

**Akash K. Seth** is a sophomore pursuing his Bachelors in Design from Department of Design, Delhi Technological University. He's positively enthusiastic about his projects and works. He's persistent in his approach towards learning anything new. Exercising his skills with determination, Akash has constantly been improving in his ways of idea generation and problem-solving abilities. Also, he has started showing keen interest in working physically with hands rather than just learning digital tools.

Akash was a participant at Delhi Design Innovation Boot camp 2018, where he positively worked on enhancing the experience and efficiency of medical lab tests in government clinics through a mobile application- Medic Ninja.

## ESPRO

### Abstract

*The goal of the project is to redesign an electric chopper that is affordable, portable and easy to use for all stages of food preparation in Indian households. This project stems from the Semester Design Project. The objective was to improvise and redesign the existing form (casing/appearance) of consumer goods e.g. toaster, hand blender, etc. The design process in its entirety is detailed throughout this report, including methodology, procedures, analyses, and end results. A detailed description, including finalized CAD models of all components is provided as well. The design has evolved throughout the process and the current design is the result of intense efforts and analysis. This report serves to document the entire process from initial background research to final recommendations for improvement to the final design.*

### Introduction

The product chosen was an Orpat express chopper (as shown in Figure 1(a)). A cost-effective, durable and efficient chopper running on a 250-watt motor that has an output of 18000 rpm. It comes with two blades for chopping and whisking respectively and a 700 ml BPA free container that doubles up as a storage container with a multipurpose splash guard. The operation is done through a single pulse button providing a range of cutting options like – chopping, mincing and pureeing. It's provided with a gasket like rubber attachment at the base that prevents slipping. Although being a good enough device for everyday use, it comes with its own set of problems that affects the experience with the device.

The express chopper was tinkered (as shown in Figure 1(b)) and studied in detail through sketches. Market surveys were conducted. A task analysis was conducted as a comparative study between users and first-time users. Online surveys and in-person interview was also conducted. Similar products were also studied. Conceptualization involved a lot of ideas from mechanical chop station to the utilization of fluid at high pressure to chop. However, keeping the brief in focus which required the change in the form/casing keeping the mechanism intact was the key element to the idea of **Espro**. There is a general convention of pushing down on the lid when using similar devices like the chopper i.e. mixer grinder. Even though the newer models come with a locking mechanism, the user has a tendency to put their hand on top during operation. Espro utilizes this conventional behavior to its advantage to operate itself. The container jar is made to rest on a groove in the power base. When the user has put the food in the container and assembled the device and pushes down on the container's top this groove slides in, which in turn presses on the switch starting the motor and thus starting the device.

## Objective

The objective of the following project is to improvise and redesign an electric chopper based on user feedback and survey.

## Problem Identification

To begin with the phase, the device was used to identify the first-hand problems. Review videos, articles, similar products, and other sources were looked at for primary research. Further, Google forms were circulated online. Offline forms were made which were used to interview both users and non-users to understand different perspectives. Interviews were conducted with homemakers, shopkeeper/salesman who were using similar products/devices. User study/Task analysis was conducted on homemakers and students in the hostels to understand their behavior and actions with the product.

Chopping is a skill mastered over the years. The quality of chopping of the ingredients directly affects the taste, texture, and presentation of the dish. The art of using a knife itself requires practice and precision. Indian households, women utilize this time of chopping in front of the TV using a chopping board and a knife to cut vegetables and other cooking essentials for their next meal preparation. However, these appliances seem to take away the experience of a knife. The 15-20 min. activity gets over within seconds. On analyzing the surveys and interviews, a lot of problems came into light that can be worked upon -The fine gap between the pulse button and power pod risks the entry of water during usage and cleaning. The button's unconventional design often seems to confuse the users to a point where they start opening it thinking it's a lid. Smaller food components get logged in the space between the blade and container and don't get chopped. The detachable blade design being unconventional causes the user to forget to remove it after use, resulting in the blade getting stuck to the spindle and falling off on emptying the container. Devices of similar operation have the powerhead in the bottom, unlike the chopper. The user found it difficult in associating blades with its usage.

## Need Statement

***To redesign the electric chopper utilizing the existing convention of a mixer grinder, where the lid is pushed down when in use.***

## Background Study and Research

The major study of the product was related to understanding user needs and requirements, through Qualitative (18 physical interviews and documentation) and Quantitative (20 Online Google Form) surveys.

There was rigorous effort put into the following phase of the project to get to the root cause of the analysis.



Figure 1 (a) Current/ Existing Design (b) Components of  
an existing design  
(from left to right)

## Task Analysis - a user study of the product

A user study was conducted of the Orpat Express Chopper to observe the interaction of the product with people. The participants were of two types - namely, a user (one who has used the product before) and a non-user (one who has never seen the product before). The users were provided with the following materials- A packaged box of Orpat express chopper, knife, onions, a storage container. They were required to chop the onions finely, collect the output in a storage container, clean the components and reassemble the components in the box. The assignment was immediately followed by a feedback session from the candidates. The data were analyzed in a tabular form (as shown in Table 1).

Table 1: Task Analysis

Persona	Findings	Remarks
<p>Name-Apoorva</p> <p>Profile-Student</p> <p>Age-20</p> <p>User</p>	<p>The user begins with chopping the onions first and finds himself in a state of discomfort due to the burning sensation in his eyes. The next set of tasks are affected and the subject shows a lack of motivation. However, he completes the tasks.</p>	<p>Overall Satisfaction from Usage</p> <p>Ambiguity in the function of the blades.</p> <p>The “heavier part” (Power pod) should be placed in the bottom half to get better stability and to have power cord in the base.</p> <p>Unappealing pulse button</p> <p>To accept inputs during the process without removing the setup.</p> <p>Ex - Chop bananas and add milk and other ingredients during the same time.</p>
<p>Name- Hrishikesh Madhav</p> <p>Profile-Student</p> <p>Age-18</p> <p>Non User</p>	<p>The user finds the physical form of the chopper unappealing. He finds the pulse button to be confusing. Also he claims that the ridges provided in the bowl are not beneficial enough.</p>	
<p>Name-Athishay Gupta</p> <p>Profile-Student</p> <p>Age-18</p> <p>Non User</p>	<p>The user took a sufficiently long amount of time, studying the manual yet failed at many steps throughout the process.</p>	<p>The main concern while buying the product would be size and capacity.</p> <p>The subject would like to add a speed regulator and a locking mechanism.</p>

