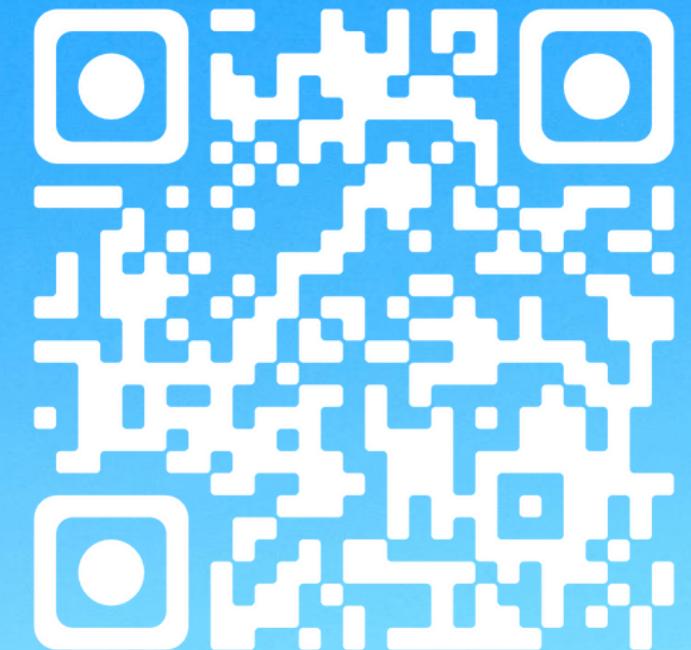




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IoT Safe Locker

Lab Of IoT Project



The Team



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Our Goal

The Secure Box project aims to transform a conventional security box into a smart solution, enhancing it with advanced features to improve security and simplify usage.

Traditional boxes are limited in their ability to protect contents as they rely solely on the physicality of the lock to ensure security. However, this approach is often vulnerable to attacks and key loss, compromising the protection of the items inside.

Our Implementation Ideas



KEYLESS ACCESS

Eliminate traditional key-based access by integrating a servo motor system to lock and unlock the door electronically.



ENHANCED SECURITY

Implement a two-factor authentication system utilizing both password and fingerprint recognition for superior security measures.



ENVIRONMENTAL MONITORING

Incorporate sensors to monitor humidity and temperature levels inside the box, ensuring optimal conditions for stored items.

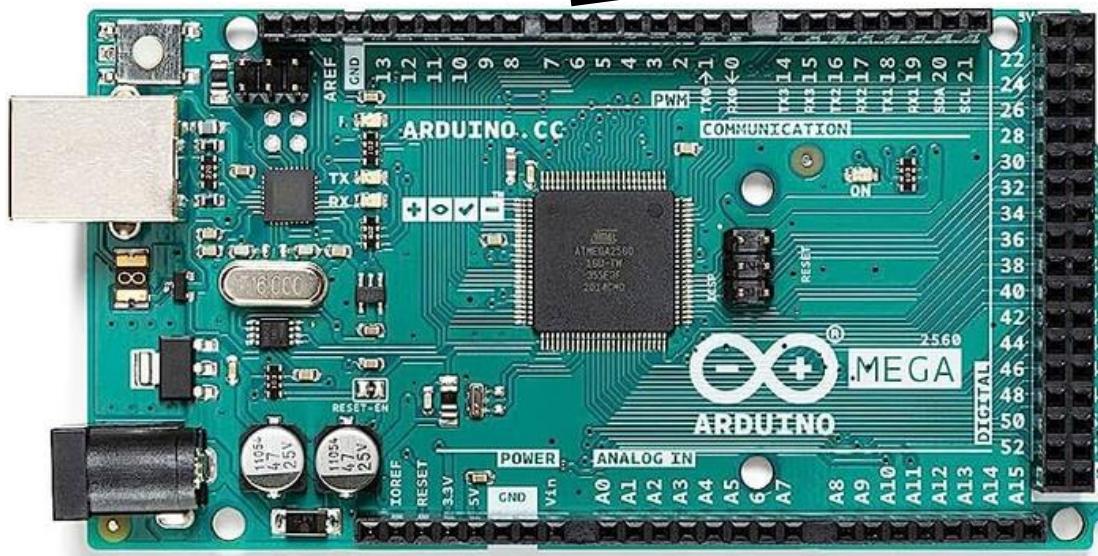


REMOTE MANAGEMENT

Enable comprehensive control and monitoring of the box via a Node-RED server, providing remote access and management capabilities.

Hardware used

All three components are linked using the I2C communication protocol.
Enables efficient bidirectional communication between devices.



