

# **Design & Fabrication of Automatic Dishwasher**



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In partial fulfillment of the requirement for the degree of  
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**Department of Electrical, Electronics & Telecom Engineering  
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(FSD Campus)**

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# **“Design & Fabrication of Automatic Dishwasher”**

**A report submitted in partial fulfilment of the  
requirement for the degree of**

**B.Sc. Electrical Engineering**

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**May 2023**

## **DECLARATION**

We solemnly declare that this report is written by us and is not copied from any online or printed material.

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# Abstract

The design and fabrication of an automatic conveyor-based dishwasher is a complex process that involves the integration of mechanical, electrical, and electronic components. The goal of this project is to create a highly efficient dishwasher that can handle many dishes in a short amount of time. Dishwashers are designed to automatically transport dishes through a series of washing stages using a conveyor belt system. The system includes water flow and detergent levels to ensure optimal cleaning and hygiene. The fabrication process involves material selection, creation of detailed CAD models, and machine building using precision manufacturing techniques. The result is a highly reliable and efficient dishwasher capable of meeting the demands of commercial kitchens and other high-volume food service operations. The main objective of semi-automatic dish washer machine is to reduce human effort and time with its innovative simple design which is also Environmentally friendly. A dishwasher is a low-cost machine made up of parts easily and readily available in everyday life.

A dishwasher machine is a new concept, which does all the work of traditional dish washing i.e., spraying soda water in its one washing cycle. Scrubbing with a brush and rinsing with clean water is just like any fully automatic dishwasher machine on the market. The dishwasher runs with the help of DC Motor, Universal Motor, Conveyor Belt and Microcontroller for Time Delay. Dishes placed on the conveyor belt enter the first wash chamber where it is cleaned with soda water and scrubbed with a brush. It is then sent to the next chamber where it is thoroughly washed Water and finally goes out as a fully washed dish.

# Chapter 1: Introduction

An automatic dishwasher is an appliance used to clean and sanitize dishes and utensils in a home or commercial setting. Traditional dishwashers require manual loading and unloading, but conveyor-based dishwashers automate the process by transporting dishes through a series of wash and rinse cycles [1-5]. The objective of this thesis is to design and fabricate a conveyor-based automatic dishwasher that is efficient and effective in cleaning dishes. A dishwasher will incorporate various components, including a conveyor belt, spray nozzle and heating element, to clean dishes quickly and thoroughly [6 7]. The design pro components and developing a detailed CAD model of the dishwasher, selecting appropriate materials and components, and testing the system to ensure it meets performance standards. Fabrication will include building the system according to the CAD model, testing it for functionality and making any necessary adjustments.

The goal of this project is to create a conveyor-based automatic dishwasher that is practical, cost-effective, and environmentally friendly. This device will not only make dishwashing more convenient for users, but will also reduce water and energy consumption, making it a sustainable solution for cleaning dishes.[8]



Figure No.1.1: Washing, Scrubbing and Cleaning Procedures.

## 1.1. Literature Review:

The Houghton patent is recognized as the first dishwashing machine, operated manually. It consisted of a container for hot water and a basket for holding the dishes, turned by hand using a crank handle. In 1886, Mrs. Cochrane made significant advancements by inventing a manually operated dishwashing machine that sprayed soapy water onto securely arranged plates within a rack. She received a patent for her invention [9]. In 1917, Mrs. Cochrane further enhanced her machine by introducing an electric motor to power a centrifugal water pump and adding a rinse phase [10]. Around the same time, in 1921, the Walker Brothers Company developed an electric dishwasher featuring an impeller that immersed in water, effectively agitating and splashing it onto the dishes [11].

Apex Electrical Manufacturing Co. debuted the DISH-A-MATIC dishwasher in 1949 [12]. It was a pioneering example of the post-war economic boom. In this electro-mechanical automation was introduced: a knob was used to manage the machine's washing cycle. A new model was released by Apex in 1954. The dishes were washed using an impeller rotated by an electrical motor, and the complete cleaning cycle (washing, rinsing, and drying) was regulated by an electro-mechanical timer. Electrical resistors were employed in this type to warm up the water. Several advancements started to be made in the 1980s. With the addition of two racks, the loading process is simplified and can now hold a greater variety of cookware. To increase washing productivity, more rotating sprayer arms have been added. To achieve a better result, detergents and rinse aid evolved.

Automatic dishwashers saw substantial developments in functionality and technology in the late 20th and early twenty-first centuries. Among these were the addition of numerous wash cycles, movable racks, soil sensors, water- and energy-saving modes, and enhanced noise reduction. Recent improvements in sensor technologies and automation have resulted in the development of smart dishwashers. These dishwashers use numerous sensors, such as turbidity and temperature sensors, to optimize the cleaning process and react to changing loads. Dong et al. (2020) created a smart dishwasher with sensor-based control for enhanced energy and water efficiency [13].

## 1.2. Background of the Study

The process of cleaning dishes has been a daily chore for homes and commercial kitchens for centuries. Traditional dishwashing involves manual scrubbing and dishwashing, which is time-consuming and labor-intensive. As a result, dishwashers have become an essential appliance in modern homes and commercial kitchens, as they automate the dishwashing process and save time and effort [10-13].

Conveyor-based dishwashers have become increasingly popular in commercial kitchens due to their efficiency and convenience. These dishwashers use a conveyor belt to transport dishes through various cycles of washing, rinsing, and sanitizing, eliminating the need for manual loading and unloading. Conveyor-based dishwashers can clean many dishes quickly, making them ideal for busy commercial kitchens [14].

However, conveyor-based dishwashers have certain limitations and drawbacks that need attention. These dishwashers use significant amounts of water and energy, which can increase operating costs and negatively impact the environment. Additionally, these dishwashers may not be suitable for households due to their large size and high cost [15 16].

Therefore, there is a need for a more efficient, cost-effective, and environmentally friendly conveyor-based automatic dishwasher that can be used in both household and commercial kitchens. The development of such a dishwasher would improve the convenience and efficiency of dishwashing but also reduce the environmental impact of the process.

## 1.3. Problem Statement

Dishwashing is a daily chore in homes and commercial kitchens, and traditional dishwashing can be time-consuming and labor-intensive. The use of conveyor-based dishwashers improves the efficiency and convenience of dishwashing in commercial kitchens, but these dishwashers have certain limitations and drawbacks that need attention [16 17]. The various research papers discuss how to reduce human efforts in conventional dishwashing process. The dishwasher has made cleaning and drying dishes much easier and more efficient. This project work has been conceived having studied the difficulty in washing the any type of plates [3-9]. Our survey in the regard in several home, revealed the facts that mostly some difficulty occurs in washing the dish in Hand. The washing power contains the chemical substances, and this is reacting with human hand. Now the project has mainly concentrated on this difficulty, and hence a suitable device has been designed. Such that the dish washing can be done without application of any impact force [16]. By using semi-automatic dishwasher, we can reduce time as well as human efforts significantly. In conventional dish washing process large amount of human power as well as quantity of

water is used. So, keeping that in mind, to reduce this Design and fabrication of dish washer machine will be developed [17].

