KLE TECH.

KLE Technological University

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V SEM B.E (A & R)

MINI PROJECT (ENGINEERING DESIGN)

TEAM NO/NAME: TEAM-10

TEAM MEMBERS NAME & USN:

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KLE Technological University
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Department of Automation and Robotics

CERTIFICATE

This is to certify that the below-mentioned team has implemented the project entitled " Cleaning Kitchen Utensils " as part of the Mini Project Course, code 18EARW301, in the department of Automation & Robotics, KLE Technological University, Hubballi, during the 5th Semester of B.E program for the academic year 2022-23. The project repfulfillsfils the requirements prescribed.

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Examiner 1:

Examiner 2:

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1. Introduction to the broad theme or challenge:

The main theme given to us is Home Automation.

Home automation is building automation for home, automation system will monitor and control home attributes such as entertainment systems, and appliances. It mainly refers to the automatic and electronic control of household features, activities and appliances. It means we can easily control the utilities and features via the internet to make life more convenient and secure and even spend less on household bills.

The most common applications of home automation are lighting control, Outdoor lawn irrigation, kitchen appliances, and security system.

The domain selected by our team is Cleaning kitchen utensils.

The cook's favourite pot or pan is one of the most frequently used tools in a residential kitchen, but many people fear it.

Hand-washing the dishes Even those who have a dishwasher prefer to hand wash their cookware. Whether due to dishwasher space constraints or the aggressive methods used in modern dishwashers. Dishwashers aren't always run after each meal, but a specific pot or pan may be required.

Both lunch and dinner necessitated an immediate wash. We hope to have completed our project by the end of this semester. created a device that simulates hand washing and will allow these types of cookware to be mechanically cleaned. We narrowed our scope to successfully complete the project while keeping our timeline and budget in mind.

Identifying the systematic design process to be followed --- Write a brief note on the Engineering design process. Along with the flow chart and the various phases and steps in the process.

A designer's or a design team's intuitive skills generally fall short when it comes to producing complex, complicated, or a family of goods. We must take a thorough approach to tackle the given problem and find the most unique and appropriate answer. That approach is known as the engineering design process. To do this, a reliable strategy must be created, enabling rigorous planning and methodical execution, and simplifying the entire design process to a simple exercise that can be retrieved from inevitable events. It also specifies a timeline for the design stages, which yields a predictable project schedule.

2. <u>In order to solve the above problem statement, one must follow a number of procedures in engineering design. They are as follows:</u>

1. **Clarify the task and build out the specification and requirements.**
   The specification as it was given to the designer might not be complete, and it frequently calls for clarification and more details. The designer must also decide what specific goals the solution must accomplish. Additionally, he or she must be certain that the design will have the necessary commercial drive and intellectual stimulation to see it through to completion. The specification will be fully defined and a list of needs and limitations will be compiled at the conclusion of this phase.
2. **Conceptual design phase.**
   From the user statements, which are obtained from the interaction and interviewing the user, we have to filter out the user's needs and wishes. According to the needs and requirements, we have to make some conceptual designs and this phase is known as the Conceptual design phase.
3. **Abstract the task to identify the essential problem.**
   Abstracting the task means describing it most broadly. To truly grasp the user's issues, requirements, and desires, the designer must put themselves in the user's position. We must put ourselves in the user's shoes and experience what they go through while performing the activity (cleaning the utensils). Creating a list of the issues and determining their root causes The designing team must sort through the user's rough statement to get the actual statements. And we have to revise the problem statement and finalize the problem statement
4. **Search for a possible solution.**
   We must do market research by the problem statement to identify any potential solutions. From market research, we learn about the items and solutions that are available. We also learn whether the solution is resolving the user's issue and what other problems might result from it. From there, we must create a workable and suitable solution for the user.
5. **Establish the functional structures.**
   This describes the solution's boundaries (what is included and excluded from the design) as well as the functional process through which energy, materials, and signals (information) flow from input to output to satisfy the specification. It entails reducing the overall function down into smaller sub-functions until the work for each sub-function is crystal clear and straightforward. In essence, the creation of useful structures is meant to aid in problem-solving.
6. **Evaluation of concept variants using technical and economic criteria.**
   In this phase, we have to evaluate our design or solution according to the technical and economic criteria. It also includes evaluating the solution with user needs, cost of the product, Energy consumption, and all the criteria's to be considered.
7. **Embodiment of the design.**
   The authors realistically note that many features will need to be clarified, confirmed, or optimized during the embodiment design stage, and when this is done, it will become clearer whether the correct solution concept has been chosen. They conclude on a positive note by saying that no embodiment design can possibly aspire to improve a subpar solution notion. The final

general finding is that the assessment of the project's financial sustainability should be done as soon as possible after the end of the embodiment design.

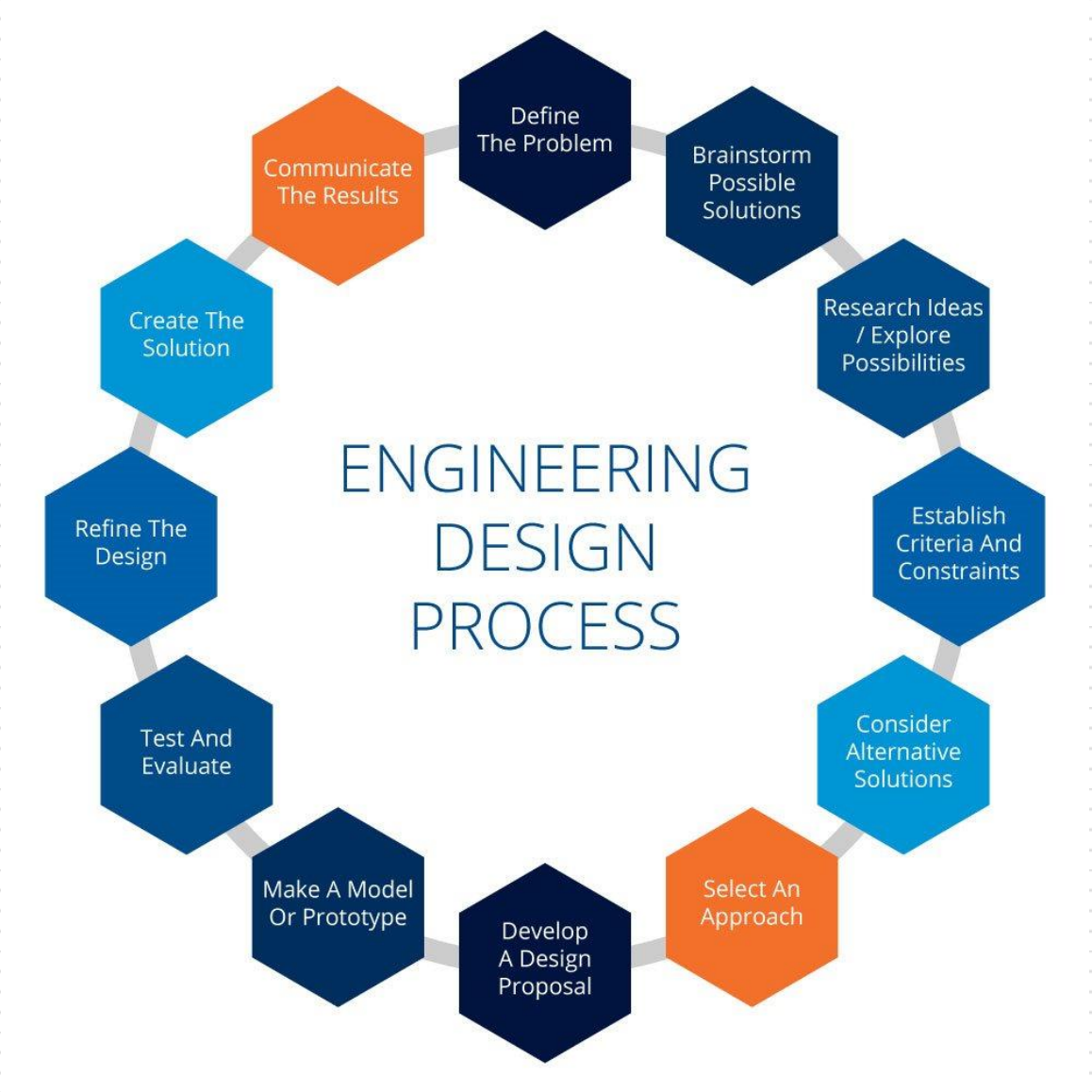


Figure 1 Engineering Design Process

3. Planning & Task Clarification:

Design planning is described more broadly as a field of inquiry that draws upon the principles of project management, organizational strategy, and collaboration to control a creative process.

The planning process allows for a high level ooptimizationon to meet the requirements of an objective. The steps include problem-solving processes such as determining our problem objectives and constraints, prototyping, testing ,and evaluation.

Steps Involved in Planning to clarify the need:

- Identifying customer needs can be done in several ways.

• Either the designer is approached directly by a customer with a specific problem, or the designer finds an opportunity in the market by identifying a need for a new or improved product.

• Market analysis must be conducted at the start of the design process.

• The analysis requires a thorough study of the total market.

• This includes its trend, competition, volume, profit, opportunities, consumer needs, and some indication of customer feeling for the product.

• Remember, the majority of designs are development designs.

• Thus, knowing what others have provided as a solution is very important before you attempt to offer your solution.

• It is also important at this stage not to provide solutions; you are gathering information with which to provide a better solution.

When clarifying the task, one should start by collecting the essential functions and the existing task-specific constraints concerning the energy, material and ,signal transformations. When all of the information is available, it must be grouped, ordered and,labeledd.

Importance of task clarification:

The design task is generally presented to the design and development department in one of the following forms:

• as a development order (from outside or the product planning department in the form of a product proposal)

• as a definite order

• as a request based on, for instance, suggestions and criticism by sales, research, test, or assembly staff, or originating in the design department itself.

Conclusion of task clarification:

Task clarification sets the foundation for solving a design task, where the foundation is continually revisited to find weak points and to seek the structural integrity of a design team approach. In this sense, it is a pervasive activity that does not occur simply at the beginning of the process but is employed throughout.

Our progress in the planning and task clarification:

According to our vision of "utensil cleaner," we initially visited several stakeholders and gathered information about the problems they face, as well as understanding their pain points and planning the processes we must follow to solve the particular problem. Here in the bellow areas, we have the problems which they are facing to clean the utensils like dishes.

- Household purposes
- Bachelors
- Senior citizens
- Canteen
- Mess

- Hotel, restaurants
- Government Schools
- Hospitals

Collection of Need statements and generating the initial need statement:

We have visited several stakeholders, like household purpose users, hotels, college canteens, messes, etc. We gathered some requirements related to their problem. Here are some of the points that were gathered from the stakeholders.

- Better cleaning the utensils
- Germ protection
- Environmental and economically friendly
- Time efficient
- User friendly
- Stress reducer
- Etc….

Gantt chart:

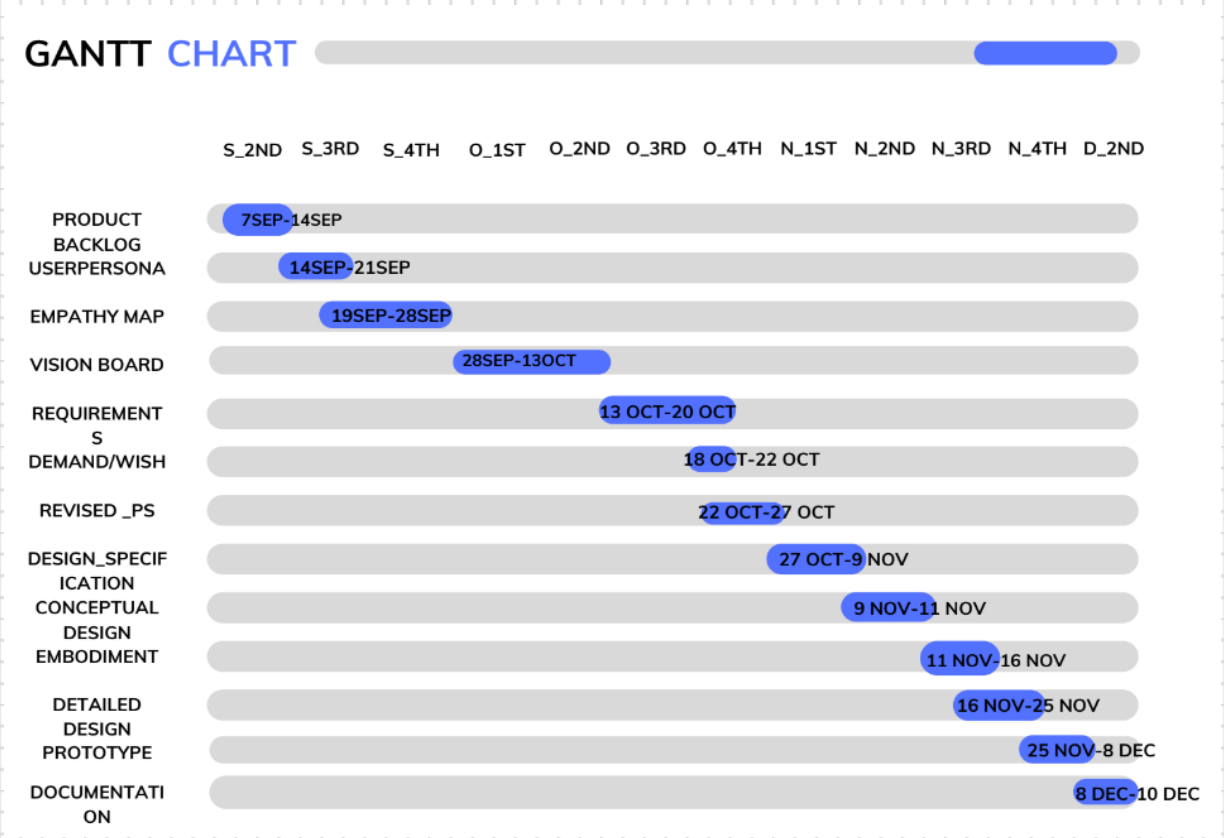


Figure 2

3.2 Market research and analysis:

According to the dishwasher market analysis, based on the product type, built-in dishwashers accounted for 68.6% of the global dishwasher market share in 2020. This is primarily due to the higher adoption of built-in dishwashers in households and commercial spaces of developed markets. As per the dishwasher market forecast, based on the application, the households segment leads and is projected to be the fastest-growing owing to the growth in the adoption of technologically advanced and cost-effective dishwashers in households.

As per newly released data by Future Market Insights (FMI), the **dishwasher market** is estimated at **US$ 34,194.8 Mn** in 2022 and is projected to reach **US$ 58,409.6 Mn** by 2032, at a CAGR of **5.5%** from

2022 to 2032. Share of the dishwasher market in its parent market (house appliance market)approximatetely **~2%-6%**

Attribute	Details
Estimated Dishwasher Market Size 2022	US$ 34,194.8 Mn
Projected Dishwasher Market Size 2032	US$ 58,409.6 Mn
Value CAGR (2022-2032)	5.5%
Dishwasher Market Top Players Share in 2021	~8%-10%

User persona and Empathy map:

We have identified few initial Users, Establish Collaboration with them and collect information, Needs, etc., and created User Personas and Empathy Map. User personas are extremely useful to grow and improve a business: they help uncover the different ways people search for, buy, and use products, so you can focus your efforts on improving the experience for real people and use cases

Identifying users:

The best way to know your users is to **talk to them directly**. Thus, a live interview is the most popular and effective means of user profiling. However, if you are in the early stages of product development, you don't have any users yet. In this case, you can instead analyze your competitors and speak with their users. The three things we must focus on during a live interview are "what," "why," and "the final word of the users." In the case of utensil cleaners, we have users such as "hose hold" users, hotels, canteens, and so on. The Three most important needs of our Users:

- Better cleaning of the utensils
- Reduce the work effort
- Save water and Time

User persona:

In this stage we start the design process by conducting user research building an empathy map with our target users and identifying exactly what they need from the product we are designing. A persona is generally based on this user research and incorporates the needs, goals, and observed behaviour patterns of your target people.

Chandrashekhar

"I am searching the perfect solution to wash the dishes"

MAJOR

Hotel Manager

Recidence

Vidyanagar Hubli

AGE

45

Bio

Chandrashekar is a worker in the LAXMI DARSHINI canteen. He lives in Lokappan-hakkal. Chandrashekar is a very humble person, kind with a friendly nature. While cleaning utensils, many times he gets cuts on his hands,affected by waterborne diesease and energy. He needs a solution that helps in cleaning utensils safely and hygienically.

