Smart Tea Machine Design Project Report

ECE 2242

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Declaration Statement

We, the undersigned members of the group, collectively affirm that this report titled "Smart Tea Machine Design Project Report" is our own joint work except where specifically referenced. We take full responsibility for its accuracy and completeness.

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Date: April 7, 2024

Acknowledgments

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Abstract

This report details the design process in creating an Arduino operated automated tea machine. The goal of this design project was to create an accessible appliance to automate a common manual process for both homeowners and customers to save them time, reduce costs and improve their user experience. By researching automated tea making machines currently on the market, user needs, and the tea steeping process, the team was able to develop various prototype ideas and set design objectives. The objectives of the Smart Tea Machine were creating a user-friendly interface, dispensing water, sugar and tea to the user, and sensing water level and temperature of the water used for steeping. After brainstorming multiple prototypes ideas, the final design was chosen by taking durability, simplicity, cleanability, portability and versatility into consideration. The prototype chosen employed five sensors, and four actuators to achieve the objectives. Servo motors and a push button was used to dispense water and while a DC motor and a push button was used to dispense sugar packets. Another servo motor was used to dispense a tea bag into a cup of water. An LCD was used to communicate with the user, and a buzzer was employed to notify the user when the tea steeping process was finished. A water level sensor, and temperature sensor were also incorporated into the machine. Additionally, a motion sensor was used to turn on the LCD when the user approached the machine. Lastly, an RFID was also utilised to allow the machine to be used in commercial settings. After simulating the circuit using Tinkercad, a PCB was designed and tested. The PCB created was fully functioning and integrated with the mechanical design of the machine. Major challenges of designing the Smart Tea Machine include the implementation of the RFID and the water dispensing mechanism. Future improvements include making the design more versatile to accommodate for wider varieties of tea and improving the mechanisms used to dispense various ingredients. In conclusion, the project was successful overall, and all design objectives were achieved.

1. Introduction

Despite developments in both household and commercial appliances in the modern age, homeowners and customers alike still require more accessible and automated appliances for common manual processes to save time, reduce costs, and improve user experience. Many processes that are still manually done have not yet been refined and been made accessible to a wide variety of users. This design project aimed to automate one such process for both customers and homeowners. After thorough research into various processes that could benefit from automated refinement and taking into consideration project requirements, the tea making process was decided upon by weighing pros and cons of all brainstormed ideas with the use of a Go-No-Go Chart as seen in Figure 1 and the "Idea Development" section of the design notebook listed in the appendices.

#	Project Ideas	Maintain Budget	Four to Six Different Sensors	Three to Four Different Actuators	Short Build Time	Experience with Most Components Necessary	Can Be Easily Tested	Overall Result	Rationale for Eliminations and Maybes
1	Mini automatic lawn mower	No	Go	Go	No	No	No	NO	Large motors would be needed to build this idea, and therefore would be out of our budget. Additionally, an outdoor setting would also be needed to test the lawn mower.
2	Coffee or Tea Making machine	Go	Go	Go	Go	Go	Go	GO	
3	Fingerprint sensor to open doors or security boxes	Go	No	No	Go	Go	Go	NO	This idea does not meet the scope of the project, i.e. does not use the required amount of sensors and actuators.
4	Clap-on lights	Go	No	No	Go	Go	Go	NO	This idea does not meet the scope of the project, i.e. does not use the required amount of sensors and actuators.
5	Plant gardening system	No	Go	Go	Go	Go	Go	GO	
6	Voice Detector RFID & Keypad Security Lock	Go	Go	No	Go	Go	Go	NO	This idea does not use the required amount of actuators.
7	Water quality monitoring	No	No	No	Go	Go	No	NO	This idea uses an excessive amount of sensors in order to test for a wide range of pollutants, and therefore, exceeds the budget.
8	Treat Dispensers	Go	No	Go	Go	Go	No	NO	This idea does not use the required amount of sensors.
9	Smart blinds	Go	No	No	Go	Go	Go	NO	This idea does not meet the scope of the project, i.e. does not use the required amount of sensors and actuators.
10	Weather monitoring (temp, humidity, etc)	Go	No	No	Go	Go	Go	NO	This idea does not meet the scope of the project, i.e. does not use the required amount of sensors and actuators.
11	Smart Trash bin	Go	Go	Go	Go	Go	Go	GO	
12	Smart thermostat	Go	Go	No	Go	Go	Go	NO	This idea does not use the required amount of actuators.
13	Air quality monitoring	Go	No	No	Go	No	No	GO	This idea does not meet the scope of the project, i.e. does not use the required amount of sensors and actuators. Additionally, it would be difficult to test different types of air.
14	Smart Vacuum	No	No	Go	No	No	No	NO	This idea does not meet the scope of the project, i.e. does not use the required amount of sensors and actuators. Additionally, it exceed the budget due to the large motors necessary to build it.
15	Health monitoring system (eg. BPM)	Go	Go	No	Go	Go	Go	NO	This idea does not use the required amount of actuators.
16	Barbecue/Oven monitoring	Go	Go	No	Go	Go	No	NO	This idea does not meet the scope of the project, i.e. does not use the required amount of sensors and actuators. Additionally, a barbecue or oven would always be needed to test the device
17	Sun tracking system	No	No	Go	No	No	No	NO	This idea does not use the required amount of sensors. Additionally, the solar panel components needed would be far too expensive.
18	Door and Window locker	Go	Go	No	Go	Go	No	NO	This idea does not use the required amount of actuators.
19	Smart desk	No	Go	Go	No	No	No	NO	This idea would exceed the budget and would require a large scale build
20	Smart pantry	Go	No	No	No	No	No	NO	This idea does not meet the scope of the project, i.e. does not use the required amount of sensors and actuators.

Fig. 1. Go-No-Go Chart Outlining if project constraints are met by various ideas

The tea making process could be improved for any individual by prioritizing convenience and cost efficiency. While tea making machines are currently available on the market, the lack of popularity is driven by high prices and lack of customization for creating different types of tea. For example, the Breville One-Touch Tea Maker is one of the few tea machines on the market that fully automates the tea making process in a similar fashion to a coffee machine and retails for upwards of $200 [1]. Both tea enthusiasts and casual tea drinkers need a higher quality and cheaper alternative to machines currently on the market. The tea making process can also be difficult for individuals with disabilities due to the manual nature of the process. Moreover, automating the process would facilitate making tea for individuals with less experience as a machine would ensure consistency in temperature, water level, and flavour. This design project aimed to specifically automate the process by:

- Creating an LCD user friendly interface
- Sensing temperature and water level of water required for tea making
- Dispensing water to the user
- Dispensing tea into water (either in the form of a tea bag or loose leaves)
- Dispensing sugar to the user

With these objectives in mind, a smart tea machine was created with the intention of practical applications in various places like homes, offices, workplaces, restaurants, cafes, healthcare facilities, events, and catering.