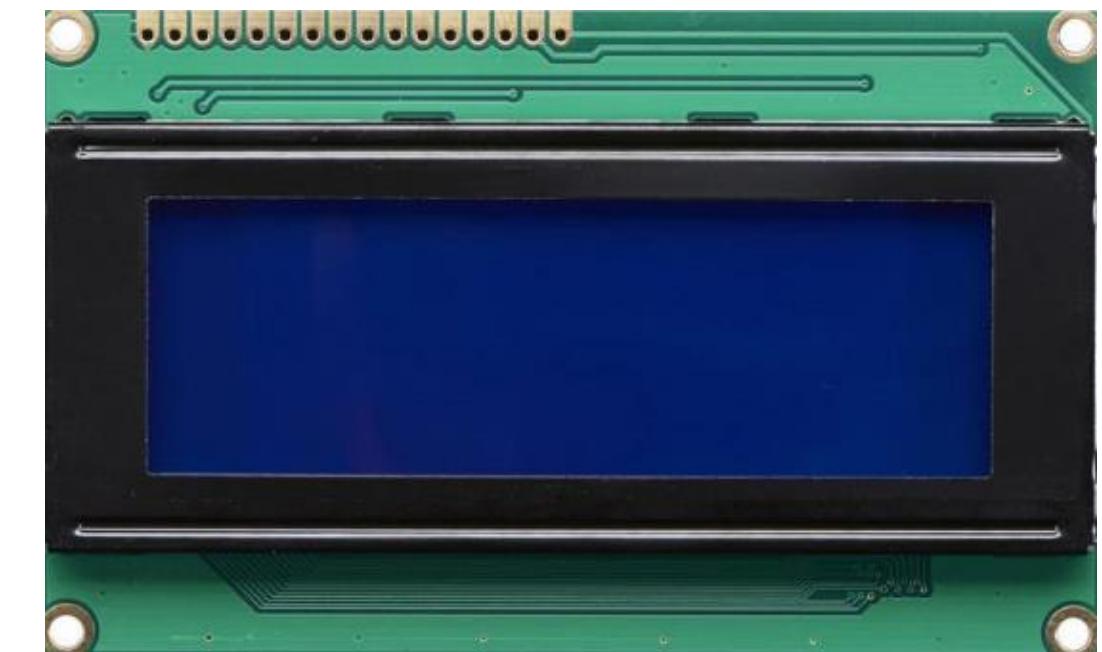
ARDUINO MEGA 256

- The main controller managing the system's operations.
- Acts as a master device to coordinate communication.



ARDUINO UNO REV2 WIFI

- Integrated WiFi module for wireless connectivity.
- Functions as a slave to receive commands and send data to the Arduino Mega.



20X4 LCD SCREEN

- Provides a visual interface to display important information.

Hardware used

Sensors connected to the Arduino Mega:



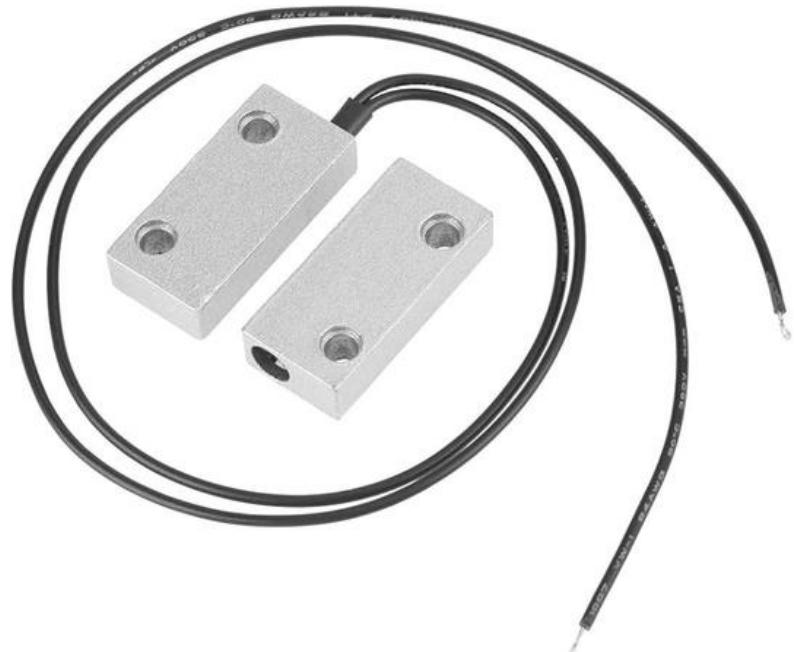
FINGERPRINT SENSOR

A biometric sensor that captures and stores fingerprints for personal identification purposes.



