

Design and Fabrication of Automatic Dosa Maker



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Abstract: Dosa is a traditional food common in South Indian homes. It has been an integral part of South Indian breakfast since ages. Dosa is usually cooked with a non-stick pan and spatula which is time consuming and needs continuous attention of the cook. As the value of time is increasing day by day, especially with the increase in working women, the demand for ready-to-eat traditional food is also increasing. Different prototype developments for Dosa Maker have been conducted widely. Automation plays an important role in the food sector. Automation reduces cycle time, limits human interference hence increasing productivity. The main problem that arises during the design of Dosa maker is to bake both sides of the Dosa automatically. The present work mainly focuses on design, development and fabrication of a fully Automatic Dosa Maker enabled to bake both sides of Dosa without any manual help. A programmed Arduino Mega is used to control the working of the entire system. A servomotor is used here, which helps to flip the Dosa in order to bake both the sides thus enabling to make tasty and hygienic Dosas. The Automatic Dosa Maker is a user friendly and portable machine. As the whole device works on its own it is easy to operate. The whole device runs on electric power. Using electricity as a source of power has less impact on the environment compared to the conventionally used petroleum gas.

Keyword : Automatic, Dosa, Fermented batter, Flipping arm

One plain Dosa without oil contains about 112 calories[10], of which 82% is carbohydrate and 16% protein and 2% fat. You can also use other healthy ingredients instead of rice such as oats or rawa to alter the taste and calorie count of Dosa. The fermentation process of batter increases the vitamin B, vitamin C and decreases the phytate (the hard to digest component of legumes) content. The microorganisms responsible for the fermentation are naturally present in the ingredients of Dosa batter (the rice and black gram), some of them are provided by water and air. These microorganisms are multiplied during the soaking process, then again during the resting process after grinding. A temperature of 25°-30°C[9] is found to be highly favorable for the microorganisms to boost the fermentation process. Dosa batter can be stored for as long as 1 week or even more, if it is not fermented. Already fermented Dosa batter will stay good for about 3-4 days[1]. As a food product - easy digestibility, good nutritive value and easiness to make contributes to the increasing popularity of Dosa in all parts of India and also in other countries.

I. INTRODUCTION

Dosa is a traditional food item commonly used in south Indian homes. It is a rice pancake originating from South India, made from fermented batter which consists of main ingredients such as rice and black gram, soaked and ground together to a smooth batter generally in 3:1 or 4:1[1] proportion with a dash of salt. The fermented batter is mixed with water to get the desired consistency. Traditionally, Dosa is served with a bowl of sambar, coconut chutney and spicy tomato chutney along with the other accompaniments. Dosa was already in use in the ancient Tamil country around the 1st century AD. Since time immemorial fermented foodstuffs are an important part of the diets of many parts of the population because of their benefits in providing high nutritive value, better organoleptic characteristics, shorter cooking time, prolonged shelf life and enhancement of flavor and aroma in foods.

1.1 Objective

- The main aim of this work is to conceptualize, design and fabricate a fully functional automated
- Dosa making machine which bakes both the sides of the Dosa.
- It makes Dosas automatically at the press of a button without the need for human intervention in its cycle of operation.
- Human workforce is eliminated in every possible situation in the present scenario. This makes what is usually a daily activity an effortless task that doesn't require your attention.
- Another advantage is the drastic decrease in cost as compared to other machines similar to its kind.

