An-Najah National University

Faculty of Engineering & Information Technology

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Bachelor degree in Computer Engineering

Graduation Project 2

Perfumix Machine

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Acknowledgment

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Additionally, our deepest gratitude goes to our families, who have been our pillars of strength, constantly offering encouragement and understanding during the challenging phases of this project.
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Disclaimer Statement

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Abstract

The Perfumix Machine is a pioneering perfume production system that redefines the traditional boundaries of fragrance creation in retail environments. While its primary function is to facilitate the automated mixing and packaging of perfumes, it offers users the flexibility to choose from a plethora of scent combinations or craft their own unique blend.In addition to this machine being unique, what distinguishes Perfumix is its capability to be controlled remotely, empowering users to operate the machine from a distance with ease.

The Perfumix Machine's architecture is divided into six pivotal sections: a Fill Station, a Mixing Station, a Bottle Cap Drop Station, a Bottle Sealing Station, a Control Unit, and an Input/Output Interface. The Mixing Station utilizes an air jack system for accurate positioning of perfume bottles during the mixing phase. The Fill Station ensures the precise pouring of the crafted scent blend. Next in line is the Bottle Cap Drop Station, responsible for systematically placing the caps onto the bottles. This is followed by the Bottle Sealing Station, which guarantees a secure and airtight closure of each perfume container. The Control Unit, powered by an Arduino Mega and complemented by various sensors, orchestrates the operation of the entire system. Meanwhile, the Input/Output Interface offers users an intuitive interaction point, through a dedicated mobile application, facilitated by an ESP8266 module for connectivity.

In our design, we've incorporated a range of sensors, including IR sensors and ultrasonic sensors, alongside DC, servo and stepper motors. Key structural elements like a conveyor system were achieved using bearings, linear bearing, gears, chains, chrome rods, and a circular iron base for holding the dual air jack and the perfume bottle holder. The microcontroller at the heart of our system is an Arduino Mega, further enhanced with the ESP8266 module. Additionally, we ensured seamless integration with other critical components, including pumps and air jacks, to achieve a cohesive and efficient system.

Chapter 1

Introduction

1.1 Statement of the problem

In the evolving perfume industry, shop administrators face challenges in efficiently mixing perfumes due to manual processes prone to errors and inconsistencies. As the range of fragrances expands, tracking inventory levels and ensuring consistent mixing quality becomes overwhelming. Moreover, amateurs venturing into perfumery find the manual mixing intimidating and risky. The outdated methods fail to meet the demands of the modern perfume market, highlighting the urgent need for an automated solution to enhance efficiency and improve the perfume mixing experience.

1.2 Objectives of the work

The objectives of this work are multifaceted in our effort to improve the perfume mixing procedure for shop administrators. Our main goal is to create the "Perfumix Machine," an automated system that can effectively manage different phases of scent creation. The process starts with a special station where scents are dispersed according to predetermined specifications. The following processes involve a specialized mixing station to assure the ideal aroma combination, a station for bottle cap drop, and finally a station for sealing the product. While accommodating both seasoned shop owners and those who are new to the perfume industry, this integrated system seeks to deliver uniform quality. Our design includes a user-centric interface that simplifies choosing a scent based on preferences for gender. Additionally, the machine has sensors to track and automatically replenish running low stock, ensuring uninterrupted productivity. Together, these advances seek to improve efficiency, reduce manual labor, and streamline perfume stores' overall operations.

1.3 Scope of the work

Throughout the development of the Perfumix machine, our methodology was both exhaustive and systematic, covering multiple stages. Initially, we pinpointed the desired functionalities for our apparatus and made informed choices on essential components, encompassing sensors, motors, drivers, and custom-designed parts. Moreover, we selected the apt controller to facilitate fluid mechanics and operations of the machine. For ease of assembly and troubleshooting, we compartmentalized the project into distinct units: Input/Output, Mixing, Filling, Bottle Cap Drop, and Bottle Sealing stations. Each of these units was meticulously tested in isolation, and then combined to ensure cohesion and efficient operation. Interdependent units were rigorously evaluated to guarantee smooth interactivity. Conclusively, we devised an algorithm tailored for precise control over the Perfumix machine and conducted comprehensive tests on the entire system, ensuring its reliability in all conceivable conditions.

1.4 Significance of our work

Perfumix stands poised to redefine the perfume industry, especially in the retail sector. It offers unparalleled personalization in scent blending, enhancing customer satisfaction and loyalty. By integrating advanced technology and innovative design, the machine ensures precision and minimizes wastage.

Overall, retailers can harness Perfumix's simplicity, accuracy, and scalability, irrespective of their experience in the fragrance world. Its user-friendly mobile app elevates the consumer experience, setting a revolutionary benchmark that has the potential to reshape industry best practices and standards.

1.5 Organization of the report

This report is structured in various segments. The initial part introduces the project and outlines its goals. The subsequent part highlights the extent and limits of the undertaken work. The next segment details the approaches and steps taken to finish the project. The following section shares the outcomes and observations, including any hurdles faced and their solutions. The next part delves into the importance and potential influence of the project. To wrap up, the concluding segment recaps the report's main insights and suggests directions for upcoming endeavors. Supplementary materials and data connected to the project are furnished in the appendices.

Chapter 2

Constraints, Standards/ Codes and Earlier course work

2.1 Constraints

Our machine's construction and design were hampered by a number of factors:

1. Power supply - Several parts of the machine required distinct voltage and current levels; for instance, the air jacks and valve required 220 volts, while the stepper, DC motors, and pumps needed 12 volts. To address this, we utilized a computer power supply which offered 5 volts and 12 volts. For the 220 volts, we sourced it from standard electricity outlets found in homes and laboratories.