Goals

- He needs a safe and hygienic solution.
- He wants ro minimize the usage of water while cleaning the utensils

Frustrations

- He cannot bear the additional water consumption while cleaning the utensils.
- He gets cuts on his hands,affected by waterborne diesease and allergy

Channayya

"ಕಾಯಕವೇ ಕೈಲಾಸ"

MAJOR

Manager

Education

Metric pass

AGE

48

Bio

Channayya is from Rona taluk and lives in Hubli with his family. He works in the Senior Boys' Hostel Mess at KLETECH BVB in Hubli. He needs to clean number plates in a short time. Workers in the mess experience back pain and joint pain from cleaning a number of utensils. He needs a solution to clean his plates in a short time. He also wants to relieve his workers' efforts.

Goals

- He wants to clean a number of plates within a short time.
- The gel or soap should not be remain in the utensil after clean after cleaning the utensil.

Frustrations

- Physical pain in hands,joints and backpain.
- Sometimes utensils could not cleaned properly by his labourers.

Sudha

"I will create a futuristic and epic smarthome one day."

MAJOR

Software Engineer

Education

BE,Mtech

AGE

34

Bio

Sudha is a software developer living in HSR Layout, Bengaluru. Sudha is married and was born to a former teacher and a homemaker. Sudha does not get enough time to clean the utensils after her office work. She gets frustrated and irritated while cleaning the utensils in a hurry. She needs a solution to clean the utensils in a short period of time. She wants to become a modernised person.

Goals

- She needs a solution to clean the utensils in less time.
- The solution should be cost efficient

Frustrations

- She feels uncomfortable and irritated while cleaning the utensils in a hurry
- Not enough time to clean the utensils

Umesh Adiga

"I want to become successful businessman"

MAJOR

Hotel Manager

Recidence

Vidyanagar Hubli

AGE

42

Bio

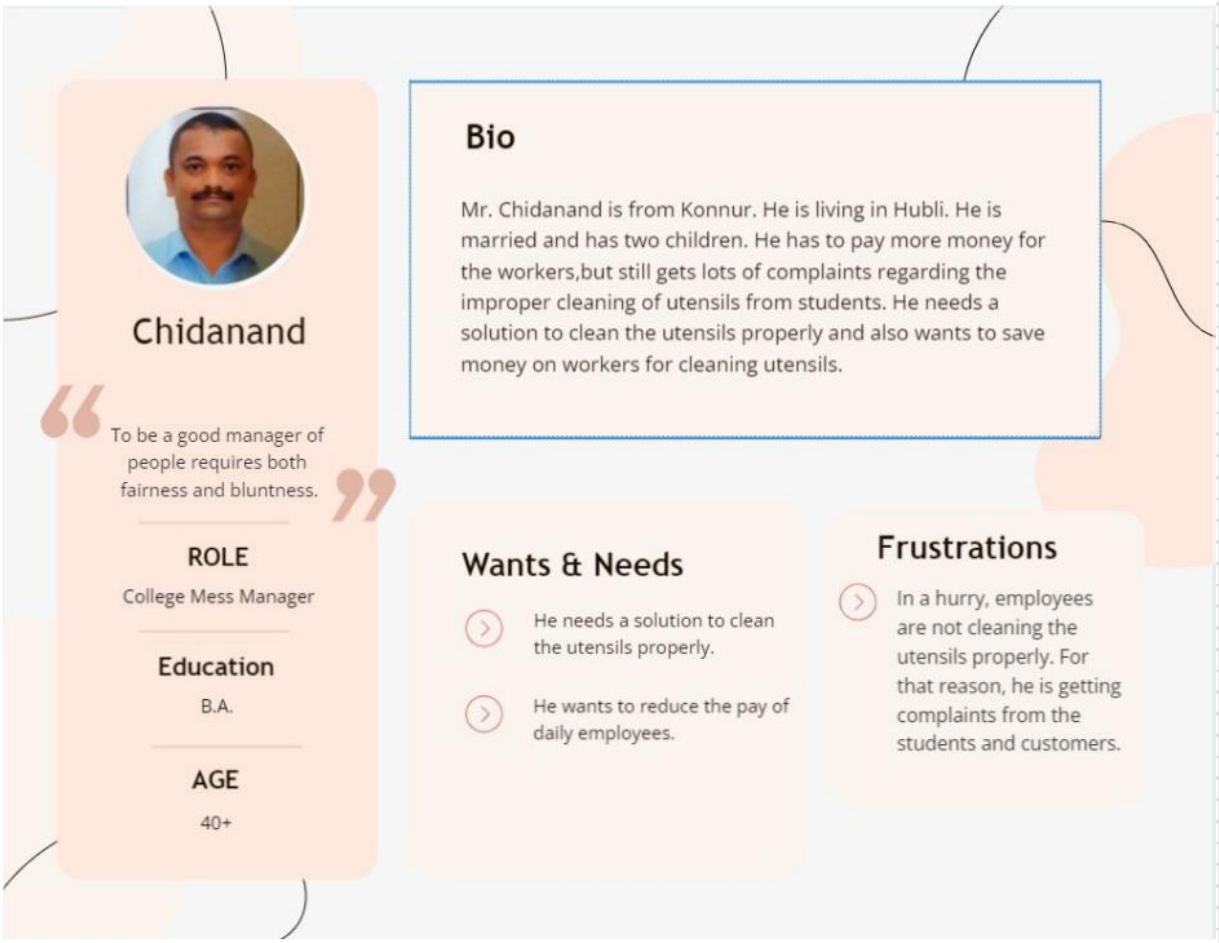
Umesh is a manager of Udupi Hotel who manages the hotel and lodge in Shirur Park. He is facing lots of water wastage in his hotel and he has to pay more money to the workers. He has a modernised mindset and also a kind person who wants to reduce the workers' efforts. He is more conscious about saving water and time.

Goals

- Needs a solution that reduces the worker's effort.
- Wanted to minimise the use of water to clean the utensils.
- He wanted to modernize the utensil cleaning process.

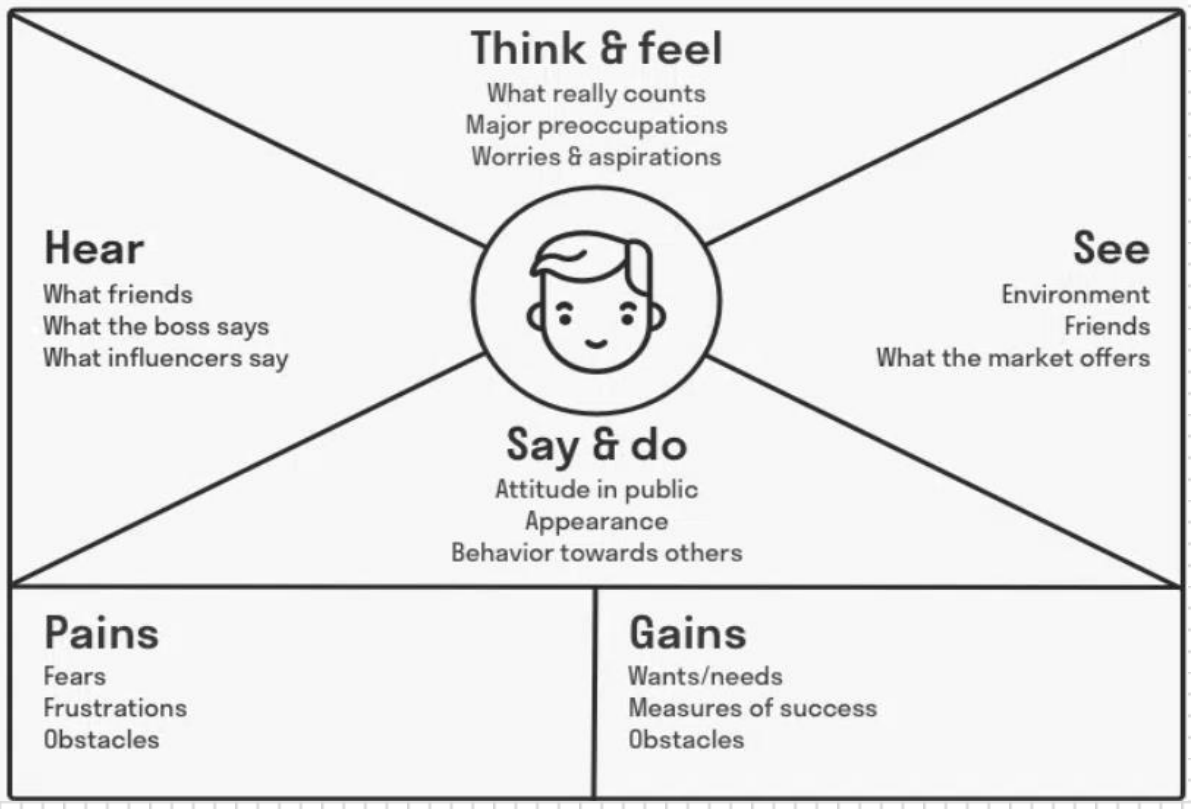
Frustrations

- Water scarcity in his hotel
- Money spent on workers' daily wages



Empathy map:

An **empathy map** is a collaborative visualization used to articulate what we know about a particular type of user. It externalizes knowledge about users in order to create a shared understanding of user needs, and aid in decision making. Traditional empathy maps are split into 4 quadrants (*Says*, *Thinks*, *Does*, and *Feels*), with the user or persona in the middle. Empathy maps provide a glance into who a user is as a whole and are **not** chronological or sequential. Usual format of the empathy map:



Empathy map related to our scenario:

Pains:

- Improper cleaning of utensils
- Joint pain and back pain while cleaning utensils
- Maximum wastage of water
- Difficult to pay daily wages to the employees

See:

- The cleaning area is not hygiene
- Sometimes, workers fall ill while cleaning the utensils
- Takes lot of time to do manually
- Worker’s hands get numb may lead to infections
- Water expense is more

Think and feel:

- Lack of time
- May fall ill
- Working continuously, leads to back pain
- Maximum wastage of water
- reducing the manual work

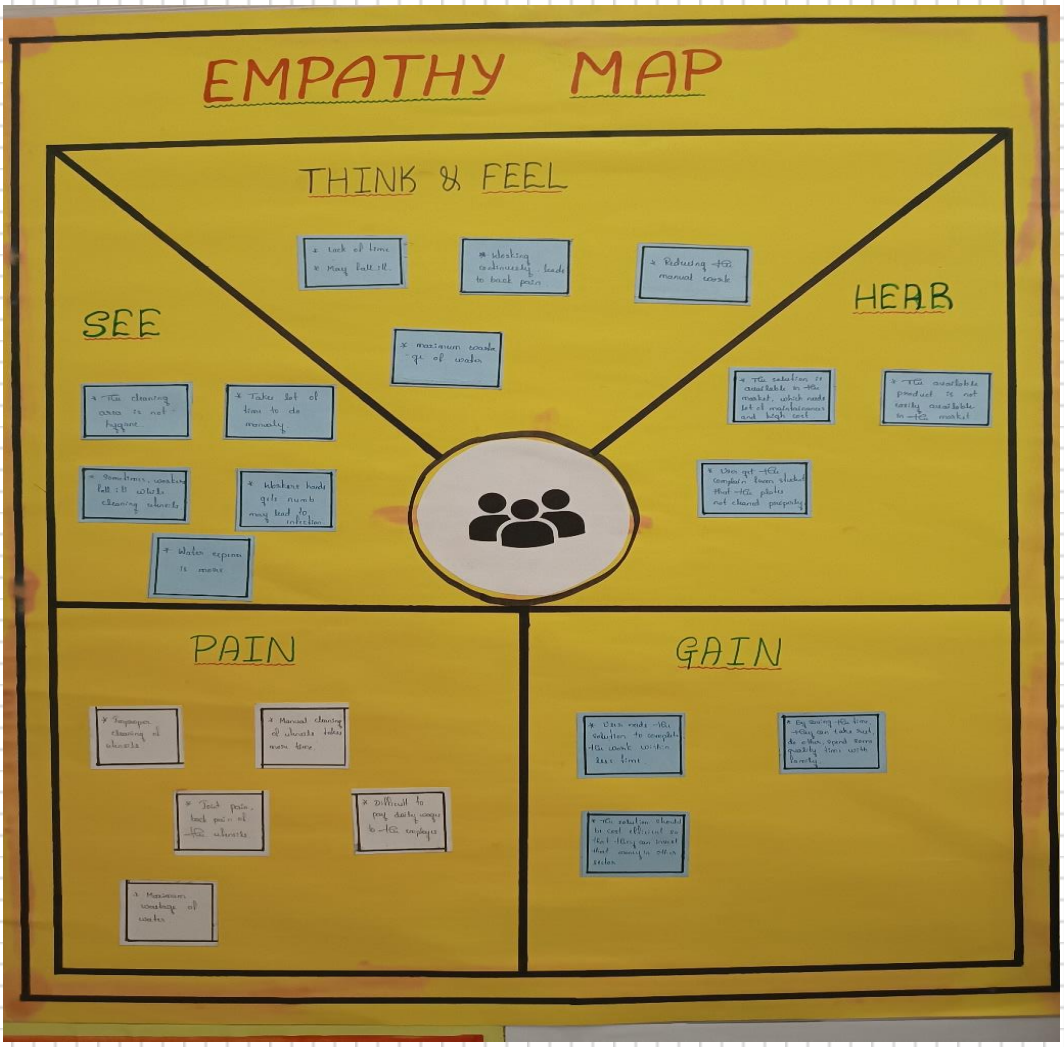
Hear:

- The solution is available in the market which needs lots of maintenance and high cost.
- User get the complain from students that the plates not cleaned properly.
- The available product is not easily available in the market

Gain:

- User needs the solution to complete the work within less amount time.
- The solution should be cost efficient so that they can invest that money in other sectors
- By saving the time, they can take rest, do other work, spend some quality time with family members.

The empathy map:



The initial problem statement:

User needs a solution to save the time in cleaning utensils, to reduce human effort, hygienic, safe and less maintenance device for cleaning kitchen utensils like plates.

User story:

The structure of the user are part of an agile approach that helps shift the focus from writing about requirements to talking about them. All agile user stories include a written sentence or two and, more importantly, a series of conversations about the desired functionality.

Also we Categorize the user stories and Prioritize Requirements in different types with "Reach","Acquisition","Activation","Retention" and "Loyalty".

Here we have some user stories related to our scenario….

"As a housewife, I want a light weight and strong product ,it can be used whenever I want it can be used and keep it aside".

"As a software engineer, I want a product in order to manage the time rather than cleaning utensils, so that I can spend some quality time with my family".

"As a daily wager, I want a product which would consume less power, so that can save money on electricity bill. so that I could get a greater number of plates to be washed at a time".

"As a middle class person I want a cost efficient product so that I can easily afford it".

“As a student, I want a product which could wash my dishes so that I can spend time and money on other things”.

“As a mother , I want a durable product so that whenever my children do some mischievous thing it could be damaged easily”.

