

ChessMash Product Report

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IKEA were not engaged in any consultancy or collaborative capacity with this project and the outcome is in no way endorsed by them.
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Restatement of Product Opportunity

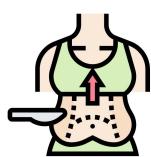


Background & Insights

Young cooking beginners aged 19-34 struggle with consistent food preparation and lack confidence in cooking techniques. This often leads to a poorer diet quality and issues like overweight and obesity [1]. Additionally, eating out or buying pre-prepared food is significantly more expensive than cooking at home, with the actual cost of food in a restaurant meal being less than a third of what customers pay [2].

According to our user surveys and interviews, cooking beginners find it challenging to establish and maintain regular cooking habits. They perceive tasks related to cutting as deterrents to their continued practice and skill development. These tasks, such as cutting and smashing, are perceived as time-consuming and physically demanding, making them tiring. The challenge of cutting food into specific shapes adds to the difficulty. These repetitive and challenging tasks act as significant barriers preventing cooking beginners from maintaining regular cooking habits and improving their skills.

Our product aims to alleviate these difficulties and promote regular cooking habits. By using the product, the time and effort spent on cooking can be significantly reduced. This makes it easier for beginners to continue cooking and could potentially lead to cost savings with increased home cooking in the long run.



Therefore, our product aims to minimise the time and effort expended on these tasks, simplifying the cooking process for beginners. This could potentially save money in the long run and spark a greater interest in cooking.

Core Product Objectives as Physical Functions

1. The product should be lightweight and easy to hold.
2. The product should be intuitive and simple to use.
3. The product should be compact and convenient for storage.
4. The product should be multi-functional to save money and space.
5. The product should be easy to wash and clean.

Prioritised Design Values

1. Improve the efficiency of kitchen tasks
2. Encourage beginners to continue their culinary journey
3. Make the design captivating by adding creative elements to the frame
4. Inspire beginners to try cooking a variety of different foods and explore new challenges.

Concept Development



Original Design and Selection Rationale

Selection Criterion	Multifunctional Chopping Board	Egg Breaker	Automatic Alert Cutting Board	Shell & Hole processor	Conveyor Chopper	Knife Dryer Block	Knife Sharpener & Cleaner
Electronic	✓	✓	✓	✓	✓	✓	✓
Mechanism	✗	✓	✗	✓	✓	✓	✓
Feasibility		✗	✗	✓	?	✓	✗
UI/UX				✓	✓	✓	
Innovation				✓	✗	✓	

In addition to last term's final design, we've identified several potential ideas for selection. Using matrix selection, we pinpointed the most promising concept. The final design should meet the Product Design Specifications (handheld, battery-powered, electro-mechanical) and demonstrate innovation and feasibility for implementation, aligning with the project's focus on electro-mechanical design. From the matrix, the Shell & Hole Processor and Knife Dryer Block were chosen.

Concept Transformation

Stage 1: Transforming target food to potatoes

Based on user feedback, the product was deemed not useful as they rarely consume nuts with shells or coconuts. Instead, mashed potatoes are the 7th most popular British dish [3], with a 78% popularity rating. Aiming to design a user-friendly potato smasher, we noted that individuals aged 19-34 have the highest confidence [4] in cooking potatoes, with an average confidence level of 93.4%. Therefore, focusing on potatoes as the target food is a good starting point for developing a tool to assist novice cooks.

Stage 2: From potato smasher to multi-functional food smasher

To save money and space, we examined commonly consumed and easily prepared foods and interviewed our target users about dishes they wish to prepare but find challenging. Our findings revealed that students frequently consume noodles (Udon, Chinese noodles, Spaghetti) and mashed vegetables (potatoes, sweet potatoes). Although they have a sweet tooth, they avoid making desserts due to the complexity involved.

We decided to create a multi-functional food smasher for various soft foods. Its primary use is mashing cooked or boiled items like potatoes and pumpkins, but it can also prepare fruit jam, hand-made noodles, traditional desserts (mooncakes, wagashi), and squeeze lemon juice.

Stage 3: Modular design of the basic form



To ensure easy cleaning and minimal storage, our product features a modular design with three components:

1. Body: Houses electronic components, includes up and down buttons, a charging port, and is designed for handheld use.
2. Food Container: Connects the main unit to various pattern plates and provides food storage.
3. Bottom Plates:
 - Flat with Holes: Varying sizes and shapes for smashing food and making noodles.
 - Curved with Holes: For squeezing fruits like lemons.
 - Dessert Mold: For making desserts like mooncakes and wagashi.