2. Arduino mega - Our original choice was the Arduino Mega to control the machine. However, the model we purchased outputted 3 volts from its Input/Output digital pins instead of the expected 5 volts and produced 1 volt instead of 0 for pins set to low. This discrepancy caused issues with the relays connected to the pumps, motors, and valve as they couldn't operate without the required 5 volts. To resolve this, we switched out the malfunctioning Arduino Mega for a new unit that delivered the right voltage.

3. DC motor - During the initial mixing phase, we employed a yellow plastic DC motor. We tailored the 3D mixer design according to the motor's size. However, we encountered issues with the mixing process. As the air jack descended, the mixer would clash with the exterior of the bottle, resulting in the motor breaking.

4. Time limitation - We found it extremely difficult to complete this project during the summer semester because it was the first time we had to construct a machine with so many electronic components, required so much power and so many different voltage levels (3.3, 5, 9, 12, 220 volts), and consisted of hardware components about which we know insufficiently. We had to identify the components and the connections, as well as become familiar with the Arduino and write codes. In addition to the large size of the project and its main dependence on the air compressor, it was difficult for us to work outside the electrical workshop.

5. Centering and accuracy - Our project involved creating a perfume production line where the perfume bottle moves through several stages. Each stage requires pinpoint accuracy, especially when aligning with the bottle's narrow opening. We encountered challenges with our sensors; their readings varied based on lighting conditions, requiring frequent recalibration. Another challenge was handling the various perfume components due to their small quantities.

6. Design - Some of the pieces for the design were not easy to obtain, so we faced difficulties in finding and searching for them in several places, and we also collected the whole design piece by piece and installed it manually.

2.2 Standards and Codes

The software components of the system include an Arduino program written in C++, which incorporates several libraries and functions such as Servo.h, SoftwareSerial and ESP8266WiFi.h. The user interface was developed using html and CSS, while the backend were implemented using JS and web server. The system adheres to relevant industry standards and codes in the design and implementation of its software components.

2.3 Earlier coursework

Under our education phase in computer engineering, we studied a number of courses that were helpful in helping us create this system. Through courses in Microcontroller, Critical Thinking, Networks, and Electronics, we gained invaluable insights that significantly influenced our project. These modules bolstered our proficiency in microcontroller programming using the Arduino Mega and honed our analytical abilities to tackle project-related issues. They provided hands-on experience in coding, an understanding of communication protocols essential for the machine's remote functionality, and a grasp of basic electronics crucial for refining the machine's physical components. To bolster our expertise, we also undertook online classes focused on Arduino programming basics. And there is a lot of references that helped us. [1][2][3][4][5]

Chapter 3

Methodology

This chapter will cover the hardware components used in building the system, and the overall system design. We will also go through how the system functions, as well as how the software, and mobile app were all implemented.

3.1 Hardware Components

3.1.1 Microcontrollers

Arduino Mega 2560

The ATmega2560 chip is the centerpiece of the microcontroller platform known as the Arduino Mega. It has a total of 54 digital I/O pins, 14 of which can be used for PWM output, 16 analog input pins, 256k of flash memory storage, and 4 UARTs for hardware serial connection. A 16 MHz crystal oscillator, USB port, power jack, ICSP header, and a reset control are all included on the board.

The SDA and SCL pins next to the AREF are upgrades in the Mega 2560 R3 version. The IOREF, which allows shields to adapt to the board's voltage, and another pin that is left unconnected but is reserved for future usage are also added close to the RESET. The Mega 2560 R3 is compatible with current shields, but it is also built to accept shields that take advantage of the extra pins.

Figure 3.1: Arduino Mega 2560

ESP8266-DevKitC ESP8266-WROOM-8266U Core Board

Our project focused on creating a serial communication link between the ESP8266 and Arduino Mega microcontrollers for the Perfumix machine. Furthermore, we set up a web server-like access point to allow client devices to connect seamlessly to the Perfumix network. This connectivity feature empowered users to craft personalized perfume blends remotely from any spot in their vicinity. Upon receiving a perfume blend order, the details were relayed via the serial communication link to the Arduino Mega, triggering the automatic scent creation process.

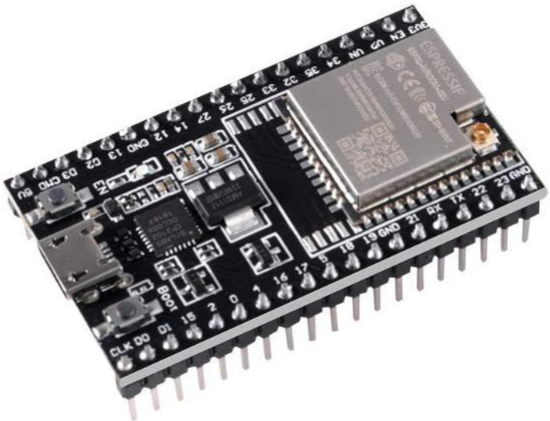

Figure 3.2: ESP8266-DevKitC ESP8266-WROOM-8266U Core Board

3.1.2 Motors and drivers

Servo motor

In our project, we used Micro Servo motors, which have a rotational range of approximately 180 degrees (90 degrees in each direction). We required two servo motors for the bottle cap drop station, moving at certain angles in order to work as two consecutive gates.

Figure 3.3: Servo Motor

J-5718HB2401 Stepper motor and YS-DIV268N driver

In our project, we used bipolar four-wire stepper motor, specifically the J-5718HB2401 model, as they are highly precise and efficient to move the conveyer of production line forward and backward. To drive the motors, we used the YS-DIV268N driver with a 12V power supply. The motor coils were connected to the A and B pins of the driver, while the control pins were connected to the corresponding Arduino pins, with the negative pins unified with the Arduino ground. The DC+ and DC- pins were supplied from a 12V power supply.

