

Design and Development of Mini Tea and Coffee Machine

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Abstract: The aim of this project is to cater to the specific requirement of the consumer especially of small scale sector with the intention of providing the consumer with the option of selecting the types of tea/coffee he/she wants and also providing them option to select a suitable reservoir of water such as a 1 litre mineral water bottle thereby moving a step further of the machines which are available in the market for small scale organisations/industries/offices.

Keywords : Premix, Micro Controller, servo Motor, Solenoid Valve,

1. INTRODUCTION

1.1 Overview

Beverages like tea and coffee have become a part of a daily routine of people around the world. Employees at an MNC or a relatively small industry, everyone wants to have a cup of their favorite beverage daily. While an MNC can afford to have beverages ordered from their high end canteens, a small office cannot. Small offices depend on a roadside stall to fulfill their beverage requirements. Tea and coffee from these roadside stalls is of questionable quality. The water used in these beverages could be from any tap, affecting its quality. The cleanliness of utensils used in making these beverages cannot be trusted. Another thing that is virtually impossible to consider are the individual preferences. It is very difficult for the roadside stall to cater to the different preferences of different customers in an office. Some would like sugar free tea, strong coffee, mild tea etc. Also the time that it takes for the beverage to dispense is crucial. Offices where every minute is precious, it could take 10-15 minutes for the beverage to reach the customer. Tea and coffee vending machines can solve this problem. However, tea and coffee vending machines available in the market today are expensive and bulky. As such, small offices cannot afford such machines.

1.2 Objective

The objective of the project is to design and develop a mini tea and coffee making machine, which dispenses the beverage of required quality in less time. The machine uses readily available tea and coffee premix powder to prepare the beverage. The machine offers options like:

- Strong Tea/Coffee
- Regular Tea/Coffee
- Mild Tea/Coffee
- Sugar free Tea/Coffee

Another important feature is provision of mineral bottle slot, where a mineral water bottle can be bought and directly attached to the machine thus eliminating any questions of purity.

1.3 Nomenclature

| | |
|------------|-----------------------------|
| ATmega328P | Single Chip Microcontroller |
| T | Torque (kg-cm) |
| PWM | Pulse Width Modulation |
| tsp | Teaspoon (5 ml) |
| Premix | Instant Tea/Coffee powder |

2. LITERATURE REVIEW

During the course of the project, two distinct type of tea and coffee vending machines were observed:

- Household Tea and Coffee Machine
- Tea and Coffee Vending Machine

Household tea and coffee machines such as Philips HD7450[1], Morphy Richards Tea Maker[2] are used where limited amount or predetermined amount of beverage has to be produced. The working of these appliances is quite simple. The appliance consist of a container made of plastic in which tea or coffee premix powder is placed according to the requirement of the user. The appliance consists of a reservoir for storing water, this reservoir is connected to the heater. The quantity is of water is measured according to the requirement by the user and when the user switches on the machine the water gets heated and pours into the container thereby providing the required beverage. Tea and Coffee Vending Machines are quite complex and generally used in hotels or cafeterias or large offices. These machines generally consist of an Electronic System which controls all the operations, Heating System to ensure that the water is always heated and remains at the required temperature, Mechanical system for controlling the amount of premix powder, this is generally done by using screw extrusion process. These machines provide an interface from which the user has to select the type of beverage he/she wants. Once the input from the user has been registered, the screw present in the powder container rotates. Corresponding to the amount of revolutions of screw the powder falls into a secondary cup where a stream of hot water mixes with the powder and the beverage is produced which then flows in to the main cup. The amount of water flowing is controlled by valves which are operated using timing circuits.

3. MACHINE COMPONENTS

3.1 Electronic Component

3.1.1 Servo Motor

A servomotor is a rotary actuator or linear actuator that allows for precise control of angular or linear position, velocity and acceleration. It consists of a suitable motor coupled to a sensor for position feedback. It also requires a relatively sophisticated controller, often a dedicated module designed specifically for use with servo motors

3.1.2 Arduino Uno Microcontroller

The ArduinoUno[3] is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or a battery to get started.

3.2 Water Heating Unit

Water heating unit consist of the following parts:

- I. Water Heating Element
- II. Cut-off Thermostat
- III. Solenoid Valve

Water heating element works on the principle of resistive heating. It consists of a heating coil which gets heated when an electric current passes through it. Water from the bottle gets heated due to the coil. A thermostat present in the heating unit ensures that the temperature of the water does not increase beyond a specific temperature value. A solenoid operated valve ensures that the hot water reaches the cup in the required quantity by timing the opening and closing of the valve.

3.3 Container

Container can be made of food grade plastic[4] or food grade steel[5]. The container is provided with an arrangement for controlling the quantity of premix, which will fall in the cup. In the mechanism, slider crank mechanism is used for controlling the quantity. The quantity of premix powder that can be stored in the container is 154 ml.