**User Journey Mapping:** The sequence of the user's interaction with the product is represented through a radial timeline visual. This visual consists of a timeline of all touchpoints between a user and a product. This was further utilized to find alternate approaches and “What if...?” scenarios to the process of the task.(as shown in Figure 3)

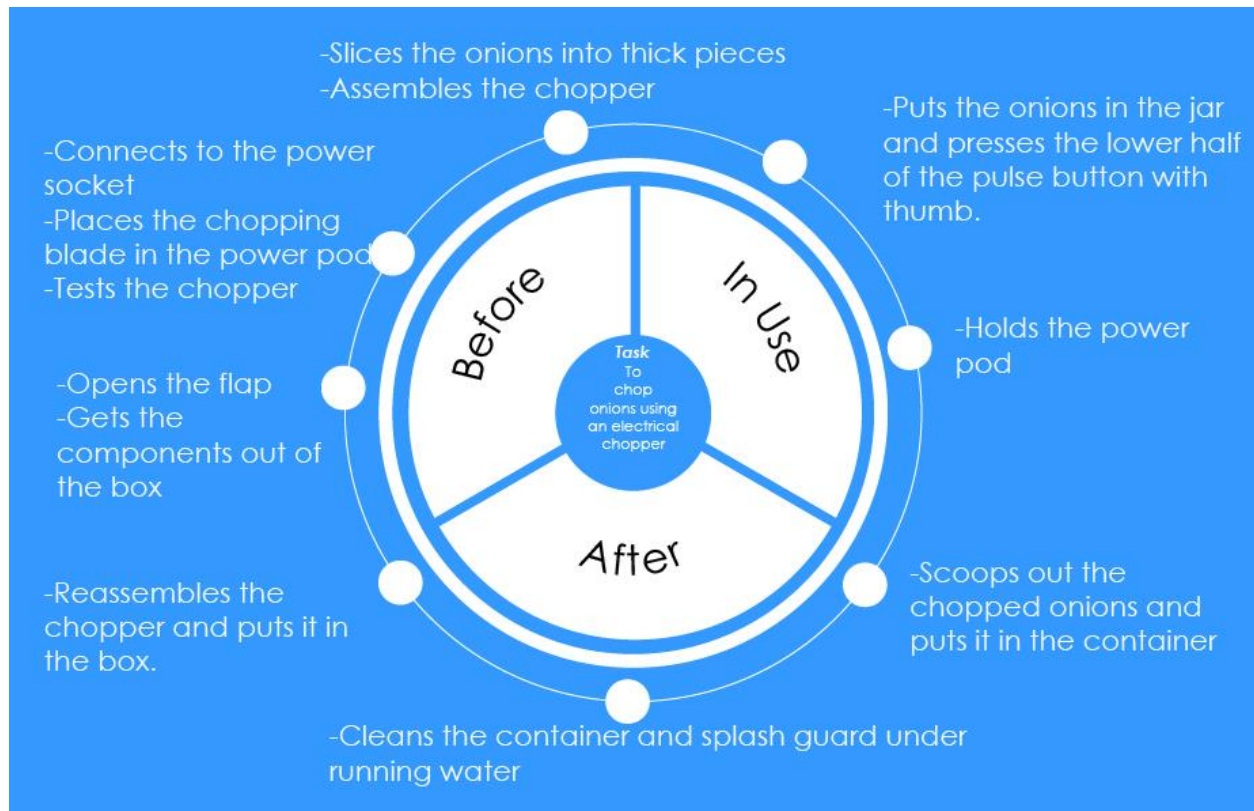


Figure 3 User Journey Map of the chopper in use (Clockwise)

**Experience Mapping:** Mapping of the experience from a user's perspective was done to identify strategic opportunities, pain points and generate further ideas. The experience was scaled on the satisfactory level of the user from the product usage. Three stages of the process of usage were taken into account- Before, In use and After which were further subdivided into crucial steps. (as shown in Figure 4)