2. Literature Review

The literature review consisted of researching the tea steeping processes and various tea making products currently on the market to better understand the needs of users. Tea brewing refers to the general process in making tea, while steeping is the process of immersing tea leaves in water. These findings aided in the development of initial prototypes and helping to outline the objectives of the machine listed above.

A study done by Katherine Ann Tartar at MIT called “Simplifying Tea Steeping: Design Innovation Driven by User Needs" succinctly summarizes the current automated tea machine models, steeping methods and proposed alternatives [2]. Tartar conducted a survey of 235 individuals in the ages of 18 to 27 to determine their preferences in the tea making process. She found that most user preferred tea bag over loose-leaf steeping due to the inherent messiness of the process using a strainer. This insight prompted further research into the differences between tea bag and loose-leaf steeping, revealing three key differences [3]:

- Tea bags are made from low quality, cheaper leaves that have been pulverized down to tiny pieces, while loose leaves are whole, therefore, providing stronger flavour
- As the tea steeps, loose leaves are able to expand more and unravel to release flavour while tea bags are tightly packed restricting flavour, but taking less time to brew
- Both tea bag and loose-leaf steeping require hot water, while loose leaves additionally require a device to infuse the leaf flavour into the water, which can be simple paper filters, tea pots, or strainers.

Tartar’s study also outlined the top features that the individuals surveyed would want in a tea machine, which include water temperature testing, timing, removal of tea leaves, portability, simplicity and cleanability. Another important piece of information from Tartar is the comparison of various tea machine currently on the market and their short falls as seen in the Figure 2. This comparison helped the team brainstorm prototypes that address the shortcomings of current automated tea making options.

	
a) **Keurig Brewing System** Optimized for temperatures and brew time for coffee, not for tea. Unable to use own loose leaf teas in the device, only KCups. Flavor from coffee brewed may linger in the tea brewed later.	b) **Breville Tea Maker** At $250, the Tea Maker is out of the price range of most consumers interviewed. Only one out of 234 surveyed would pay over $200 for a tea maker. Brews a minimum of 500mL (16.9 fl oz), or two cups of tea, which is not ideal for an individual serving.
	
c) **IngenuiTea** While low cost and the correct size for individual portions, the IngenuiTea requires a separate water heater. It also has a failure mode where it can dispense tea sooner than desired when not over a cup, creating a mess.	d) **Teforia** While offering value-added features to the customer like smartphone integration, Teforia's price of $1300 ($650 for the first customers) targets only the super-rich. The tea carafe adds to dishes the user has to clean and neither the infusion globe nor the tea carafe are dishwasher-safe.

Fig. 2. A chart by Tartar highlighting various tea making machine currently on the market [2]

Lastly, research was done into cold vs hot water tea steeping to determine which would be more effective in steeping the tea in the machine. According to research by Lantano et al., cold water steeping is most effective in extracting healthy molecules like antioxidants, while hot steeping was faster but and extracted more flavour [4]. The study also considered an emerging method which involved hot steeping and then adding ice to the tea. This information was taken account when deciding the steeping method and water temperature used in the tea making process.

3. Design Constraints and Standards

There were three major design constraints outlined at the beginning of the course:

- The final product must contain four to six sensors
- It must contain three to four actuators
- The software must work simultaneously with all components

Other design constraints determined by the team were pertaining to the budget, build time, and testability. The team determined that the budget would not exceed $100 excluding the $50 cost of the Arduino kit. The project selected also had to have a short build time allow for debugging and successful function by the early April deadline. Furthermore, the project selected would need to be tested easily. Projects that were eliminated were often difficult to test due to their costly and time-inefficient nature. For example, a water quality monitoring system that was considered in Figure 1 would require the purchasing of various unique sensors and simulation of polluted water. Lastly, the team decided that the project chosen should not require the use of too many (more than 3) components that the members did not have experience working with.

4. Design

Based on the objectives of the machine, initially the team decided to use the components summarized in table 1 below.

Table 1: Sensors and Actuators Initially used in the Smart Tea Machine

Type	Component	Signal	Quantity	Purpose
Sensor	Temperature sensor	Digital	1	Detects temperature of water being used to make tea
	Water level sensor	Analog	1	Detect how much water is needed to make tea
	Motion sensor	Digital	1	Detects when user wants to turn on machine
	Push button	Digital	2	Allows user to dispense water or sugar
	RTC	Digital	1	Times the process
	RFID	Digital	1	Allows user to earn discounts in a commercial setting
Actuator	Servo Motor	Digital	2	Dispenses water and tea bag in cup as well as sugar if it is uncontained
	Stepper Motor	Digital	1	To help dispense sugar if in the form of packets
	LCD	Digital	1	Displays instructions to user and narrates process
	Buzzer	Digital	1	Notifies user when tea making process is finished

The block diagram in Figure 3 was developed based on the table above which outlines the inputs and outputs in relation to the Arduino.