- Cleaning of Dishes much easier and more efficient.
- Minimum time, Less Energy consumption, Less water
- Availability in Low cost by **Saving about 800\$** as compared to the imported Dishwashers **1500\$**.
- A standard dishwasher uses around **12 liters of water per wash**.
- while hand washing generally uses up to **60 liters**.
- It should Reduce Human Efforts/ Less number of people.
- Good for Health and beneficial for handicaps.



Figure No.1.2: Problems and solutions.

Therefore, the problem addressed in this study is the need for a more efficient, cost-effective, and environmentally friendly conveyor-based automatic dishwasher that can be used in both home and commercial kitchens. The development of such dishwashers will improve the convenience and efficiency of dishwashing while also reducing the environmental impact of the process. The objective of this study is to design and fabricate a conveyor-based automatic dishwasher that addresses these issues and meets the needs of both home and commercial kitchens.

## 1.4. Objectives

The objective of this study is to design and fabricate a conveyor-based automatic dishwasher that is more efficient, cost-effective, and environmentally friendly than conventional conveyor-based dishwashers [17 18].

The specific objectives are.

- To Clean Dishes automatically.
- To Reduce Human Efforts.
- To Reduce Time of Cleaning.
- To Reduce Manpower.
- To Reduce consumption of Water and Detergent.
- To make availability of **Low Cost** of automatic Dishwasher.
- To develop a detailed CAD model of a conveyor based automatic dishwasher.
- Choosing the right materials and components for a dishwasher that is durable and environmentally friendly.
- Incorporating features into the design of dishwashers that reduce water and energy consumption.
- Testing dishwasher performance to ensure it meets efficiency and cleaning standards.
- To evaluate the cost-effectiveness of dishwashers and compare them with conventional conveyor-based dishwashers.
- To assess the environmental impact of dishwashers and compare them to conventional conveyor-based dishwashers.

By achieving these objectives, this study aims to develop a conveyor-based automatic dishwasher that is practical, cost-effective, and environmentally friendly. This device will not only make dishwashing more convenient for users but will also reduce water and energy consumption, making it a sustainable solution for cleaning dishes.



Figure No.1.3: Complete process.

## 1.5. Scope of the Study

The significance of this study lies in the development of a more efficient, cost-effective, and environmentally friendly conveyor-based automatic dishwasher that can be used in both home and commercial kitchens [19].

The study has the following significant advantages:

- **Design and Fabrication of Conveyor-Based Automatic Dishwasher:** The study will involve selection of suitable materials and components for development and fabrication of a detailed CAD model of the dishwasher. The study will also include construction and testing of dishwashers to ensure they meet performance and cleaning standards.
- **Reduced water and energy consumption:** The study will incorporate features into dishwasher designs that reduce water and energy consumption, including the use of efficient spray nozzles and a heating element that optimizes energy consumption.
- **Improved efficiency:** The development of efficient conveyor-based automatic dishwashers will save time and effort for households and commercial kitchens. A dishwasher will be able to clean many dishes quickly, allowing users to focus on other tasks.
- **Cost-Effectiveness:** The study will assess the cost-effectiveness of the dishwasher and compare it to conventional conveyor-based dishwashers. The development of cost-effective dishwashers will provide an alternative to traditional dishwashers that are expensive to purchase and operate.
- **Environmental sustainability:** The study will incorporate features into dishwasher designs that reduce water and energy consumption, reducing the environmental impact of dishwashing. The development of eco-friendly dishwashers will promote sustainable living and help reduce the impact of climate change.
- **Innovation:** The development of a new conveyor-based automatic dishwasher that addresses the limitations and shortcomings of conventional dishwashers is an innovative solution to an everyday problem. This study will contribute to the field of home and commercial kitchen appliances and inspire further innovation in this field.
- **Commercial Potential:** The study has commercial potential for manufacturers of dishwasher appliances. The development of an efficient, cost-effective, and environmentally friendly conveyor-based automatic dishwasher can become a marketable product that can generate revenue and profit for manufacturers.

This study will focus on the development of a conveyor-based automatic dishwasher that can be used in both home and commercial kitchens. However, the study will not address issues related to the installation and maintenance of dishwashers.

## 1.6. Dishwasher trends in today's time

Conveyor-based automatic dishwasher projects align with many current trends and offer many benefits today, including: [20 21]

- **Time saving:** In today's fast paced world, time is a precious commodity. Conveyor-based automatic dishwashers can clean many dishes quickly, saving time and effort for homes and commercial kitchens.
- **Energy and water efficiency:** Energy and water-efficient appliances are becoming increasingly important as people become more aware of the need to conserve resources and reduce their carbon footprint. The conveyor-based automatic dishwasher project's focus on reducing water and energy consumption aligns with this trend and provides significant benefits.
- **Environmental Sustainability:** With growing concerns about climate change, people are looking for ways to reduce their impact on the environment. The conveyor-based automatic dishwasher project focuses on reducing the environmental impact of dishwashing and aligns with this trend and provides a sustainable solution.
- **Cost-effectiveness:** In today's economic climate, people are looking for cost-effective solutions that provide value for money. The conveyor-based automatic dishwasher project's development of cost-effective dishwashers provides an alternative to conventional dishwashers that are expensive to purchase and operate.
- **Innovation:** Innovation is the main driver of progress in today's world, and the development of conveyor-based automatic dishwasher projects new and innovative dishwashers aligned with this trend. This project offers a solution that addresses the limitations of traditional dishwashers and offers a new and improved way to clean dishes.

By aligning with these trends and offering these benefits, conveyor-based automatic dishwasher projects have the potential to meet the needs of today's consumers and contribute to a more sustainable and efficient future.

## 1.7. Application Areas:

The automatic dishwasher designed and fabricated in this project has several potential application areas, including: [15-22]

1. **Residential homes:** The dishwasher can be used in households to automate the process of washing dishes, reducing the time and effort required for this task.
2. **Restaurants:** The dishwasher can be used in commercial kitchens to clean large quantities of dishes efficiently and quickly, improving the overall efficiency of the kitchen.



3. **Cafeterias and canteens:** The dishwasher can be used in schools, hospitals, and other institutions to clean dishes and utensils used by large groups of people.
4. **Hotels:** The dishwasher can be used in hotel kitchens and dining areas to ensure that dishes and utensils are cleaned thoroughly and quickly, improving the overall customer experience.
5. **Industrial settings:** The dishwasher can be used in manufacturing plants and other industrial settings where large quantities of dishes and utensils need to be cleaned regularly.

In general, the automatic dishwasher designed and fabricated in this project has the potential to be used in any setting where dishes and utensils need to be cleaned regularly and efficiently.