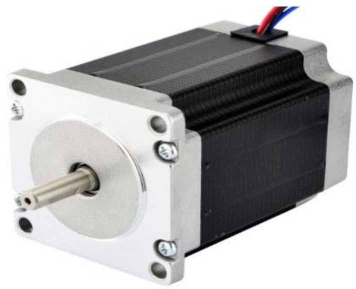

Figure 3.4: J-5718HB2401 Stepper motor

Figure 3.5: YS-DIV268N driver

DC motors

A DC motor is an electrical machine that converts electrical energy into mechanical energy. In our project, we used one DC motor to operate the 3D-printed mixer in the mixing station and another to power the wheel in the 3D-printed sealing station. Both motors were connected to relays for control purposes.

Figure 3.6: DC motors

3.1.3 Sensors

IR Sensor Module

We utilized ten IR sensors in our project. Eight of these were designated to detect stop stations: five for the fill station, one for the bottle cap drop station, and one for the sealing station. Additionally, one sensor was used to detect the presence of the perfume bottle, and another to determine if the bottle cap was empty or full.

Figure 3.7: IR Sensor Module

Ultrasonic Sensor

An ultrasonic sensor is a device that measures the distance to an object by using sound waves with frequencies above the upper audible limit of human hearing. We used five ultrasonic sensors to measure the liquid levels in the storage containers to notify the user that the quantity in stock has ended by sending a notification.

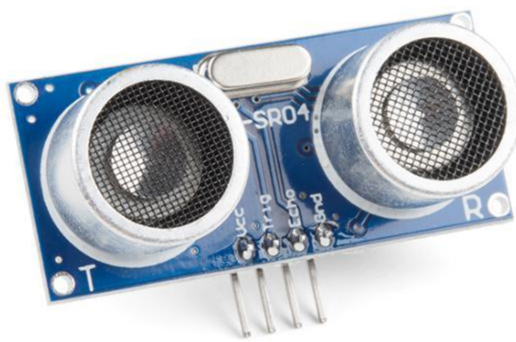

Figure 3.8: Ultrasonic Sensor

3.1.4 Input/Output Devices

LCD and I2C

An LCD is a common electronic screen utilized in various devices.

For our project, we incorporated a 20x4 LCD to present essential information and directions to the end-user. This approach enhances the user experience, streamlining interactions with our system. Specifically, the LCD displays queries and guidance for user input via the keypad. Once this input is assessed, the relevant outcomes are showcased on the LCD.

Furthermore, we integrated the I2C Serial Interface Module. This module facilitates the connection of an LCD to a microcontroller using the I2C transmission method. Serving as an intermediary, it transforms the LCD's parallel signals into serialized ones for the I2C channel. Leveraging this adapter simplifies LCD-to-microcontroller connections, reducing wiring and needing just two I/O pins on the microcontroller for control. Its design also supports the attachment of various devices on a singular I2C channel, proving invaluable in scenarios with spatial and wiring constraints.[6]

Figure 3.9: 20*4 LCD and I2C

Keypad

A keypad is comprised of buttons set in a grid formation, with each button's location identified by its respective row and column. Such keypads are often integrated into systems run by microcontrollers, as seen in designs using the Arduino platform. [12]

Within our project, we have made use of the keypad as an input device to provide customers with the ability to select their desired drink. This is achieved by displaying clear and concise instructions on the accompanying LCD display, which the customer can then input into the keypad to confirm their choice.

Figure 3.10: Keypad

RGB LED

An RGB LED is a specialized Light Emitting Diode capable of displaying Red, Green, and Blue colors. By varying the intensity of these primary colors, it can render a wide range of hues. Its color control is achieved through Pulse Width Modulation (PWM). [13]

The RGB LED interfaces with microcontrollers, such as the Arduino, via three distinct pins dedicated to Red, Green, and Blue. Modulating the voltage to these pins using PWM facilitates changes in the LED's color and luminosity. In our project, we employed the RGB LED as an indicator to signify the system's status, enabling users to easily discern different feedback or operational conditions based on the LED's color.

Figure 3.11: RGB LED

3.1.5 Power Devices

Power Supply

In addressing our project's voltage requirements, we settled on a computer power supply. It was aptly equipped to deliver the essential 5 volts for diverse components and the needed 12 volts for both DC and stepper motors. Furthermore, this supply guarantees consistent current output to meet our project's specifications.

Figure 3.12: Power Supply

Arduino Power Cable

The Arduino Power Cable facilitates the linkage between the Arduino board and power outlets, including computer USB ports or external wall chargers. Its main role is to deliver power to the board, while also aiding in data exchange and programming tasks. In our project, we employed this cable to guarantee a consistent 5-volt energy source to the Arduino, necessary for its optimal operation.

Figure 3.13: Arduino Power Cable

AC Adapter

Since the power supply that powers the entire project is not sufficient to operate 5 pumps needed 12V-4A, we had to connect this transformer to the five pumps in order for them to work properly.

Figure 3.14: AC Adapter

3.1.6 Other Devices

Bottle Cap Drop

We integrated a 3D-printed bottle cap drop component into our machine. This specially designed part serves as a mechanism to precisely position and release the bottle caps, ensuring a smooth and efficient bottling process.

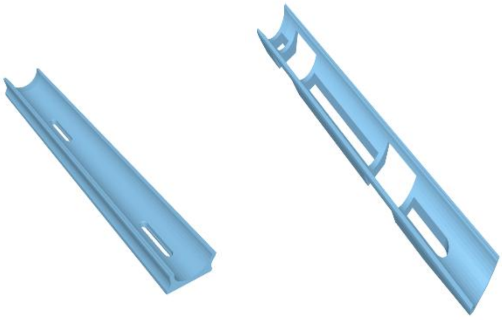

Figure 3.15: Bottle Cap Drop

Mixer

We incorporated a 3D-printed mixer into our machine, which is pivotal in ensuring the uniform blending of perfume ingredients. This ensures that every bottle has a consistent and distinct fragrance profile.