II. METHODOLOGY

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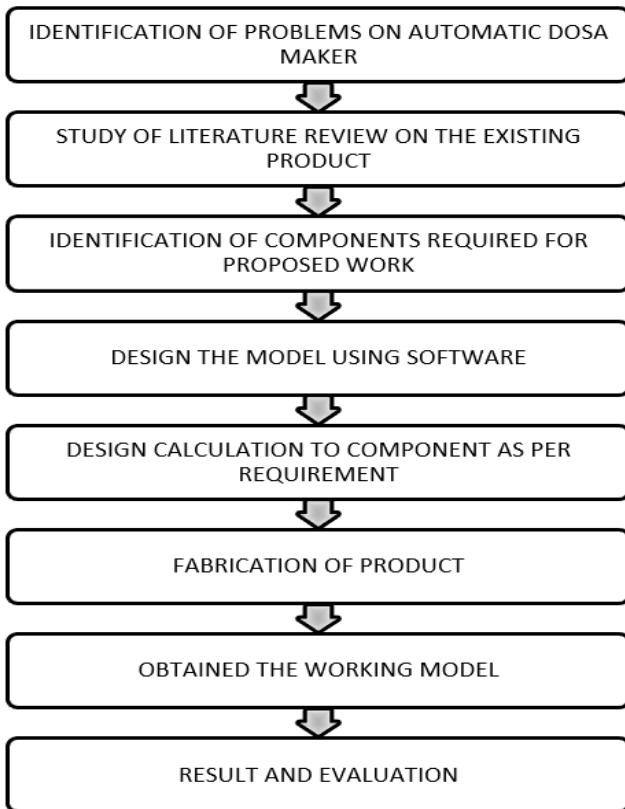





Fig 2.1 Methodology

III. COMPONENTS AND SPECIFICATIONS

Components	Photograph	Specifications
Arduino Mega		Operating Voltage = 5V Input Voltage = 7-12V Clock Speed = 16 MHz
12V 10A SMPS		Item model no. = 12V 10A Input Voltage = AC 90 - 264V Output Voltage = 12V DC, 10A Wattage = 120 Watts
Servo Motor		Model = MG995 Operating Voltage = 4.8V - 7.2V Operating Speed at 4.8V = 0.20sec/60°



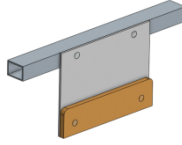


Motor Driver		Continuous Output Current = 1.2A Logic Control Voltage (VSS) = 4.5-5.5V
DC Motor		Name = RT-500TB-12560, DC motor Speed at 6v no load condition = 2840rpm/min
Sliding Arm		Length (mm) = 150 Height (mm) = 30 Thickness (mm) = 5
Induction coil and induction cooker kit		Induction coil Power = 1800 W Voltage = 220/230 V
Potentiometer		Shaft Diameter = 6mm Shaft Length = 13mm Mounting Thread Diameter = 7mm