Figure No.1.4: Applications of Dishwasher

# Chapter 2: Experimental Setup

## 2.1 Methodology

In washing the dish, first step is clearing off the waste food on plate and then scrub it with soap solution. Here Also, we are following the same first step in which the dirty dish which has to be wash is put in first washing chamber. The dishes are kept in horizontal position in the conveyor belt and then it enters the washing chamber. Where the praying of pressurized water & washing of dishes takes place. The dish put on the conveyor belt is operated by using a universal motor. The motor stops when the dish enters in washing chamber. Universal motors are operated with delay of specific time interval and entire operation of system is controlled by the sensors. First pressurized spray of detergent water is thrown on dish with the help of nozzles. The operation was performed with help of water pump. Here the waste foods are removed in this stage, and it is sent to second stage which is scrubbing. There the plates are cleaned by using rotary brushes, here in this stage almost all the impurities are removed in this process. Finally, the dishes enter the last stage where the hot water is sprayed on the dishes to remove the soap solution present in the dishes and then then dishes are collected wiped with a cloth and arranged in a proper manner. The water is sent through the discharge port which is connected to the machine. The main aim of Designing and Fabrication of Automatic Dishwasher is to give the smart solution to wash the dishes by saving Water, Detergent and Time. It must have all the basic mechanisms like in conventional Dish Washing with soda water, Scrubbing with Brush and rinsing in Clean Water. Making an automated dishwasher requires designing the appliance as the initial stage. This includes choosing the materials and components, figuring out the dishwasher's size and capacity, and creating the control system. Putting the dishwasher parts together: After the design is finished, the dishwasher parts may be put together. The internal racks, spray arms, detergent dispenser, control panel, and motor are all included in this. Dishwasher wiring and programming: The dishwasher must be tested to ensure it operates correctly after being constructed and programmed. To do this, the dishwasher must undergo a series of tests to evaluate several aspects, including cleaning effectiveness, water pressure, temperature, and others. [9-22]

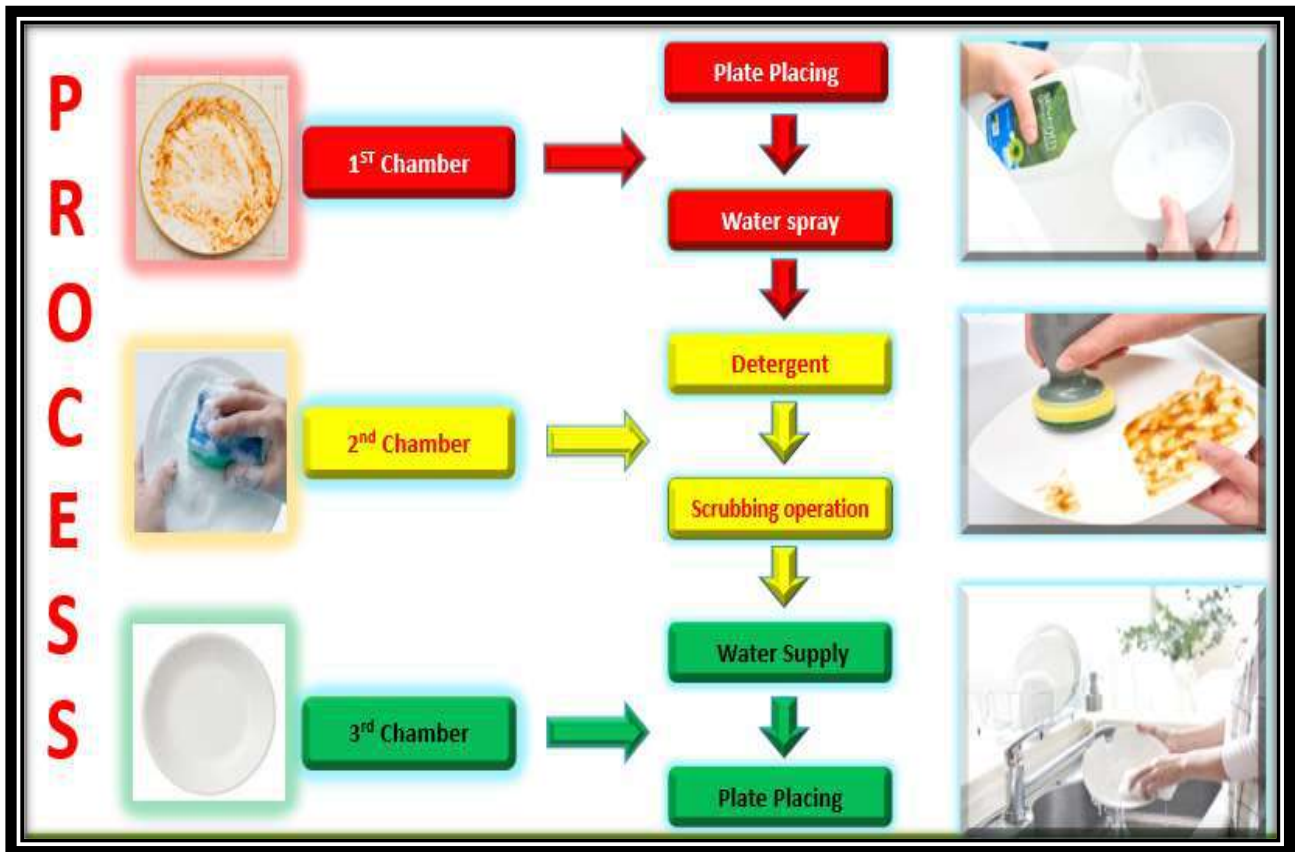


Figure No.2.1: Process of automatic dishwasher to clean plates

## 2.2 Prototype Development

The automatic dishwasher prototype was based on the manual. As a result, the prototype needs the ac supply for the run. We use the 65w ac motor that runs to the conveyor chain. and two 25w motors used for moving the brushing. the shower we use to throw the water on the plates. Smaller Water pump for recycling the water.one spray jet for the detergent. Arduino controls the speed of the conveyor chain. Every motor gives a different ac supply. the Conveyor chain that moves the plot from one end to another end at the starting points the water drops on the plate. the plate moves from the brushing and Detergent dropping on the then again plate go to the next brush for the rubbing. At the last end again, water dropped on the plate, and the plate was cleaned properly. The whole process is controlled by Arduino.