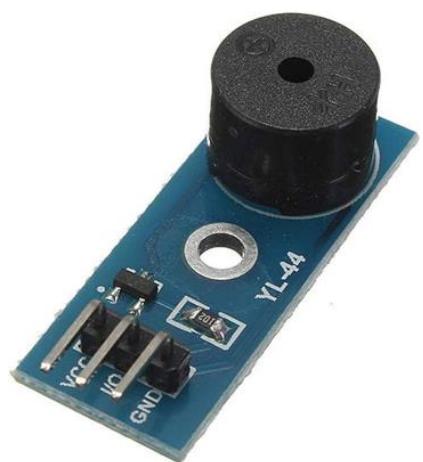
KEYPAD

A numeric keypad consisting of 16 keys used for inputting codes or combinations.

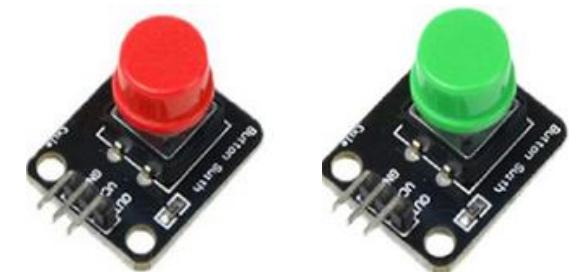


MAGNETIC BUTTON

A magnetic sensor used to detect the status of the door (open or closed) by sensing the presence or absence of a magnetic field.



BUZZER



BUTTONS



LEDS

Hardware used

This board serves as the slave device in our system. It is utilized to facilitate communication with the Node-RED server since the Arduino Mega lacks a built-in WiFi module.



Sensors connected to the Arduino Rev2 WiFi:



DHT22 SENSOR

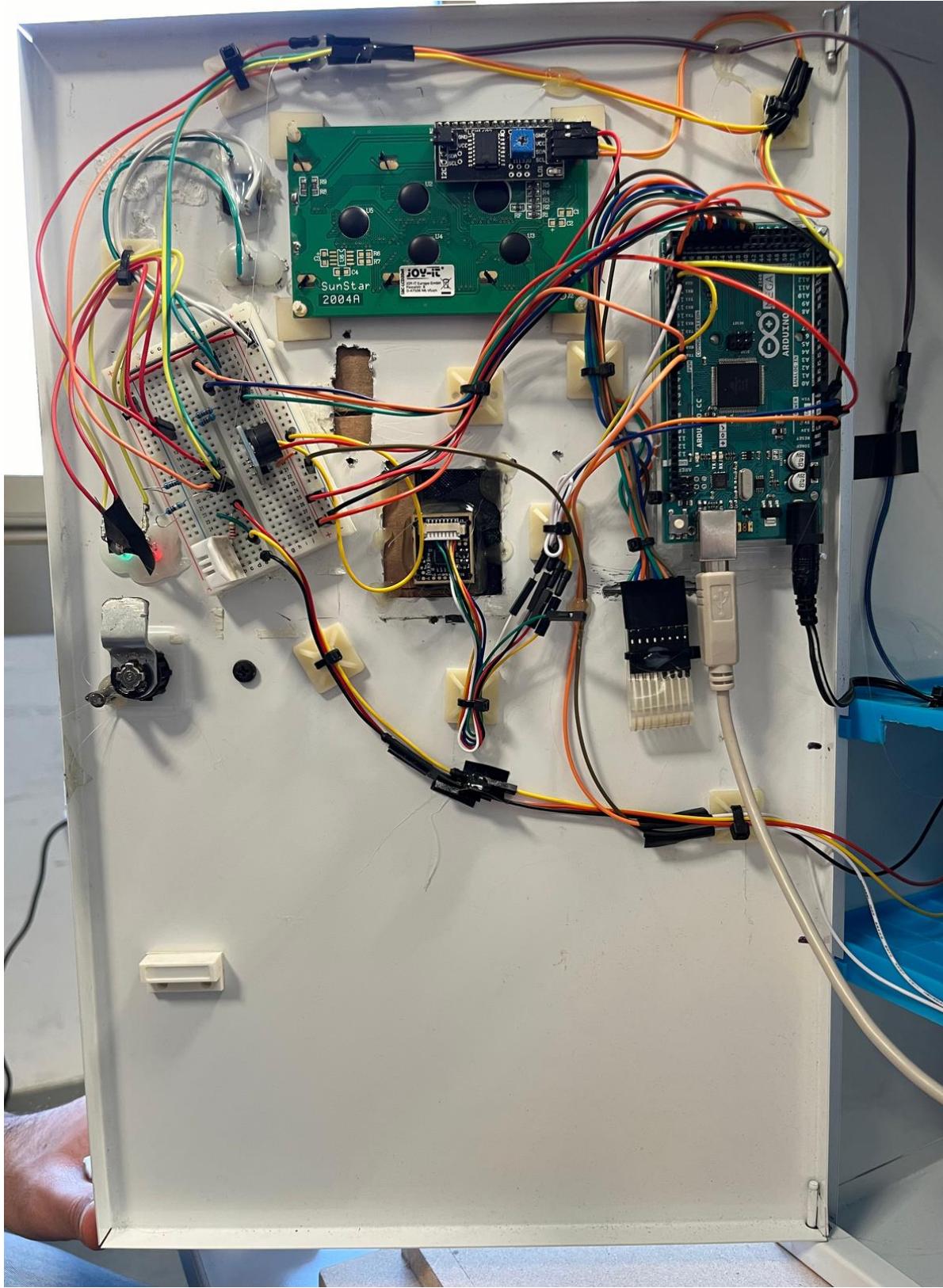
A digital temperature and humidity sensor that provides measurements of ambient temperature and humidity.