Table 3.1 Components

IV. MECHANISM

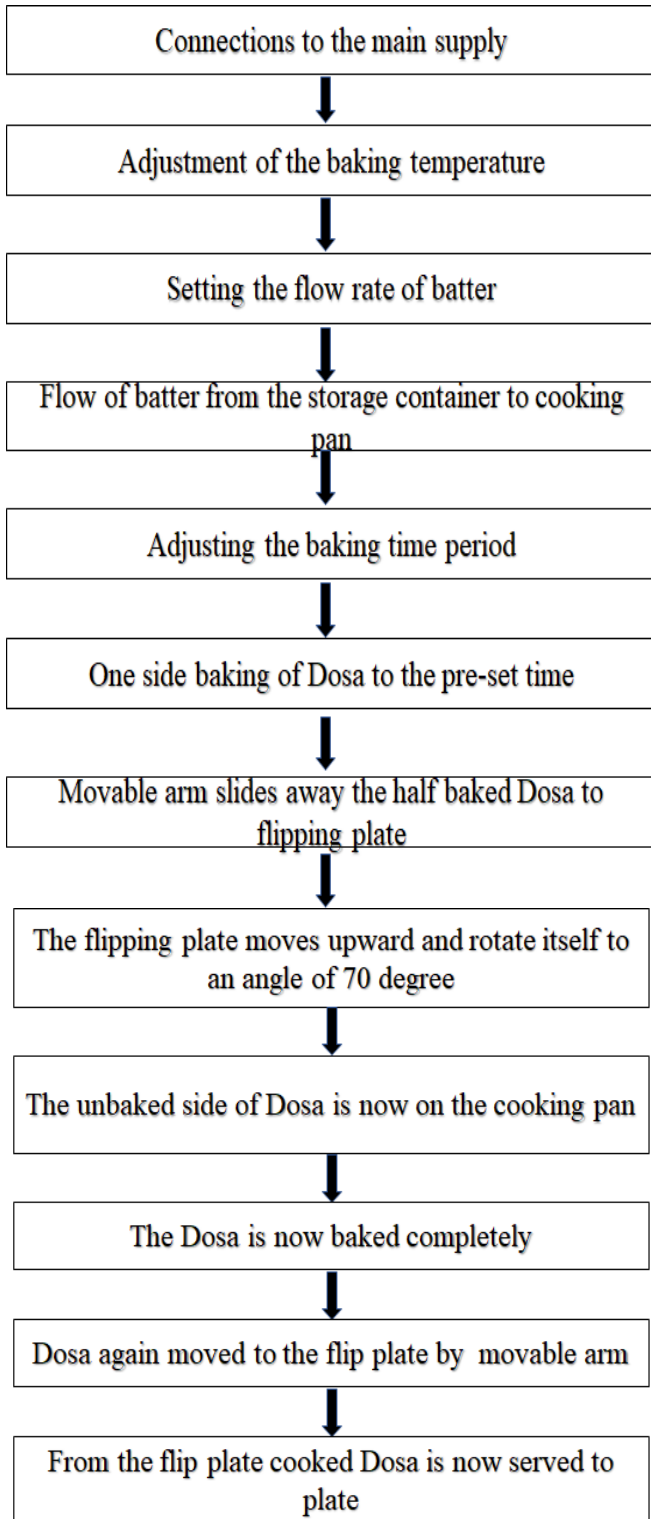


Fig 4.1 Mechanism

The power pins of induction cooktop and SMPS are connected to the main power supply separately. From SMPS, power is supplied to Arduino Mega [2] [8] through a voltage regulator. The temperature is adjusted on the induction cooktop. The oil is applied on top of the cooking pan surface to avoid sticking, by a movable sliding arm which travels from left extreme position to right extreme position. The position of the sliding arm is sensed by Arduino Mega by taking the values of switches S_1 and S_2 .

At the left extreme position, switch S_1 will be ON and switch S_2 will be OFF which corresponds to value (0,1) and at right extreme position value will be (1,0). Arduino Mega controls the DC motor through a motor driver [2] circuit. A lead screw is driven by the DC motor M_1 . Rotary motion of lead screw is converted to linear motion of the sliding arm by nut and screw mechanism. The quantity of batter and baking time are varied through two individual control knobs K_1 and K_2 which sets values for - time for which solenoid valve [4] remains open and time for baking one side of Dosa respectively. Both the control knobs are connected to two potentiometers respectively. The potentiometers are connected to the analog pins of Arduino Mega[2]. As the control knobs are adjusted, the resistance in potentiometers varies thus leading to variation in current flow. This variation in current is taken as input signal to the Arduino Mega through an analog to digital converter. A value between 0 to 3 seconds is assigned for K_1 and a value between 30 seconds to 2 minute is assigned to K_2 . Based on the time assigned to K_1 Arduino Mega controls the solenoid valve through a relay. When the relay is turned ON, current from SMPS reaches the solenoid valve and activates it. Dosa batter from the storage container [7] flows to the cooking pan. After the batter is baked to the pre-set time [6] assigned to K_2 , the sliding arm moves from left extreme to right extreme. As the sliding arm moves, it slides away the one side baked Dosa to the flipping plate. As the Arduino Mega senses the presence of the sliding arm at the right extreme end ($S_1, S_2 = 1, 0$), the arm is called back to the left extreme by programming in Arduino Mega. The DC motor runs in the opposite direction and the sliding arm reaches the left extreme end. The flipping plate is now at the lowest position and switches S_3 and S_4 are in ON condition i.e., 0 values for both switches. The flipping plate arms are rotated by DC motors M_2 and M_3 . As the flipping plate arms move upwards, the flipping plate maintains a balanced horizontal position with the help of a servo motor. The flipping plate arms now reach the limit switches S_5 and S_6 at the top position whose values now change from 1 to 0. Based on the programmed angle the servo motor rotates the flipping plates to flip the Dosa to its unbaked side. A shaking action is given to the flipping plate by the servo motor in order to make sure that Dosa is not sticking on to the flipping plate. Now the baking time is again taken from control knob K_2 . After the Dosa is baked to the assigned time, the sliding arm travels from left extreme end to right extreme end and slides the Dosa again to the flipping plate. Again, by the action of both DC motors M_2 and M_3 , the flipping plate arms move upwards and the servo motor maintains the horizontal position of the flipping plate. After the flipping plate arms reach vertical direction ($S_5, S_6 = 0, 0$), the servo motor rotates in the opposite direction and flips the fully baked Dosa on to the serving plate [3].