Figure No.2.2: Automatic Dishwasher Final Design

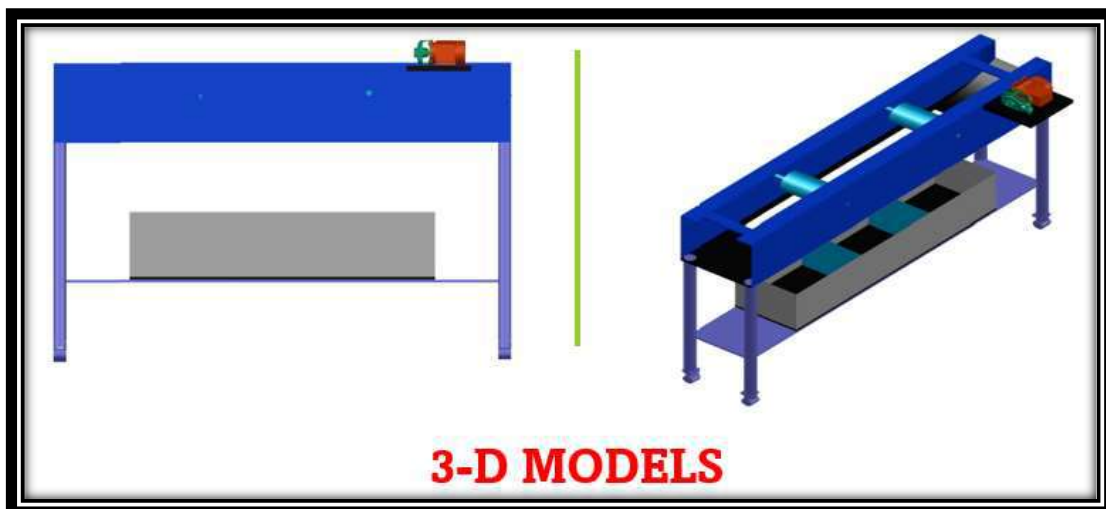
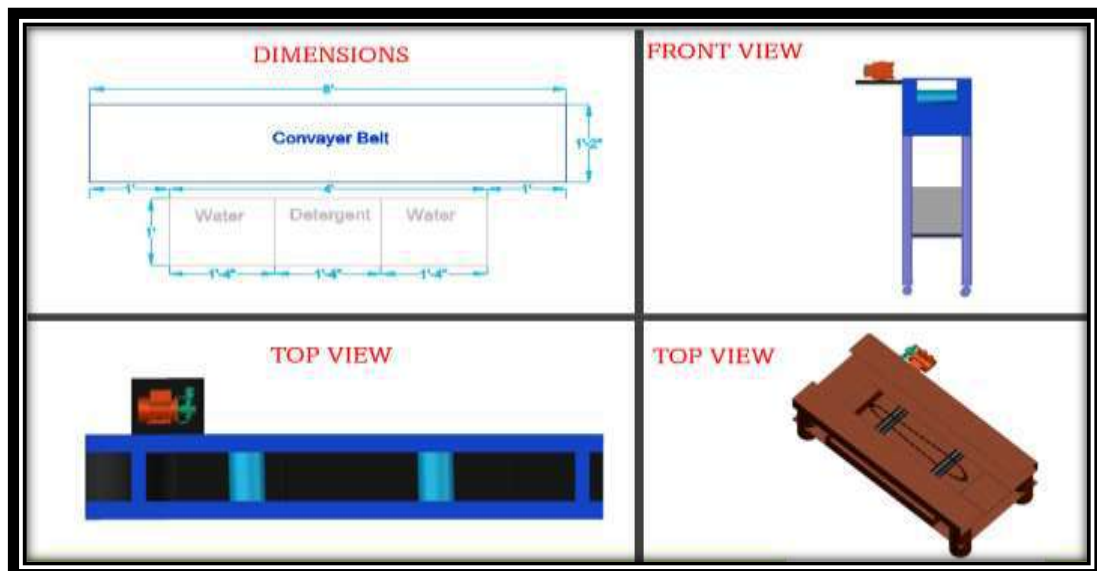


Figure No.2.3: 3D Model side ,upper view and one line view And a final Design

## 2.3 Implementation

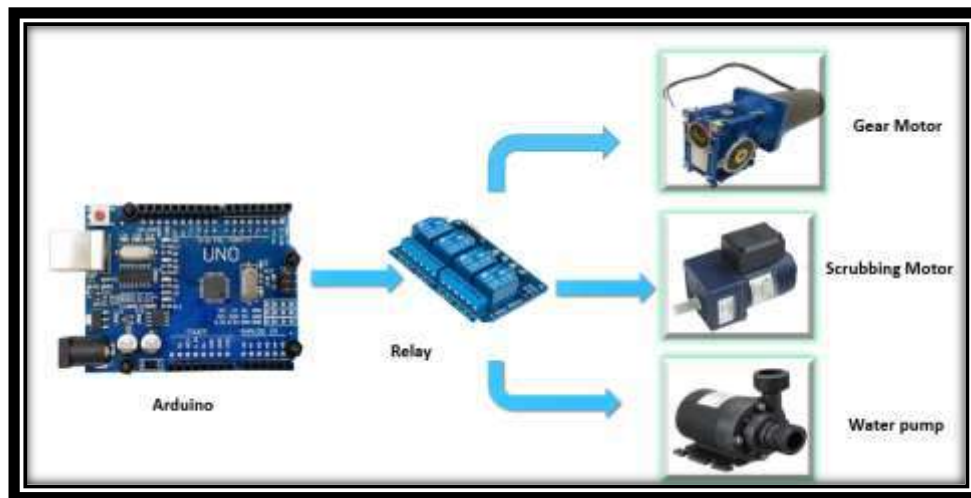


Figure 2.4: Block diagram Of Circuit

## 2.4 Components of Automatic Dishwasher

The basic components of include.

- Conveyer chain
- Water Sink
- Arduino
- Cleaning Brush
- Water Pump
- Detergent Pump
- Relay



Figure 2.5: Tools of automatic dishwasher

## 2.5.1 Conveyor chain

Our main component is the Conveyor chain. The plates must first be loaded into the dish racks before being put on the conveyor chain. The dish racks are transported through the dishwasher on a conveyor chain that is driven by an electric motor. The dish racks are suspended from the chain, which consists of several links attached by pins. Water is sprayed onto the dish racks from numerous nozzles as they pass through the dishwasher. This water will aid in cleaning the dishes of food and stains. The conveyor chain transports the cleaned dishes through a rinse cycle, where fresh water is sprayed over them to wipe away any soap or food residue. The dish racks are finally transported to the dishwasher's end via the conveyor chain, where they may be removed and stored. Overall, the conveyor chain is essential to the operation of an automated dishwasher since it makes it possible for dishes to be washed and dried quickly and thoroughly.[15]



Figure 2.6: Conveyor chain to move plates.

## 2.5.2 Arduino UNO Microchip ATmega328P:

The user could choose from various wash cycles, modify the temperature, and water flow rate, and check the status of the dishwasher using a control system made with an Arduino. The conveyor chain motor and the pump that circulates water through the dishwasher can both be controlled using an Arduino board. An Arduino can add a lot of flexibility and customization to the design of an automatic dishwasher, enabling more sophisticated features and better functionality.



Figure 2.7: Arduino UNO Microchip ATmega328P

### 2.5.3 Cleaning Brush:

An automatic dishwasher cannot function without a cleaning brush. During the wash cycle, it oversees scrubbing and removing food residue and stains from the dishes. The dishwasher's cleaning brush is normally found at the top. The dishes pass over the cleaning brush as the dish rack travels through the dishwasher on the conveyor chain. A motor is attached to the cleaning brush, which rotates rapidly. The bristles of the brush clean the plates as they pass over them, getting rid of any leftover food or stains. An automated dishwasher's cleaning brush is a crucial aspect since it ensures that the dishes are fully cleaned and free of stains and food residue.