“As a business tycoon , I want Aesthetic appearance product so that

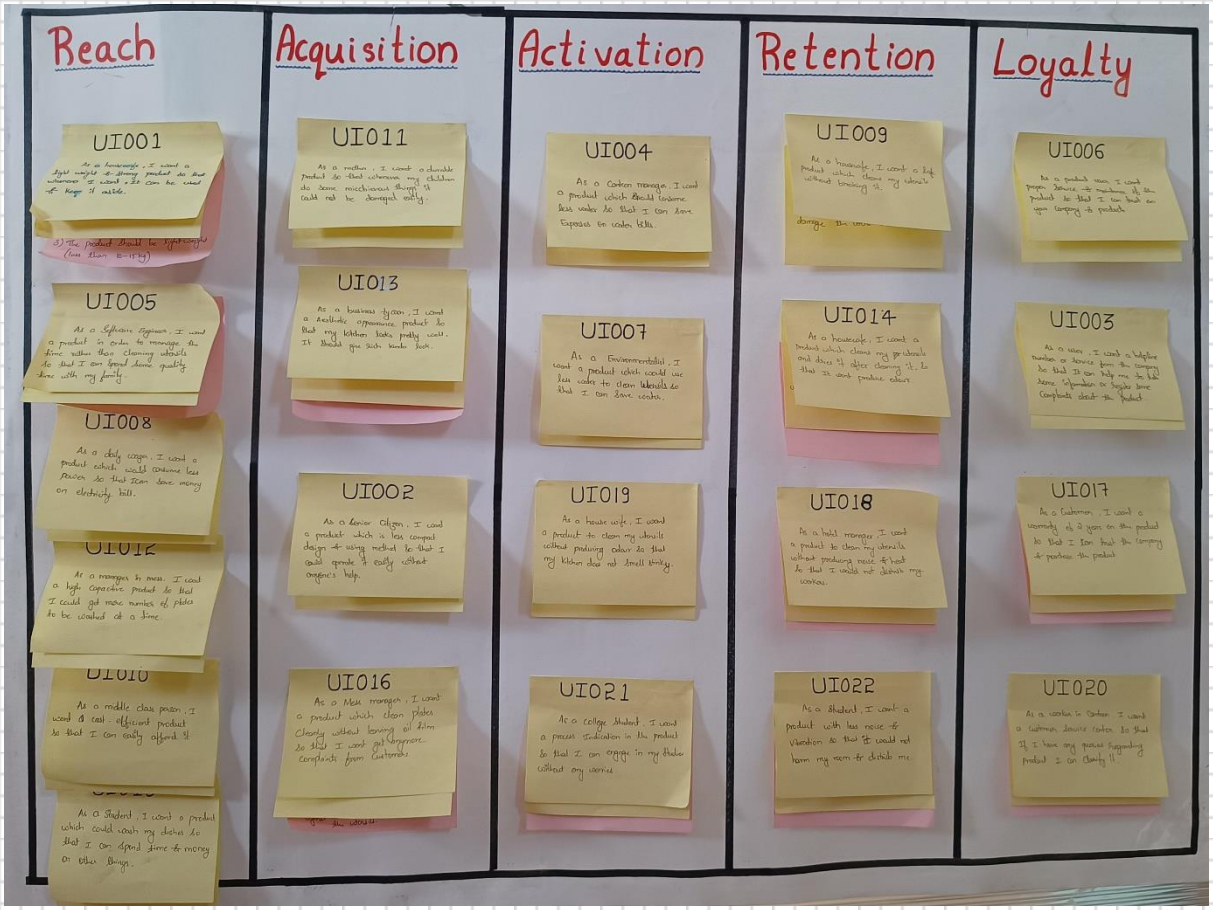
Many kitchen looks pretty well, It should give rich kind of look”.

“As a senior citizen , I want a product which is less compact design and using method so that I could operate it easily without anyone’s help”.

“ As a mess manager, I want a product which cleans plates cleanly without leaving oil fil , so that I want get anymore complaints from consumers”.

“As a environmentalist , I want a product which would use less water to clen the utensils so that we can save the water.”

“As a housewife I want a product to clean my utensils without providing Oder so that my kitchen does not smell stinky”.



Final need statement:

In this stage we Create final need statement by scenarios and use cases with the User Persona situated in the environment.

“Develop a time-efficient safety device to clean the oily, greasy and hard food remaining on utensils with a portable, power-efficient system with process indication”.

Competitive Products benchmarking
Benchmarking is a process that measures products, services, results, and other key performance indicators against competitors. Competitive benchmarking is the only way to determine what your success is truly worth.
Some of main players in the Utensil cleaning home appliance segment:

Brand	Product	Rating	Price
Godrej	Godrej Eon Dishwasher	4/5	Rs.19,490
Faber	Faber 12 Place Settings Dishwasher	4.1/5	Rs.25,700
Voltas Beko	Voltas Beko 8 Place Settings Table Top Dishwasher	4.2/5	Rs.25,990
IFB	IFB 12 Place Settings Hot Water Wash Dishwasher	4/5	Rs.37,990
Bosch	Bosch 13 Place Settings Dishwasher	4.4/5	Rs. 41,480
LG	LG 14 Place Settings Wi - Fi Dishwasher	4.3/5	Rs.52,480

The users facing problems with these utensil cleaning machines' company:
Space: A dishwasher needs a lot of space so you need to be prepared to add a heavy appliance to your kitchen.
Not Completely Autonomous: A lot of dishwashers need rinsed utensils and like washing machines, dishwashers need the addition of soap tablets and sometimes water softeners.
Placement: A huge restriction to Dishwashers is that they require a place that is connected to electricity, water supply and sewage, it becomes a headache to find such a place in tiny kitchens.
Minimum Requirement: Dishwashers have a minimum number of utensils to be put in to be used so if you are living alone or eat out too often, then there would not be a sense of purchasing a Dishwasher. Apart from that, you might need to pile up utensils until it reaches minimum requirement (which isn't a huge problem in a desi household though).
Cleaning: Dishwashers need their filters to be cleaned regularly.

Design specifications:
Our product has the design specifications; those contain the important requirements of our product. In the table below, we have the specifications of the utensil cleaner we are planning to design.

Table 1

R. No	Requirements	Importance	Demand /Wish	Category
1.	**Time Efficient**	5	Demand	Energy
1.	**Energy/power efficient**	5	Demand	Energy
1.	**Properly clean the utensils**	5	Demand	Quality control
1.	**Less water consumption**	5	Demand	Quality control
1.	**Safety of utensils**	5	Demand	Safety
1.	**Lightweight**	4	Demand	Material
1.	**Cost efficient**	4	Wish	Material, Production
1.	Durable	4	Demand	Material
1.	**Semi-automatic**	4	Demand	Ergonomics
1.	Different modes of cleaning	4	Wish	Energy
1.	Easy to clean after use	4	Demand	Quality control
1.	**Warranty Assurance**	4	Demand	Maintenance
1.	Easily available and replaceable of components	4	Demand	Recycling
1.	**Aesthetic Appearance**	3	Wish	Geometry, Material
1.	**Process indication**	3	Demand	Signals
1.	Provide long maintenance interval	3	Demand	Maintenance
1.	Providing good service	3	Demand	Maintenance, Schedule
1.	More Capacity	2	Wish	Geometry
1.	Easy-to-use	2	Demand	Ergonomics
1.	Odorless after use	2	Wish	Safety, Quality control
1.	Noise reduction	2	Wish	Safety
1.	IoT based	1	Wish	Signals, Ergonomics
1.	Auto-resume after power failure	1	Wish	Signals, Energy
1.	Drying performance	1	Wish	Energy
1.	Less Heat reduction	1	Demand	Energy
2.	**Stainless steel utensil holder**	4	Demand	Material
3.	**Water Recycle and Reuse**	4	Demand	Recycling
4.	**Proper Water outlet**	4	Demand	Safety
5.	**Efficient cleaning of oil, and**	4	Demand	Energy

	greasyand hard food remains			
6.	**Easy to move around(portable)**	4	Demand	Transport
7.	System Diagnostics	3	Wish	Operation
8.	Facility to variable Dish cleaning agent	3	Wish	Operation
9.	Good cooling capacity	3	Wish	Energy
10.	**Stop the process in the water leakage situation**	3	Demand	Signals
11.	Detergent sensors release the proper amount of dishwashing liquid	3	Demand	Signals
12.	Shock Proof	2	Wish	Safety
13.	Variable water temperature	2	Wish	Kinematics/Forces
14.	Protective layer inside the product	2	Wish	Safety
15.	Fit for the smaller kitchens	2	Wish	Ergonomics
16.	Auto program	2	Wish	Signals
17.	No need of rinsing the utensils before loading them into the system	2	Wish	Operation
18.	Accessories upgrading options	2	Wish	Quality control
19.	Indication of heavy load	2	Wish	Signals
20.	Water hardness detector	2	Wish	Signals
21.	Eco-mode option	2	Wish	Quality control
22.	Does not need any installation	1	Wish	Assembly
23.	Section to dry the utensils	1	Wish	Operation
24.	Wall mounted	1	Wish	Ergonomics
25.	Scrub function	1	Wish	Kinematics

4 . Conceptual Design:

4.1 Identification of essential problems – Revised problem statement:

Some of the consumer needs were sorted out of the many needs and wants for the next stage of product development. These needs are the user's fundamental requirements, and our product will satisfy them.

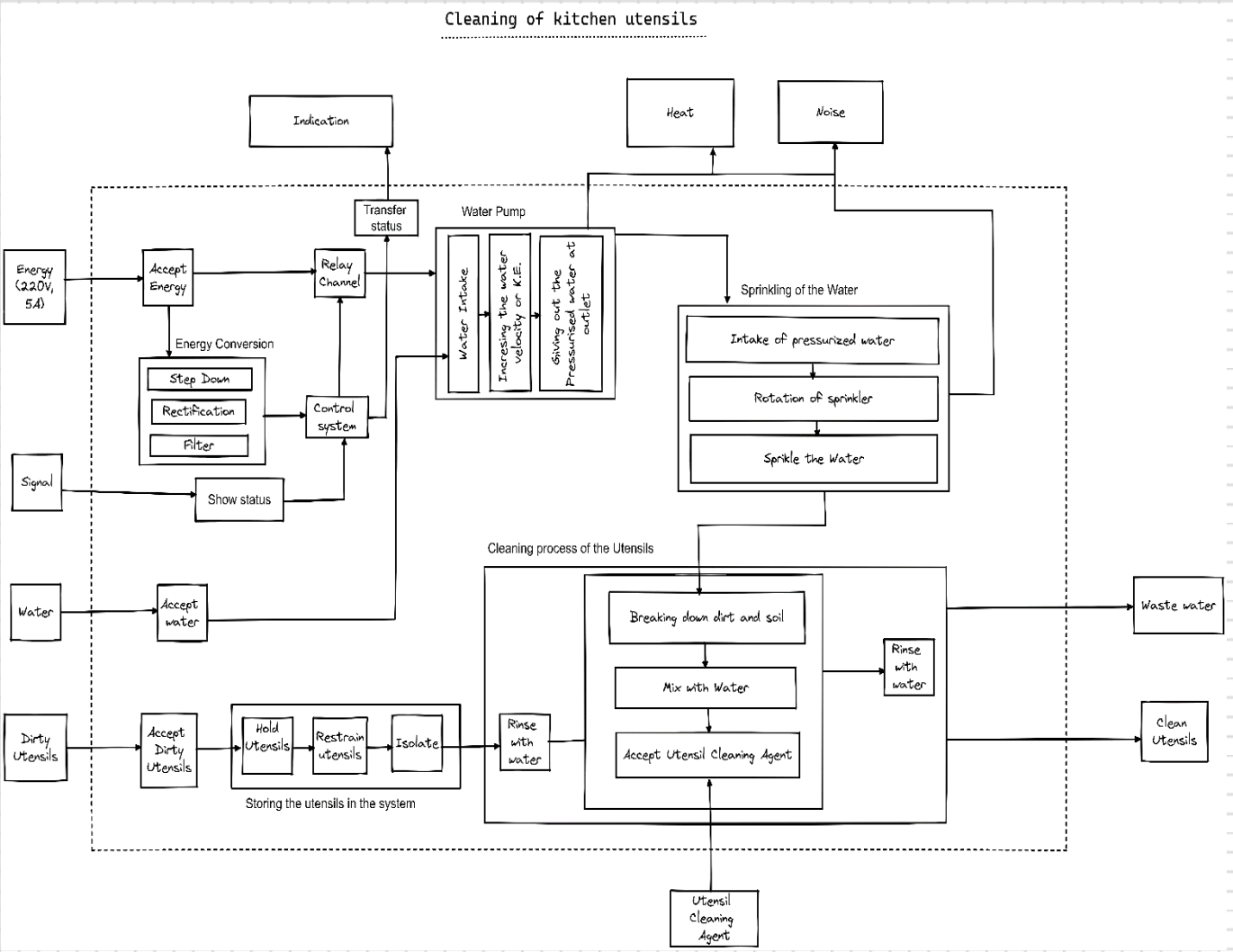
1. Time Efficient
2. Energy/power efficient
3. Safety of utensils
4. Efficient cleaning of oil, and greasy and hard foodremains
5. Easy to move around(portable)
6. Process indication

Our problem description has been rephrased based on the aforementioned users' fundamental requirements. And the revised problem statement is

Revised Problem Statement:

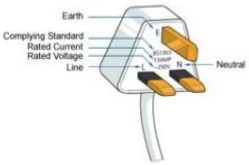
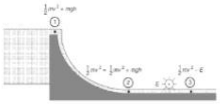
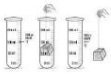
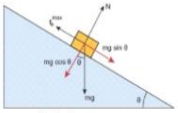
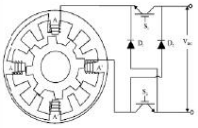
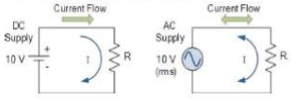
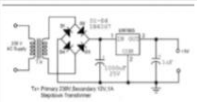
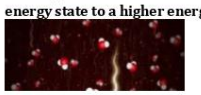
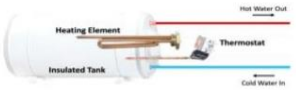
Develop a power-efficient, safe and portable device to clean the oily, greasy, and hard food remaining on utensils with safety of utensils.

4.2 Identification of Overall function and Detailed functional analysis – Establish function structures:

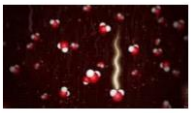
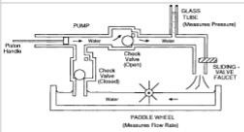
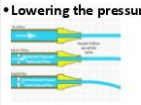
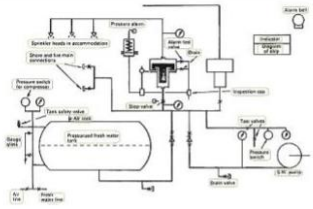
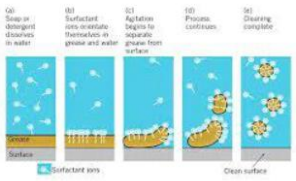
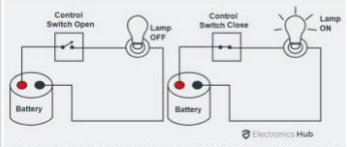


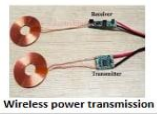
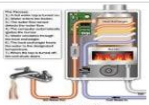
4.3 Search for working principles and working structures:

➢ **Identifying the working principle:**

Sub-Function	Physical Effect	Working Principle
Accept Energy	• Resistance • Conduction	
Accept Signal	• Communication between user and machine	 Push Buttons  Touch Screen
Accept water	• Potential energy is converted into kinetic energy PE ⟶ KE	
Accept dirty utensils	• Friction • Absence of Matter • Space configuration •	
Accept utensil Cleaning Agent	• Storing the cleaning agent	
Storing of utensils	• Friction • Gravity • Slope and angle of repose θ=tan-1(2h/d) - h	 Angle of repose To hold the utensils without damage then the utensils should be placed at a certain angle.
Relay channel	• Electromagnetic Induction • Switch Input: 0 1 control 0 | 0 0 control 1 | 0 1	
Control System		Monitors a process then causes some action to occur to maintain the desired system parameter.
Energy Conservation	• Law of conservation of Energy 	
Heating of Water	• Exciting the water molecule from a lower energy state to a higher energy state. 	