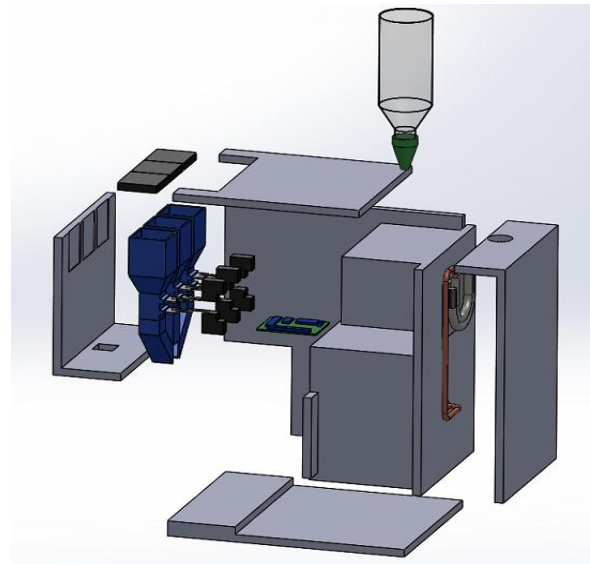
3.4 Appliance Body

The body is made of Mild Steel [6] sheet which provides a structure on which all the components can be mounted and also provides support.

4. MATERIAL SELECTION

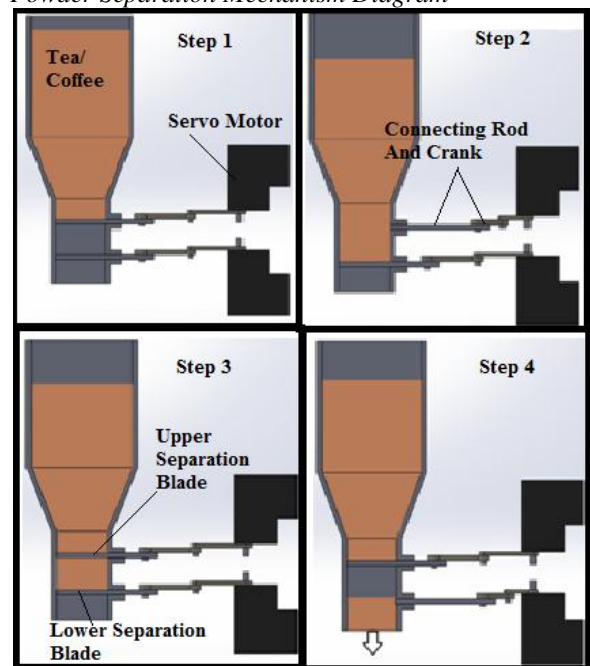
| Serial Number | Component Name | Material |
|---------------|-------------------------|-----------------------------|
| 1 | Container | Food Grade Plastic or Steel |
| 2 | Servo Motor (T:2.5kgcm) | Standard Component |
| 3 | Connecting Rod | Plastic or Mild Steel |
| 4 | Crank | Plastic or Mild Steel |
| 5 | Body | Mild Steel |
| 6 | Heating Coil | Nichrome |

5. EXPLODED VIEW OF TEA AND COFFEE MACHINE



6.MECHANISM

6.1 Powder Separation Mechanism Diagram



6.2 Explanation Of Mechanism

- Step 1 represents the initial condition when both the separation blade are in closed position.
- In step 2 the uppermost separation blade opens up due to which the tea/coffee/sugar powder falls down in the space between upper and lower blade, thereby separating 1 teaspoon of powder which is represented by step 3.
- In step 4, the lower most separation blade opens due to which 1 teaspoon of powder falls into the cup.
- The same 4 steps are repeated depending on the selection of type of beverage by the user.
- The separation blades are controlled with the help of a servo motor which is driven by an Arduino micro-controller circuit.

- Once the desired quantity of powder falls into the cup, the water heater delivers the hot water into the cup at a temperature of 70°C-85°C [7].
- The contents in the cup are stirred with a spoon and the beverage is ready to be served.

7. EXPERIMENTAL DETAILS

7.1 Proportions of premix according to requirements

7.1.1 Proportion for Tea

| TEA | Premix | Water | Sugar |
|---------|--------|-------|-------|
| Regular | 3tsp | 100ml | 1tsp |
| Strong | 5tsp | 100ml | 1tsp |
| Mild | 2tsp | 100ml | 1tsp |

7.1.2 Proportion for Coffee

| COFFEE | Premix | Water | Sugar |
|---------|--------|-------|-------|
| Regular | 4tsp | 100ml | 2tsp |
| Strong | 6tsp | 100ml | 2tsp |
| Mild | 3tsp | 100ml | 2tsp |

8. CONCLUSION

In this project, we have designed and developed a mini tea and coffee making machine which is capable of dispensing the required quality (taste) of beverage in less time. The powder separation mechanism used in this machine has certain advantages over the presently used screw extruder mechanism. For instance, it is less complex and is consistent in operation. The heating unit consumes less power, thereby reducing operating costs.

9. REFERENCES

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