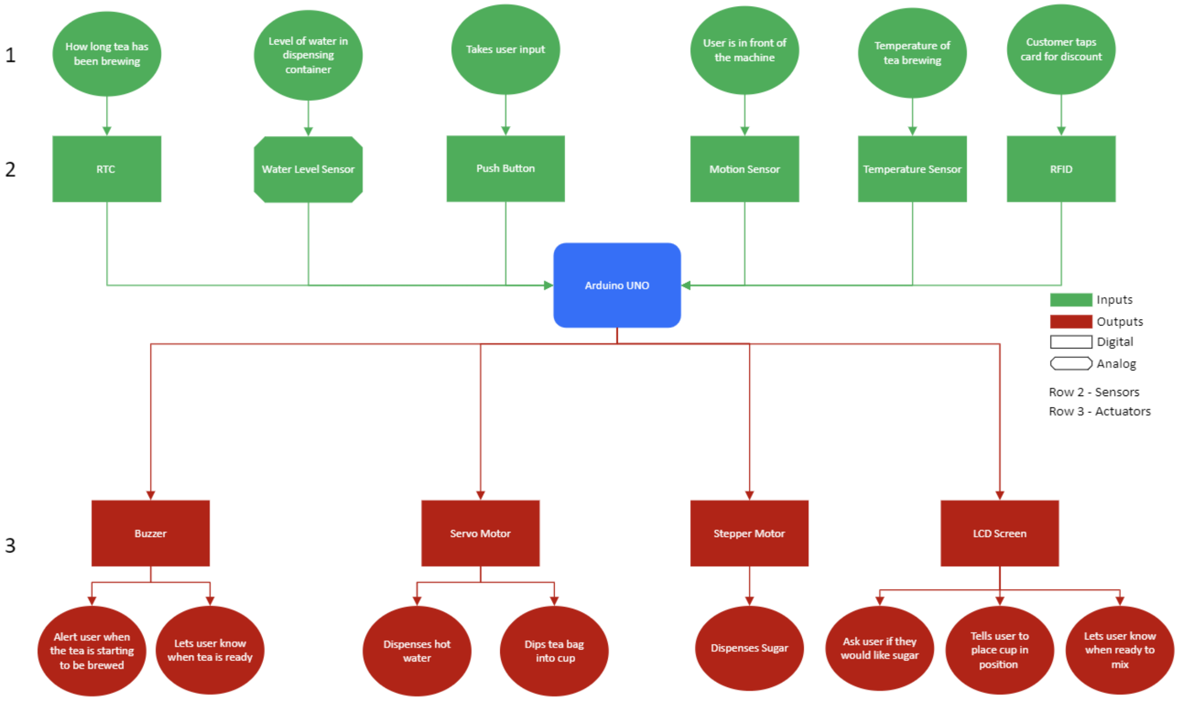

Fig. 3. The initial block diagram with RTC and stepper motor

Choosing a Prototype

Using the insights gained in the literature review, various prototypes ideas were generated and decided upon using a decision matrix as seen in Table 2. The three prototype ideas were developed, two of which used a tea bag while one used loose leaves. The team considered creating prototype designs using both loose leaves and tea bags, however decided to focus on tea bags as it would be more time-efficient for users. Additionally, it was decided that the prototype were to be constructed out of recyclable materials to reduce costs. The attributes used to rank the alternatives were based on the customer needs explored in the literature review and the team's priorities.

The metrics used to rank the prototype were as follows:

1. Simplicity: Is the prototype easy to operate, in other words, is it user friendly?
2. Cleanability: Does the prototype leave excessive waste for the user to clean up afterwards?
3. Durability: Is the machine prone to damage or breaking?
4. Versatility: Does it allow the brewing of various types of tea?
5. Portability: Is the machine easy to move around?

The metrics had different weighting depending on how important they were to the team's objectives, as shown by the order in which they appear above. The weights were on a scale of 1 to 5. Each prototype idea was ranked on a scale of 1 to 10 in each of the categories and total scores were added up.

There was also qualitative analysis that was considered in choosing each prototype. Prototype 1, as seen in Figure 4, was the most compact and simple alternative but was lacking full integration of the tea dipping mechanism into the machine. Additionally, dispensing packets of sugar would be better suited for a commercial setting, while being less convenient for a homeowner. Seen in Figure 5, Prototype 2 would be more ideal for tea enthusiasts rather than casual tea drinkers due to the use of loose tea leaves. Furthermore, avid tea drinkers are likely unconcerned with automated tea making, as they would be more willing to use traditional methods to make quality tea. The team aimed to make the tea making process more accessible for individuals who want to save time, so this eliminated the second prototype as an option. Moreover, Prototype 2 would not be able to accommodate the amount of water needed to steep the tea leaves. Lastly, Prototype 3, as seen in Figure 6, was more compact than Prototype 1 but clustered many of components into a small area, making it non-user friendly and more difficult to construct. There was also the use of the tube to direct the tea to the cup, making the design prone to damage and leaking. Prototype 3 also use sugar that was uncontained, making it a messy alternative. All prototypes ranked the same in the category of versatility as they could only accommodate one type of tea steeping. Considering the result of the decision matrix and qualitative factors, the team decided Prototype 1 was the best alternative as it ranked the highest and met user needs the best.

Table 2: Decision Matrix Evaluating Prototypes

Metrics	Weight	Prototype 1	Prototype 2	Prototype 3
Simplicity	5	8	5	6
Cleanability	4	9	6	8
Durability	3	7	6	4
Versatility	2	5	5	5
Portability	1	8	5	8
Total Score		115	82	92