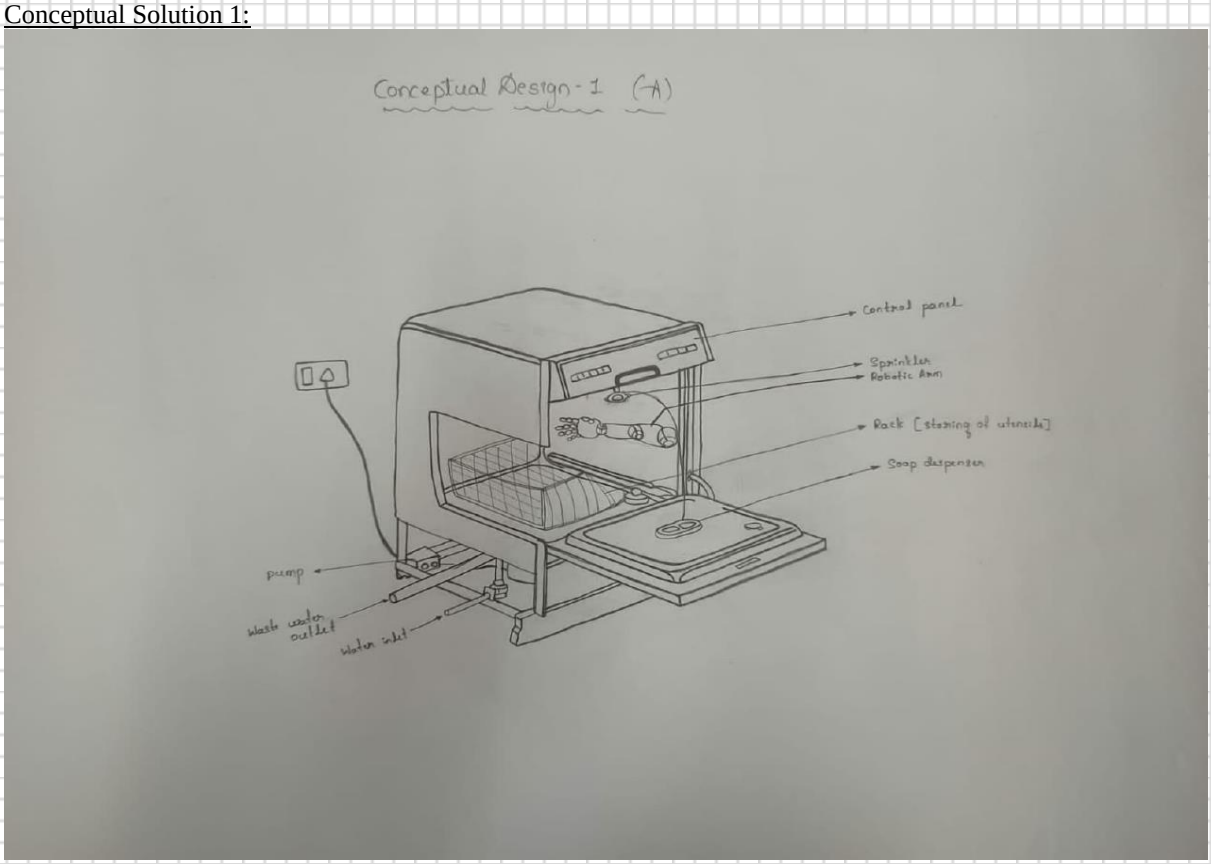
New Section 4 Page 1

		 converting the electrical energy into heat through the heating element to raise the temperature of the water to a particular degree.
Pumping of Water	• **Conversion of Potential energy into kinetic energy**	
Sprinkling of water	• **Lowering the pressure**  $\frac{P}{\rho g} + \frac{v^2}{2g} + Z = Constant$ Where $\frac{P}{\rho g}$ = Pressure head or Static head $V^2/2g$ → Velocity head / Dynamic head / Kinetic head Z = datum head	
Cleaning of Utensils	• **Molecule Interaction and reaction** • **Saponification** **organic fats and oils in the soils are converted into soap when mixed with a free alkali (bases) in the cleaners.**	
Show status	• **The vibration of the Particles**	 Propagation of light wave in air medium  Propagation of sound waves in air medium
Power Button	Turns an electronic device on or off	 By pressing the power button, a circuit is closed on the mainboard. At that moment, the power supply receives the signal to supply the computer with power and thus starts up.

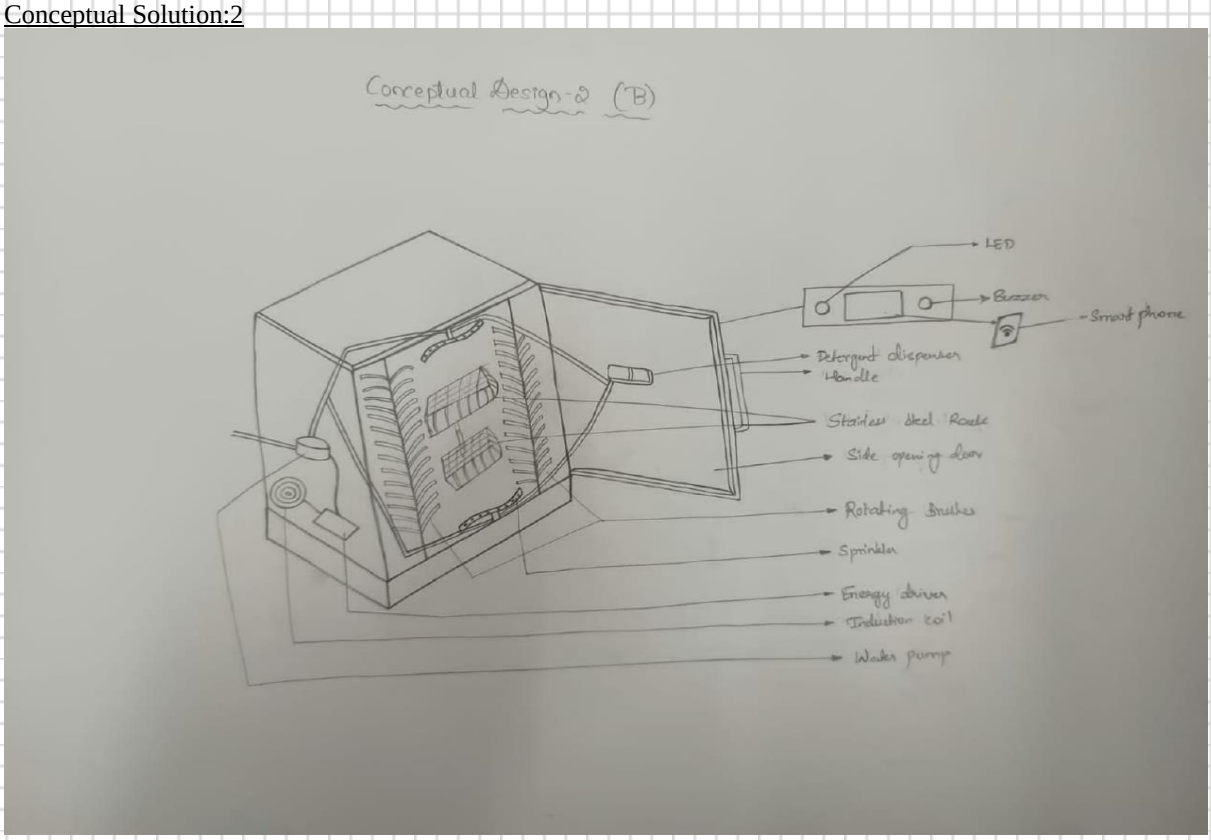
Subfunction	Solution Idea-1	Solution Idea-2	Solution Idea-3	Solution Idea-4	Solution Idea-5
Accept Energy	 3-pin female shutter socket	 2 pin socket	 Wireless power transmission	 3-pin male socket	 3-pin male direct wire power supply
Accept Signal	 Push Buttons	 Rotating button	 Touch screen	 By using RFID cards and reader	 IoT-based signal transmission
Accept water	 Circular Rotating valve	 90-degree rotating valve	 Metal pipe hose	 Electrical valve	
Accept dirty utensils	 Front loading door	 Side loading door	 Top loading door		
Accept utensil Cleaning agent	 Liquid cleaning agent	 Small soap cleaning agent	 Powder cleaning agent	 Sachet cleaning agent	
Storing of utensils	 Stainless steel tray	 Stainless steel multi-dish holder	 Plastic tray	 Stainless Steel Rack	
Relay channel	 Waterproof Relay	 Heater Relay	 Motor Start Relay	 TBM- 50 Relay	 Miele dishwasher relay
Energy Conversion	 Ac to Dc convertor module	 Ac –Dc Convertor	 Single Phase Ac –Dc Convertor	 SMAKN ac to dc converter	
Control system	 Raspberry Pi	 Arduino	 Node MCU	 STM-32	 PIC Microcontroller
Heating of Water	 By gas heating	Radiations	Solar water heater	Passing through a copper pipe	By coil
Pumping of Water	Axial Split Centrifugal Pump	diaphragm pumps	Submersible pump	VP60K Circulation pump	VP50C Water pump
Sprinkling of water	Cleaning spray arms	Fire Sprinkler heads	BOSCH, SIEMENS, BALAY DISHWASHER SPRINKLER ARM 11010055	Upper arm wash feed	Dishwasher roof spray arm
Cleaning of Utensils	Robotic hand dish cleaner	Cleaning with a water jet	Rotating Brush	High pressure of water	
Show status	Via RGY LEDs	Via Buzzer	mobile app using IOT	Via Display	

4.4 Generating alternate solutions

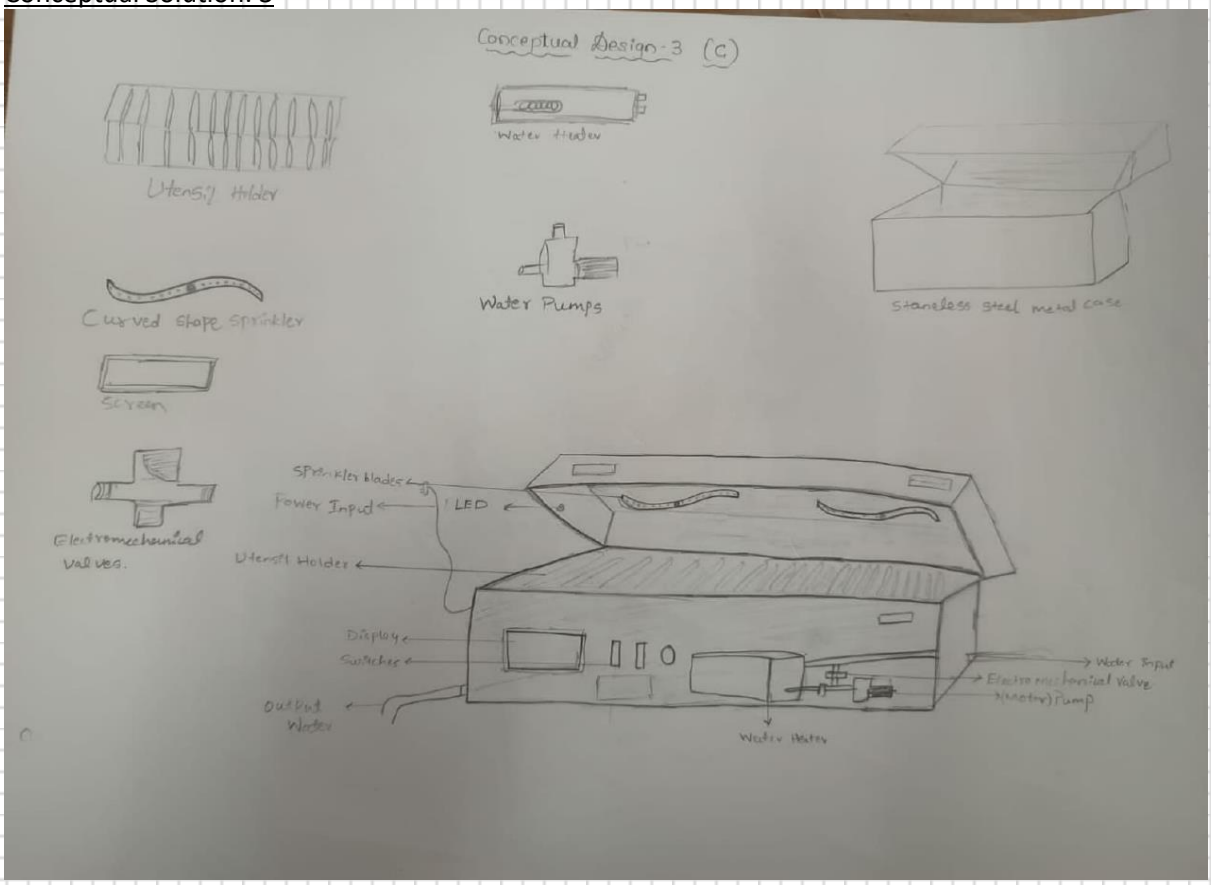
Conceptual Solution 1:



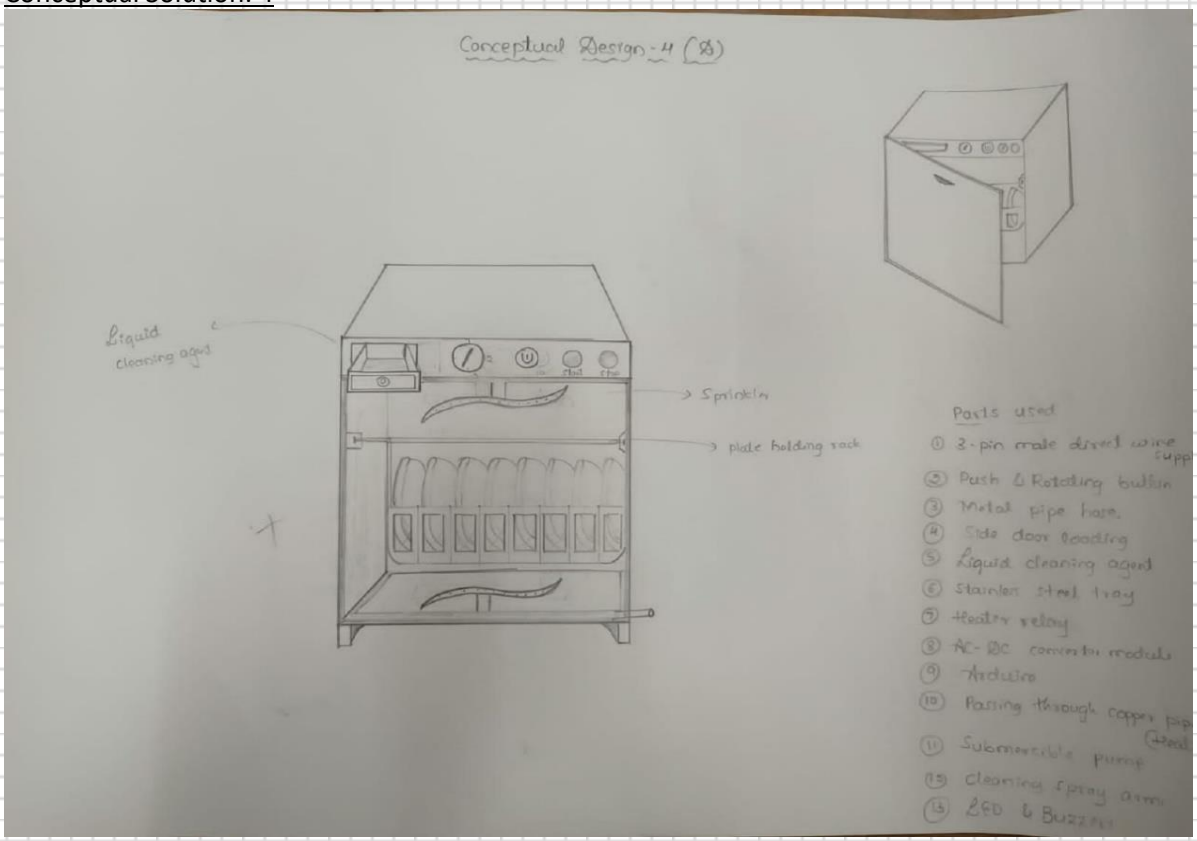
Conceptual Solution:2



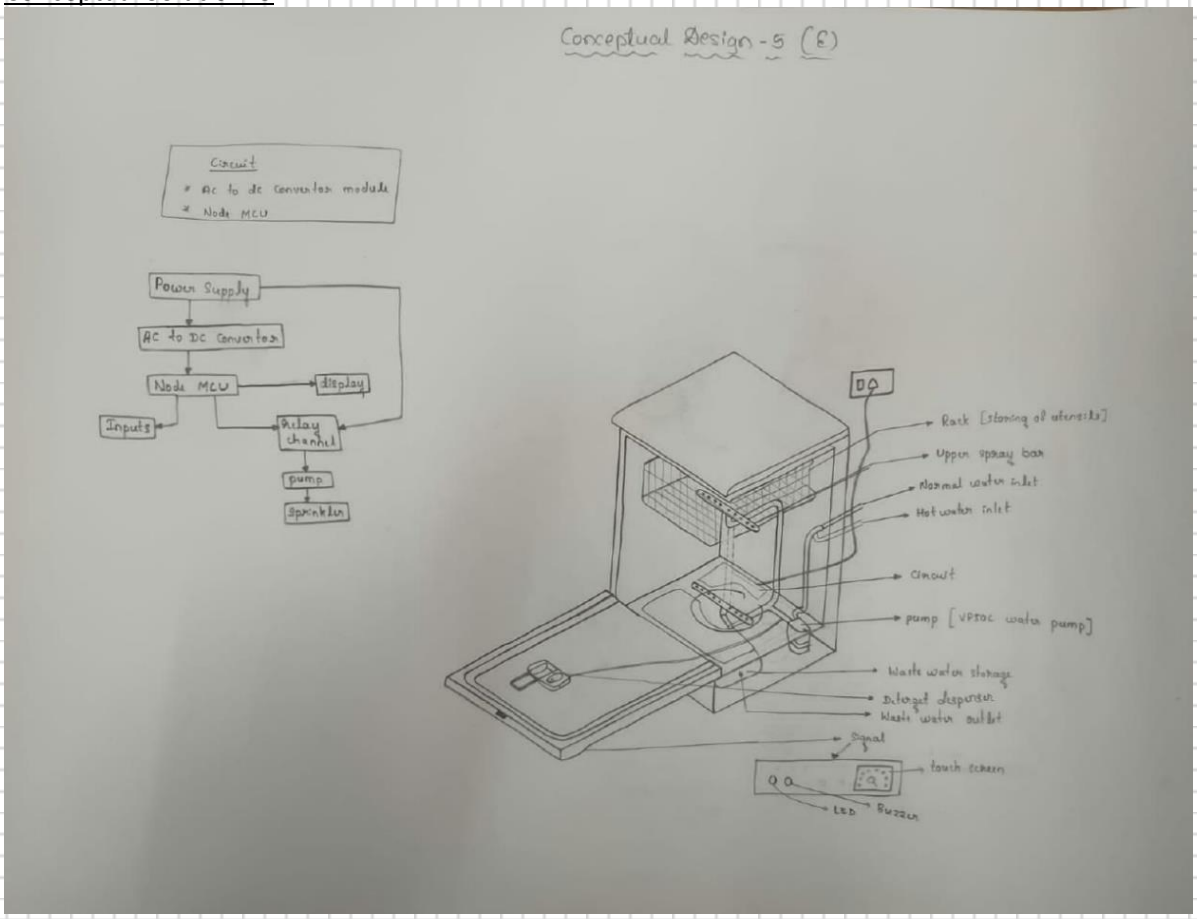
Conceptual Solution: 3



Conceptual Solution: 4



Conceptual Solution: 5



4.5 Evaluation of alternate solutions:

Concept screening

Selection Criteria	A	B	C	D	E	Reference (Amazon basics 8)
Time Efficient	0	–	–	0	+	0
Energy/power efficient	–	–	+	+	+	0
Safety of utensils	–	–	–	+	+	0
Efficient cleaning of hard food remains	+	0	0	0	–	0
Easy to move around(portable)	+	0	–	+	0	0
Process indication	+	+	–	–	0	0
Pluses	3	1	1	3	3	
Sames	1	2	1	2	2	
Minuses	2	3	4	1	1	
Net	1	-2	-3	2	2	
Rank	3	4	5	1	2	
Continue?	YES	NO	NO	YES	YES	