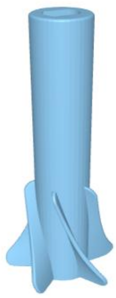

Figure 3.16: Mixer

Capper

We included a 3D-printed capper in our machine, which is essential for securely sealing each bottle. This ensures that the fragrance remains intact and prevents any leakage or contamination.

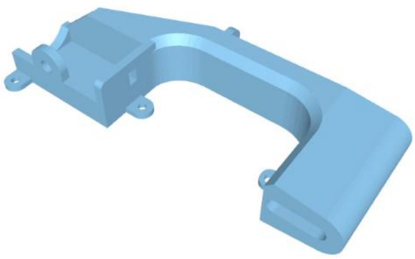

Figure 3.17: Capper

Suck Stand

We incorporated a "Suck Stand" 3D-printed alignment fixture into our project, specifically designed to straighten the needle. This ensures that the needle can be accurately and seamlessly inserted into the perfume bottle, eliminating any potential misalignment or damage during the filling process.

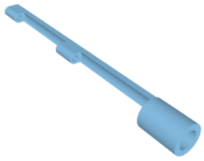

Figure 3.18: Suck Stand

Servo Gripper

Upon the bottle being properly centered, the sequential operation of the servo motors is initiated. The first servo motor moves to a specific angle, facilitating the opening of the gate and the release of the bottle cap. Subsequently, the servo returns to its initial position, ensuring the gate's closure. The second servo then takes its turn, opening to drop the new cap in place of the previous one, effectively preparing the station for the next perfume bottle in line.

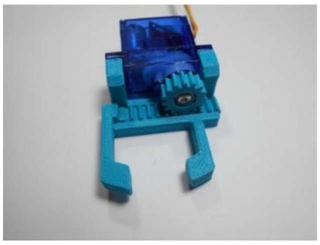

Figure 3.19: Servo Gripper

Bottle Holder

The "Bottle Holder" serves as a fixture designed to securely hold and stabilize the perfume bottle in place during various stages of the process. This ensures precise positioning and prevents any unwanted movement or displacement while the bottle undergoes different operations within the machine.

Figure 3.20: Bottle Holder & Revolving Nozzle Set

Conveyor Belt components

In our machine, we utilized a wooden structure consisting of 2 chrome rods, chains, 5 bearings, 2 linear bearing, 2 gears, and a circular iron base for holding the air jack and the perfume bottle holder to create the conveyor belt. A gear was also utilized to link the chains and the stepper motor. To facilitate the movement of the iron base over the conveyor, we have integrated a plastic belt that collects the air lattice, so it bends easily while moving the base.

Figure 3.21: Conveyor Belt: Rods linear round rod, linear block, shaft support

Figure 3.22: Plastic Belt

Relay

A relay is an electronic switch that can be used to control high voltage and current loads using a low voltage and current signal. A 5-volt relay module is a type of relay that can be controlled by a 5-volt signal, which is compatible with the Arduino microcontroller. In our project, we have incorporated an 8-channel relay module to control the operation of five pumps. This relay module acts as an interface between the Arduino and the pumps, enabling precise on/off control for each pump independently. Through this 8-channel relay, we can regulate the flow of various perfume components by activating specific pumps as needed, ensuring a consistent and accurate mixing process. Additionally, we connected a DC motor to relay 6, which serves the closing station. Another DC motor is connected to a separate relay. For the two valves in use, we connected them to two distinct relays housed in a protective plastic box to safeguard against electrical hazards(220Volt).

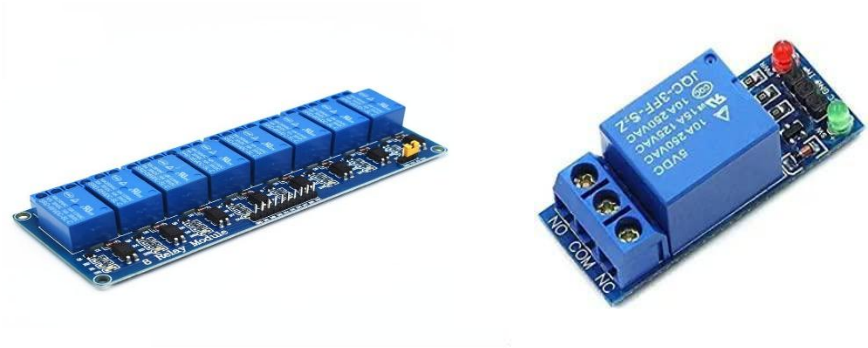

Figure 3.23: Relay Module

Valve AC 220V

In our project, the 220V valve associated with the air jacks manages compressed air flow to both jacks, enabling both lifting and lowering actions. This valve ensures precise speed and force of the lift, guaranteeing safe operation. It also maintains optimal pressure within the system, which is crucial for the jack's performance and longevity. Moreover, the valve can swiftly release air in emergency situations and contributes to the system's energy efficiency by minimizing air wastage.

Figure 3.24: Valve AC 220V

Air Jacks

In the mixer station, we've incorporated an air jack equipped with a mixing tool attached to a DC motor at its tip. When the sensor determines that the bottle is in the correct place below it, the mixer goes down into the bottle and then thoroughly blends the perfume components, ensuring a uniform fragrance. Once the mixing process is complete, the jack returns to its place again.

Figure 3.25: Air Jack – Mixing Station

The air jack incorporated into the iron base of our machine serves as a pneumatic component responsible for controlled vertical movement of the perfume bottle holder. This mechanism is integral to achieving precise positioning of the bottle throughout various stages of the process, including mixing, filling, and capping. The air jack's swift and secure response to signals enhances both the functionality and safety of the Perfumix machine, effectively combining mechanical and pneumatic principles.

In the context of the filling stage, the air jack integrated into the base supporting the perfume bottle assumes a crucial role. Triggered by the sensor's reading and the subsequent halt of the motor at the accurate center, the air jack, connected to a relay, undergoes vertical elevation through air pressure. This well-regulated motion facilitates the gradual lowering of the perfume into the bottle, ensuring meticulous and uniform filling.