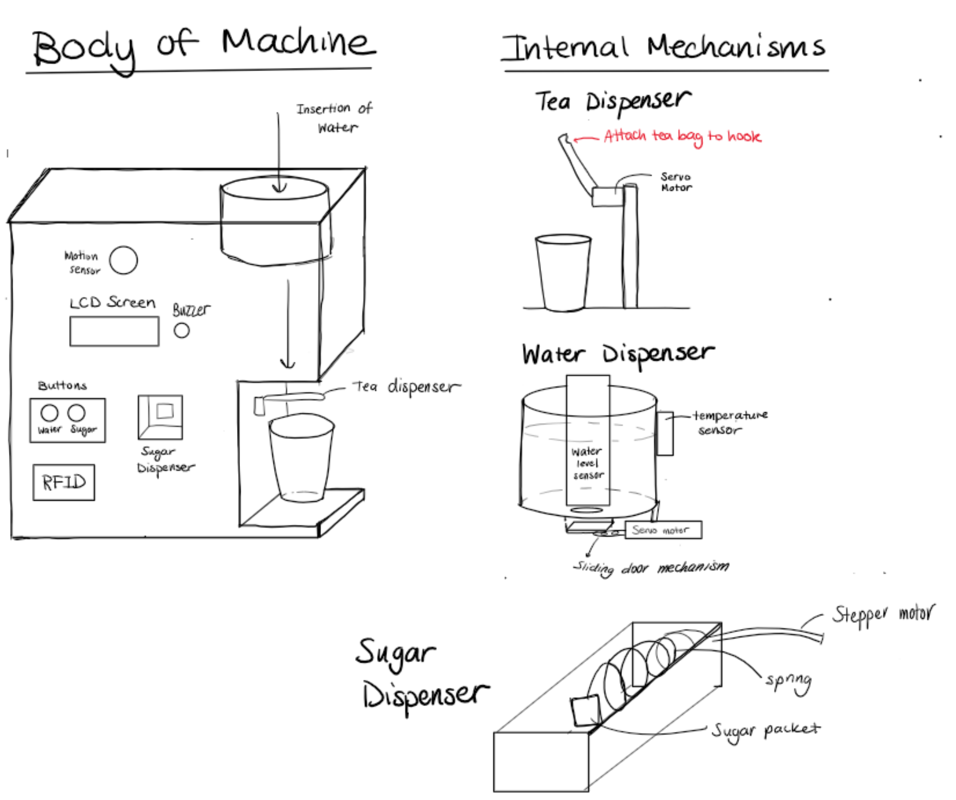

Fig. 4. Preliminary sketch of Prototype 1

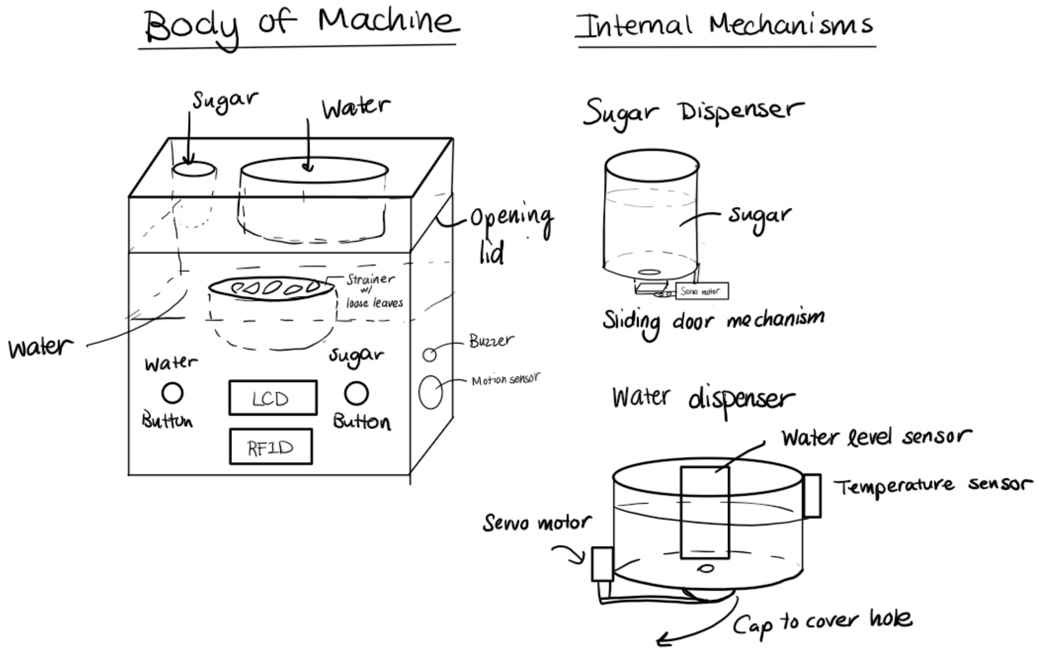

Fig. 5. Preliminary sketch of Prototype 2

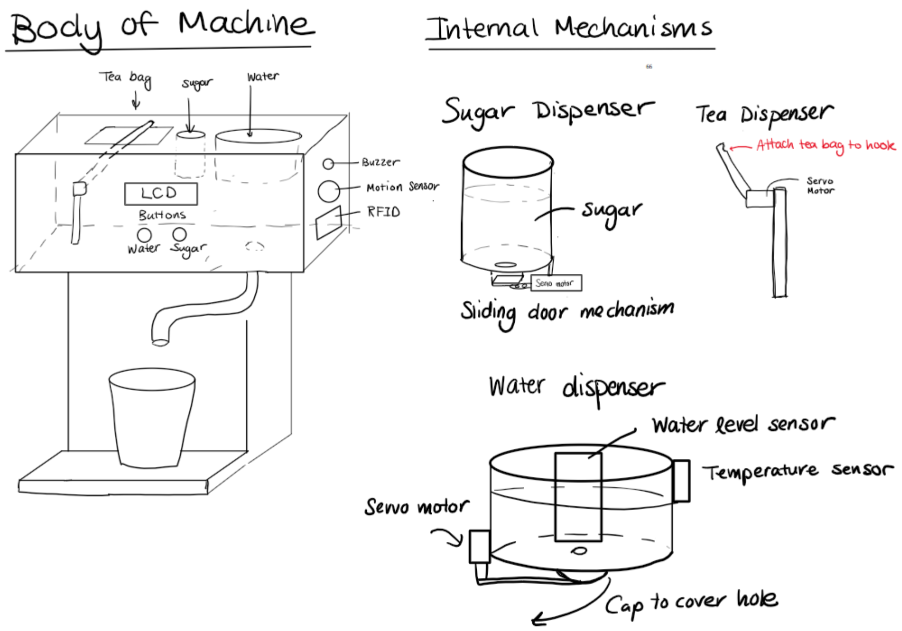

Fig. 6. Preliminary sketch of Prototype 3

Final Block Diagram and Sketch

After the final prototype was decided upon, the team was able to refine the initial block diagram into the final one seen in Figure 7. The team decided to use a DC motor instead of stepper motor due to previous experience with DC motors and access to one. Additionally, the RTC component was eliminated as the Arduino has a built-in timing function that was simpler to code and implement.

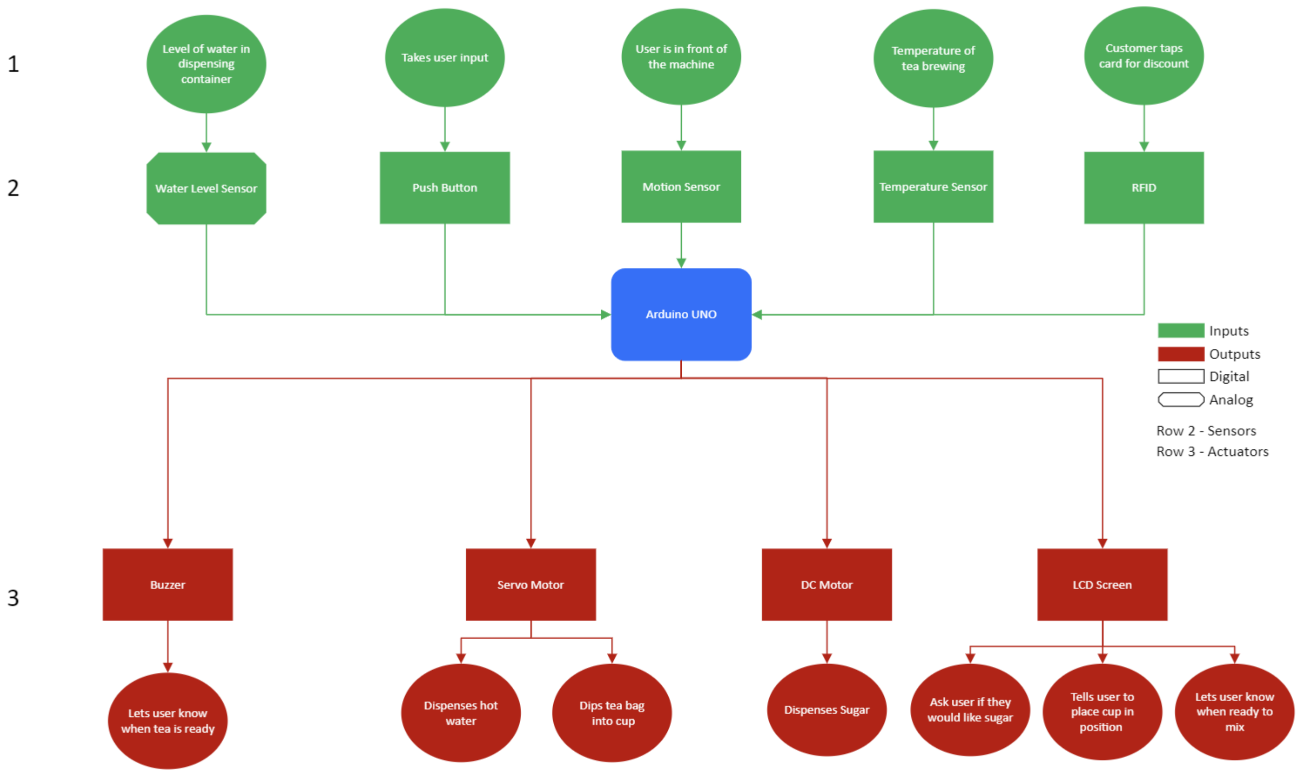

Fig. 7. Final block diagram showing all sensors and actuators that were used in final prototype

A final sketch of the prototype was also created with dimensions and all final features, as seen in Figure 8.