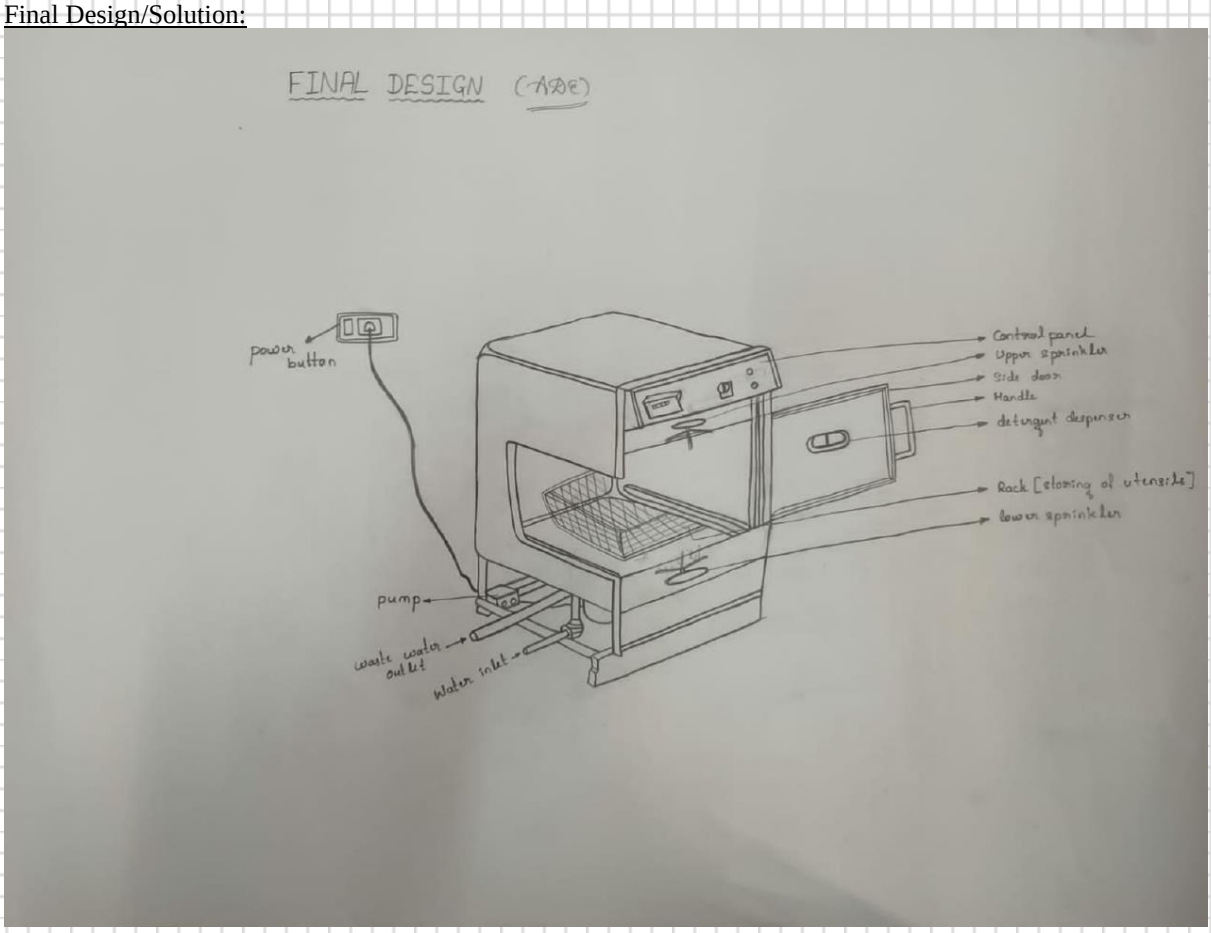
Concept scoring

Selection Criteria	Weight	A	D	E	G (ADE)
Time Efficient	20	6 120	5 100	8 160	8 160
Energy/power efficient	15	5 75	8 120	6 90	5 75
Safety of utensils	25	8 200	6 150	7 175	7 175
Efficient cleaning of hard food remains	20	5 100	5 100	4 80	8 160
Easy to move around(portable)	10	7 70	6 60	5 50	6 60
Process indication	10	6 60	7 70	6 60	5 50
Total	100	625	600	615	**680**

.

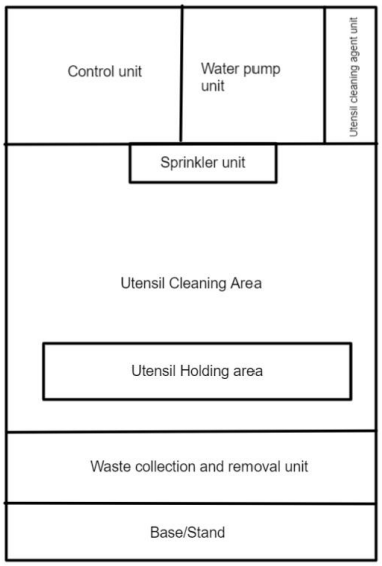
4.6 Preliminary design – Final selected concept:

Final Design/Solution:



5. Embodiment of Design:

Product Geometric Layout:

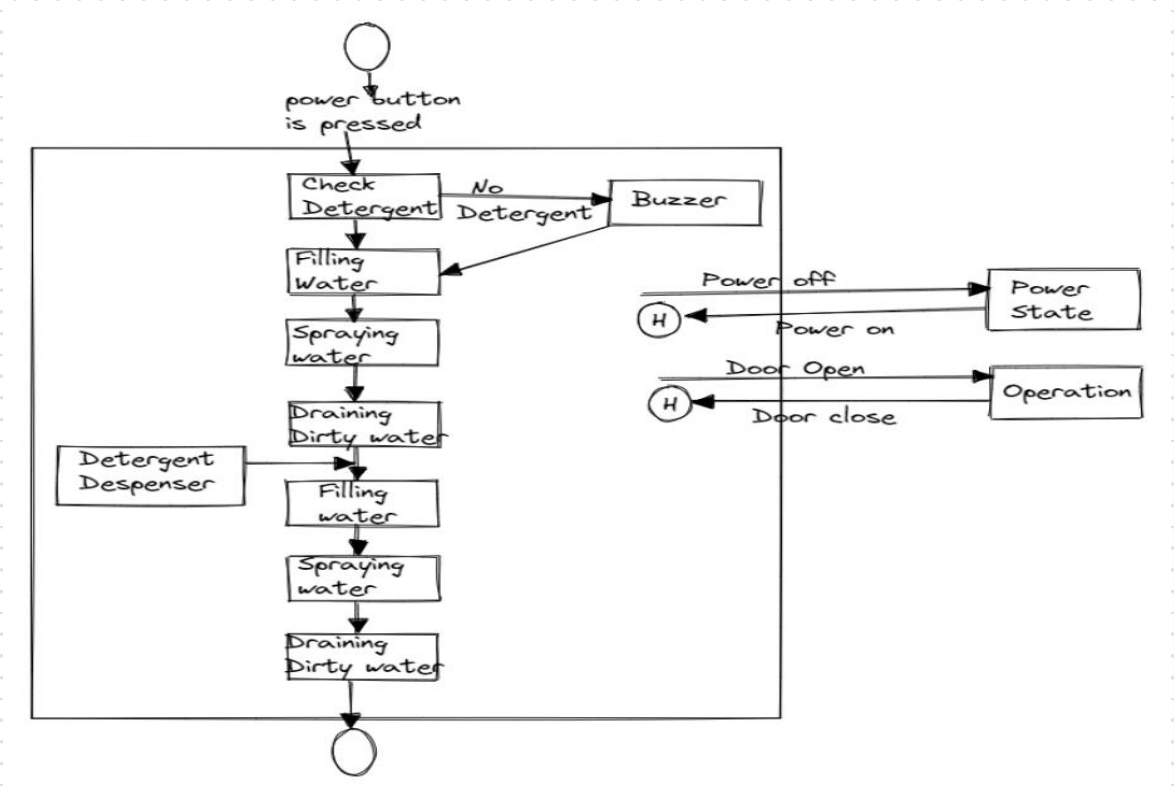


So as per the function tree, overall functions, and finalized product design, we have constructed an appropriate product architecture for the dishwasher.

In this architecture, we have kept the control unit, power unit, water pump unit, and utensil cleaning agent unit at top of the product. Followed by a sprinkling unit and utensil holding unit in the cleaning area, just below it. At last, we kept the waste/dirt removal at the bottom of the product which is on the top of the base.

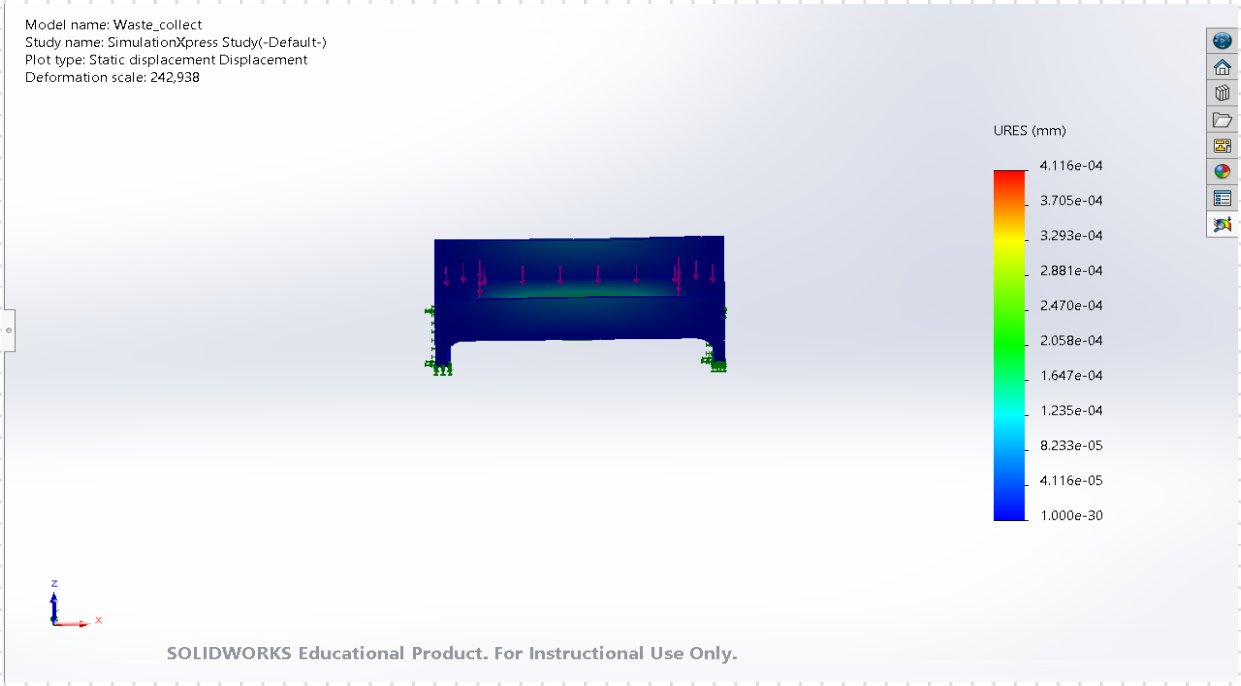
Flow Diagram of the dishwasher:

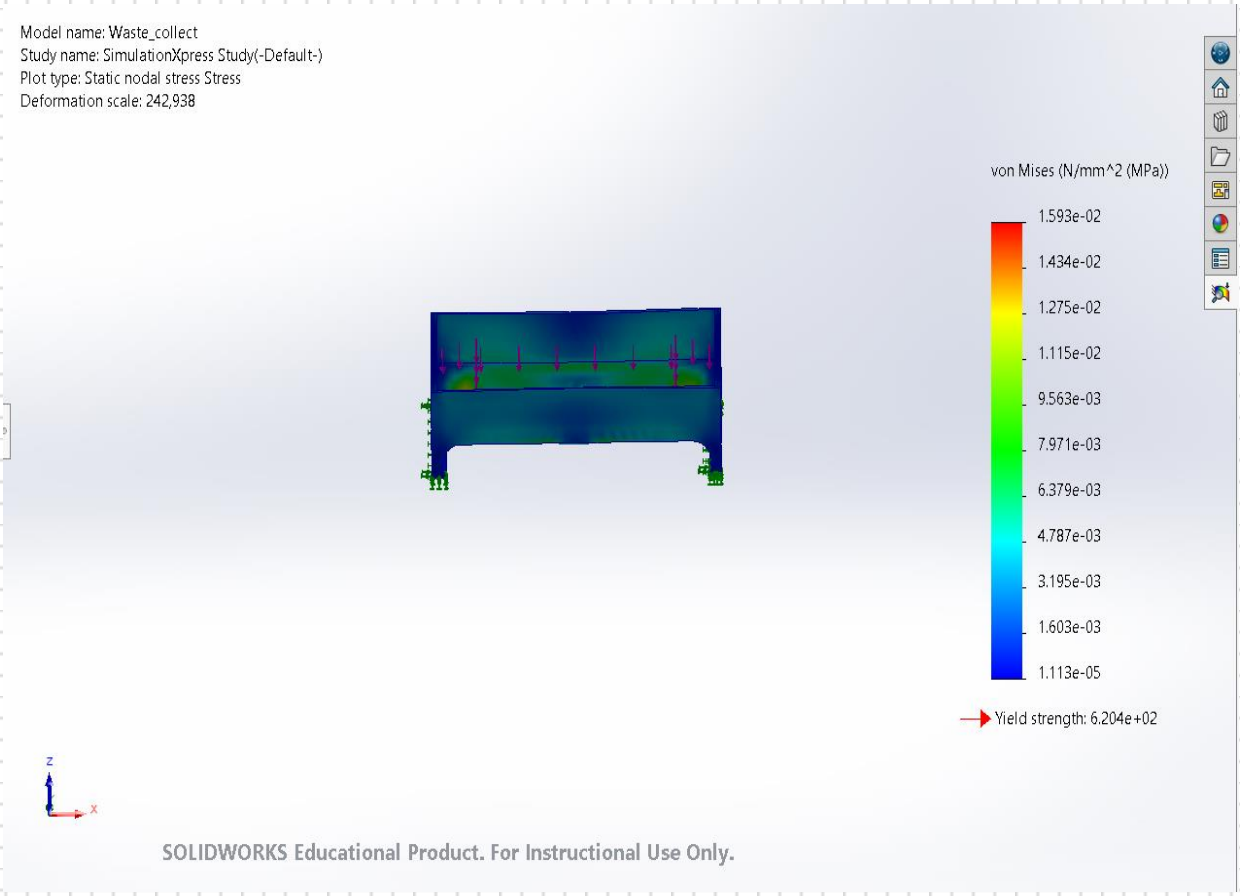
The process proceeds as follows: by pushing the button, the user must choose the wash mode. The system now determines whether the dishwashing agent is present or not; if not, the process moves on. If so, the system operates in the chosen mode. Water is transferred from a container by the diaphragm pump to a sprinkler that is mounted within the cleaning machine. The pump must have sufficient power to pressurise the water that the sprinkler uses to rotate, and the sprinkler must be placed such that it immediately begins to rotate on its own. The water that is then sprayed has the potential energy to clean the dishes. After the operation is complete, the system notifies the user removes the water that was sprayed from the waste removal unit.