Figure 3.26: Air Jack – Filling Station

The outer design

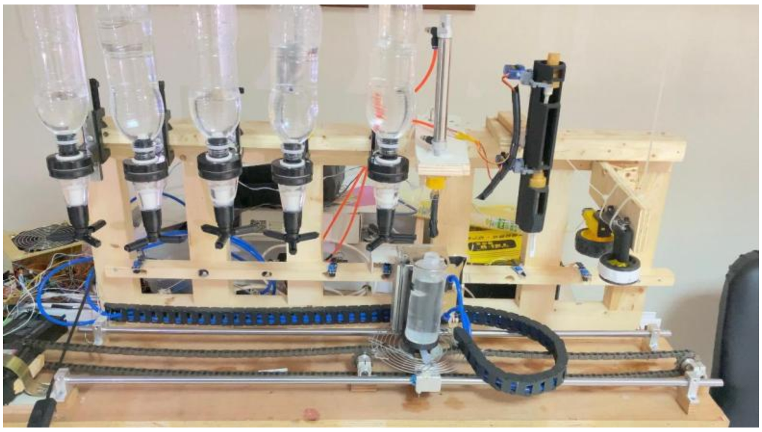

Figure 3.27: Outer Design

Filling Station

Figure 3.28: Filling Station

Mixing Station

Figure 3.29: Mixing Station

Bottle Cap Drop Station

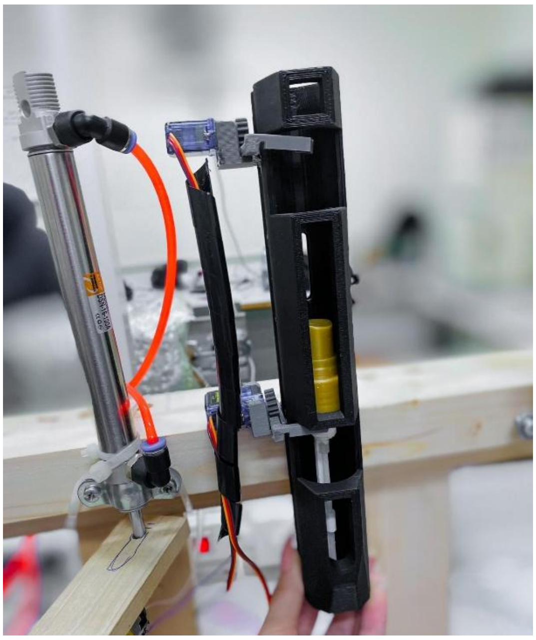

Figure 3.30: Bottle Cap Drop Station

Sealing Station

Figure 3.31: Sealing Station

Pumps and Tubes

We incorporated three 12-volts pumps into our machine: the first pump transfers hot water from the water heater to the group head, the second pump is responsible for mixing the ingredients in the group head, and the third pump transfers the prepared drink from the group head to the cup.

Figure 3.32: Pump & Tube

On/Off switch

We used an on/off switch to control the power supply.

Figure 3.33: On/Off Switch

Breadboard

To establish connections between different components during the testing phase, we employed a breadboard. This enabled us to link the 5-volt and 12-volt power supplies to devices necessitating these specific voltages, ensuring functionality verification prior to permanent wiring. Furthermore, the breadboard facilitated the incorporation of the necessary resistors for the switch sensors, serving as a pull-up for its input pin. This arrangement was temporary, preceding the soldering of components onto a smaller board. Lastly, we utilized the breadboard to establish a connection between the ESP8266 and the Arduino microcontroller.

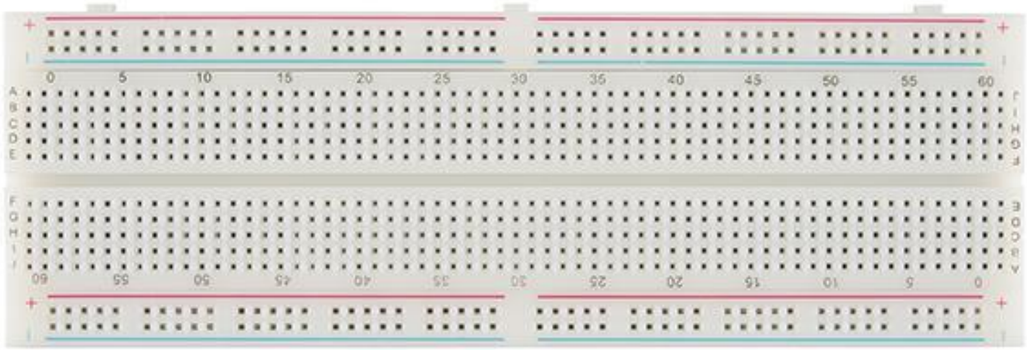

Figure 3.34: Breadboard

Wires

We used 3 types of wires: male-to-male, female-to-female, and male-to-female wires for various connections.

Figure 3.35: Wires

3.2 Software Implementation

Firstly, we ensure the perfume bottle is correctly positioned by checking the reading from the IR sensor. Additionally, the start switch must be pressed, or the machine will not operate.

Once a perfume bottle is in its designated spot, the user needs to select the desired perfume type (for men, women, or unisex) and its name. This selection can be made either on the LCD screen or through our web server.

Regarding the volume, in its initial design, the machine caters to a specific bottle size. As the amount dispensed from each perfume tap is consistent, we can only control the size by changing the tap. We've designed the machine for easy tap changing, offering sizes like 25 ml, 35 ml, and more. If a user opts for a different size, they can simply swap the tap to get their desired volume.