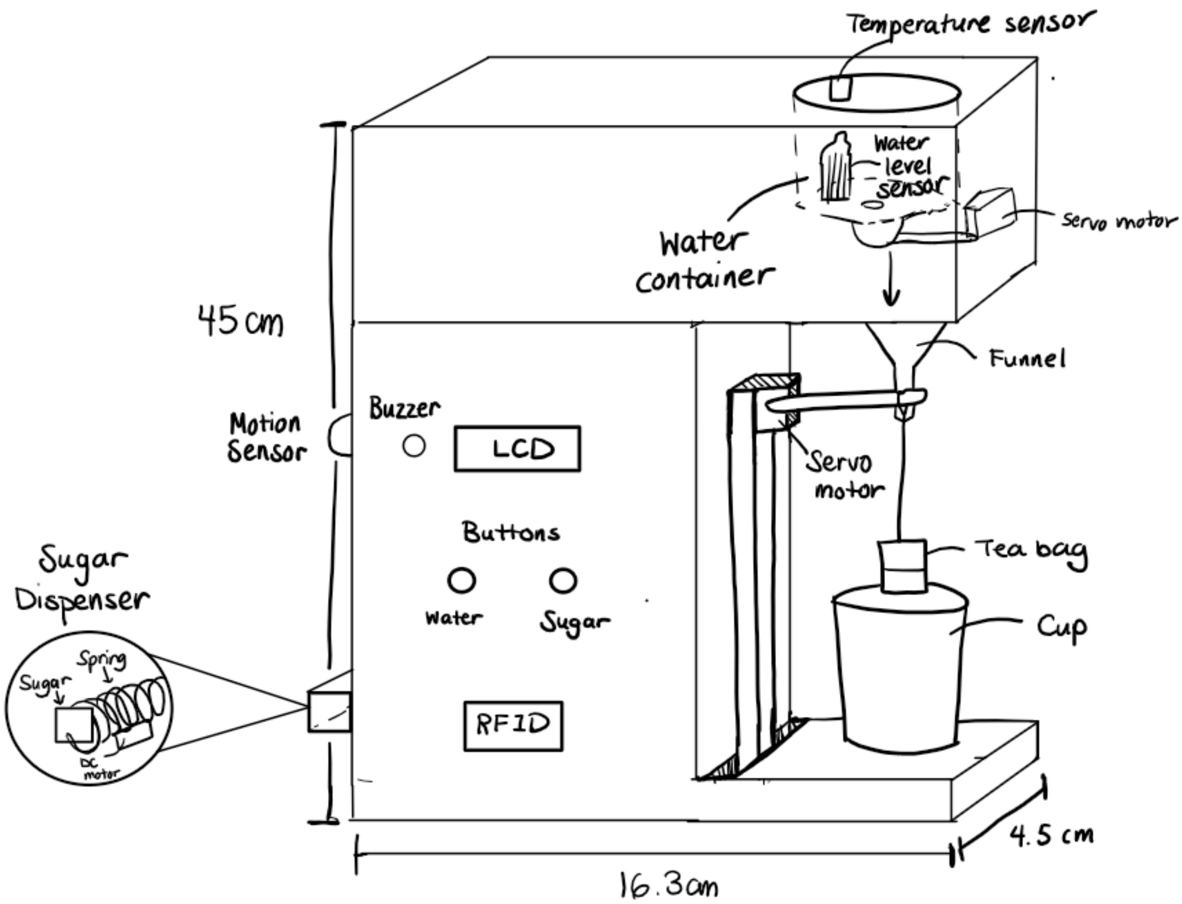

Fig. 8. Final sketch of the chosen prototype with dimensions and the placement of all sensors and actuators

Tinkercad Design

After the block diagram was built, the team got started on building the circuit through the circuit simulation website called Tinkercad. The Tinkercad library contained most of the components in the project, however some specific ones were not available. The components that were not available were the RFID, DHT11 Temperature Sensor and water level sensor. As seen in the diagram in Figure 9 below, the water level sensor was replaced by the potentiometer, and the DHT11 was substituted with the TMP36 for the simulation. The Tinkercad simulation can be accessed through this public link: Tinkercad Link.