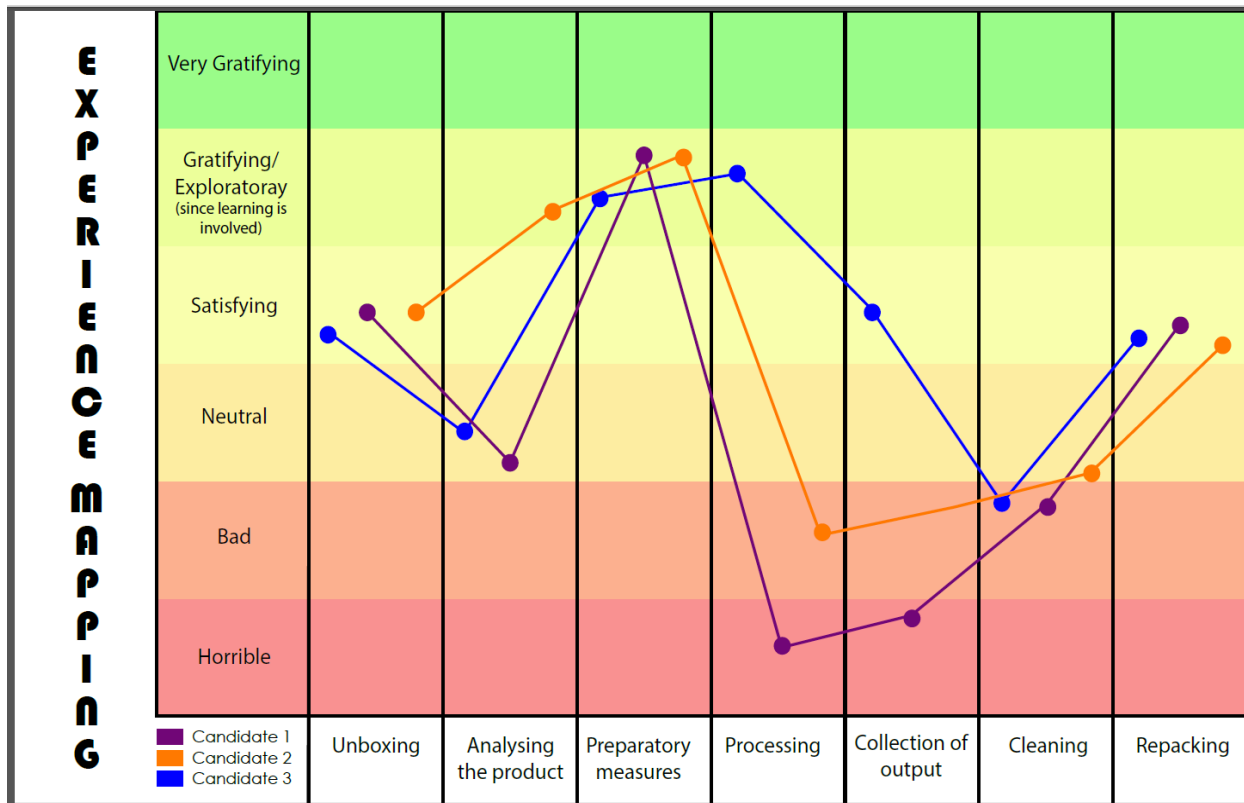


Figure 4 Experience Map of the chopper in use

**Empathy Mapping:** An empathy map was developed to gain a greater insight into the user's interaction with the chopper. Instances from the interviews, survey and task analysis were included in the different sections of the map namely- Say, Does, Thinks, Feels.(as shown in Figure 5)

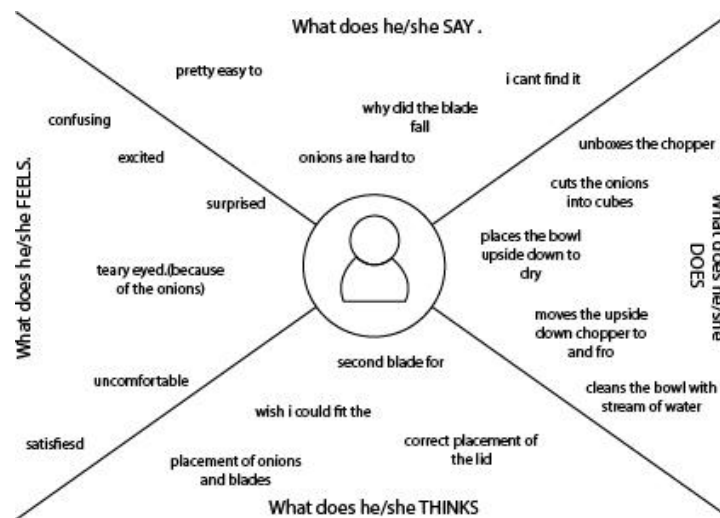


Figure 5 Empathy Map



**User Persona:** When developing a product, it is essential to define the user base. From the numerous interviews and user interactions, segments of the demographics were selected and quantified into qualitative personas to represent them.

Majorly the segments were divided as working professionals (as shown in Figure 6(a)) and homemakers (as shown in Figure6(b)) - which were the target audience.