SERVO MOTOR

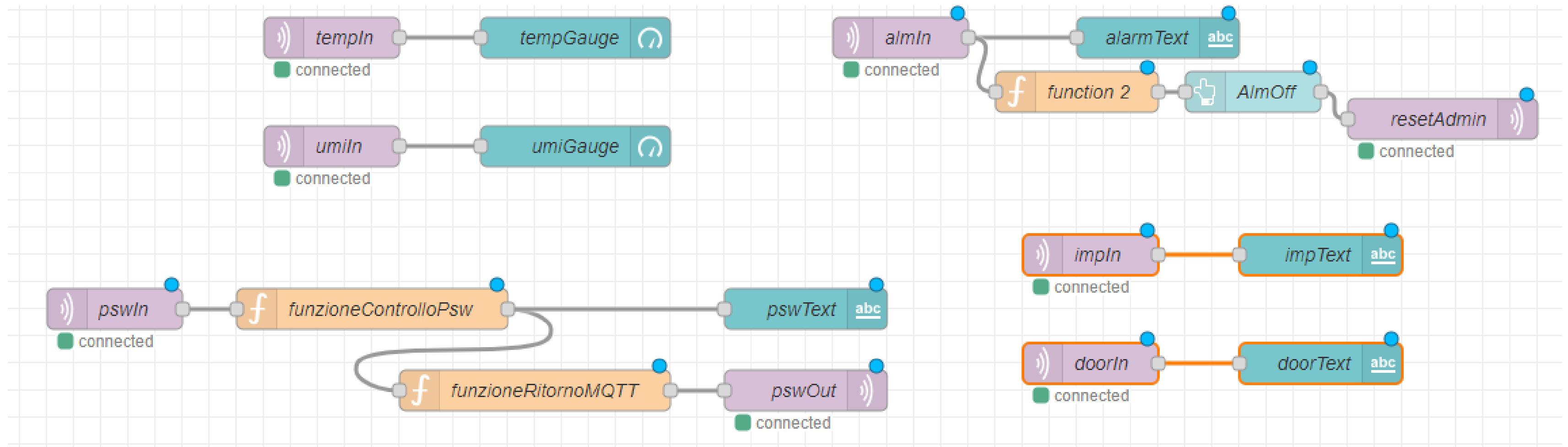
The servo motor is a key component used to control the opening and closing of the box door.