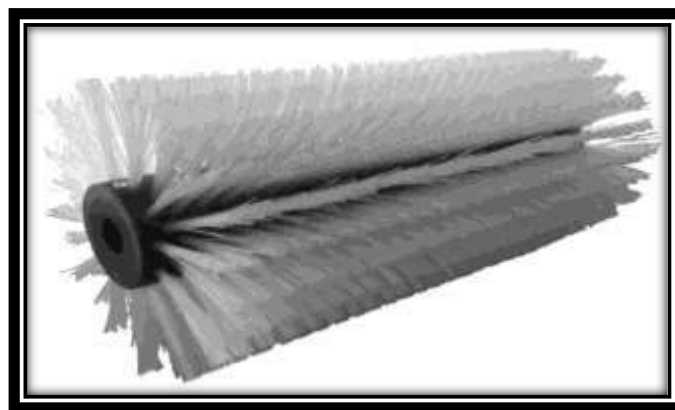


Figure 2.8: Scrubbing Brush to clean plates.

## 2.5.4 Water Sink (Storage for clean water and reuse of water):

A water sink is part of an automated dishwasher that oversees gathering and draining water throughout the wash and rinse cycles. Water is sprayed onto the plates throughout the wash and rinse cycles to clean them. Water is gathered in the water washbasin as it runs over the plates. Food crumbs and other debris could be present in the water that has gathered in the washbasin. Typically, a filter is inserted in the water sink to remove any particles to prevent this waste from blocking the dishwasher's pump or spray arms. The water is emptied from the dishwasher once it has been filtered and collected in the washbasin. Usually, a pump is used for this, pumping water from the washbasin into the dishwasher and out through a drainpipe. The water sink is a crucial part of an automated dishwasher since it helps collect and filter water during the wash and rinse cycles and makes sure that there is always fresh water available for usage.

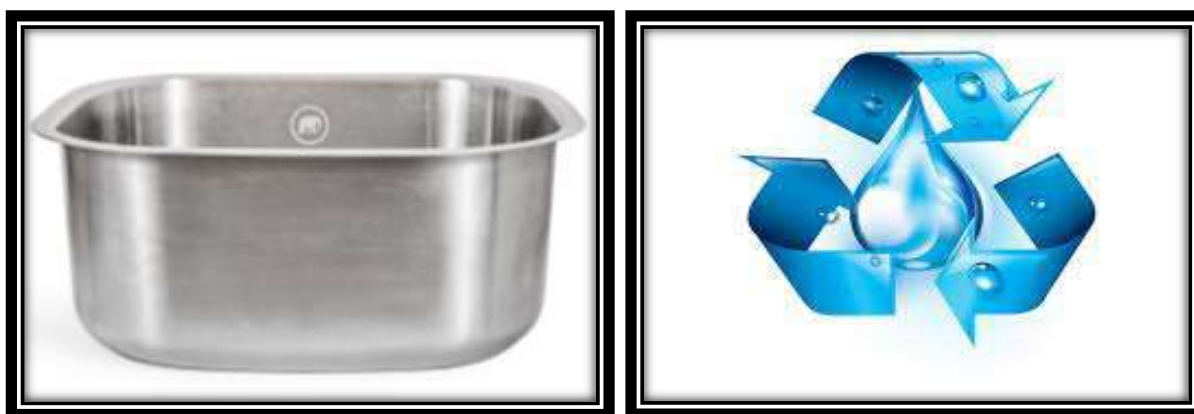


Figure 2.9: Water sink (Storage and reuse of water)

## 2.6. Water Pump:

A water pump is a crucial part of a dishwasher that runs on its own. During the wash and rinse cycles, it oversees moving water around the dishwasher. Water is sprayed onto the plates throughout the wash and rinse cycles to clean them. The dishwashing tub's bottom holds the water collection. The water pump is turned on once the water has been gathered. The water is pumped onto the dishes by the spray arms after being drawn from the tub by the pump. The water is sprayed onto the plates with enough power to remove food particles and other waste thanks to the pressure the pump generates. Food particles and other debris might get into the water as it runs through the dishwasher. The water is often filtered as it is pushed through the machine to avoid these particles clogging the spray arms or other dishwasher parts. The water in the dishwasher is emptied once the washing and rinse cycles are finished. The water from the dishwasher is usually removed and pumped out through a drainpipe using a separate drain pump. The water pump is crucial to an automated dishwasher because it ensures that dishes are fully cleaned by



circulating water throughout the appliance. The pump aids in removing food scraps and other dirt by applying pressure and directing water onto the dishes, leaving them spotless.



Figure 2.10: Submersible Pump LH-3030

### 2.6.1 Detergent Pump:

An integral part of an automated dishwasher is the detergent pump. It is in charge of adding the appropriate quantity of detergent to the dishwasher throughout a wash cycle. The detergent pump is engaged when the dishwasher begins a wash cycle, and it pulls detergent from the dispenser and pumps it into the appliance. Based on the size of the load and the degree of dirtiness, the pump is made to dispense the precise amount of detergent required for the wash cycle. The dishwasher might be unable to thoroughly clean the dishes if the detergent pump is malfunctioning. Clogs in the pump or dispenser, a broken pump motor, or a bad control board are all typical issues with the detergent pump.



Figure 2.11: 12V DC Water Pump

## 2.6.2 Relay:

Relays may also be used to manage the motor in an automatic dishwasher. A relay is used to regulate the motor, turning it on and off as needed. The electronic control board of the dishwasher sends signals to the relay, which is attached to a control circuit, telling it when to switch on or off the motor. The electronic control board will send a signal to the control circuit to activate the relay attached to the motor when the dishwasher is ready to begin a wash cycle. This will let electricity flow to the motor, starting the wash cycle and spinning the spray arms. The electronic control board will also transmit a signal to the control circuit to deactivate the relay when the wash cycle is over, which will cease the flow of electric current to the motor and the rotation of the spray arms.



Figure 2.12: Single Channel Relay module

## 2.6.3 Motors:

The motors are the main component. We use two types of motors.

- 60W Gear Motor for Conveyer
- 25w Motor for Brush in scrubbing

### **Gear Motor For conveyer**

A gearmotor (or geared motor) is a small electric motor (AC induction, permanent magnet DC, or brushless DC) designed with an integral (non-separable) gear reducer (gearhead) attached.