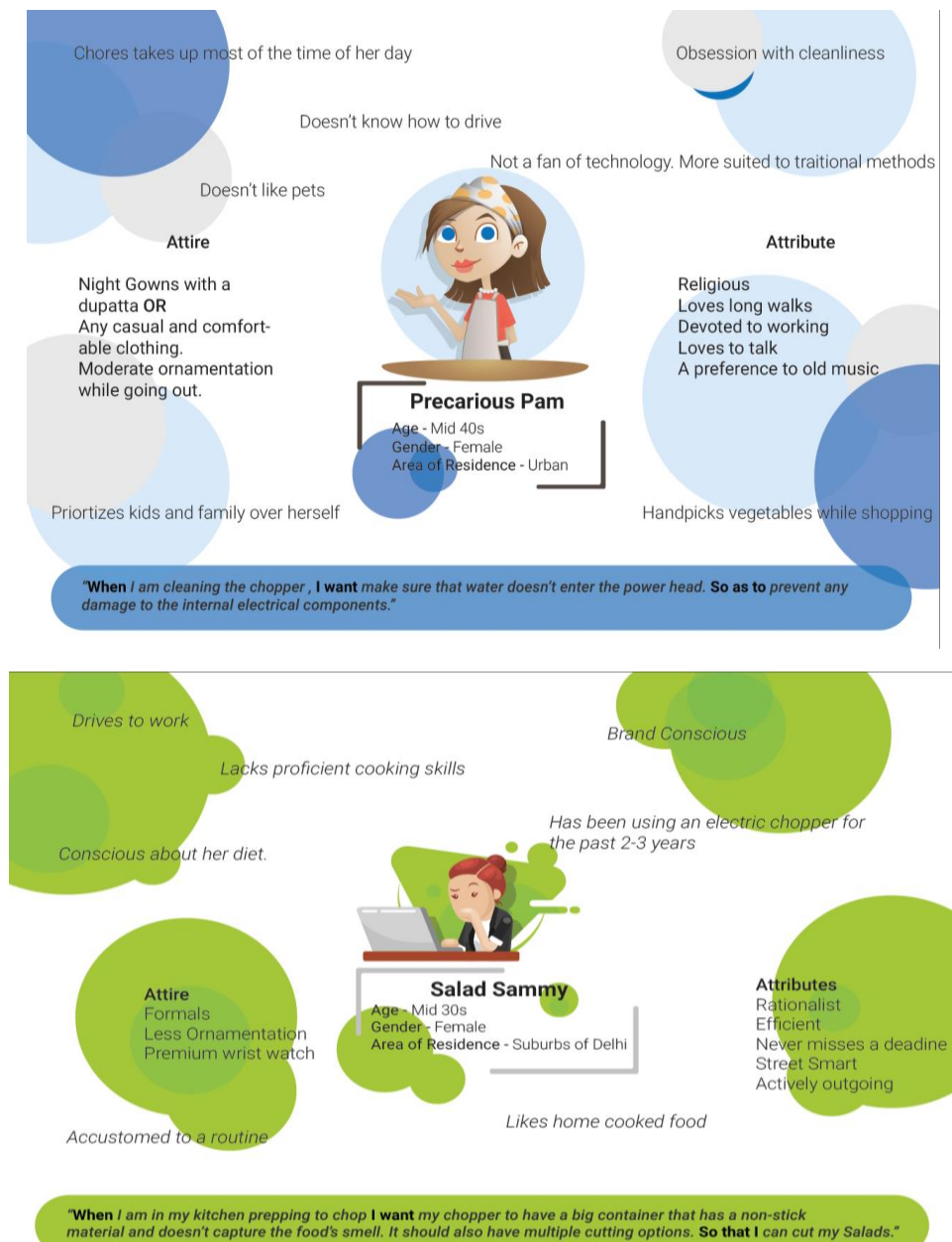


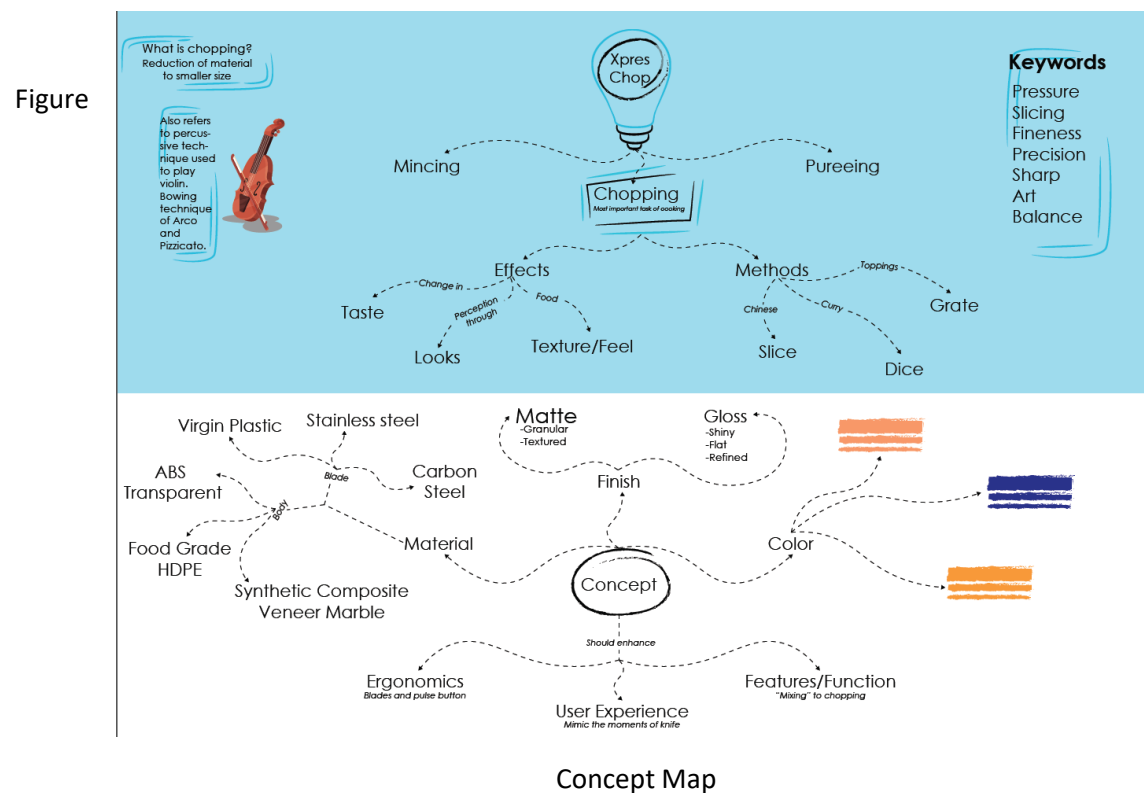
Figure 6 (a) Persona of a homemaker (b) Persona of a working professional



## Concept Generation

There were many steps and iterations to the design evolution. Design generation began with a design breakdown/ tinkering of the product to the following functional components : blades, power pod, container, pulse button. For each component designs were generated and iterated based on mentor feedback. Throughout this process several alpha designs were created.

The initial conceptualization involved exploration into component wise design generation which moved into a few mechanical operable designs too. However, mentor feedback and brief requirement brought the conceptualization phase back into focus and the further designs involved change in the form only.(as shown in Figure 7)



## Areas of Study in Ergonomics

The product was further analyzed through an ergonomics study to better understand the shortcomings. The following aspects were studied-

- Cognitive aspects of the user machine interface- It is as important to achieving a cognitive fit between user and machine as it is to achieve a physical fit. The problem arising here is the comprehension of parts when in unassembled state. There seems to be an excess of components causing confusion thus leaving the user frustrated.

- Psychological environment- It is necessary to ensure a clear understanding between the expectations and attitudes of a user in their own environment.