Parametric Design:

Therefore, based on the finalized design, we have decided to construct a prototype that can wash up to 6 plates at once. The basic dimensions of the finished product are as follows: length: 330mm, width: 350mm, and height: 550mm.



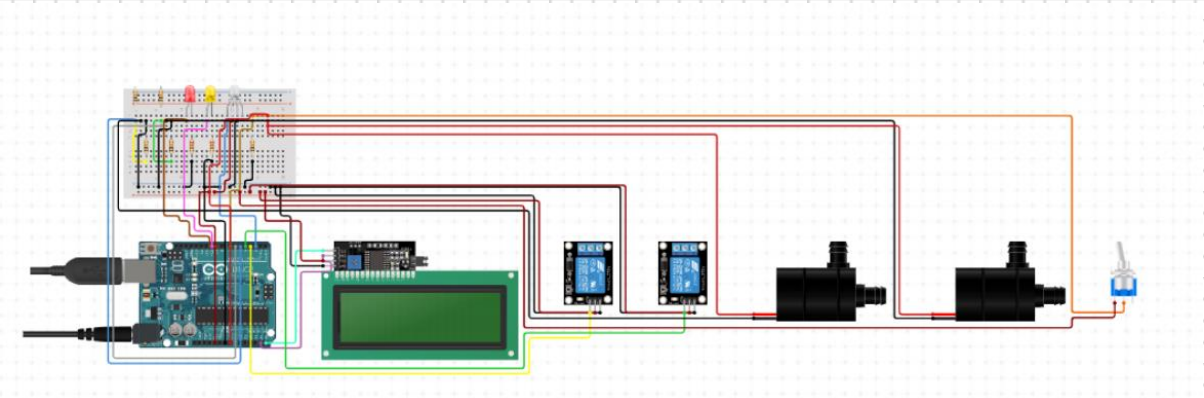


Some Special Purpose parts:

Diaphragm pump:

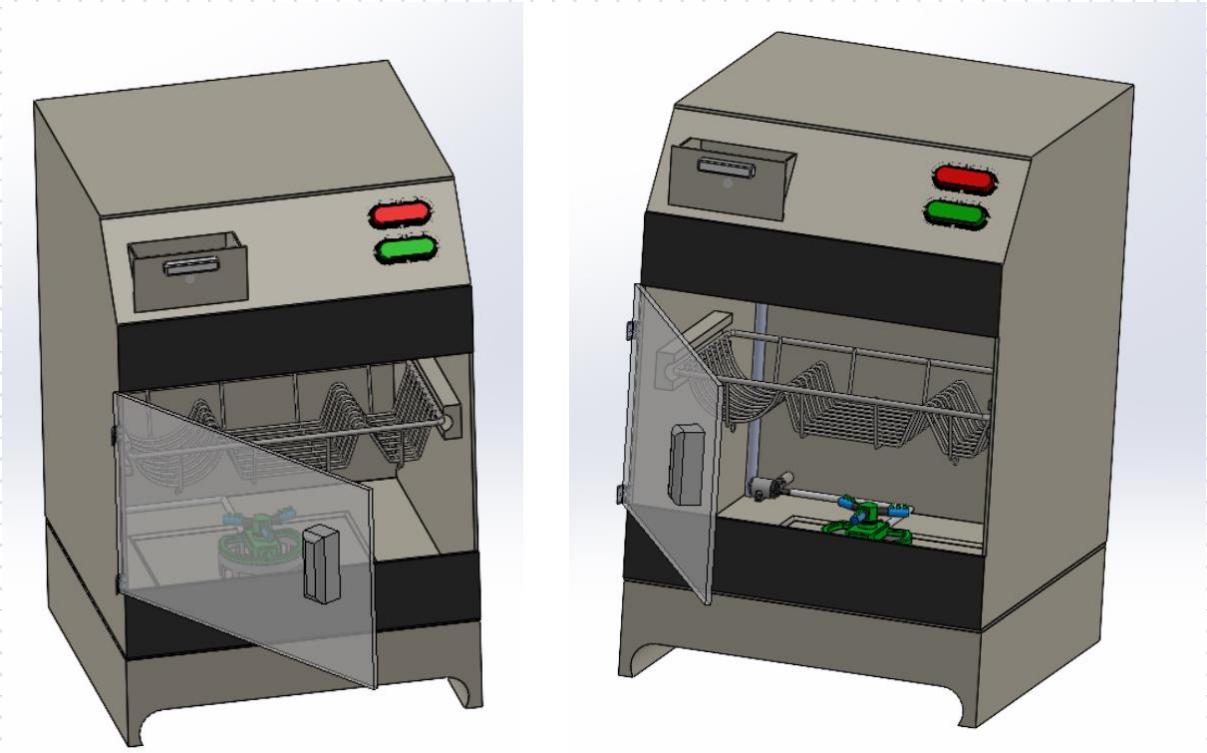
Lawn Sprinkler:

Circuit Diagram:



3D Model:

++

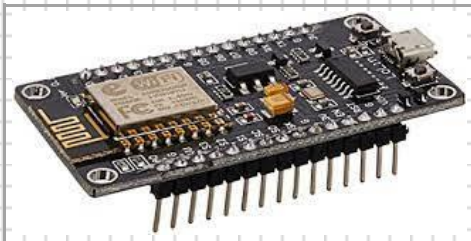


6 Detailed Design:

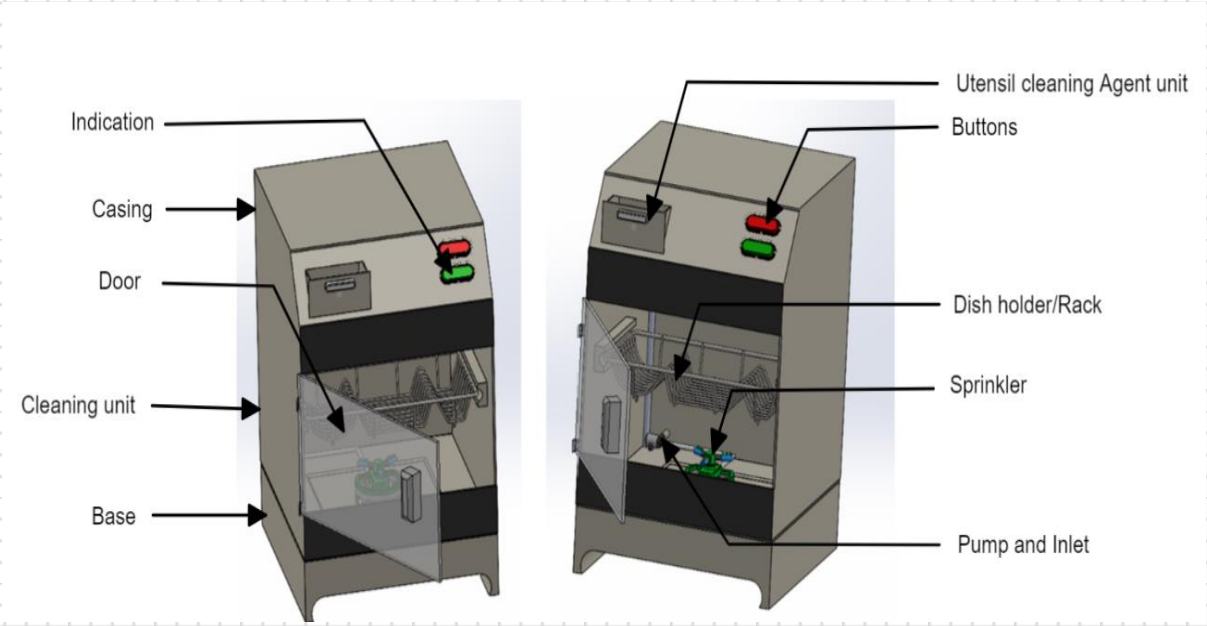
6.1 Selection of materials:

Subfunction	Working Principle-1	Working Principle-2
Accept Energy	 3-pin male socket	 3-pin male direct wire power supply
Accept Signal	 Push Buttons	

Accept water	 Metal pipe hose	
Accept dirty utensils	 Front loading door	 Top loading door
Accept utensil Cleaning agent	 Liquid type	 Powder type
Storing of utensils	 Stainless Steel Rack	 Plastic rack
Relay channel		

Energy Conversion	 Ac to Dc convertor module	
Control system	 Node MCU	 Arduino
Show status	 Via Display	 Via Buzzer

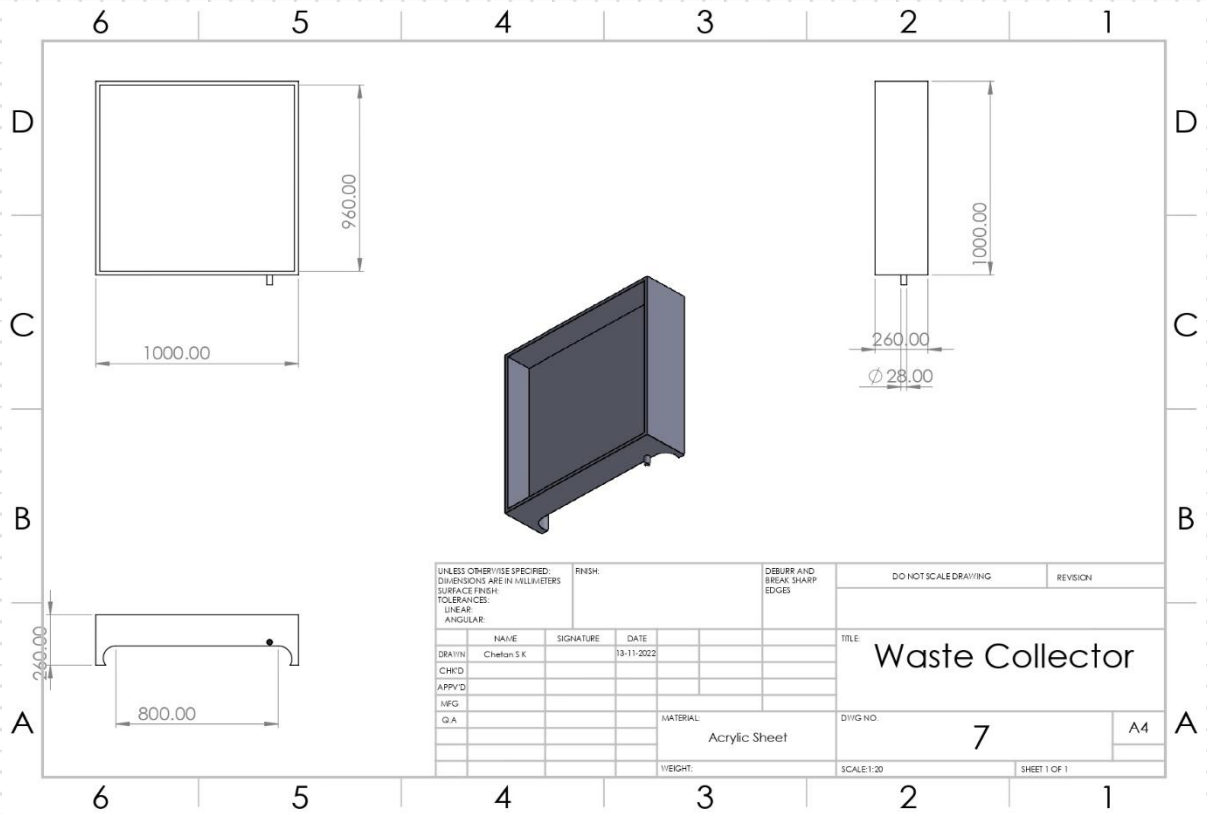
6.2 <u>Elaborate detail drawings and parts lists</u>:

