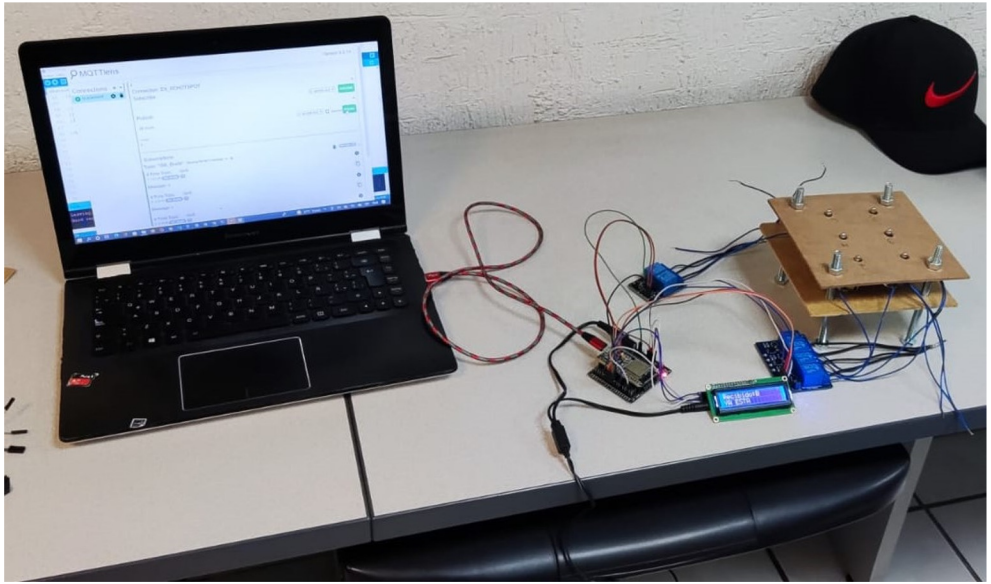


Braille cell prototype

Tests

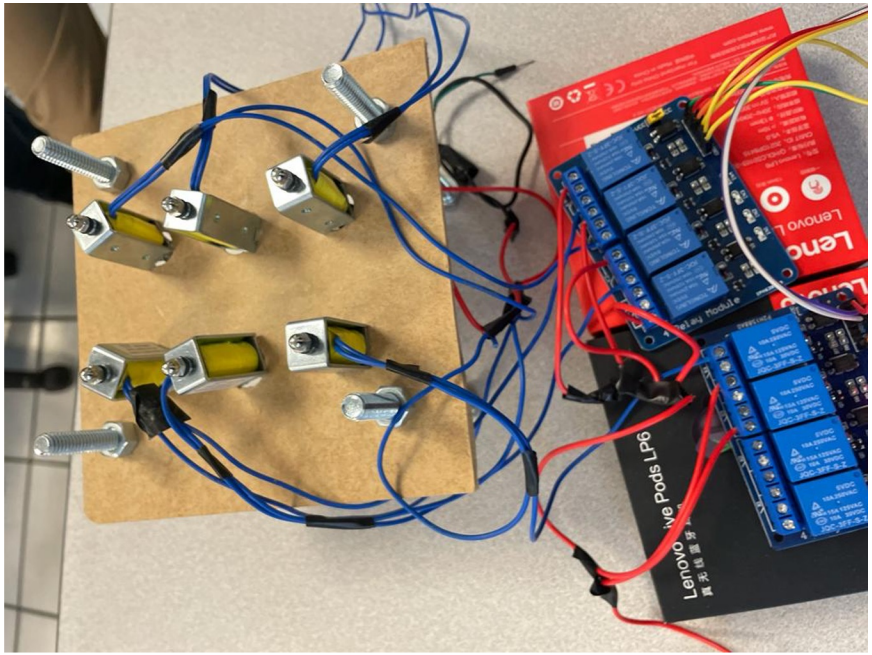
- Accuracy test of character output in sequence.
- Random character output accuracy test.
- Correct display of pins during the reading mode.

All tests were successfully passed.



Prototype in the testing phase

Discussion



During the first interactions, the solenoids remained active indefinitely to represent a letter.

Excessive power heat dissipation occurred.

High energy consumption and damage risks were identified.

Solution:

Activation time reduced to 4 seconds.

Enough to be interpreted by the user.

CONCLUSION

It was shown that it is possible to create a Braille cell with affordable costs for its development.

The following stages of the project will consist of reducing the prototype's size and testing with users to validate its usability, usefulness, and effectiveness.