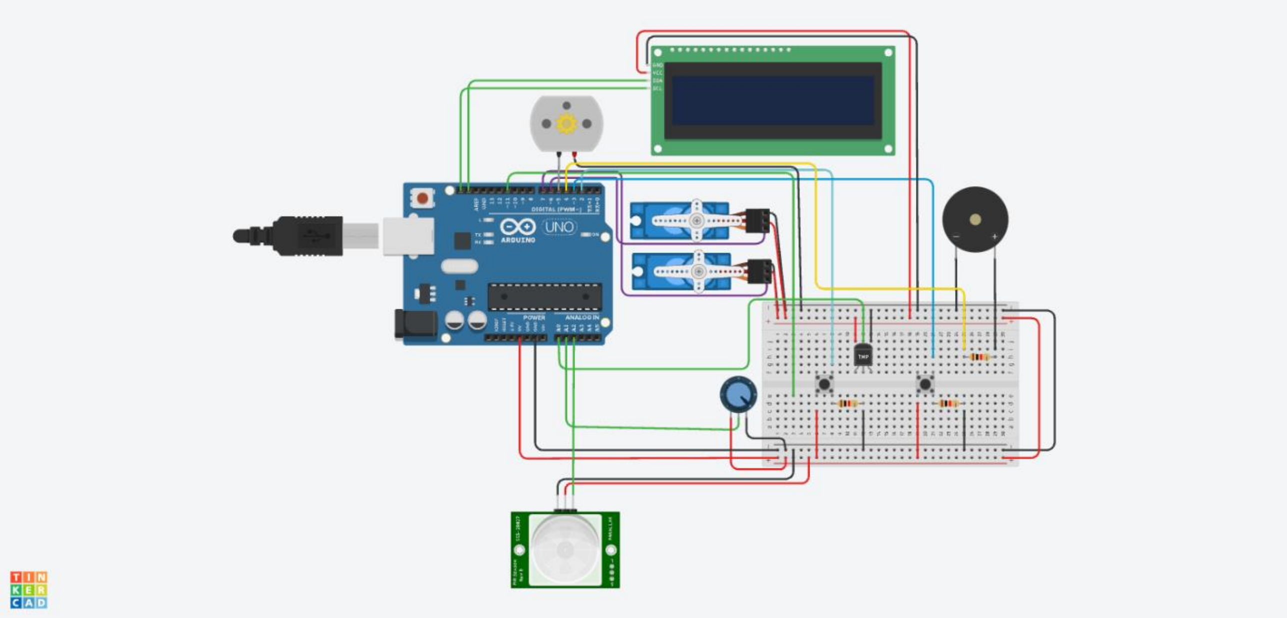

Fig. 9. Circuit built on Tinkercad

Software Development

To make sure the components of the machine were functional, the team got started on programming the Arduino while working on the Tinkercad prototype. Through the circuit simulation on Tinkercad, the prototype's program was shown to be operational as the electronic components worked together as intended. The final program was modified as Tinkercad did not include certain electronic components. The code for the Arduino's program can be found in this file: FINAL_code.ino.

The program starts with calling the necessary libraries for controlling components such as servo motors, LCD, DHT temperature sensor, RFID, and MFRC522 for RFID communication. It then defines the pin connections for various components that are used in the machine. Once the pin connections are defined, the program moves onto the setup function in which components such as the LCD display, servo motors, buzzer, DC motor, RFID and the buttons are initialized. Serial monitor communication is also programmed in this part of the code for testing purposes. Following the setup, the program enters the loop function, where the majority of the machine's algorithm runs. Within the loop function, other functions are called to perform specific tasks as displayed through pseudocode in Figure 9. Table 3 breaks down each function's purpose.

```
void setup() {…}

void loop() {
   void welcomeUser() {…}
   void checkWaterTemperature() {…}
   void dispenseWater() {…}
   void dipTeaBag() {…}
   void displayBrewingTimer() {…}
   void sugarDispense() {…}
   void teaDone() {…}
}
```

Fig. 10. Pseudocode outlining the major functions in the final code in the Arduino IDE

Table 3: Functions used in Arduino Code and Their Purposes

Function	Purpose
welcomeUser()	Displays a welcome message when the user approaches the machine.
checkWaterTemperature()	Checks the water temperature and prompts the user to replace or add hot water if it is not at the desired temperature.
dispenseWater()	Dispenses water until the water level reaches a certain threshold.
dipTeaBag()	Dips a tea bag into the water for brewing.
displayBrewingTimer()	Displays a timer for the tea brewing process.
sugarDispense()	Dispenses sugar using a DC motor.
teaDone()	Indicates when the tea-making process is completed and prompts the user to scan an RFID card for points

PCB Design

After the completion of the Tinkercad simulation, the PCB Schematic was designed and the board was created. The schematic and board design can be seen in Figure 11 and Figure 12 respectively.

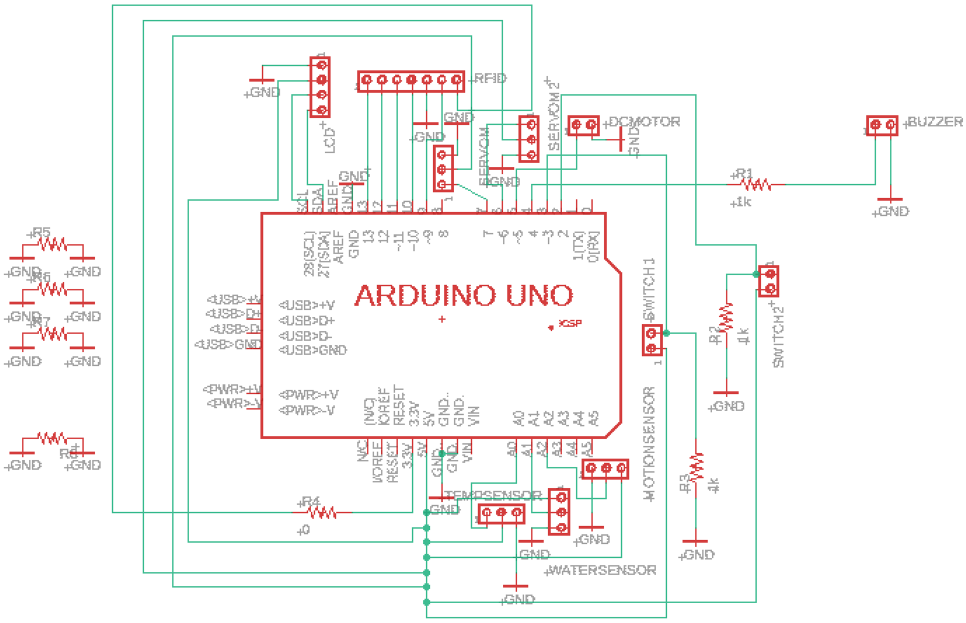

Fig. 11. Schematic of PCB board

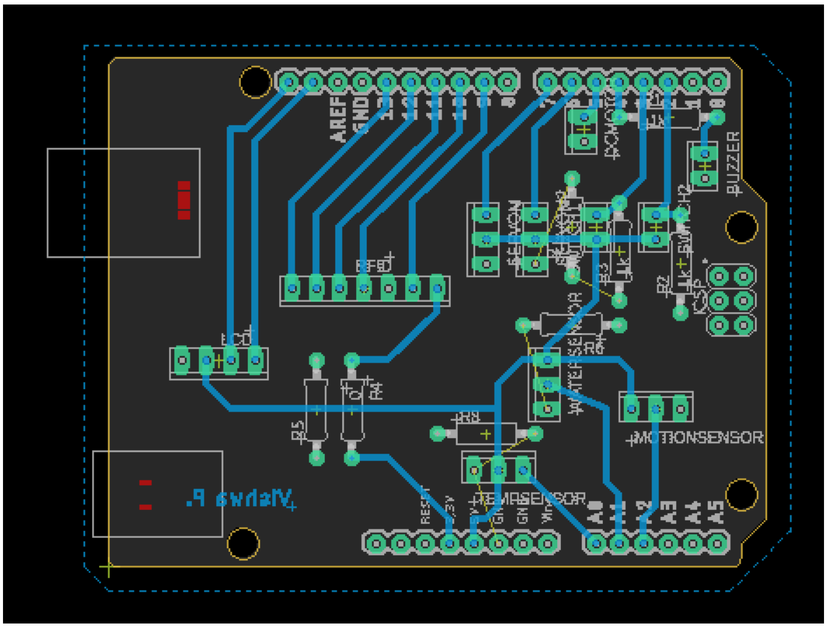

Fig. 12. Final PCB board design

5. Implementation

Technical Testing and Debugging

The prototype was tested in multiple phases. The first testing that was done was using a breadboard. The code was tested without the physical mechanisms in place (as seen here). All electronic components were functional except the temperature sensor. The temperature sensor displayed an incorrect temperature due to improper connection on the breadboard. After this error was fixed, the temperature sensor was able to function properly.