The perfume preparation process starts with the packing phase. A perfume typically consists of one or more essential oils mixed with alcohol. As the moving bottle progresses along the production line, it is detected by IR sensors at designated points. Each filling in the bottle, pumps from the storage containers operate for a set duration to replenish the perfume taps. We use a timer instead of a sensor for this because essential oils aren't conductive.

After filling, the bottle advances to the mixing station. Once detected by the IR sensor, an air jack descends to the bottle's level. A mixer, attached to a DC motor, then stirs the perfume components. Upon completion, the mixer returns to its original position.

Next, the bottle transitions to the cap-lowering station. Upon detection by the IR sensor, the first servo gate opens, placing the initial cap onto the bottle. This gate then closes, allowing the second servo to place the cap down for the subsequent bottle.

The bottle then moves to a capping station where an innovative mechanism ensures the cap is securely tightened. The bottle is held between two wheels: one rotates (driven by a DC motor) while the other remains stationary, ensuring a tight seal.

Finally, after passing through all the stations, the bottle arrives at its final position, detected by an end limit switch. It pauses briefly for the user to collect it before returning to the start position, ready for the next cycle.

We've also placed an IR sensor at the lid storage to notify users when refills are needed. Furthermore, five ultrasonic sensors are positioned on the storage containers. Should any container run low, the user receives a notification.

All system statuses are displayed on the LCD screen. Notifications are also transmitted to both the web server and the LCD.