System Architecture



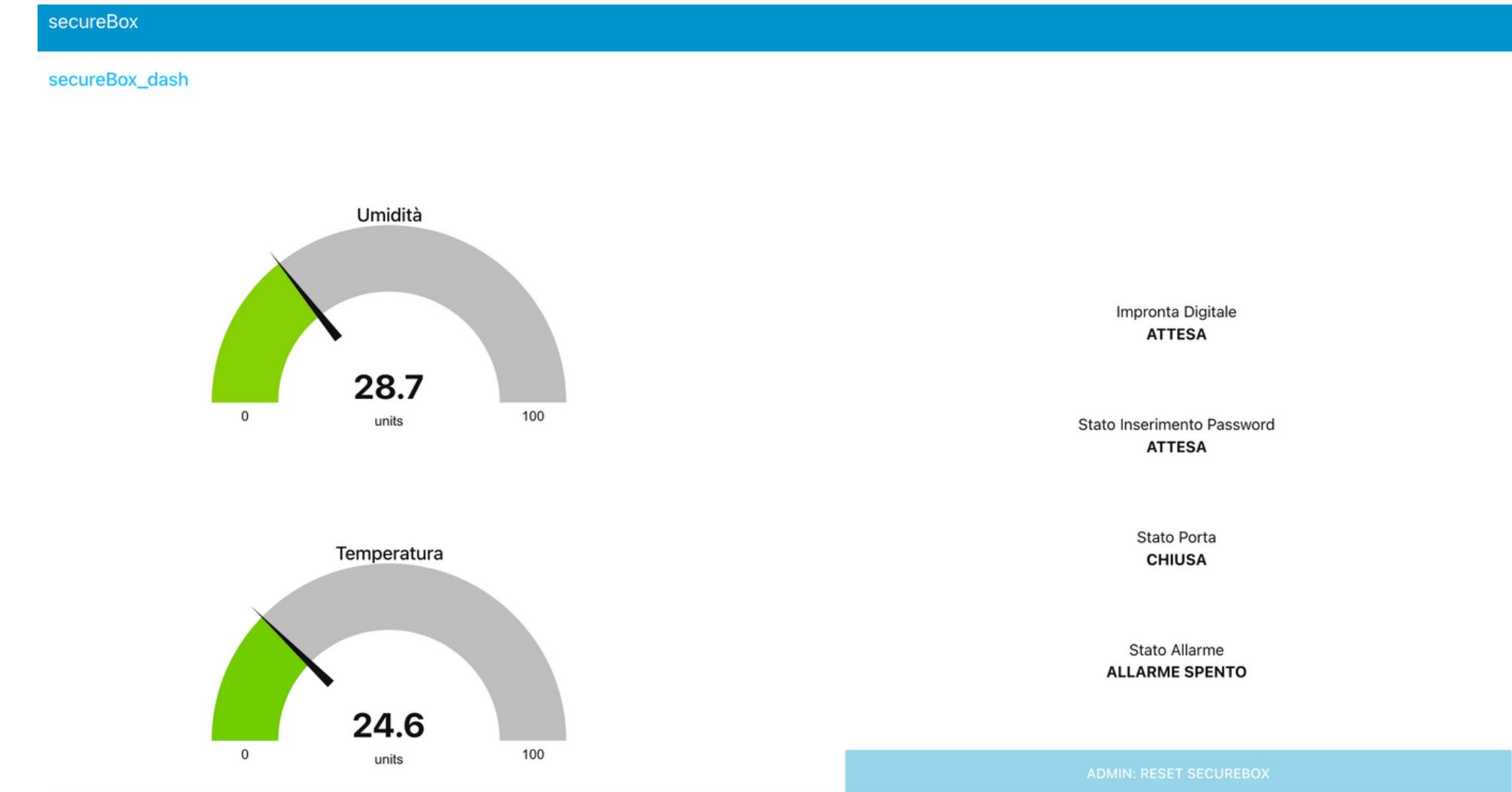
As we can see, the architecture consists of two Arduinos (Mega and Uno_Rev3) connected via I2C. The Arduino Mega acts as the Master and controls the entire system, being connected to all the sensors and actuators (except the ServoMotor). The Arduino Uno, on the other hand, acts as a bridge to communicate with the MQTT broker.

