

Requirements Evaluation

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Main system:

Expected operation:

- The system shall be able to give coffee capsules.

The system simulates the process of giving a capsule through the two motors.

The first motor points to the variety of the coffee capsules selected, and the second one releases the number of capsules selected of that variety.

The system dispenses the capsules from the right to the left of the machine and only moves to the next section until

- The system shall have multiple sections to storage different capsules.

The system has 6 sections: Espresso, Latte, Mocha, Cappuccino, Black e Ristretto.

- The system shall have a login screen.

The system has a login screen through the 3.2 LCD Display directly connected to the RaspberryPi 4B

- The system shall have a low capsule status.

If any of the sections has less than 3 capsules left, the subsystem sends a message to the main program that immediately sends an email to the machine operator warning about the needed refill

- The system shall have an authentication status.

The system doesn't have an authentication status despite having a rigid control of the authentication process

- The system shall have a login function

The system has a login function that consists in:

- First, identify the user through his ID
- Second, if the PIN inserted matches the ID's PIN

- The system shall allow users to log in using an NFC card.

The system does not allow the users to login using an NFC card.

This system functionality was going to be simulated with an RFID sensor, but this mechanism was not implemented.

The integration of the RFID technology required 5 pins that are being used by the 3.2 LCD Display, specifically: MOSI, RST, MISO, SDA, SCK. Since various information sources suggested that sharing these Raspberry GPIO pins between devices would probably not work and could potentially harm the involved devices, the implementation of the RFID reader was left aside.

- The system shall have regular and admin users.

The system has regular users but doesn't have admin users.

The regular user can only log in the system and request for coffee capsules.

- The system shall have a mechanism to communicate with the other machines.

The system has a mechanism to communicate with the other machines (the MQTT protocol) even though this was not tested because of the inexistence of other machines.

User Interface: Defined by the authentication and capsule selection subsystem

Authentication subsystem: Responsible for the authentication process: NFC reader, user ID and password verification.

Expected operation:

- The subsystem shall be able to get a password typed by the user

The Python interface has a page destined to receive the PIN introduced by the user

- While there's no one authenticated the subsystem shall display a login screen.

While there's no one authenticated the system is displaying the login page, where the user must insert his ID, or the PIN page, where the user must insert his PIN

- While there's no one authenticated the subsystem shall wait until the NFC reader detects a card.

As the RFID technology was not implemented due to previously mentioned reasons, the system doesn't wait for the detection of an RFID card/tag. Instead, it waits for the user to press the "Login" button that allows the subsystem to read the ID inserted on the interface.

- When an NFC card is read the subsystem shall identify the user.

The system identifies the user through the inserted ID

- When a user is correctly identified the subsystem shall request for the user id password

When the inserted ID exists, the systems asks for the associated PIN

- When a user is correctly identified the subsystem shall display a virtual keyboard on the screen.

When a user is correctly identified the system displays the numbers from 0 to 9 so the user can insert his PIN

- When the inserted password matches the user's password the subsystem shall authenticate the user.

When the inserted PIN matches the user's PIN the systems displays the coffee capsule selection page

Exceptions/Problems:

- When an error is displayed the subsystem shall return to the login screen.

The system only displays an error on the screen when the capsules selected by the user are not allowed. Instead of returning to the login screen and forcing the user to authenticate again, the system doesn't proceed to the capsule dispensing process and waits for a valid choice of capsules

- If the NFC card is not recognized the subsystem shall display an error notification.

The system doesn't read RFID cards

- When the inserted password doesn't match the subsystem shall display an error notification.

When the inserted PIN doesn't match the user's PIN, the subsystem reloads the page where he must insert the ID

Capsule Selection subsystem: Responsible for the systems evolution from the Capsule selection page till log out.