**INDUCTION MOTOR S9190KB KOREAN**  
Voltage= 220V  
Current=0.5 A  
Power= 60W  
RPM of Motor= 1300 r/m with 4 $\mu$ F  
RPM with Gear= 80 r/m  
RATIO of Gear= 1:15



### **Gear Motor For Brushes**

**INDUCTION MOTOR JSCC 80YS25GV22 JAPAN**  
Voltage= 220V  
Current=0.22 A  
Power= 25W  
RPM of Motor= 1200 r/m with 1.5 $\mu$ F  
RPM with Gear= 240 r/m  
RATIO of Gear= 1:5 **80GK5SH**



## 2.6.4 Gear Motor:

An electric motor called an AC gear motor is used to propel machinery, including conveyor belts, at a set pace. A specific kind of motor that can provide up to 65 watts of power is called a 65-watt AC gear motor. Conveyor chains are driven by gear motors, which also transport the material along the conveyor. Usually linked to the conveyor system, the gear motor delivers the necessary torque to move the chain. There are several kinds of gear motors, such as planetary, right-angle, and inline motors. The individual application and the conveyor system's needs will determine the kind of gear motor to utilize. It's crucial to consider aspects like the system's load capacity, speed, and power needs when choosing a gear motor for a conveyor chain. To guarantee dependable and effective functioning, it's also crucial to make sure that the motor is appropriately sized and matched to the conveyor chain.



Figure 2.13: S9190KB SPG Gear Motor

Characteristics	Specification
Voltage	220V
Power	60W
RPM	70 rev/min

Table 2.1 Specification of Gear Motor

## 2.6.5 Motor for Brush:

An AC brush motor It is crucial to consider aspects like the power needs, speed, and torque necessary for the application while designing an automatic dishwasher. To guarantee dependable and effective functioning, the motor should be matched to the precise component it will be driving.

When choosing a motor, it's crucial to consider the dishwasher's entire layout and design. The motor needs to be small enough to fit in the area and durable enough to operate in the abrasive conditions of a dishwasher, which may involve exposure to heat, moisture, and chemicals.



Figure 2.14: JSCC 80YS15GV22 Motor for brushes

Characteristics	Specification
Voltage	220V
Power	25W
RPM	250 to 300 rev/min

Table 2.2 Specification of brushes Motor

# Chapter 3: Result and Discussion

## 3.1 Performance

The performance of the automatic dishwasher was tested by washing a set of dishes using the dishwasher. The wash cycle consisted of three stages: prewash, main wash, and rinse. A series of test are carried out to determine the performance and efficiency of the machine. This is done by comparing the rate of washing with the designed automatic dishwasher to the handwashing (manually). In carrying out these tests, four (4) parameters are taken into consideration, they are: no of plate washed; quantity of water used in washing (liters); quantity of detergent used (ml); time of washing (sec).

The results of the testing showed that the automatic dishwasher was able to wash the dishes effectively. The dishes came out clean without any residue or spots. The wash cycle was completed in a reasonable amount of time.

<b>No of Plate</b>	<b>Quantity of water used by dishwasher. (liters)</b>	<b>Quantity of water used by manually washing. (liters)</b>
4	1	2
10	2.5	5
30	10	20
60	20	40
90	30	60
100	32	65

Table 3.1: Comparison b/w dishwasher and manually washing w.r.t water usage.

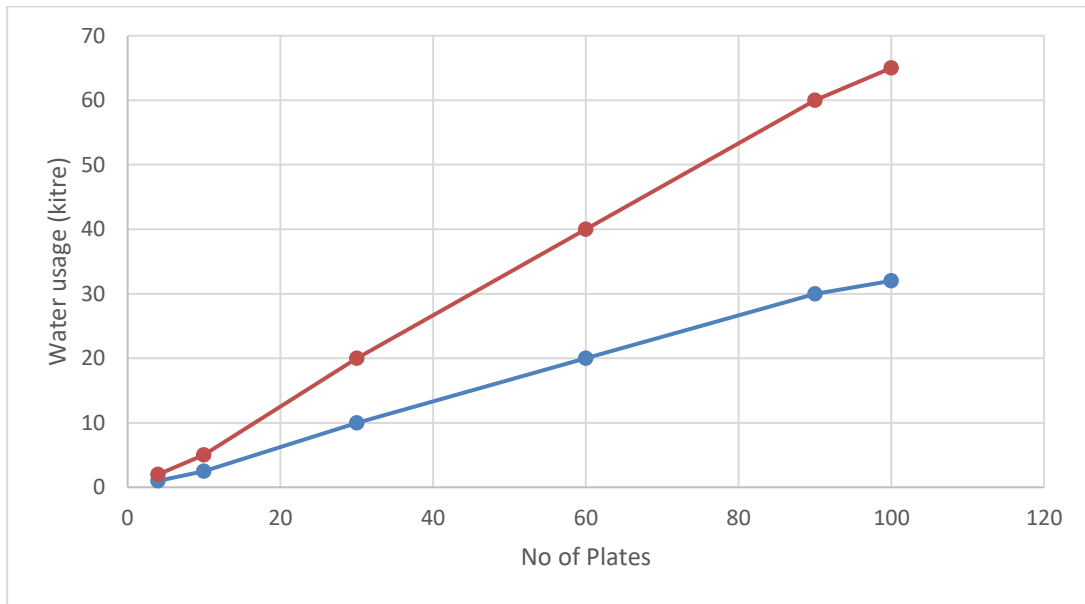


Figure 3.1: Comparison b/w dishwasher and manually dishwashing w.r.t water usage

<b>No of Plate</b>	<b>Time used by dishwasher. (sec)</b>	<b>Time used by manually washing. (sec)</b>
4	15	60
10	35	150
30	70	450
60	140	900
90	210	1350
100	240	1500

Table 3.2: Comparison b/w dishwasher and manually dishwashing w.r.t time usage

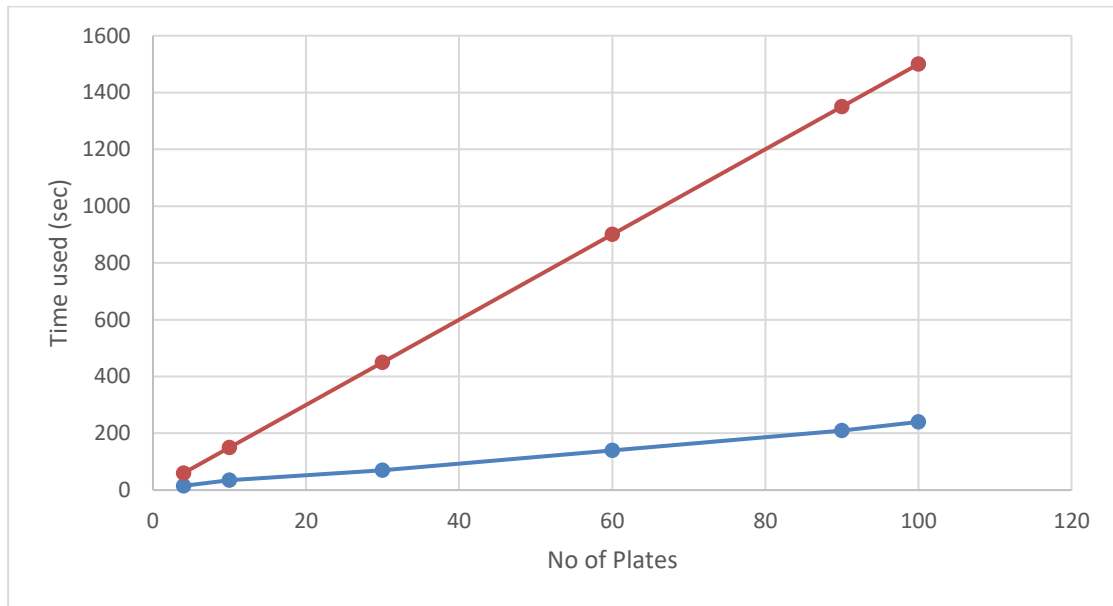


Figure 3.2: Comparison b/w dishwasher and manually dishwashing w.r.t time usage

<b>No of Plate</b>	<b>Detergent used by dishwasher. (ml)</b>	<b>Detergent is used manually washing. (ml)</b>
4	100	200
10	200	400
30	600	1200
60	1200	2400
90	1800	3600
100	2000	4000