Node Red Architecture



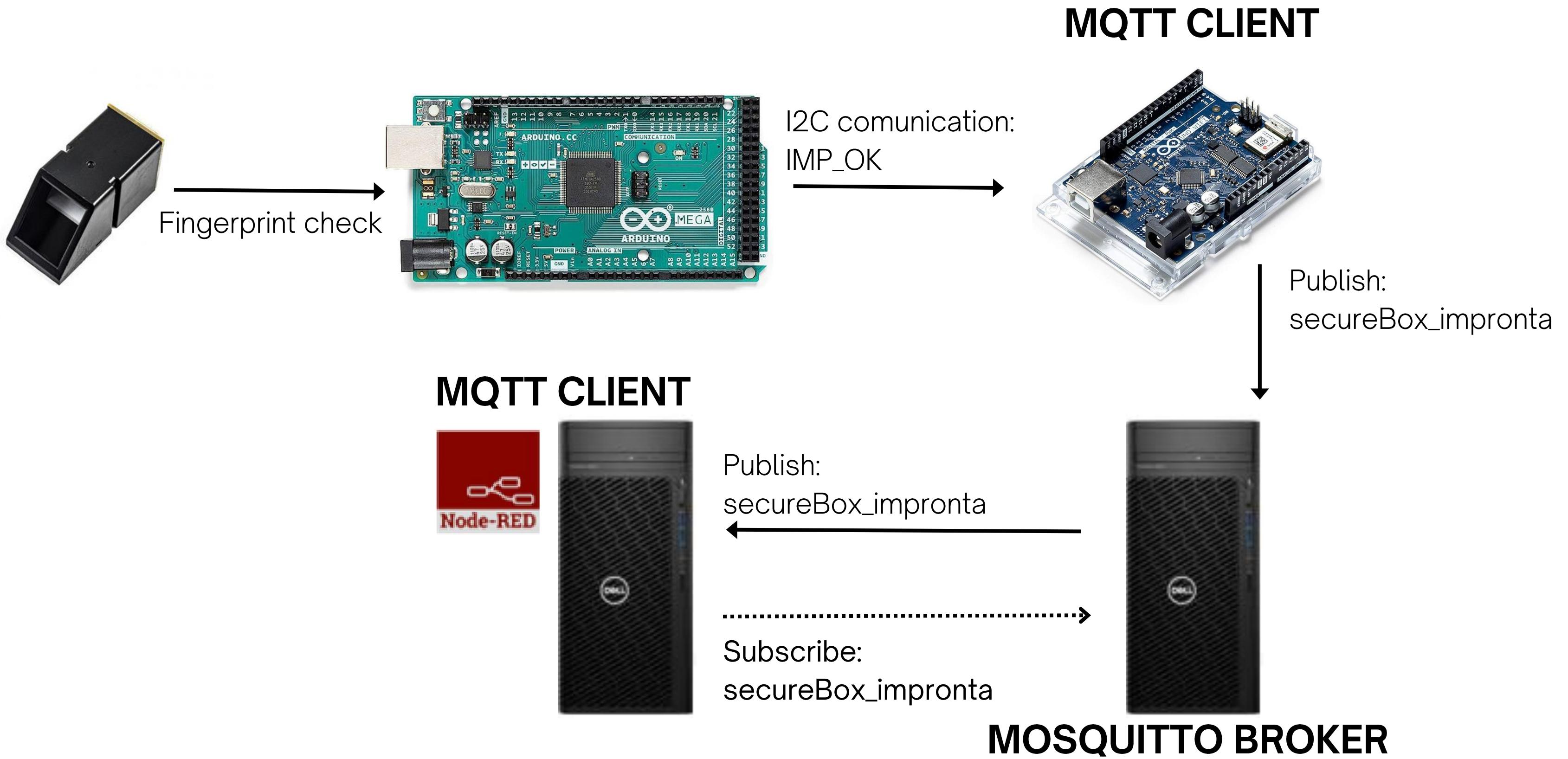
The architecture on Node-RED is very simple. We have created a topic for each function in order to simplify listening from Node-RED and reading responses from Arduino. Currently, the password is hardcoded within the function on Node-RED, but in the near future, it will be easily upgradable to a password that can be updated by the user.