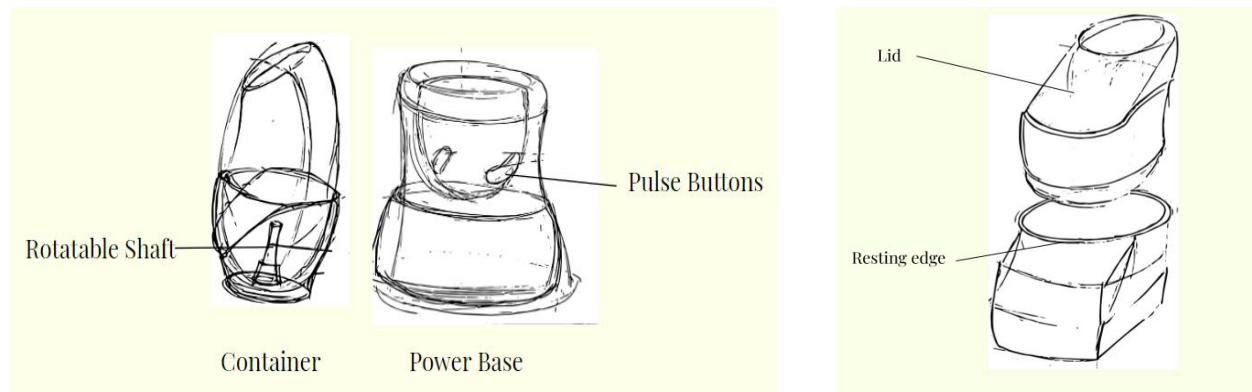


Figure 8(a) A sketch of the initial concept; Figure 8(b) A sketch of the initial concept

The first alpha design (as shown in Figure 8) composed of a rearranged configuration of the components from the initial functional breakdown. The container was shaped like a capsule curved inwards towards the top to have a slant resting lid at an angle of 30 degrees. This capsule-shaped container is made to rest in a socket in the power base. This socket is a cupola to receive the container, having slot(s) from which the button(s) and spindle protrude. The power base is shaped following the form of the motor and the cupola socket in a vertical stack. The container has a rotatable shaft extending into a plate into the bottom sealed with a valve. The container needs to be tough, transparent and be easily molded. Also it needs to be food grade. Hence, Polycarbonate is the optimal plastic. The Powerbase is made of ABS plastic.

As the components are arranged together, it would be in the following configuration starting from the bottom: The spindle will directly connect into the rotatable shaft in the container, which in turn will have blades attached on it. The container will be resting on the button(s) perfectly fitting the socket. When the user pushes down on the head, the button(s) receive the pressure and start the motor, in turn starting the device itself.

### Design Evolution leading to Final Design

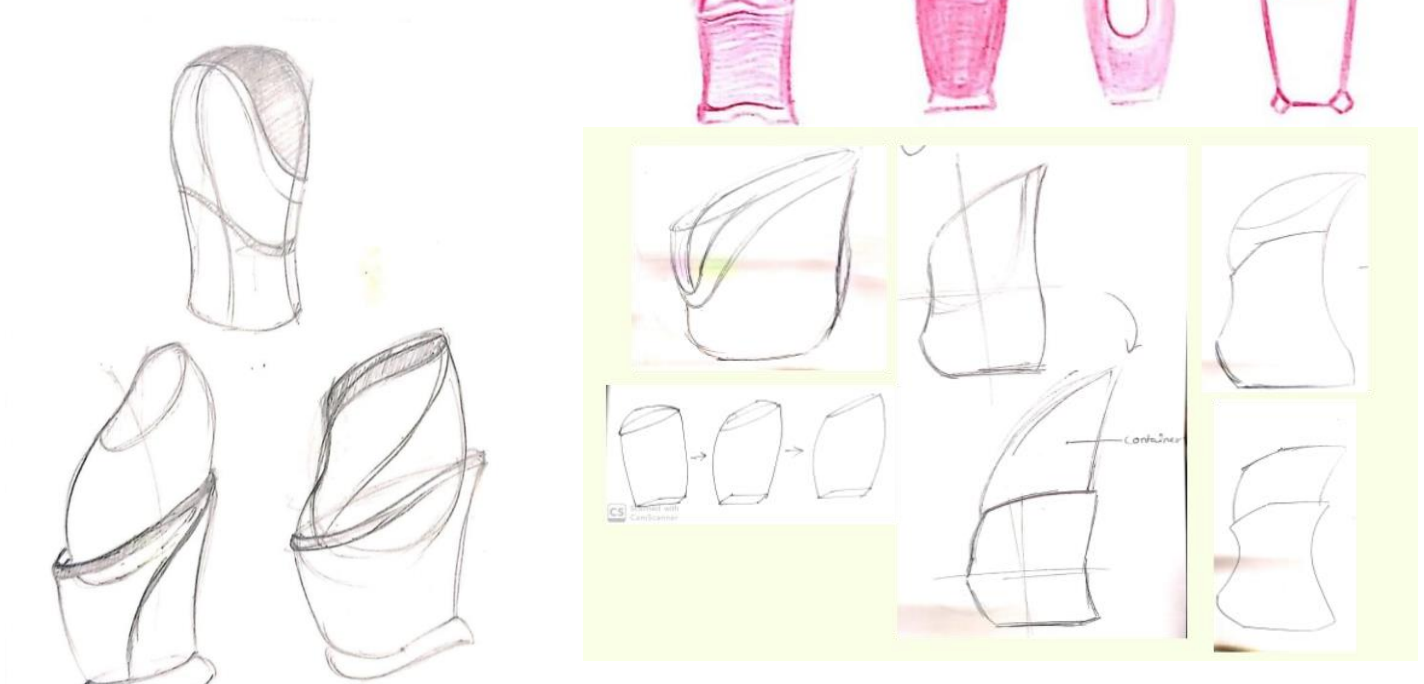
There have been many iterations of this design throughout the process. Some of the main factors that guided the re-designs were to make the product feel familiar, efficient and one that gives feedback.

### Analysis from Alpha to Final design

All concept evolution decisions were based on mentor feedback, predicted material costs, and basic engineering logic.