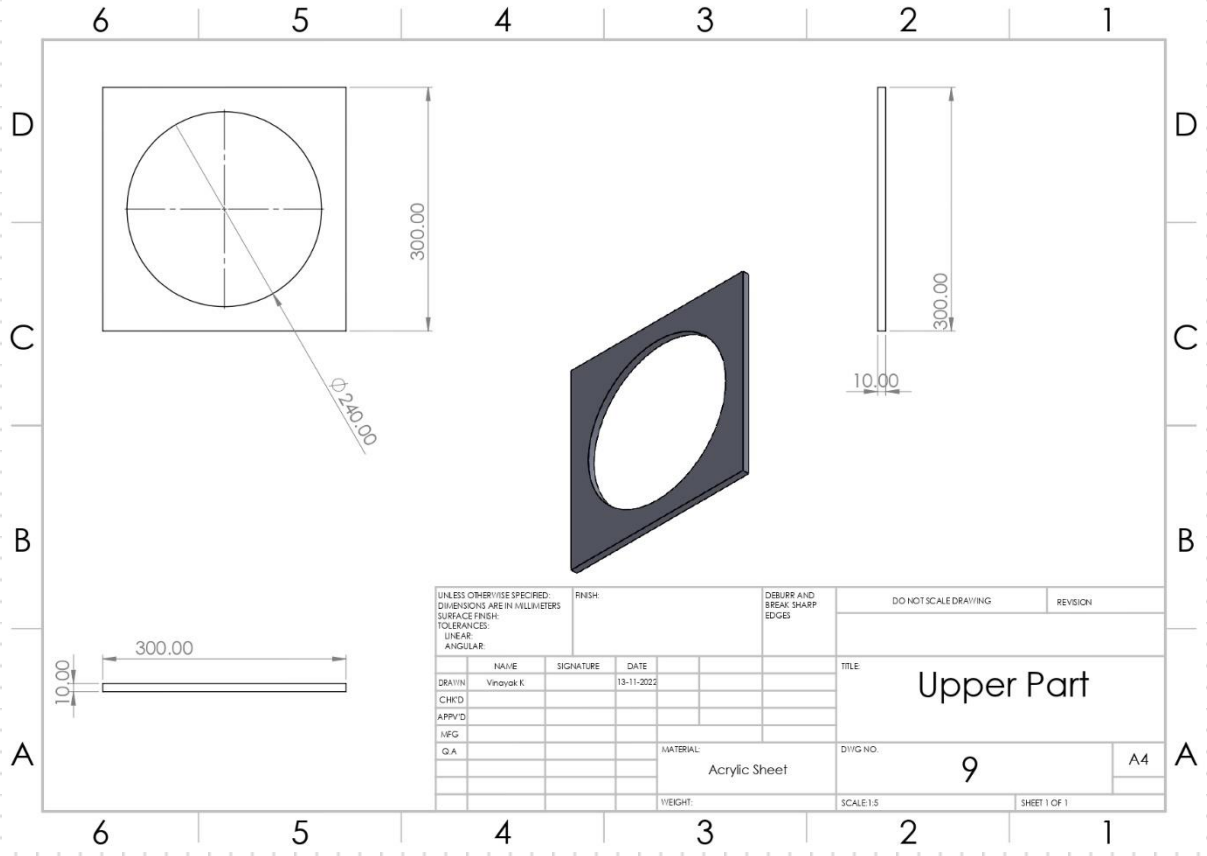


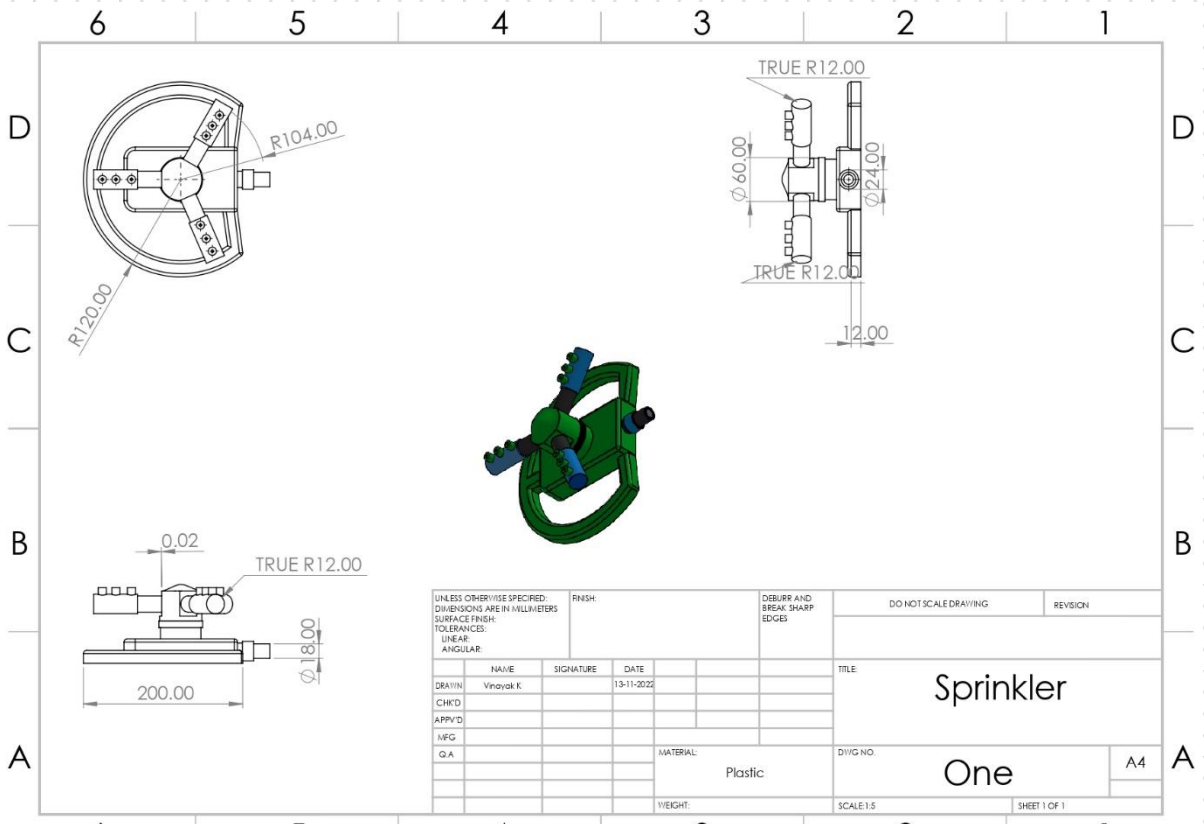
6.3 Bill of materials and Costing:

Item No	Item Name	Unit	Quantity	Cost (INR)
1	Water pump	24Watt	1	350
2	Micro DC 3-6V Micro Submersible Pump	1.1Watt	1	130
3	Sprinkler	-	1	330
4	Pipes	-	1	20/meter
5	Water Input Valve	-	1	218
6	Acrylic Sheet (Casing)	5mm,	4	335
7	Arduino Mega2560	2.4Watt	1	1550
8	Jumper wire	-	2-3 sets	213
9	Indication LED Bulb	3v	2	10
10	Switches	-	1	15
11	16*2(1602)character green backlight lcd display	5v	1	112
12	Relay modules	-	2	67
13	Adapter	12V,2.5A	1	249
14	Utensil Holder	-	1	339
16	Dish Washing Agent	50ml	1	30
17	L clamps	-	12	25
18	Rubber Insulation	-	1	81
19	Water Proofing Solution (Pedialyte flex quick)	50ml	1	54

6.4 <u>Process sheets and Documentation:</u>



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SURFACE FINISH:
TOLERANCES:
LINEAR:
ANGULAR:
FINISH:
DEBURR AND BREAK SHARP EDGES
DO NOT SCALE DRAWING
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NAME
SIGNATURE
DATE
DRAWN
Vinayak K
13-11-2022
CHK'D
APPV'D
MFG
Q.A
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MATERIAL:
Plastic
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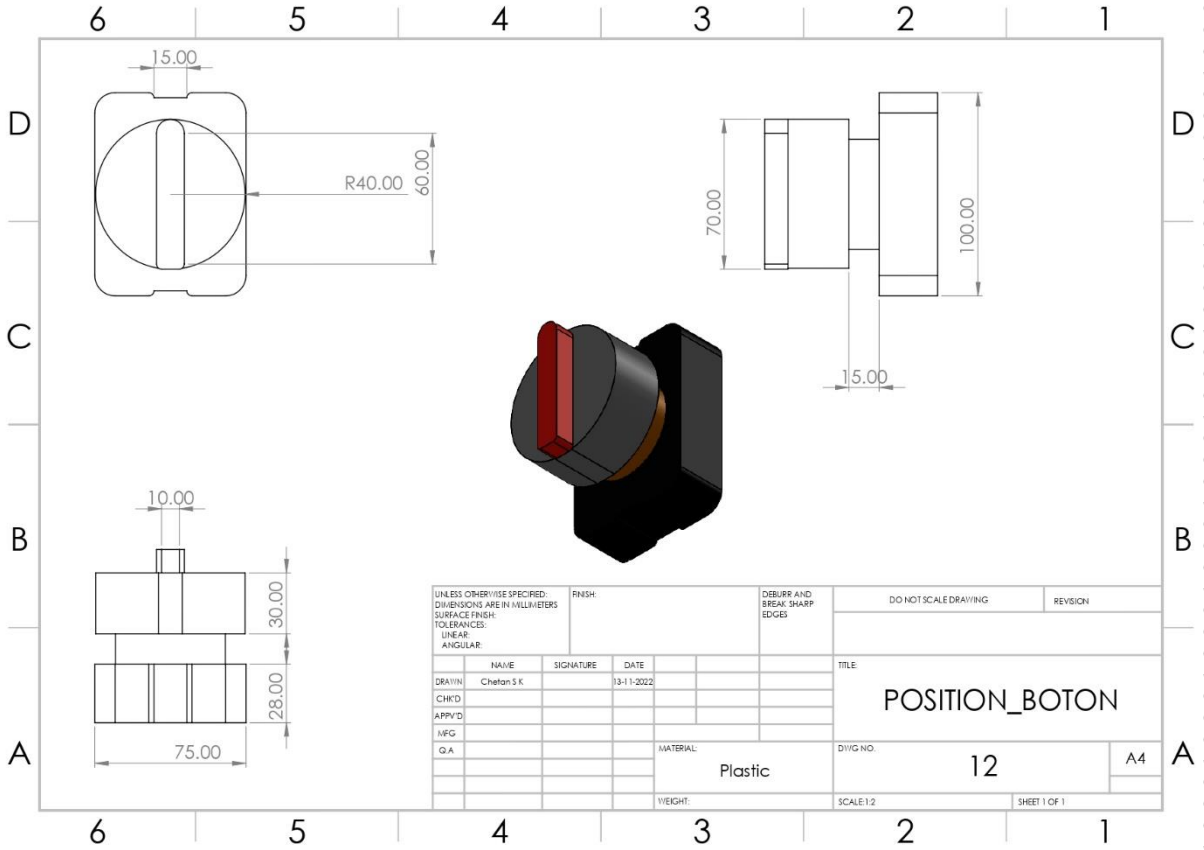
One
A4
WEIGHT:
SCALE:1:5
SHEET 1 OF 1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LINEAR:
ANGULAR:
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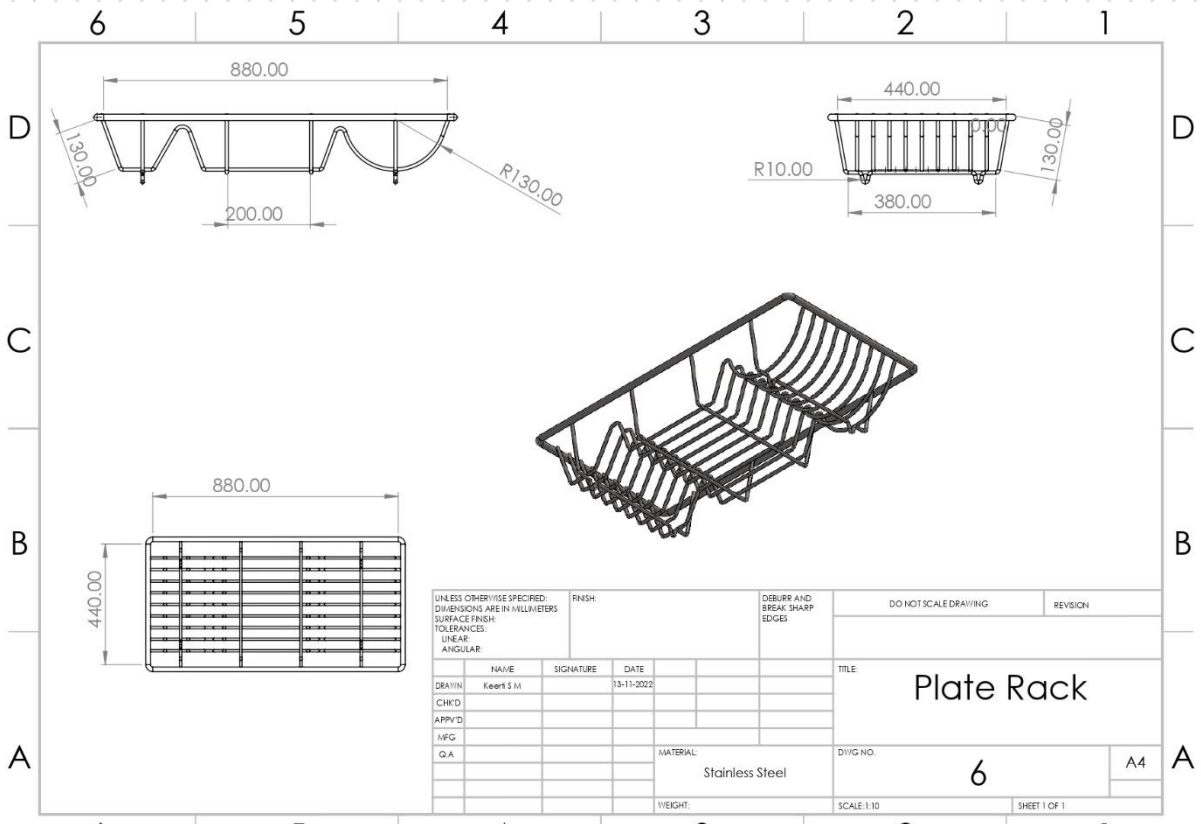
SHEET 1 OF 1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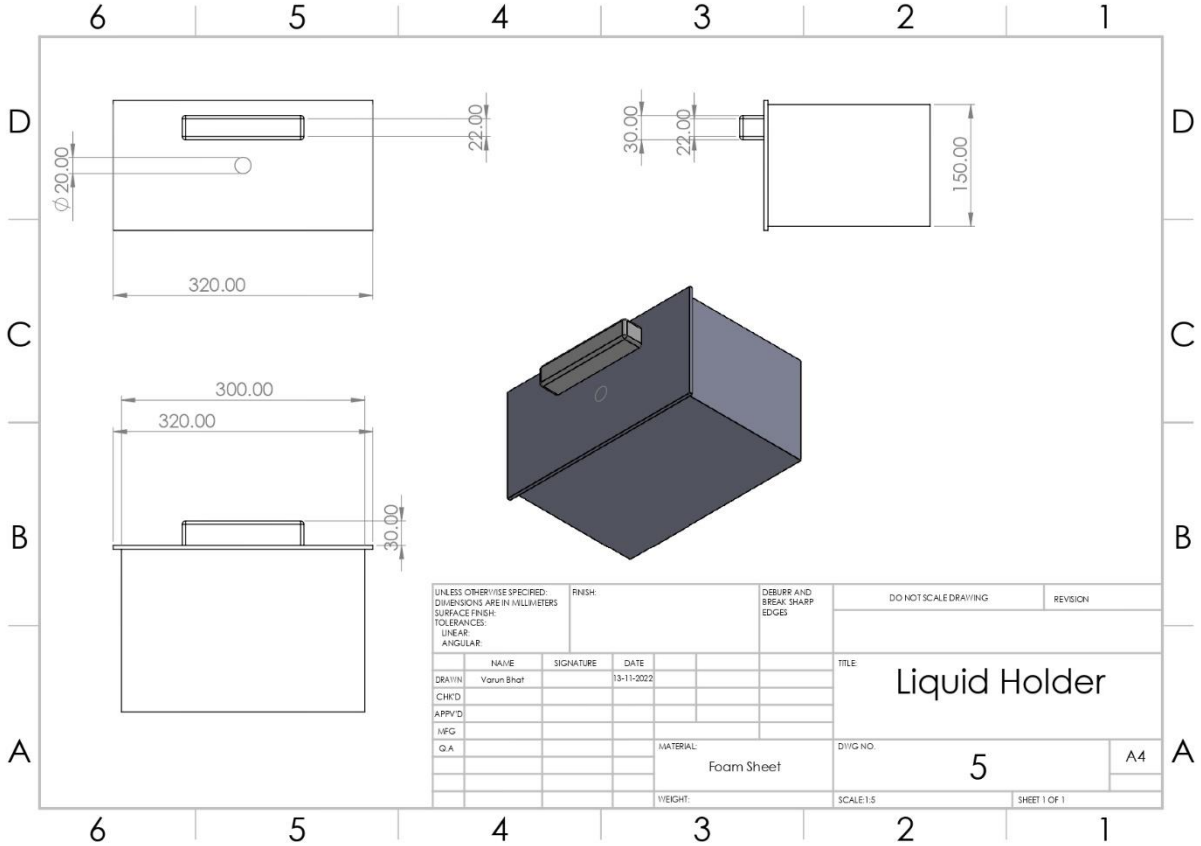
SURFACE FINISH:
TOLERANCES:
LINEAR:
ANGULAR:
FINISH:
DEBURR AND BREAK SHARP EDGES
DO NOT SCALE DRAWING
REVISION
NAME
SIGNATURE
DATE
DRAWN
Keerti S M
13-11-2022
CHK'D
APPV'D
MFG
Q.A
TITLE:
Plate Rack
MATERIAL:
Stainless Steel
DWG NO.
6
A4
WEIGHT:
SCALE:1:10
SHEET 1 OF 1