The User Experience

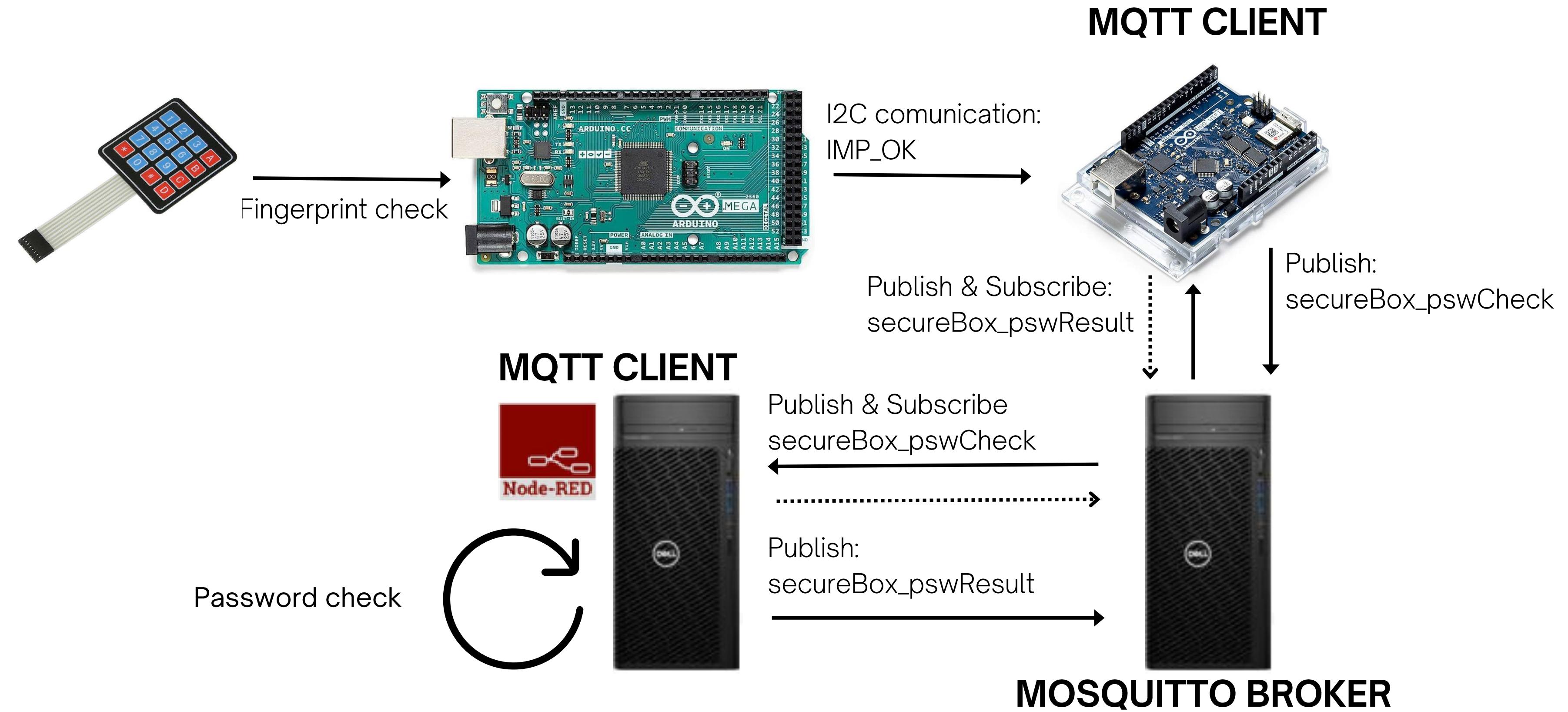


For the user, managing the safe box is very easy. A convenient LCD will provide all the information needed to open, close, and manage the individual safe box, while a dashboard on Node-RED will help administrators manage all the information regarding the safe box and intervene as needed to unlock it in case of problems.