Figure 9 Form Exploration

(a) Line Sketches, (b) Form iterations, (c) Iterations  
(From top to bottom)



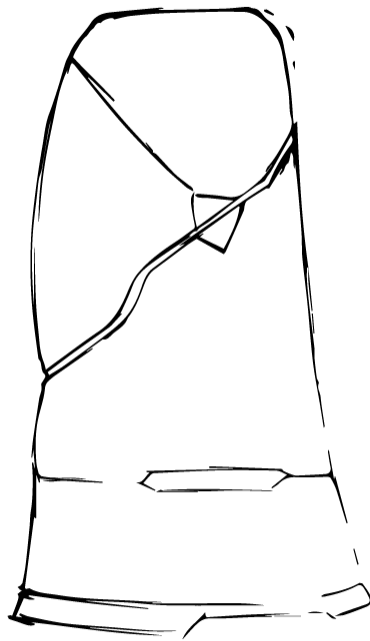


Figure 10 Alpha Design Sketch

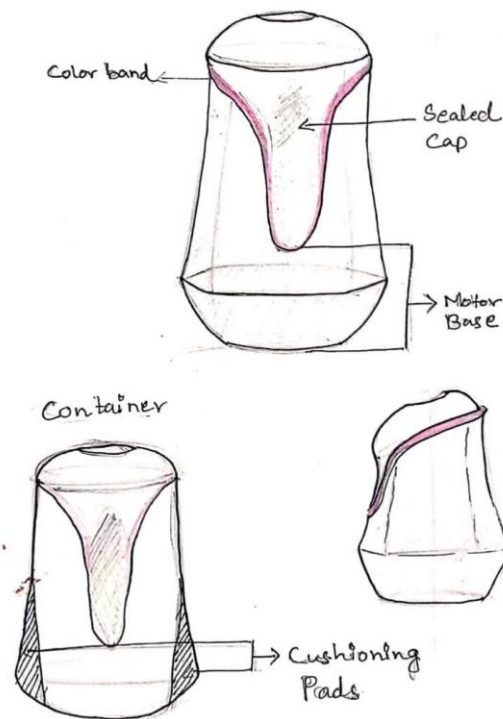


Figure 11 Final Design Sketch

## Alpha Design Description

The alpha design concept (as shown in Figure 10) comprises of a container with a protruding circular element near the bottom. The lid's size has been increased keeping in context the problem of cleaning arising from a narrow mouth.

Based on feedbacks from the users, the button(s) have been eliminated from the design. Instead there is a groove in the power base which has a spring mechanism that behaves similar to a pulse button.

The benefit of having this system is that it blends in with the users preset mindset where only the push from top is applied to start the device. Also as the pressure is increased and the further the container goes down, it increases the speed of the motor too.

Unlike the cylindrical container of the express chopper, Espro has a container with broader and more circular base providing for circulation of food instead of getting smashed in the walls

(as shown in Figure 13) . Inspired from the bottoms up beer draft system(as shown in Figure 12), Espro uses magnetic shaft less blades which fit into a slot in the container. As the container is pushed down upon, the spindle pushes the blade upwards chopping through the food which would earlier have remained lodged in the clearance between blade and container.

The sides of the power base have been added with air vents to facilitate air circulation and prevent heating.

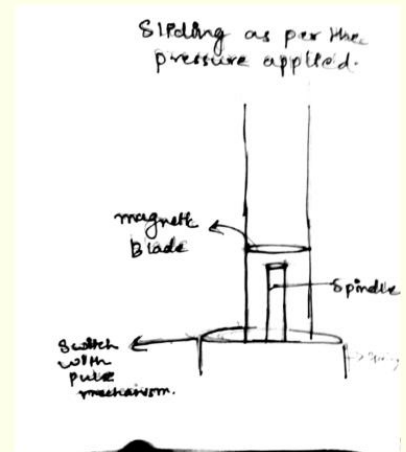
The materials chosen are as follows:

- Food Grade Polycarbonate Container and lid
- Stainless steel blades fixed on a circular magnetic plate.
- Spindle made of a certain material having magnetic properties.
- ABS casing for the power base.
- EPDM rubber base.



Inspiration

As the container is pushed down upon further the height/vertical position of the blade increases and so does the speed.

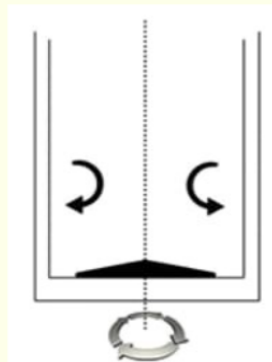


Concept

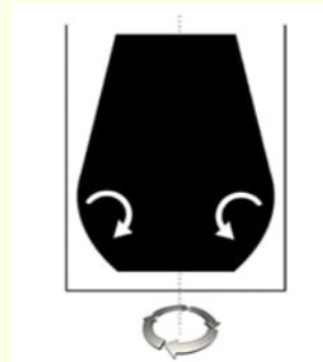
Problem analysis in the existing product

The clearance between blade and container doesn't enable for cutting of smaller food below the blade.