The RFID was not tested with the breadboard due to problems integrating its code with the entire process. When the RFID code was placed at the beginning of the execution, it did not allow any other sensors to operate. After some trial and error, it was discovered that placing the RFID code after all other sensors had finished their operations would allow the process to work.

When the mechanical components were finished, the two servo motor-based mechanisms were tested so that the angles of motion could be confirmed. The tea dipping mechanism functioned properly (as seen here) while the water dispensing mechanism was not able to hold water in the container until water was supposed to be dispensed. Alternative methods were proposed to solve the water dispensing problem such as using a rubber sealed cap, a bigger cap, or a plug. The first two methods proved unsuccessful due to water spewing from the edges of the cap, so the plugging method was utilized. The plugging method did not fully eliminate the leakage however, reduced it to drips. The two mechanisms can be seen in the videos linked below:

a. Initial water dispenser mechanism with significant leakage
b. Final water dispenser mechanism with minimal leakage

Afterwards, the PCB was soldered and each component was tested separately with generic code. During this phase of testing the RFID and LCD did not work due to short circuits created during soldering. These problems were fixed by checking the connectivity of all components and resoldering them in the lab. The PCB was tested with all components on
It and the tea process code after this issue was solved as seen in this video. Figure 13 shows the fully soldered PCB from the front and back.

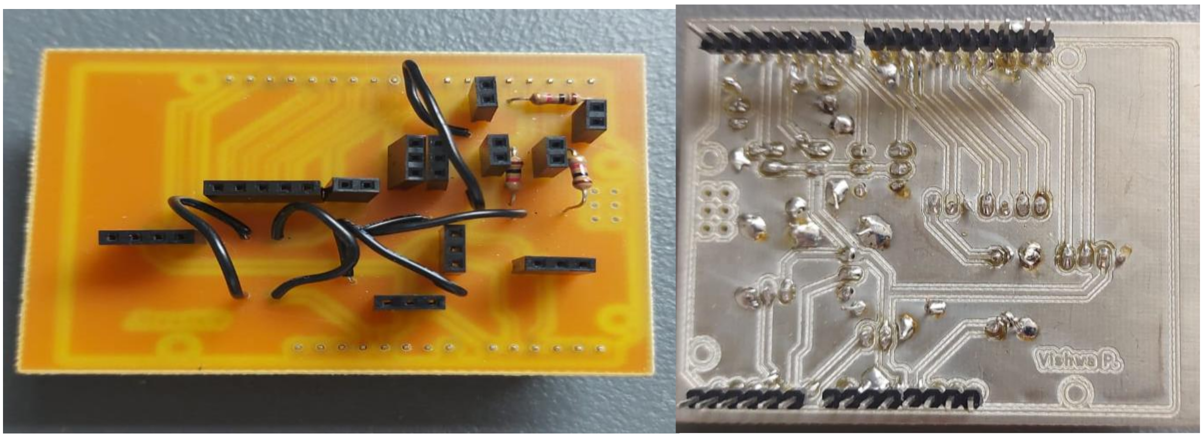

Fig. 13. Front and back view of fully soldered PCB

Another obstacle that was faced was the use of hot water in the machine. While cold steeping methods were researched, the team decided to use hot water as it is the most common method of preparing tea. Additionally, the temperature sensor used could not be immersed in water, and therefore would be able to sense the heat from steam more easily. However, since the plug of the water dispensing method was secured with hot glue, and it was in contact with hot water in the dispensing container, the plug became unattached to the servo arm occasionally. Due to this, cooler water was used to test and demonstrate prototype.

Lastly, the components were placed in the body of the machine and the Smart Tea Machine was able to function according to plan. Images of the final prototype from multiple views can be seen in Figures 14 and 15.