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V. CALCULATIONS

The Dosa batter used here is of 3:1 ratio of rice and black gram respectively. The batter density was calculated with the help of a cylinder with known diameter and height. The batter was weighed by using a weighing machine.

We know that,

$$\text{Density} = \text{Mass}/\text{Volume}$$

$$\text{Mass of volume taken for calculation} = 165 \text{ g}$$

$$\text{Volume of the cylinder} = 176\text{cm}^3$$

$$\text{Density} = 165/176$$

$$= 0.9375 \text{ g/cm}^3$$

Flow rate of batter

The weight of Dosa when solenoid valve opened for 3 seconds = 110 g

Therefore the flow rate of dosa is 27.5 g/s.

SL NO.	QUANTITY MEASURED	VALUE
1	Density	0.9375 g/cm ³
2	Weight of 1 Dosa	110 g
3	Flow rate of batter	27.5 g/s

Table 5.1 Results



Fig 5.1 Fabricated Machine

VI. TESTING

In order to check the working of machinery, the whole Dosa making sequence of the machine is operated using the batter with following properties. The Dosa batter used here is of 0.9375 g/cm³ density and consists of rice and black gram in 3:1 ratio respectively. Oil is wiped on top of the pan by the sliding arm, to and fro motion of the sliding arm takes 14 seconds. The solenoid valve remains open for 3 seconds and 110 gram of batter is poured into the nonstick pan in 3 seconds. Each side of the Dosa is baked for 2 minutes at 1200 Fahrenheit. The flipping action takes 12 seconds to flip the Dosa to the pan and 2 seconds to flip the Dosa to the serving plate. The machine is found to have an output rate of 1 Dosa per 4 minutes 45 seconds at 1200 Fahrenheit.

VII. MERITS

- The Dosa Maker is a light weighted machine. It is portable.
- Since it runs on electric current it does not have major impacts on the environment.

- The storage container could be separated and cleaned, thus improving hygiene.
- The handling of machine is safe, as they run on electricity
- There will be no human interference during the operational cycle.
- The temperature and flow rate of batter can be adjusted.
- Perfect round Dosa can be obtained.

VIII. FUTURE SCOPE

The main objective of this project was to design and fabricate a fully functional automated Dosa making machine, which bakes both the sides of the Dosa. For further development, the product could be redesigned to become more compact, lighter and cheaper – the outer sheet metal body of the machine could be replaced by moulded plastic covering. In future, for mass production - the number of Dosas could be increased by increasing the number of solenoid valves connected to the batter storage container. The user interface could be improved by using android apps – for ordering Dosas, to track time required to deliver the order and for e - payment. The machine could be designed to produce different types of Dosas like Masala Dosa, Plain Dosa, Set Dosa, Cheese Dosa, Adai Dosa etc simultaneously.

IX. RESULT AND DISCUSSION

In the final testing of the prototype it is found out that the prototype has an output of 1 Dosa per 4 minutes 45 seconds at 1200 Fahrenheit. A Dosa of 110 gram having a diameter in between 15 to 17 cm is obtained as output on the serving plate. The only concern is that since both the electrical control unit and the induction cooktop are close in proximity, the cooling fan provided may not be enough to keep lower temperature at the cabin where Arduino, circuit boards and SMPS are placed.

X. CONCLUSION

The main objective of this work is to design and fabricate a fully functional automated Dosa making machine which bakes both the sides of the Dosa without any human intervention during its cycle of operation. In this work electric power is used because of its convenience in regulating temperature, safe working conditions and eco friendliness. Through testing and experimentation it is found that the fabricated Automatic Dosa Maker machine could give an output of 1 Dosa per 4 minutes 45 seconds at 1200 Fahrenheit. The diameter and weight of the Dosa could be varied by changing the time for which solenoid valve remains open. The output rate could be increased by using higher temperature in the pan or by using more number of solenoid valves. The Automatic Dosa making machine could be used in hotels, restaurants, take away counters and drive throughs. This works provides better understanding of material selection, manufacturing design and different manufacturing methods involved in similar fabrication processes.

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