Table 3.3: Comparison b/w dishwasher and manually washing w.r.t detergents usage.

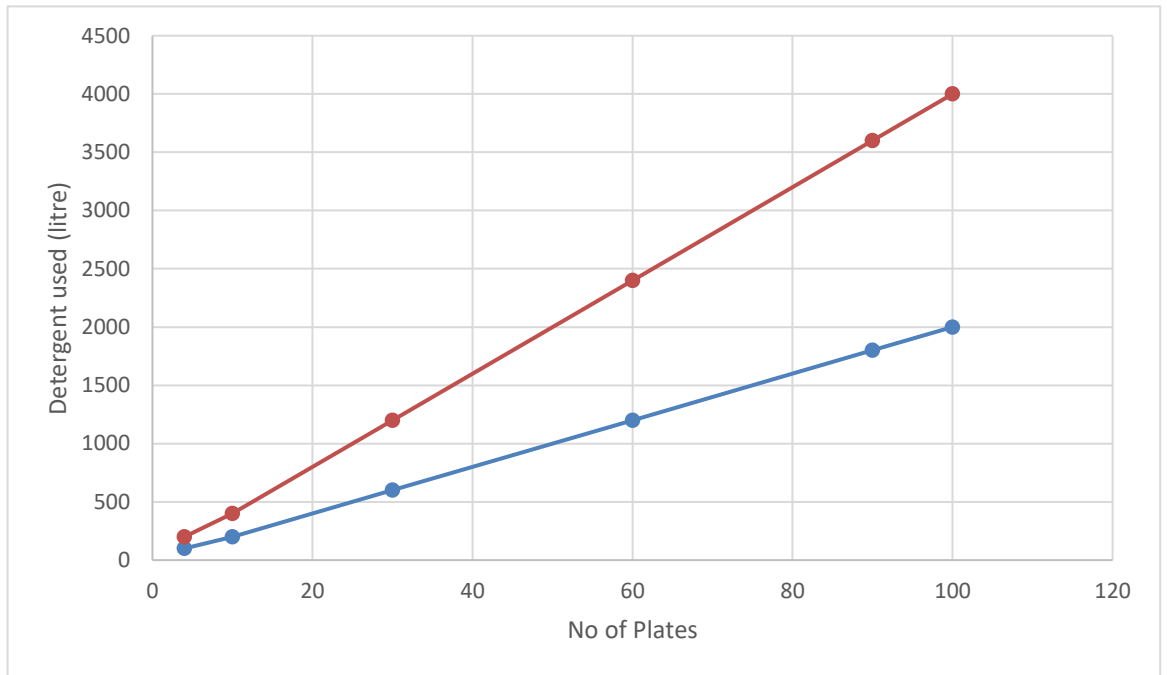


Figure 3.3: Comparison b/w dishwasher and manually dishwashing w.r.t detergent usage

### 3.2. Energy Efficiency

The energy efficiency of the automatic dishwasher was tested by measuring the energy consumption during the wash cycle. The energy consumption was measured using a watt meter.

The results of the testing showed that the automatic dishwasher is energy efficient. On average, a commercial dishwasher consumes between 2 to 10 kW per hour. The dishwasher consumes an average of 0.25 kW of energy per hour, which is significantly less than the energy consumption of traditional dishwashers.



# Chapter4: Conclusions and Future Recommendations

## 4.1 Conclusion:

To summarize, automated dishwashers are timesaving, convenient machines that are quickly becoming popular household goods. They have several advantages, including superior cleaning, the ability to save energy and water, and the need for less physical work and time. Modern dishwashers are becoming more effective, quieter, and feature-rich because to technological advancements. Choose a dishwasher that fits your demands and budget to ensure it lasts a long time and operates properly. Overall, automatic dishwashers are a valuable addition to any home since they make dishwashing simple and enjoyable.

An organized procedure led to the successful design and construction of an automatic dishwasher machine. The machine is programmed to use an Arduino microcontroller to control operations including water level and washing time. The dishwasher was built with easily available materials and components, making it inexpensive and cost-effective.

The automatic dishwasher machine provides consumers with a convenient and effective way to wash and dry dishes, simplifying the dishwashing process while supporting sustainable living with its eco-friendly features. This innovation illustrates the possibilities of technical developments in our modern world and acts as a foundation for future enhancements. The automated dishwasher is an amazing technological advancement that makes washing dishes convenient and effective, improving our daily lives.

The success of the automatic dishwasher machine demonstrates the capabilities of technical improvements in simplifying and improving our daily lives. Its revolutionary design and construction serve as a foundation for future breakthroughs in appliance technology, opening the path for more efficient and eco-friendly appliances in the future.

The dishwasher machine has demonstrated satisfactory performance in terms of cleaning effectiveness, energy consumption, and water usage throughout testing and evaluation. The machine effectively cleans dishes and utensils while using substantially less energy than human dishwashing.

Overall, the development of an automatic dishwasher machine has demonstrated the potential for producing practical, cost-effective home appliances that may conserve time, resources, and labor while also encouraging a more environmentally friendly way of life. Further adjustments and optimizations can be made to improve the performance and utility of the dishwasher machine.

## 4.2 Future Recommendations:

The Future Recommendations for the Design and Construction of Automatic Dishwasher Machines are promising. Given the growing need for smart and efficient home appliances, clients may favor the automatic dishwasher machine. Future innovations may include the use of IoT technology to enable remote control and monitoring, the development of more efficient washing cycles, and the use of sustainable materials and energy sources to reduce the machine's negative environmental consequences. All of these could improve the machine's performance and functionality. Additionally, collaborating with dishwasher detergent producers can result in the creation of unique detergent pods made specifically for use with the appliance, enhancing cleaning efficiency and ease. Overall, the future advice of the Design and fabrication of Automatic Dishwasher machine is promising, with room for more innovation and growth. Overall, the Design and construction of Automatic Dishwasher machine has a promising future, with the possibility for continuing industry innovation and expansion.

