

An Attempt to Develop an Efficient Budget-Friendly Semi-Automatic Dishwasher with an Ultrasonic Soap Dispensing System for Kitchen Utensils

Sekar K S

Department of Mechanical Engineering
Murugappa Polytechnic College, Chennai, Tamilnadu, India

Abstract- Nowadays, all large families have been divided into many nuclear families. Even women in the family need to work and generate money to support their families. Women depart for the office in the early morning and return in the late evening. As a result, they struggle to keep up with household duties. Many inventions have been developed to make such tasks simpler like washing machine, vacuum cleaner and so on. One such item is a dishwasher. Dishwashing is one of the most necessary and unpleasant home duties. The machine is used to simplify the process and save time and effort. The present work is a novel approach to develop a low-cost semi-automatic dishwasher with improved cleaning efficiency, reduced water and power consumption. This equipment is designed using CREO Modeling software. The developed machine was tested and worked fine.

Keywords- Dish washer, and Soap dispenser.

I. INTRODUCTION

The use of dishwashers becoming common in households nowadays like refrigerators and washing machines. Since 1850 when the first mechanical dishwashing machine registered for patent in the US there were a lot of modifications in the design and fabrication of the dishwashers.

But, still, dishwashers are not yet common in houses due to various reasons like higher cost, low efficiency, and higher consumption of electricity and current.

The present work aimed at designing and developing a semi-automatic dishwasher with an ultrasonic soap dispensing system that can be operated with ease and low cost. The designed machine overcomes the undesirable factors in conventional dishwashers and makes them easy to handle and safe too.

II. COMPONENTS AND DESIGN

The Semi-Automatic Dishwasher consists of three major functional systems. They are, Ultrasonic Soap Dispensing System, Rotary Cleaning System, and Water Sprayer System.

1. Ultrasonic Soap Dispensing System

The following are the important components of the Ultrasonic Soap Dispensing System:



Figure 1: Components of Ultrasonic Soap Dispensing System

- Ultrasonic Sensor
- Micro Controller
- Submersible pump
- 5V DC Adapter

2. Rotary Cleaning System

The Rotary Cleaning System consists of motors and brushes. It is the main part of the Dishwasher. In this device, RS-775 12 V DC motors are used. The brushes are made of soft plastic and connected to the motor. The brush is made of Soft Plastic with Nylon Bristles which is flexible and can also have the ability to clean every nook and corner. Arduino Uno R3 board and L298 Dual H-Bridge Motor Driver Integrated Circuit are used in the device.



Figure 2: RS 775 DC Motor and Soft Flexible Brushes used in the Rotary cleaning system

3. Water Sprayer System

The Water Sprayer System washes the brushed vessels. It consists of a Multi-Angle Water Sprayer, Foggers, Hoses, a Diaphragm Pump, a stepper motor with a belt, and a pulley arrangement. The designed Multi-Angle Water Sprayer has three hands. Each hand has four Nozzles. Each Nozzles are tilted 30°, 45°, 60° and 90°. The hands also rotate with water pressure, spraying the water onto the vessels. The Sprayer is made of strong and durable ABS Plastic. The Sprayer is connected to the Hose with the help of Quick connectors.



Figure 3: Multi-angle water sprayer

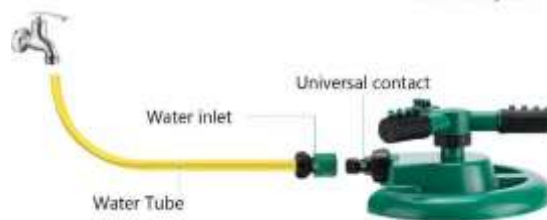


Figure 4: Multi-angle water sprayer connected to tap with the help of a hose

Foggers are also water sprayers with very fine nozzles. The nozzle size is generally 0.1mm. They are used for keeping the place wet without having water droplets. Foggers need very high pressure for spraying water. So the foggers are connected with a 12V DC Diaphragm Pump to attain the required pressure.



Figure 5: Foggers used in the device

For designing the ultrasonic soap dispensing system and rotary cleaning system of the semi-automatic dishwasher CREO software was used. The diagram shows the assembled part of various components of the major functional system.