22.00
Ø 20.00
320.00
30.00
22.00
150.00
300.00
320.00
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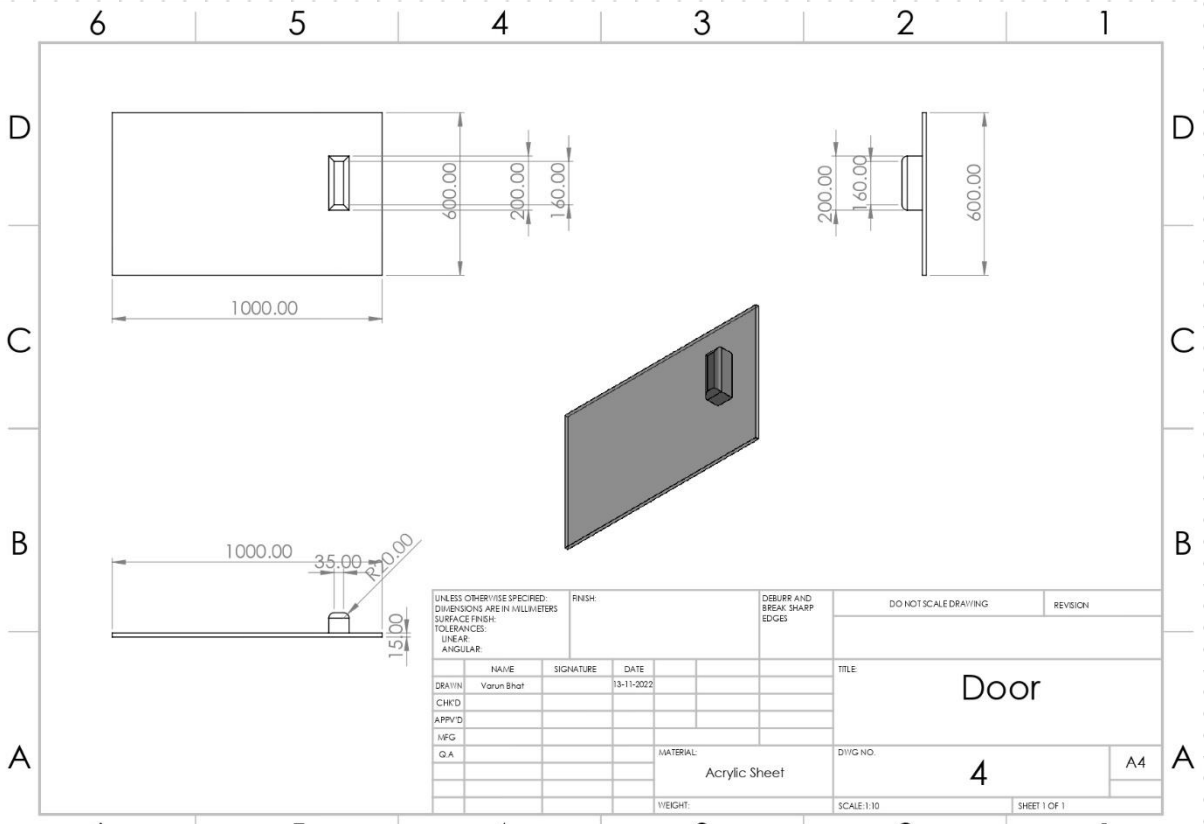
UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN MILLIMETERS
SURFACE FINISH:
TOLERANCES:
LINEAR:
ANGULAR:
FINISH:
DEBURR AND BREAK SHARP EDGES
DO NOT SCALE DRAWING
REVISION
NAME
SIGNATURE
DATE
DRAWN
Varun Bhat
13-11-2022
CHK'D
APPV'D
MFG
Q.A
TITLE:
Liquid Holder
MATERIAL:
Foam Sheet
DWG NO.
5
A4
WEIGHT:
SCALE:1:5
SHEET 1 OF 1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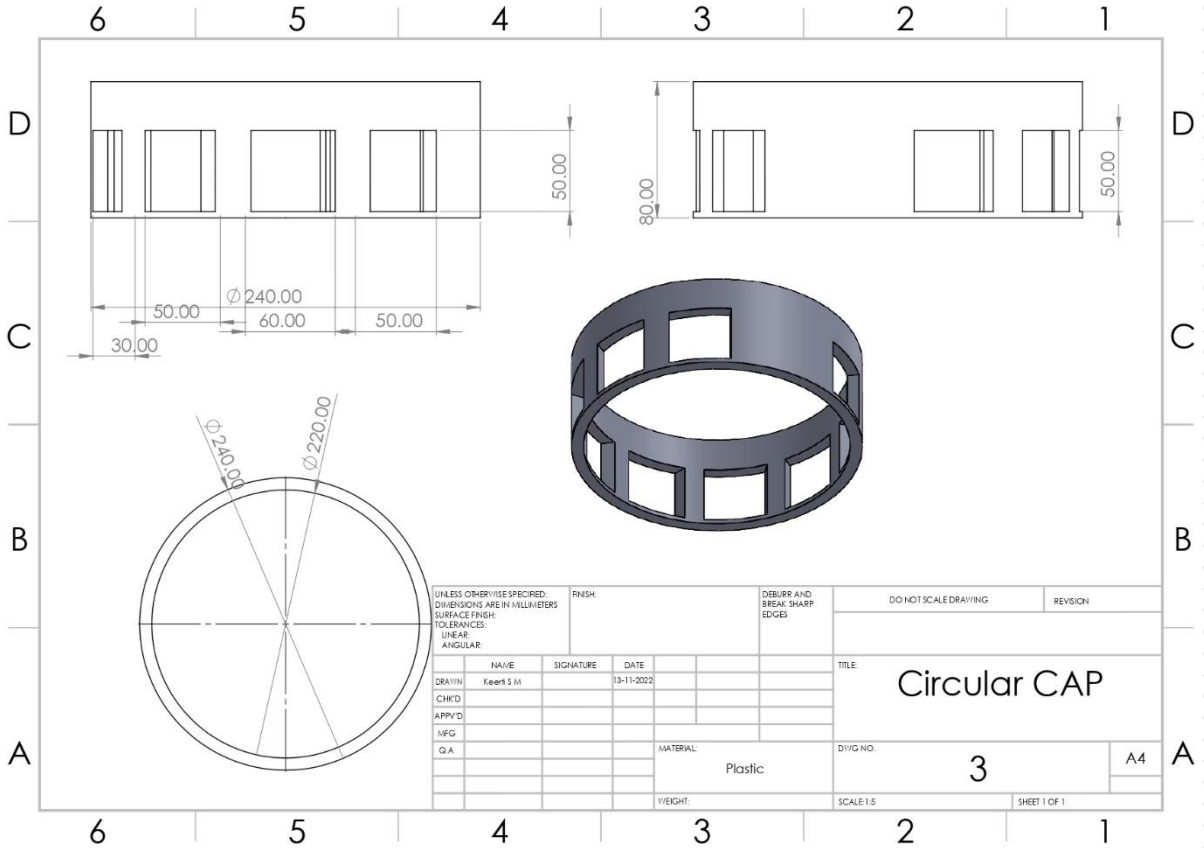
DIMENSIONS ARE IN MILLIMETERS
SURFACE FINISH:
TOLERANCES:
LINEAR:
ANGULAR:
FINISH:
DEBURR AND BREAK SHARP EDGES
DO NOT SCALE DRAWING
REVISION
NAME
SIGNATURE
DATE
DRAWN
Varun Bhat
13-11-2022
CHK'D
APPV'D
MFG
Q.A
TITLE:
Door
MATERIAL:
Acrylic Sheet
DWG NO.
4
A4
WEIGHT:
SCALE:1:10
SHEET 1 OF 1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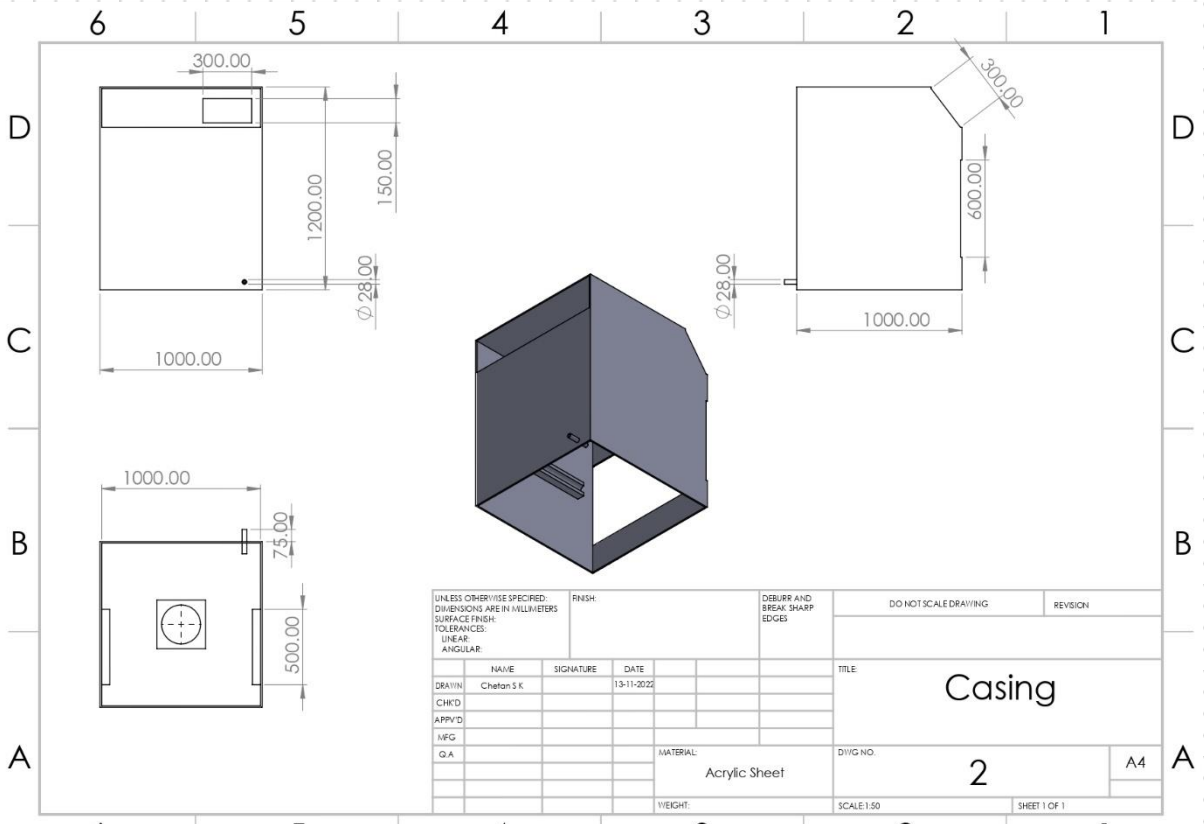
UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN MILLIMETERS
SURFACE FINISH:
TOLERANCES:
LINEAR:
ANGULAR:
FINISH:
DEBURR AND BREAK SHARP EDGES
DO NOT SCALE DRAWING
REVISION
NAME
SIGNATURE
DATE
DRAWN
Keerti S M
13-11-2022
CHK'D
APPV'D
MFG
Q.A
TITLE:
Circular CAP
MATERIAL:
Plastic
DWG NO.
3
A4
WEIGHT:
SCALE:1:5
SHEET 1 OF 1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Ø 28.00
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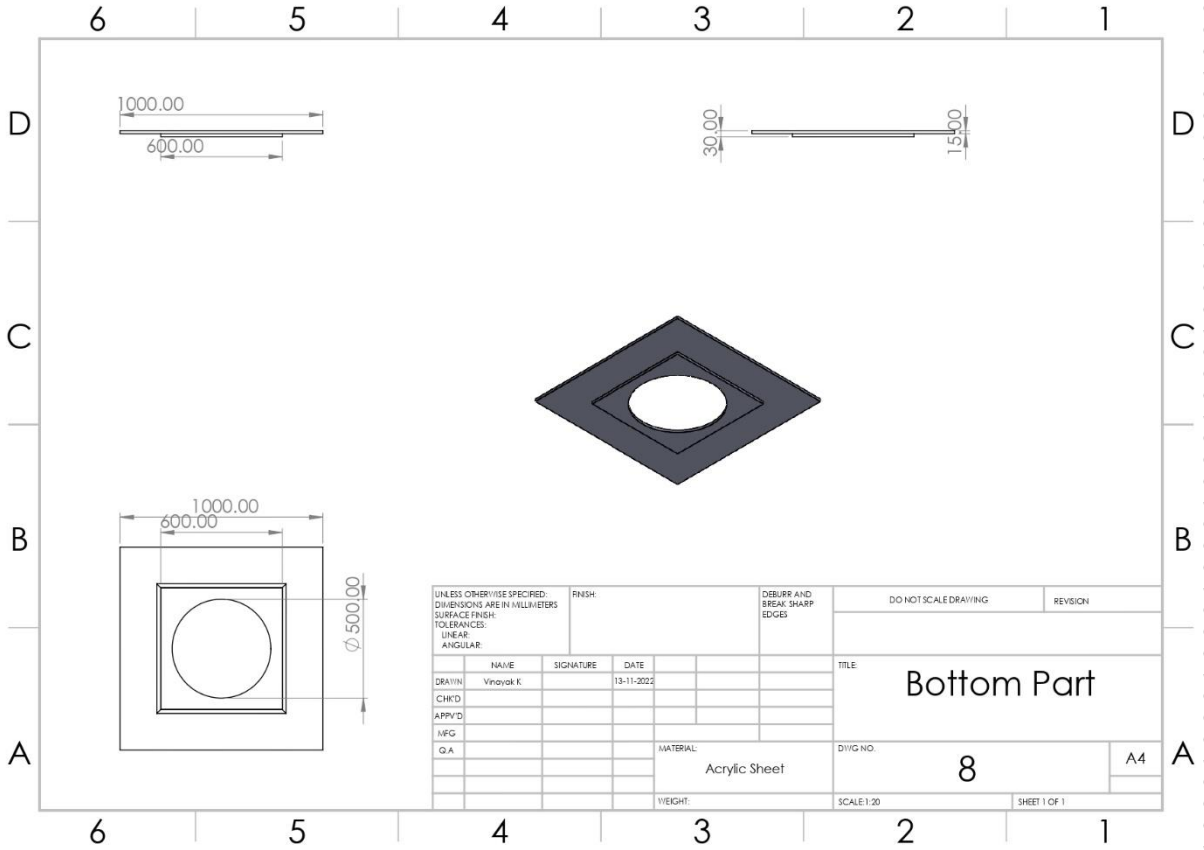
UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN MILLIMETERS
SURFACE FINISH:
TOLERANCES:
LINEAR:
ANGULAR:
FINISH:
DEBURR AND BREAK SHARP EDGES
DO NOT SCALE DRAWING
REVISION
NAME
SIGNATURE
DATE
DRAWN
Chetan S K
13-11-2022
CHK'D
APPV'D
MFG
Q.A
TITLE:
Casing
MATERIAL:
Acrylic Sheet
DWG NO.
2
A4
WEIGHT:
SCALE:1:50
SHEET 1 OF 1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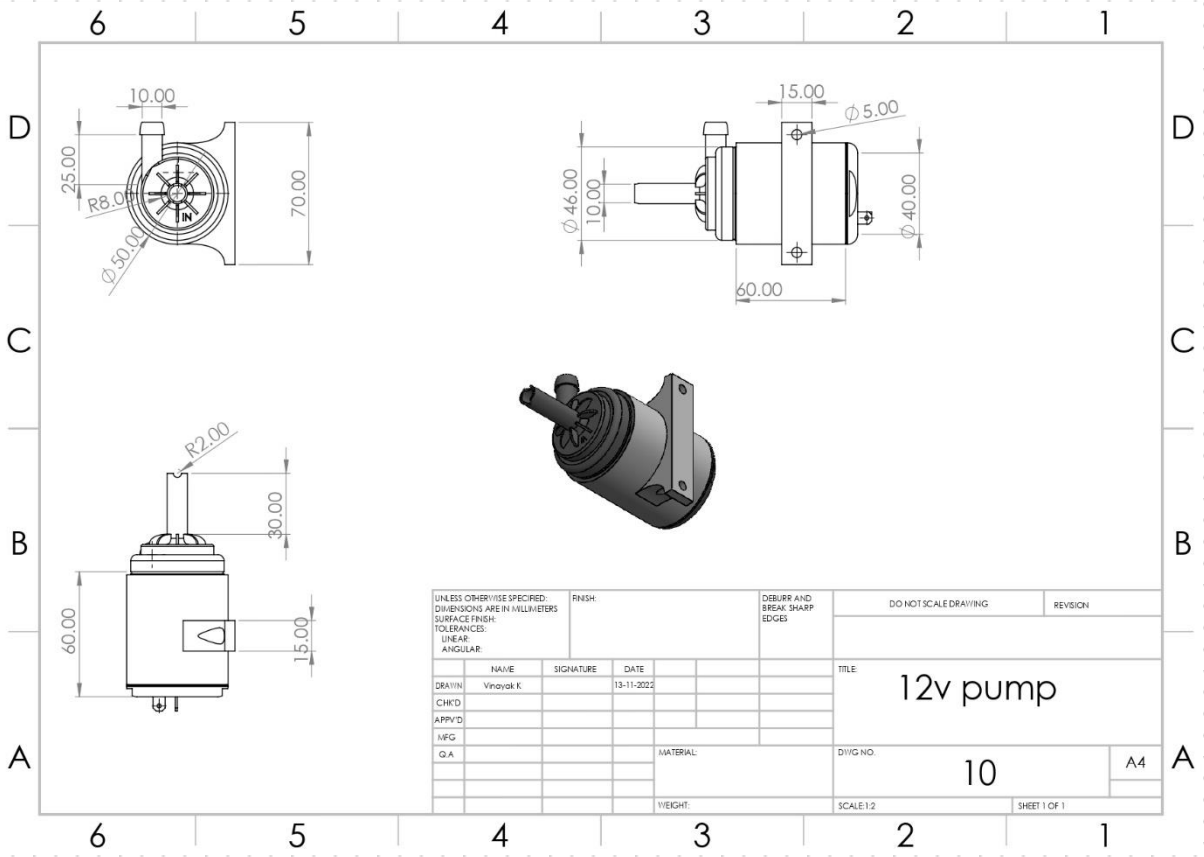
UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN MILLIMETERS
SURFACE FINISH:
TOLERANCES:
LINEAR:
ANGULAR:
FINISH:
DEBURR AND BREAK SHARP EDGES
DO NOT SCALE DRAWING
REVISION
NAME
SIGNATURE
DATE
DRAWN
Vinayak K
13-11-2022
CHK'D
APPV'D
MFG
Q.A
TITLE:
Bottom Part
MATERIAL:
Acrylic Sheet
DWG NO.
8
A4
WEIGHT:
SCALE:1:20
SHEET 1 OF 1



Refernce
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