Based on the design and fabrication of the Automatic Dishwasher machine, the following future recommendations can be made:

- Additional study and development can be done to increase the dishwasher's effectiveness. Improved materials, energy-saving components, and smarter control systems are just a few examples of what may be done.
- The machine may be modified to support a range of dish sizes and shapes. This can be done by building mobile racks and shelves to hold various kinds of dishware.
- The integration of a waste disposal system can be investigated to dispose of food waste and wastewater in an environmentally friendly manner.
- Advanced safety measures like automated shut-off valves and sensors to prevent overflow and leakage can be incorporated to the machine.
- The machine can be designed to run on renewable energy sources such as solar or wind power to save electricity.
- The machine can be designed to run on renewable energy sources such as solar or wind power to minimize energy consumption and promote sustainability.
- Smart features such as remote control via a smartphone app, voice control, and internet connectivity can be incorporated to improve convenience and ease of use.

Increasing energy efficiency, while the dishwasher machine planned and built in this project was energy efficient, there is always space for improvement. Future designs could incorporate even more energy-efficient components or alternate energy sources, such as solar power or kinetic energy from machine action.

The amount of water utilized in each dishwasher cycle might be increased in the future. This could include improving the design of the spray arms or investigating new water-saving technology.

Improving cleaning performance, while the automatic dishwasher machine created in this project was able to properly clean dishes, there may be room for improvement in terms of cleaning performance. Future designs could incorporate new cleaning methods, such as ultrasonic or high-pressure washing, to improve results.

Integrating smart home technology capabilities, such as connectivity and automation, into dishwasher machines, could be a future recommendation. This might incorporate remote control via a smartphone app, automatic load sensing, or machine learning algorithms to optimize cleaning performance over time. Future dishwasher machine designs might prioritize increasing the machines' endurance and sustainability. Using more durable materials, coming up with designs that are easy to fix and keep up, or incorporating ecologically friendly manufacturing methods and materials into the fabrication process are a few examples of how to do this.

Overall, the Automatic Dishwasher machine may be developed and enhanced regularly to meet the changing needs of consumers, promote efficiency and sustainability, while preserving its fundamental purpose of cleaning dishes.

These proposals will ideally help with the advancement of an innovation that might permit efficient power energy to reduce energy costs within the normal family and better the climate. The sector of environmentally friendly power assets has a huge degree of development, meaning genuine applications and massive financial freedom. Perfect, reasonable, inexhaustible, and similarly significant, homegrown wellsprings of energy are fundamental to satisfy the potential of our country within the coming years and it is sure that energy generation by treadmill and gym equipment will have a big influence on the fulfillment of energy requirements for future use in Pakistan Expanding environmentally friendly energy can make electricity less costly, accomplish more remarkable energy security, decrease fuel's byproduct and can support Pakistan put aside to \$5 billion over the course of the subsequent 20 years as both the energy assets are becoming more feasible for power age.

### 4.3 Future Goals:

Some potential future goals for the design and fabrication of the automatic dishwasher could include:

1. **Integration with smart home technology:** The dishwasher could be designed to integrate with smart home technology, allowing users to control it remotely and receive updates on the cleaning process.

2. **Enhanced energy efficiency:** Future designs could focus on further reducing the energy usage of the dishwasher, potentially using more efficient heating systems and water pumps.
3. **Increased capacity:** The dishwasher could be designed to clean a larger quantity of dishes, enabling it to be used in even larger commercial settings.
4. **Enhanced cleaning performance:** Future designs could focus on enhancing the cleaning performance of the dishwasher, potentially using new cleaning agents or more advanced mechanical cleaning systems.
5. **Eco-friendly features:** The dishwasher could be designed with more eco-friendly features, such as the ability to recycle wastewater or the use of environmentally friendly cleaning agents.

Overall, the future goals for the design and fabrication of the automatic dishwasher could focus on improving the efficiency, performance, and environmental impact of the appliance.

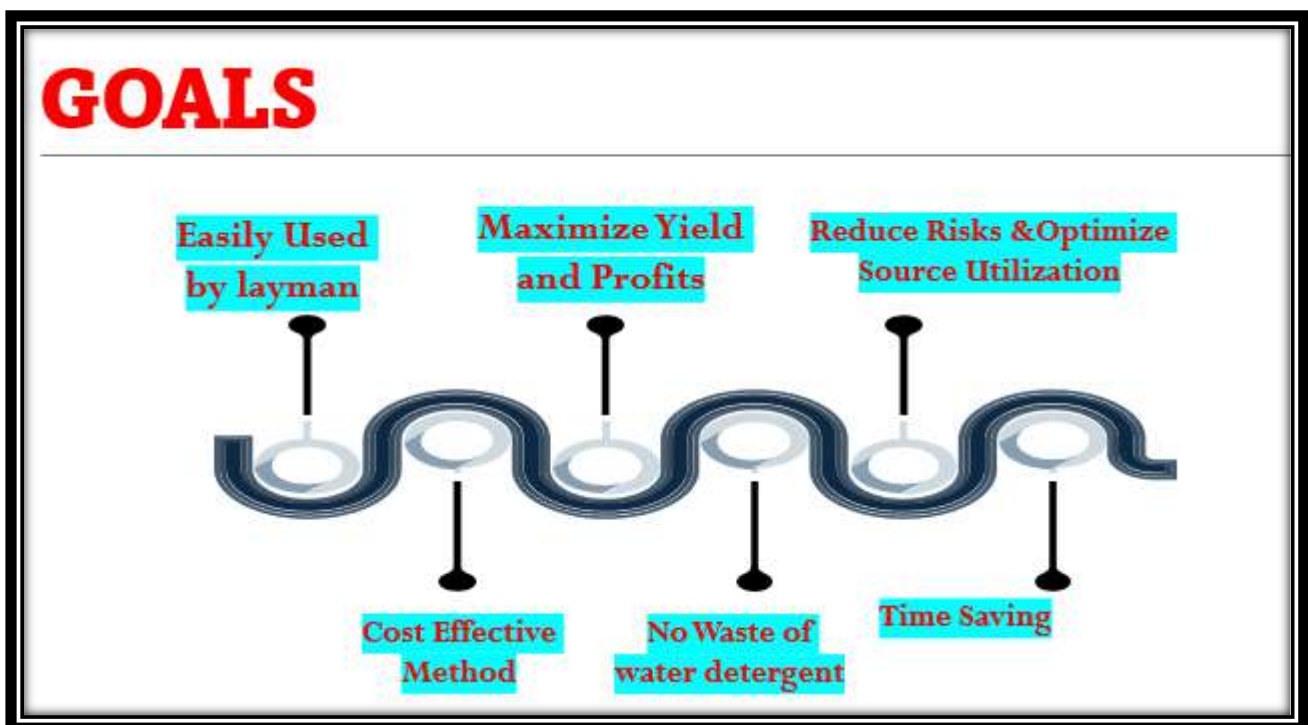


Figure 4.1: Future Goals.

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