Expected operation:

- The subsystem shall have a capsule selection screen.
The subsystem has a capsule selection screen in the python interface
- The subsystem shall allow the user to choose the number of capsules required of each flavor
The subsystem allows the user to choose how many capsules he desires of each variety.
- The subsystem shall have a function in the capsule selection screen to give the selected capsules.
The subsystem has a function in the python capsule selection screen called "Dispense", to dispense the selected capsules
- While a user is authenticated when a flavor is chosen the subsystem shall update the user's requested coffee capsules.
Every time the user changes the requested capsules, the python interface updates, allowing the user to know what he is asking for before clicking the "Dispense" button
- While an "admin" is authenticated the subsystem shall have a function to change the variety of coffee capsules in each section.
Admin users are not implemented due to lack of implementation time
- While a user is authenticated the subsystem shall display all the coffee flavors in the machine.
While a user is in the capsule selection screen, the subsystem displays the pre defined coffee flavors available
- While a user is authenticated the subsystem shall have a logout function.
While a user is in the capsule selection screen, the subsystem has a logout function that returns to the first page (ID verification)

Exceptions/Problems:

- While a user is authenticated if any of the flavors have no capsules left then the subsystem shall display that capsule variety in a black form.
If the user asks for more capsules of a variety of coffee than the present in the machine, the subsystem displays an error message in the screen

- While a user is authenticated when a user selects a coffee capsule represented in black the subsystem shall notify the user about the presence of that variety in the other machines.

This functionality is not implemented due to the inexistence of other coffee capsules dispensing machines

- If no password is inserted then the subsystem shall show a notification on the screen.

The subsystem only reads the inserted PIN when the “Login” button in the PIN page is pressed. Until then, the subsystem waits for the “Login” button press

Dispenser subsystem: Responsible for the movement of the 2 servo motors.

Expected operation:

- The subsystem shall have a function to dispense all the coffee capsules in each section.

This admin functionality was not implemented due to the lack of time but the user can choose all the capsules from a section.

- While a user is authenticated when the user requests the selected coffee capsules the subsystem shall give the user all the coffee capsules selected.

When a user is in the capsule selection screen and requests for the selected capsules, the subsystem simulates the dispensing process of all the requested capsules through the manipulation of the 2 servo motors

- While a user is authenticated when a coffee capsule is delivered the system shall update the number of capsules acquired by that user.

The number of capsules for each user is updated in the database after the dispensing process.

- When the “admin” asks for the dispense of all the coffee capsules in one section the subsystem shall dispense all the coffee capsules in the selected section.

Due to admin users are not implemented, the functionality of dispensing all the capsules in a selected section isn’t either for the same reason (lack of time)

Exceptions/Problems:

- When a flavor is chosen if the coffee capsule doesn't arrive to the user the subsystem shall call the “operator”.

The machine dispensing process was designed so it was certain that all the selected coffee capsules were dropped if the motors motion goes as expected

- If the capsule storage doesn’t rotate then the subsystem shall notify the “operator”.

The rotation of the motor was meant to be verified through the encoder in the servo motors, but the micro servo motors bought (sg90) don’t have an encoder and so, it is impossible to verify the motors position.

Storage subsystem: Responsible activating the infrared sensors for reading the number of capsules in each section and transmit that same information to the rest of the system.

Expected operation:

The infrared sensors were implemented to prove that they are working but their returned value isn't used by the system (just printed).

- The subsystem shall detect the presence of capsules.

The subsystem can detect the presence of capsules (although the infrared sensor information lacks the real context like: height of each capsule and so on...)

- The subsystem shall be able to calculate the number of capsules available in each section.

The lack of the real context in which the infrared sensors are inserted doesn't allow their value to be used to calculate the actual number of capsules left

- While at low capsule status the subsystem shall publish to an MQTT server how many capsules are left in each section.

The subsystem doesn't publish the number of capsules left in each section since this control is implemented through software.

- When refilled the subsystem shall notify the operator of such an act and report the number of capsules via email.

When the machine is refilled the subsystem doesn't report anything to the operator since he knows he is refilling the machine. It is assumed that when the machine is refilled all the sections are at its maximum capacity.

Exceptions/Problems:

- When refilled If the proximity sensor can't detect capsules then the storage subsystem shall notify the "operator"

This functionality isn't implemented by the subsystem because the infrared sensor doesn't know what an empty section looks like (i.e what is the value that corresponds to an empty section)