Figure 12 An idea inspired from the bottom's up technology



Current Agitation Technique



Proposed Agitation Technique

Figure 13 Difference between working and concept Function

## Alpha Design Concept CAD Model



Figure 14 Multiple views

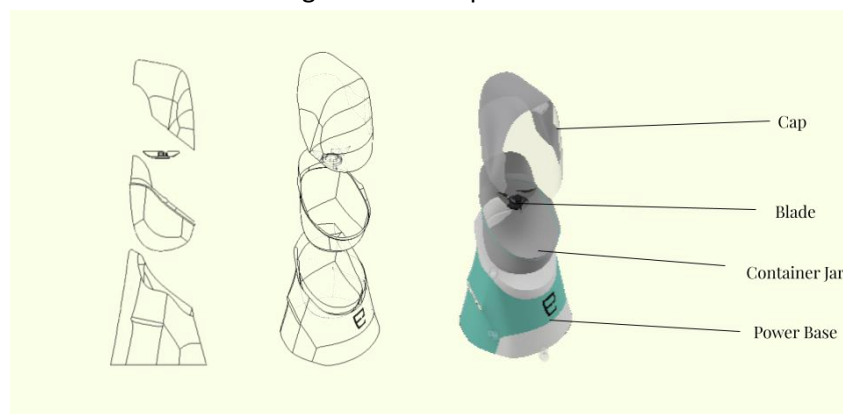


Figure 15 Exploded view and wireframes

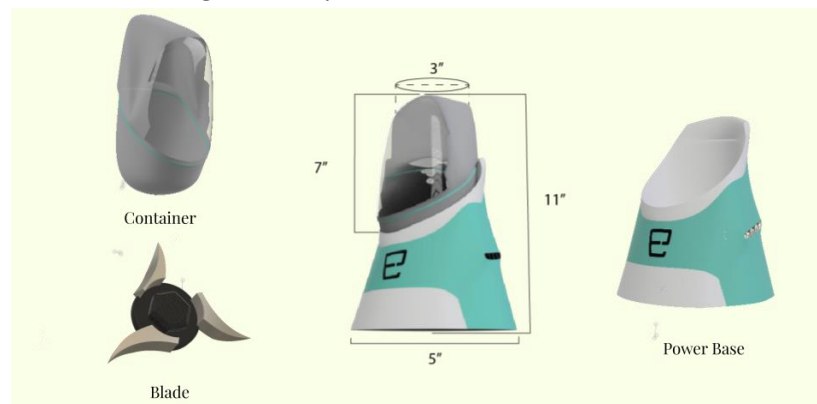


Figure 16 Dimensions of the proposed concept

## Prototype

To better understand the form of the product prototyping was done. A 1:1 block model was made with thermocol with grooves depicting the parting edges of the components.(as shown in Figure 17)  
Another 1:1 model was made in PU foam to depict the relationship between the container and power base.(as shown in Figure 18)





Figure 17 Thermocol model





Figure 18 PU foam model



Figure 1 PU foam model





Figure 20 Power Base PU Foam Model



Figure 21 Design Board

### Potential areas for Design Change

The alpha design for the express chopper had some functions and characteristics that changed in further design evaluation. Adjustments were made gradually as the project approached prototyping stage.

The body as a whole was iterated upon with the use of shapes and visual elements to unify the container and power base, so that they are a single entity instead of two. The blades were analyzed with the detachable system having a shaft wasn't absolutely necessary. However, eliminating the shaft would reduce handling of such a small component increasing safety concerns. The motive was to keep the detachable system eliminating the shaft. The pulse button(s) needed a better position. The narrow mouth of the container would have caused cleaning issues. This could be solved with work on the lid position and size.

The alpha design was bulky in its aesthetic form. A design intervention was performed to rework the form to make it more sleeker and appealing.

## Final Design Concept

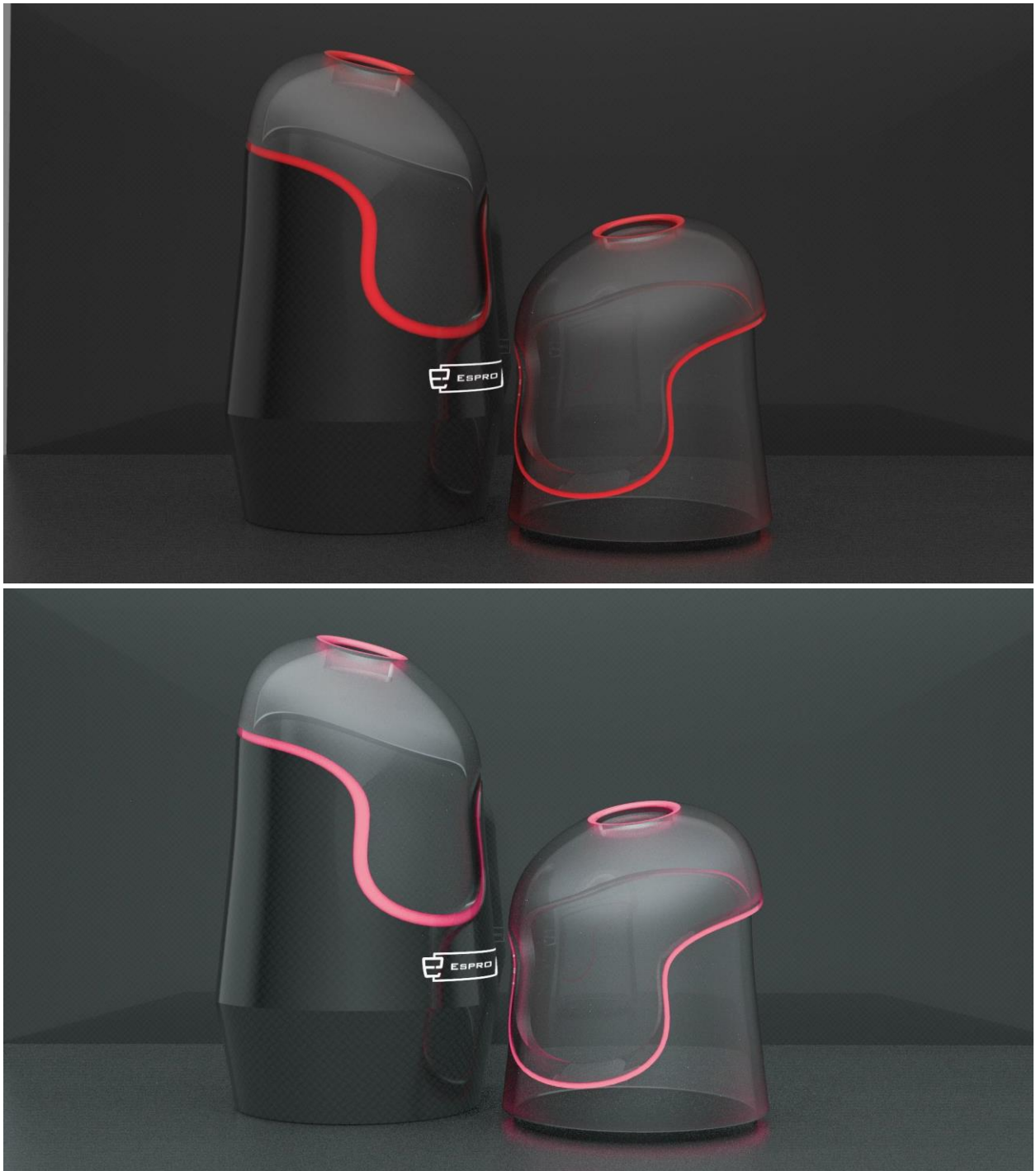


Figure 22 Rendered Final concept in two color variations namely (a) Red (b) Pink  
( From top to bottom)

The final design concept is a more sleeker development over the alpha design. It comprises of more stable base for both the container and the power base. There has been an addition of color bands at the junction of cap and the power base. This has been done in respect to the cognitive aspect of ergonomics, to reduce any ambiguity and communicate to the user the correct functioning of the assembly without external help.