3.2.1 Flow Chart

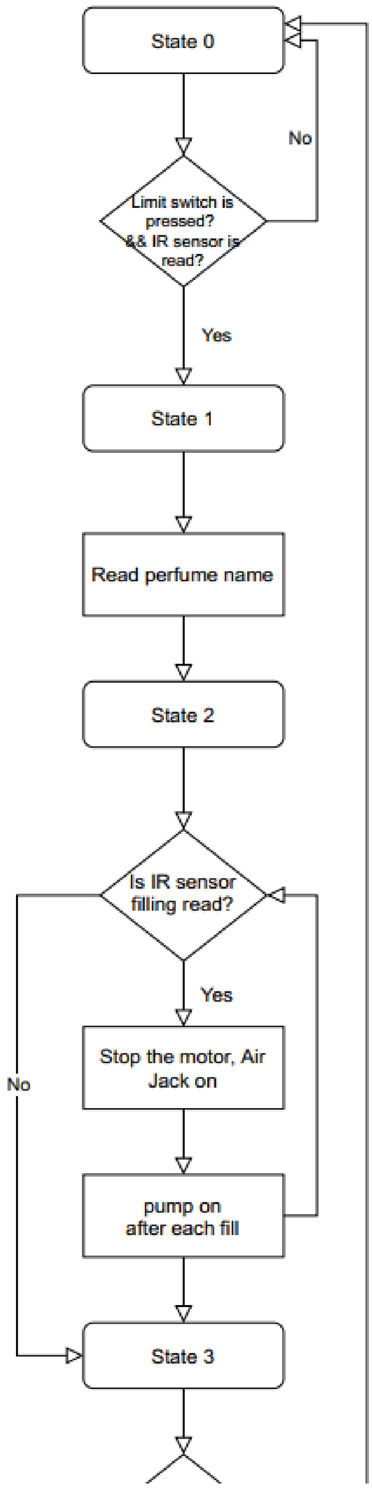

Figure 3.36: Part 1

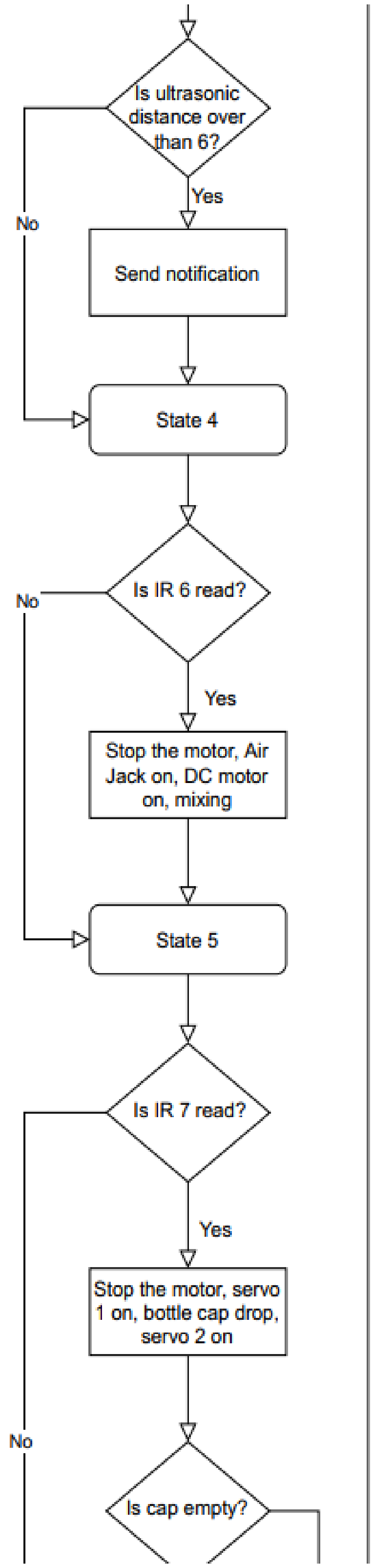

Figure 3.37: Part 2

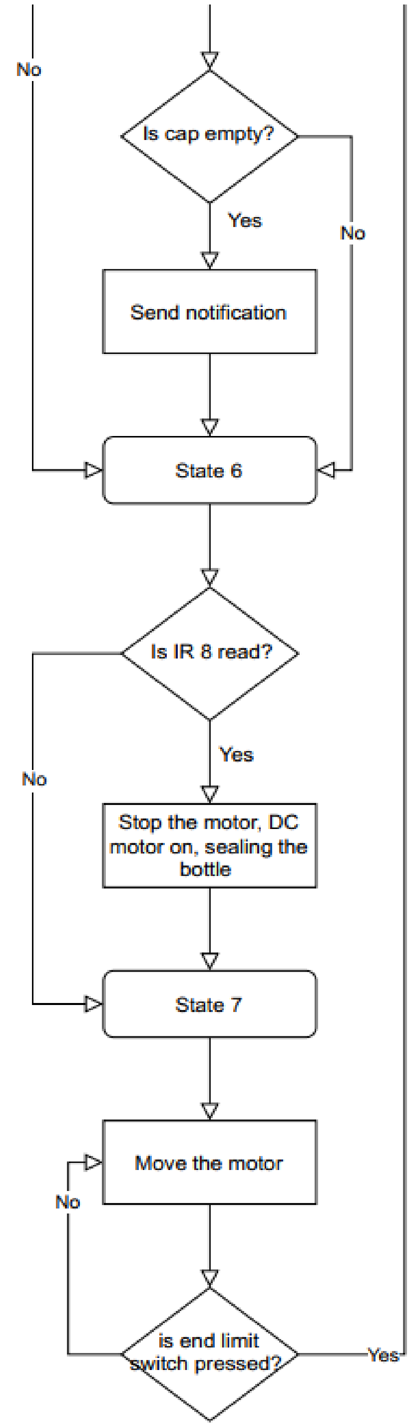

Figure 3.38: Part 3

3.3 Hardware Implementation

We have five units, each with its own responsibilities in ordering, preparing, and dispensing the perfume.

3.3.1 Input-Output Unit

This unit consists of an IR Sensor tasked with detecting the bottle's presence and an LCD screen to interface with the user. Selections regarding the type and name of the perfume are made through the web server. The primary role of this unit is to verify the proper positioning of the perfume bottle and to streamline the user's selection process.

3.3.2 Dispensing and Filling Unit

Incorporating multiple perfume taps, this unit is equipped to handle various perfume types. IR sensors are crucial for accurate bottle positioning and fill detection, while the pumps, connected to storage containers, regulate the flow of perfume. Each pump operates for a pre-determined duration, controlled by timers, to ensure the appropriate volume of perfume is dispensed.

3.3.3 Mixing Perfume and Capping Unit

The centerpiece of this unit is a DC motor with an attached mixer. Accompanying the motor, an air jack is employed to ensure the mixer aligns correctly with the bottle. For the capping process, servo motors are utilized to correctly place caps onto bottles. The capping mechanism, which consists of a rotating wheel powered by a DC motor and a stationary wheel, ensures each bottle is sealed tightly.

3.3.4 Monitoring and Notification Unit

This unit's main components are the IR sensor, which monitors the lid storage, and ultrasonic sensors that keep track of the storage container levels. An integrated web server module provides online notifications, while an LCD offers immediate updates and alerts to the user. Collectively, this unit is responsible for supervising storage levels and informing the user when refills or replacements are imminent.

3.3.5 Control Unit

Within the control Section, the Arduino oversees the entire operation of the machine. It interfaces with the ESP8266, which subsequently links to the web server. This setup empowers users to create perfume blends using the online platform. Furthermore, the machine draws its energy from a PC power supply to drive its components.

3.4 Web Server

The web server is divided into two parts. One part is for the user, can view the low levels of the ingredients in the containers in storage. The other part allows user to mix perfume using a mobile device instead of a keypad and LCD.

The producing perfume process involves one screen: to select the type of perfume and the name.

Figure 3.39: Web Page

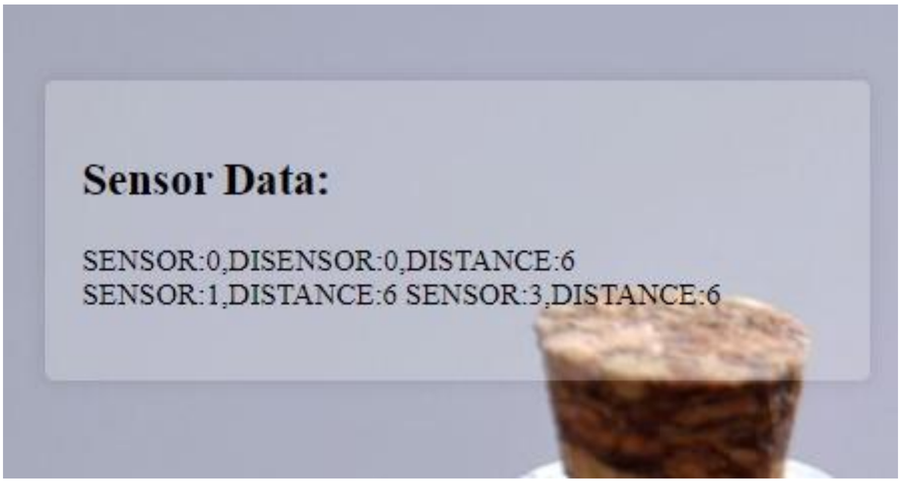

Figure 3.40: Showing Low Levels of Containers In Storage

Chapter 4

Results and Discussion

Upon the project's completion, we were able to successfully develop an automated Perfumix machine with distinctive features, such as the ability to craft customized perfume blends. The web server interface enabled users to conveniently monitor ingredient levels and seamlessly design their perfumes. This interface, when paired with a mobile device, enhanced user accessibility and experience.

Some of the problems that we faced and how we solved them:

1. After we debugged the problem, we found that the pumps were not functioning properly. Upon investigation, we discovered that the current is not enough to turn 5 pumps whose each one needs 4A to turn on. As a result, the pumps that were designed to work on 12 volts did not work. After careful consideration, we decided to use Adapter 12V specific for pumps. This solution allowed the pumps to work correctly and ensured that the project was successful.

2. Navigating the diverse power requirements of the machine's components was a challenge. While certain elements demanded a 220-volt input, others functioned on just 12 volts. Our resolution involved harnessing a power supply from a standard computer, which catered to both 5 and 12-volt needs. For components necessitating 220 volts, we relied on conventional electrical sources available in residences and laboratories.