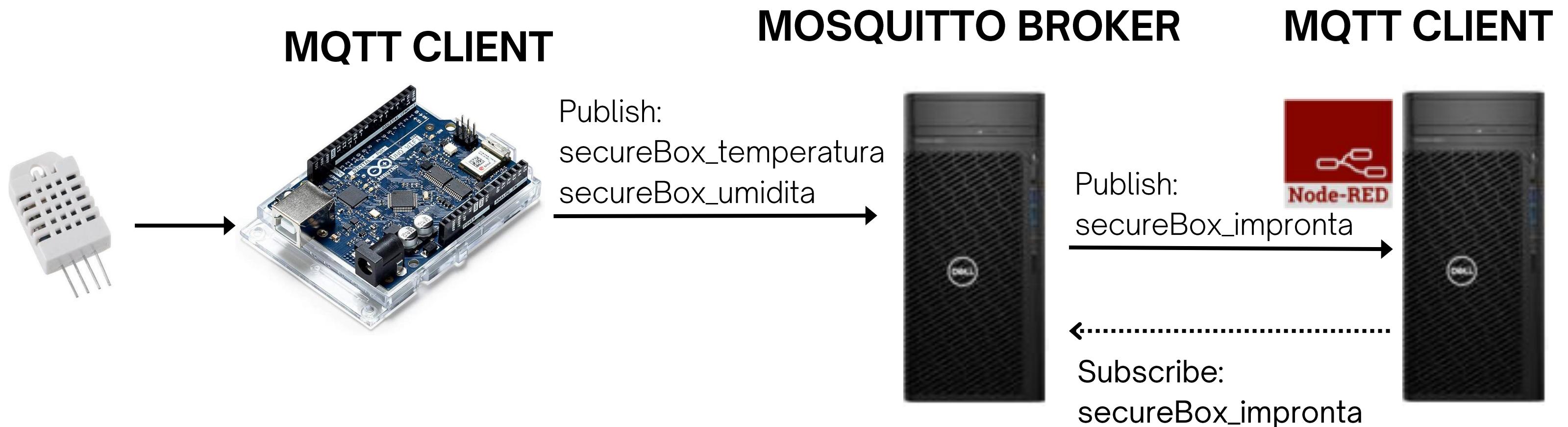
Fingerprint Authentication Process



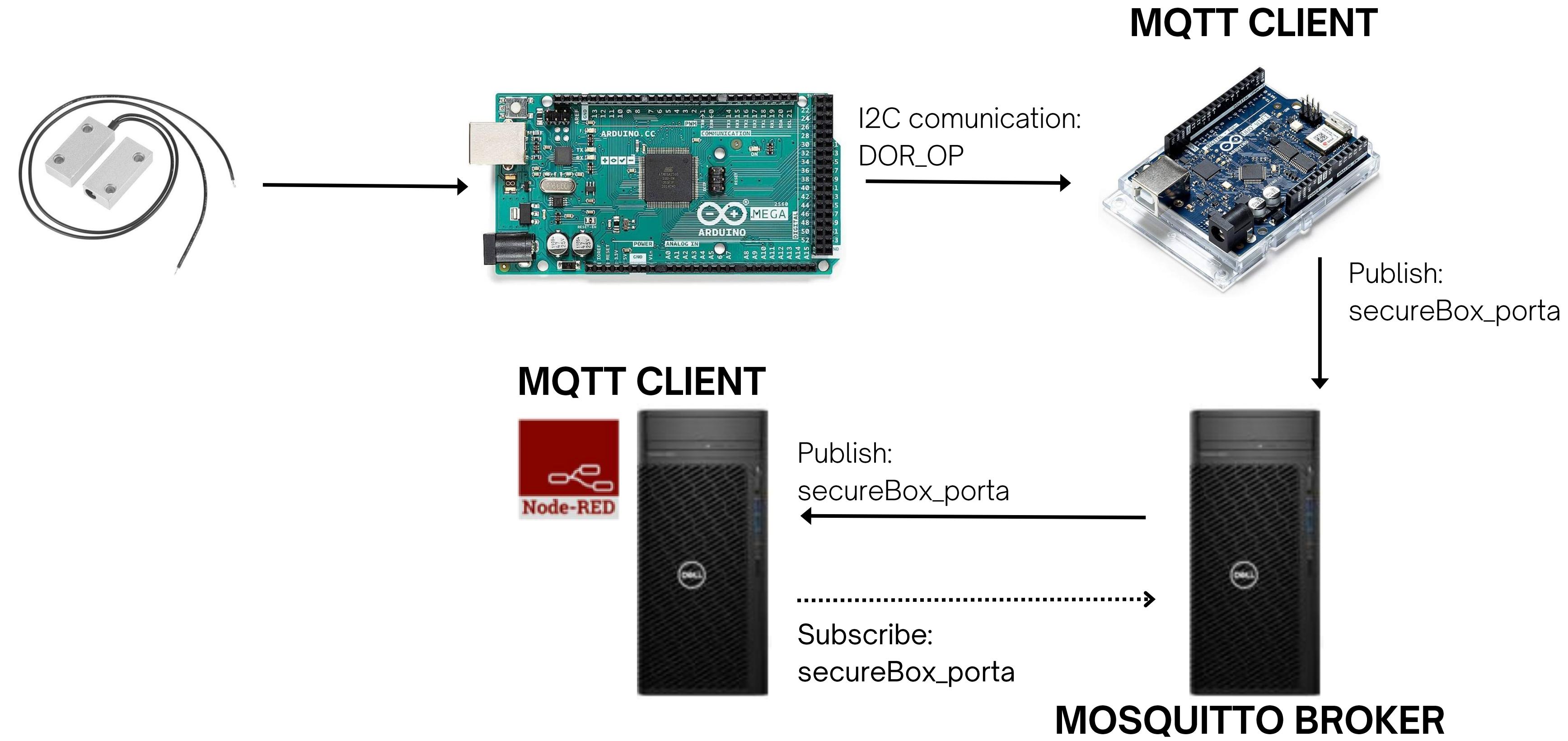
KeyPad Password Authentication



Temperature & Humidity Control



Door Status



Future Developments

01

ENHANCED SECURITY PROTOCOLS

Implement advanced security protocols to encrypt sensitive data such as passwords during transmission, ensuring higher levels of data protection and integrity.

02

INTEGRATION OF ARDUINO MEGA WIFI

Integration of Arduino Mega WiFi: Explore the possibility of replacing both Arduino boards with a single Arduino Mega WiFi unit. This consolidation aims to simplify hardware integration, enhance system efficiency, and eliminate the need for interconnecting multiple Arduino boards via I2C.

03

NETWORK EXPANSION

Explore the possibility of creating a network of interconnected secure boxes to enhance scalability and functionality.



Correct Opening

This video demonstrates the correct opening of the safe box. After providing a correct fingerprint, you need to enter the password which, if correct, will lead to the door opening prompt.



Fingerprint Error

We programmed the system to allow 5 failed attempts to scan the fingerprint. If this limit is reached, an alarm is triggered, and an admin is alerted through Node-RED.



Password Error

We programmed the system to allow 5 failed attempts to scan the fingerprint. If this limit is reached, an alarm is triggered, and an admin is alerted through Node-RED.



Fingerprint Enroll

We have provided the ability to add additional fingerprints. After entering a valid one, programming mode is entered by entering a predetermined code 'BA#123', which takes us to the programming of a new fingerprint. Once the fingerprint is stored, a counter is updated in the EEPROM of the Arduino Mega.



Intruder Detection

To detect intrusions and update values on Node-RED, a magnetic sensor is installed on the door opening. If the door is opened at any time but the login phase has not been completed correctly, an audible alarm will sound, and an administrator will be notified via Node-RED. Only the administrator will be able to unlock the safe box again.

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Thank You!