The proposed mechanism remains intact in the following design.

The container is completely transparent enabling the user to look at the food being processed and be provided with simultaneous feedback.

The colors chosen are in high contrast and give a classy appearance to the overall product.

## Unused Concept

In the concept generation phase there were lots of ideas which couldn't be taken into further stages and were discarded for a possible future project.

Two of the more prominent ones are -

- A mechanical chop station (as shown in Figure 23) with two plates balanced parallel with spring. Attached to these plates was a lever to crunch downwards enclosing the gap between the plates.
- Bladeless chopper- utilising air (as shown in Figure 24) at high pressures passed through very fine gaps to cut through the food.

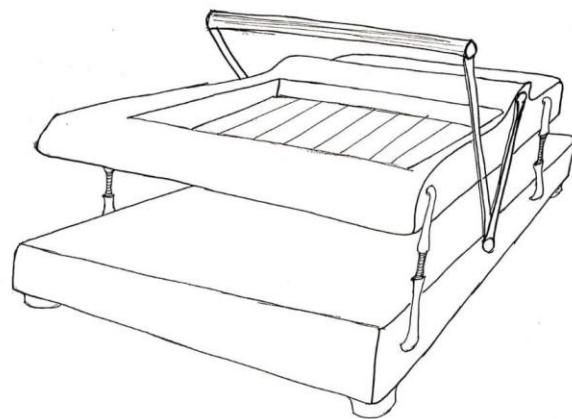


Figure 23 Mechanical Chop Station

The main reason for discarding these concepts were that they didn't fit in with the design brief and the objective of the project.



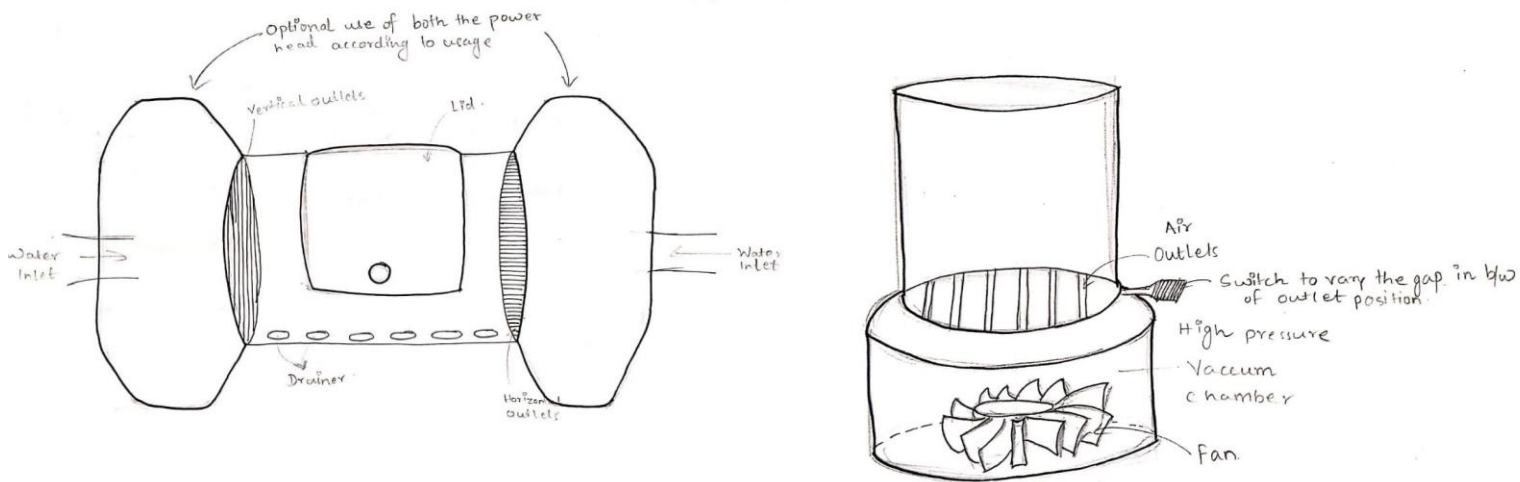


Figure 24 Air Chopping Concept (a) Utilising Fluid Technology (b) Using bladeless Technology

## Conclusion

The goal of this project was to develop a design and a prototype for an electric chopper that combines the functionalities of a mixer grinder and a chopper. The chopper is designed for everyday use by housewives who are skeptical about such devices and are more proficient with traditional methods of chopping.

Espro is more efficient than an electric chopper because it relies on the user's preset mind to operate itself. Also it eliminates the shaft in detachable blade system ensuring easy cleaning.

The final design specifications were based on users' feedback. The prototype was used to validate the specifications of the design to a certain extent. Physical testing was done to determine that the ergonomic specification of the design were satisfied. All the specification for the design were met except: the thermocol block model was preferred over PU foam model in the context of appearance.

As one of the undergraduates to tackle this problem, I believe I have made sufficient progress towards developing a final solution. However, I intend to further study the possibilities of using controlled fluid pressure to chop, which would replace the blades.



## References

- Basics of product design of Idea searching by David Bramston Ava publications
- Nigel Cross fourth edition Engineering Design Methods strategies for product design john wiley and sons publication
- Red dot design yearbook 2016/2017
  - Living
  - Doing
  - Working
  - Enjoying
- Design of the 20th century Charlotte & Peter fiell
- Applied Ergonomics Handbook Second edition edited by Ian Galer Butterworths Publications
- <https://deepblue.lib.umich.edu/bitstream/handle/2027.42/62449/me450?sequence=1>