3. Another challenge we faced was accuracy because we were dealing with small amounts of perfume. To address this, we used uniform-sized faucets, ensuring a consistent amount is dispensed each time, allowing us to accurately create the desired fragrance.

4. During the initial mixing phase, we employed a yellow plastic DC motor. We tailored the 3D mixer design according to the motor's size. However, we encountered issues with the mixing process. As the air jack descended, the mixer would clash with the exterior of the bottle, resulting in the motor breaking. After multiple unsuccessful attempts, we opted to switch to an iron DC motor, which proved to be more robust than its predecessor. Another challenge we faced was accuracy because we were dealing with small amounts of perfume. To address this, we used uniform-sized faucets, ensuring a consistent amount is dispensed each time, allowing us to accurately create the desired fragrance.

In summation, the Perfumix machine's development journey offered both accomplishments and challenges. The hurdles we faced and subsequently overcame have not only improved our machine's functionality but also enriched our technical knowledge and problem-solving skills. The project's success stands as a testament to the team's resilience, innovation, and collaborative spirit.

Chapter 5

Conclusions and Recommendation

5.1 Summary

Our team has meticulously designed and developed the Perfumix Machine, an advanced system that offers a seamless experience for users looking to craft their unique perfume blends. The machine is integrated with a web server, enabling users to orchestrate their fragrance concoctions remotely, complemented by an intuitive interface for ease of use.

Pump Functionality and Rectification: In our troubleshooting phase, we identified an issue with the pumps not operating efficiently. A deeper dive revealed that the current provided wasn't sufficient to operate the five pumps concurrently, with each demanding 4A for optimal function. Though designed for a 12-volt operation, the inadequate power led to their underperformance. Our proactive solution was to employ a specific 12V adapter for the pumps, rectifying the issue and marking a pivotal step in our project's success.

Addressing Varied Power Requirements: Balancing the diverse power demands of the machine's components presented a formidable challenge. Some parts necessitated a 220-volt supply, whereas others were content with a mere 12 volts. To navigate this, we employed a power supply sourced from a standard computer, catering to both 5 and 12-volt requirements. For those components demanding 220 volts, we tapped into the regular electrical grids available in homes and labs.

Ensuring Dispensing Accuracy: The precision in perfume dispensing was paramount, especially given the minute quantities involved. Our answer to this challenge was to utilize uniform-sized faucets, a move that guaranteed the consistent dispensation of ingredients, enabling the precise creation of the desired fragrances.

Addressing Motor Issues in the Mixing Phase: Our initial choice was a yellow plastic DC motor, with our 3D mixer design being molded around its dimensions. However, the journey wasn't devoid of hitches. As the air jack descended during the mixing process, the mixer would frequently interfere with the bottle's exterior, leading to the motor's breakdown. After several trials, the decision was made to transition to an iron DC motor, exhibiting greater resilience and reliability.

One of the standout features of our Perfumix Machine is its impeccable precision in dispensing ingredients. The component ensures that the right amount is added every time, eliminating the need for manual intervention. The entire process is streamlined and efficient, ensuring that each concoction is crafted to perfection swiftly.

In terms of user experience, the machine offers a myriad of customization options, allowing users to determine the precise quantity of each ingredient in their perfume blend. This level of customization ensures a truly personal and unique fragrance creation experience for every user.

In conclusion, our Perfumix Machine stands as a testament to innovative design and functionality. Its advanced features, bespoke customization capabilities, and fluid automation make it an indispensable asset for those looking to create their signature fragrances.

5.2 Recommendations

Recommendations:

1. The Chinese version of the Arduino board has an output voltage of 3.1 volts rather than 5 volts, so use caution when using it. Instead, we advise utilizing the Italian version.

2. Enhanced User Interface: Upgrade the web server interface with a virtual "scent palette" for an immersive mixing experience.

3. Expand Ingredient Library: Periodically add new ingredients, especially seasonal or limited-time scents, to keep user interest alive.

4. Feedback System: Embed a feedback mechanism in the web interface for insights on user preferences and areas of improvement.

5. Collaboration with Experts: Join forces with professional perfumers for curated, expert blends.

5.3 What we have learned

1. Adaptability: Encountering issues, such as the malfunctioning pumps and the plastic DC motor's limitations, taught us the importance of adaptability in engineering projects. A solution-oriented mindset is vital.
2. Interdisciplinary Collaboration: Working on the Perfumix machine made us realize that collaboration between fields, such as perfumery expertise and mechanical and computer engineering, can produce a more holistic and superior product.
3. How to work with sensors like ultrasonic and IR, and motors like DC motors, servo motors, and stepper motors, as well as devices like pumps, air jacks, and valves.
4. Importance of Testing: Especially when working with precise measures as required in perfume mixing. Ensuring that the equipment functioned under various scenarios was crucial.
5. How to connect Arduino to ESP8266 and use its Wi-Fi features.

5.4 Future Work

1. Integration of a Weighing Mechanism: By placing a scale beneath the bottle, we can precisely measure its weight. This will enable real-time monitoring to detect any malfunctions in the machine at specific stages.
2. Perfume Detection Feature: Incorporating a section equipped with gas sensors will enhance the machine's capabilities. When a user sprays a fragrance, these sensors will detect and analyze the scent. Consequently, the system can identify the fragrance components and replicate a perfume with a similar aroma.
3. Web Development for Customization: Enhancing the web interface by introducing a dedicated page will allow users to input desired perfume concentrations and select specific aromatic notes. This feature will empower users to craft a unique perfume based on their individual preferences.
4. Web and VR Enhancement: Update the web interface for personalized perfume crafting and introduce a Virtual Reality feature for an immersive exploration of ingredient origins and histories.
5. Make the system accommodate all sizes.

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