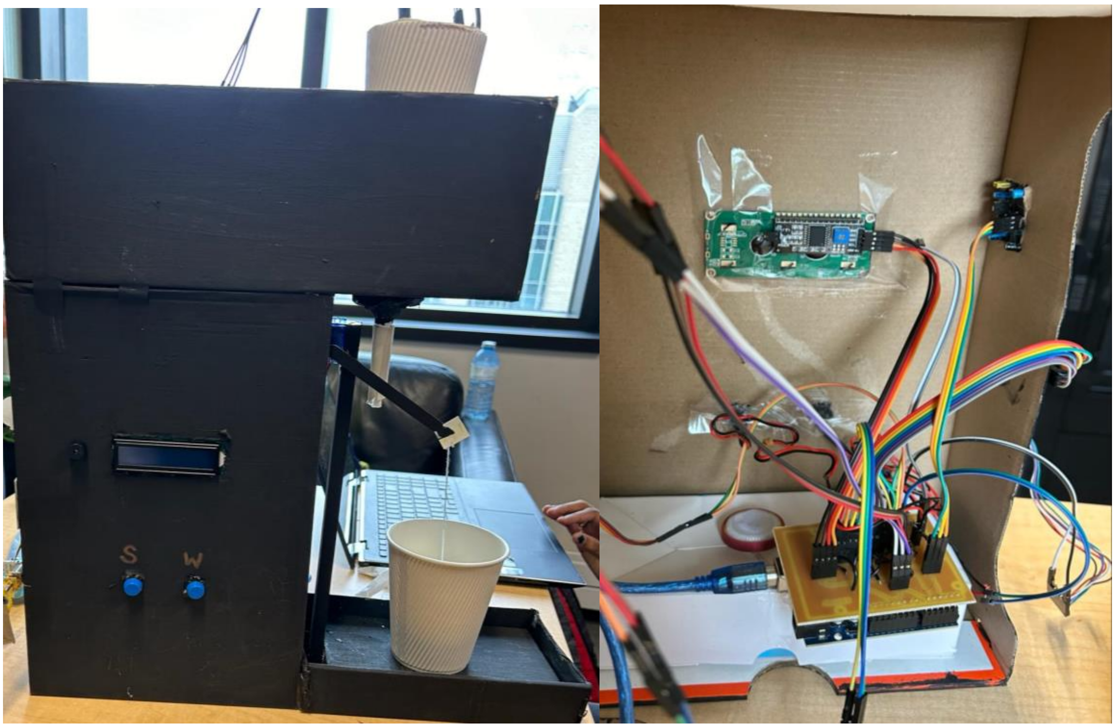

Fig. 14. Front and back view of Smart Tea Machine

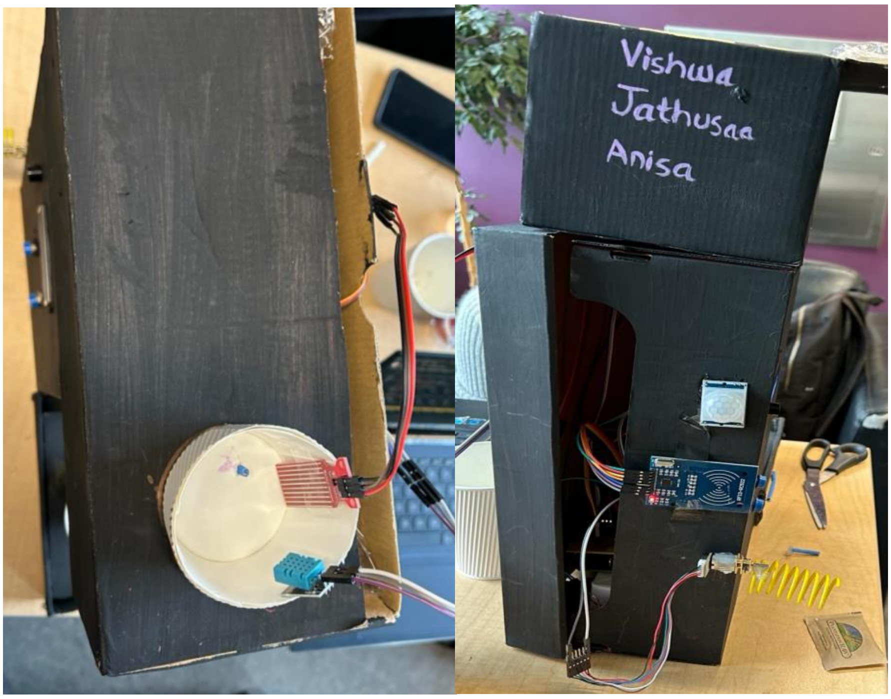

Fig. 15. Top and side view of Smart Tea Machine

A user manual outline was also created to facilitate the operation of the machine. This can be seen below:

User Manual
Introduction: The Smart Tea Machine is a portable device designed to brew tea conveniently. Powered by a 9 V battery, this machine offers flexibility and ease of use wherever you go. This user manual will guide you through the setup and operation of the Smart Tea Machine. Setup: 1. Ensure the Smart Tea Machine is placed on a stable surface. 2. Insert a fully charged 9 V battery into the designated battery compartment. 3. Make sure the water container is filled with hot water. 4. Hook the tea bag onto the brewing tea stand 5. Place your cup or mug in the designated position Operation 1. Stand in front of the machine to activate the motion sensor 2. Follow the on-screen instructions to start the tea making process 3. Press the corresponding buttons to dispense water, the tea bag, and a sugar packet 4. Follow the LCD screen prompts for guidance. 5. Wait for the tea making process to be complete as signified by the buzzer 6. Once the tea is done, remove your cup or mug from the machine and enjoy your freshly brewed tea Maintenance: 1. After each use, ensure all components of the machine are cleaned and dried thoroughly. 2. Regularly check the battery and replace it as needed to ensure uninterrupted operation. Safety Precautions 1. Do not immerse the Smart Tea Machine in water or any other liquid. 2. Avoid using the machine if it shows any signs of damage or malfunction.

Cost Analysis

The cost to build the Smart Tea Machine was minimal as the body of the machine was constructed from recyclable and reused materials, like carboard. Two items were bought online to make the machine: A pack of 9 V batteries to make the machine portable, and extra wires to facilitate the connection of the components to the PCB ($15 total). Considering the cost of the Arduino kit at $50, the total cost of the constructing the Smart Tea Machine was $65 dollars. The price indicates that the machine is a more cost effective alternative to the tea machines currently on the market like the Breville One-Touch Tea Maker.

5. Results and Evaluation

The tea machine worked as intended. All the sensors and actuators worked to achieve their objectives. This video shows the working of the whole tea machine. In the video's description, timestamps have been added for all the 11 components of the whole machine. This other video shows the LCD screen clearly throughout the whole process. The serial Monitor during the entire process was also recorded in the video linked. This was a success as all the components work together on the PCB.

During the process, the main challenge was the RFID as it was a new component. However, through trial and error, RFID implementation was successfully done. The LCD was not fully functional earlier in the process, but the issue was resolved later by resoldering the ground connection. The water dispensing mechanism required more attention due to leakage, however it was ultimately minimal and did not majorly affect the machine's operation.

The mechanical component of the machine was the main weakness. Since the machine was made from cardboard, the water easily wetted the box and the water leaked occasionally. Despite these challenges, the water leakage was managed well. Leakage was mitigated by creating a plastic shield over cardboard in contact with the water. In conclusion, all objectives set out at the beginning of the project were achieved.

7. Future Work

In terms of further improvements, several areas were identified:

Firstly, there is a need to ensure the water dispensing mechanism is more reliable. There was slight leakage and malfunction during the dispensing process. This could be prevented by using a stronger servo motor which could significantly enhance the reliability of the dispensing and allow a more watertight plug. Secondly, in the future the program could be refined to incorporate error detection in case a user accidently presses the wrong button. Implementing such a feature would improve the user's experience by providing clear feedback and guidance, reducing the likelihood of mistakes.

Other improvements:

- Enhancing the integration of the tea dipping mechanism
- Expanding the capacity to accommodate larger tea servings
- Providing users with the option to select their desired steeping time in order to facilitate the brewing of a wide variety of teas

To further development the machine, attention could be given to enhancing the user interface with more detailed features. Furthermore, exploring the use of alternative materials that are easier to clean and offer greater durability may contribute to the overall reliability and longevity of the machine.

8. Conclusion

In conclusion, the Smart Tea Machine design project has successfully achieved its objectives of automating the tea making process to provide users with a convenient solution to manually brewing tea. With thorough research, detailed design considerations and repeated testing, the team has developed a functional prototype that effectively dispenses water, tea and sugar while monitoring temperature and water level, and providing a user-friendly interaction through an LCD interface. Despite encountering challenges such as integrating the RFID system and ensuring reliable water dispensing, the team demonstrated strength and problem-solving skills to overcome such obstacles. For further improvement, refinements and enhancements can be made to improve reliability of the machine and user experience. Overall, the Smart Tea Machine has transformed tea preparation into a seamless and delightful experience.

References

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Appendices

1. Link to design notebook: Design Notebook (ECE 2242).docx

- Note: Please view in app rather than web for clear formatting (Go to editing in top right corner and select view in desktop app)

2. Link to teams channel documents: https://uwoca.sharepoint.com/:f:/s/ECE2242LabGroup/Ek_GqaFCl2RLhGjxQ7tvYxIBbbEJc3fnpIbrN0Wsf2liEQ?e=ldOM8C