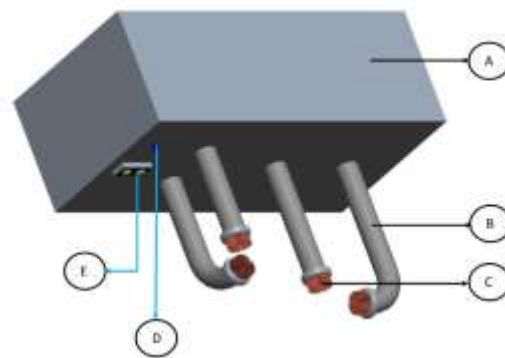


Figure 6: CREO Model of the functional systems

Table -1: Components of the CREO Model

Item	Description	Quantity
A	Frame	1
B	Motor Holder	4
C	Plastic Brush	4
D	Pipe Nozzle	1
E	Ultrasonic Sensor	1

III. FABRICATION AND ASSEMBLY

The Frame that holds the functional systems of the dishwasher was fabricated from the Mild steel rod following different manufacturing processes like drilling, welding, and grinding. The frame was covered with sheet metal in such a way that it can be easily removed and fitted again whenever maintenance and repair works are to be done on the machine. The sheet metal is fitted with the frame using standard fasteners. The Ultrasonic Sensor and nozzle for the soap dispensing system are placed in the provisions made on the frame and sheet metal assembly suitably. All the electrical and electronic components are placed in the frame. The bottom rack of the stand for holding the vessels is made from Mild steel rods by welding. The Stepper motor was assembled in the frame. Then the multi-angle water sprayer is placed in the rods in the frame suitably. The belt is connected to the water sprayer, stepper motor, and pulley. Foggers are attached to the stand through pipes and the pipes are attached to the pump.



Figure 7: Fabricated functional systems

The Semi-Automatic Dishwasher machine comprises a Dish wash Liquid tank fitted with an

Ultrasonic sensor and a plunger pump. Brushes are connected to the shaft of the motors. The motors are fitted in the space provided in the frame. The frame has space for four motors. Each motor has a brush. Two brushes for smaller utensils and the other two for larger vessels. A stand to accommodate the brushed utensils was fabricated. A Multi-Angle Water Sprayer is fitted above the stand in a belt and pulley arrangement. The stand will be fully covered to avoid splashing of water. At the bottom of the stand, the cover is bent and connected to a drain pipe to drain the water.



Figure 8: Dishwasher Stand (Cover removed)

IV. WORKING

The vessel to be washed is kept below the dish wash liquid tank. The ultrasonic sensor sends a signal to the pump and it pumps the soap liquid to the vessel. Then the rotating brushes coupled with the motor shaft brushes the surface of the vessel. Then the vessel is kept in the stand for washing. The Multi-Angle Water Sprayer kept above the stand is in the front and back motion with the help of belt and pulley arrangement. A motor drives the pulley. The polarity of the motor is changed each

time when it reaches the end of the front and back position. The forced water washes the vessels and is drained at the bottom.

The conventional dishwasher uses only high-pressure water to clean the vessels. Because of that sticky surfaces cannot be cleaned properly. It also uses more water for dishwashing. It also requires a separate space in the kitchen. With the help of rotating brushes at high speed, even the sticky surfaces can be cleaned well.

With the help of rotating brushes, the cleaning efficiency of the dishwasher is increased. It reduces the time and saves human effort. It is also Cost efficient and reliable. With the use of Ultrasonic Sensors, human effort is reduced. The only disadvantage is it requires a little human effort to hold the vessels.

In conclusion, the semi-automatic dishwashing machine developed fulfilled the requirements and performed the intended function.

Table -2: Advantages of newly developed Dishwashing machine

Conventional Dishwashers	Newly Developed Dishwasher	Result
Do not use Brush	Use brush	Cleaning Efficiency Increased
Uses 40 Liters of Water	Uses up to only 20 Liters of water Max.	Saves Water
Power Consumption is high since heating coils are used in this	Power consumption is less since fewer accessories are used	Saves Electricity
The detergent required is more	The detergent required is less	Saves Money
Cost over Rs.20,000.	Cost just Rs.5000	Saves a lot of Money

V. CONCLUSION

Conventional dishwasher machines are not popular in many houses due to reasons like high cost, low efficiency, and higher power consumption. An attempt to design and develop a budget-friendly semi-automatic dishwasher machine is made in the present work. The important functional systems were modeled using CREO software, fabricated, and assembled. The developed machine is user-friendly. It is easy to handle the dishwasher effortlessly. The machine was tested several times and it performed as expected without any deficiency.

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