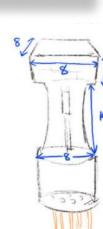
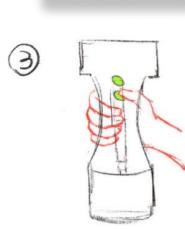
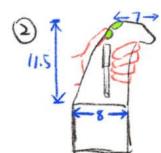
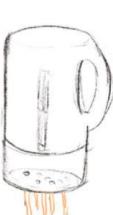
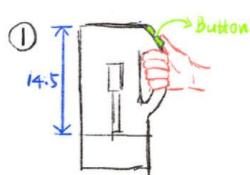
Concept Development



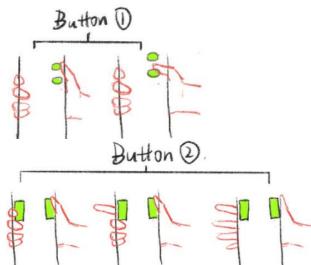
Stage 3: Form Design of Main Unit

Form

To create a compact, handheld design, we first determined the essential electrical components. We then explored their placement using foam models. Three forms were selected from initial sketches to create foam prototypes. A selection matrix was used to decide the final design based on manufacturing feasibility, aesthetics, and user preference.



Button



Two button control systems were explored:

1. Button Logic 1: Press button A to crush food and release to stop. Press button B to retract the push head.
2. Button Logic 2: Press both buttons to crush food. Release one to stop, and release both to retract the push head.

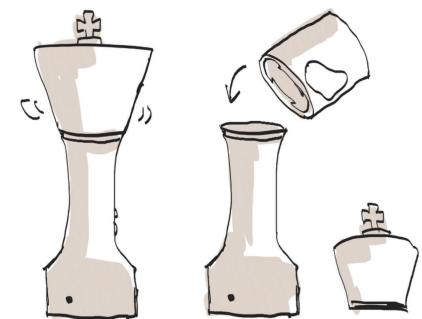
Although button system 2 is more innovative, and can allow more tight grip, as tested during the previous prototyping stage. It's noticed that group members need to repeat the system logic for about 2 times in order for users to understand and memorise.

To satisfy the aim of easy to use, we choose the Button Logic 1, and at the same time, we make the hands grip part thinner to allow tighter grip.

Stage 4: ChessMash — plates storage design and product name creation

The flat pattern plates are thin and easy to misplace, so we've designed a small storage box for them. To make the design more engaging, we've created the multi-functional smasher in the shape of a chess piece, naming it ChessMash.

ChessMash is a compact smart kitchen smasher designed to simplify cooking for beginners with limited kitchen storage space.



Plans for Prototyping



Main Part Testing



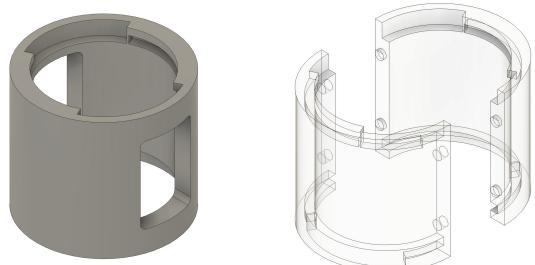
Final Main part Model



1. Upper Cubic part: The initial prototype underestimated the space required for the electronic components. Consequently, an upgraded part with increased height has been designed to accommodate these components.
2. Grip area:
 - a. Height: The prototype's height was initially set to match the length of the linear actuator, ensuring it had the minimum length to fit inside (see pic 1). However, feedback from users indicated that the grip area was too short for comfortable holding. Therefore, additional height was added to improve user comfort.
 - b. Diameter: Users also mentioned that the grip area felt too thick, making it difficult to hold tightly, especially when using their thumb to press the button. As a result, the diameter has been reduced to enhance the grip's ergonomics.
3. Button: To cater to various user preferences for button placement, the original design featured a long strip press button, allowing users to touch the button regardless of where they held the product. However, feedback indicated a preference for smaller buttons, as the long button made it difficult to switch from one button to another due to their distance apart. Thus, a smaller, square-shaped button has been developed to address this issue.

Food Container Testing

Initially, we planned a container with a solid PP wall and two transparent PC parts for visibility. However, this design is complex and unsuitable for injection molding, making it challenging and costly. Instead, we've opted for a fully transparent PC container, divided into two parts assembled using a boss structure, to facilitate injection molding.



Bottom Plate testing

Different plates with different size holes are being printed to test its ability on our targeted food such as potato, dough for noodle, mooncake, lemon, fruits, etc.

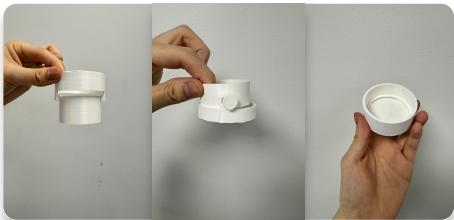


*Adjustments are then made based on the tested results.

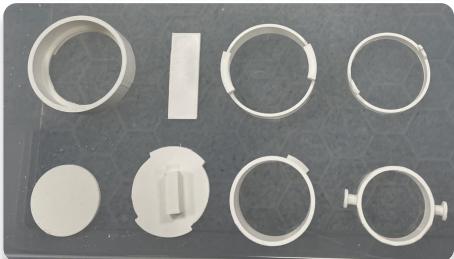
Plans for Prototyping



Connection Prototyping



For the connection between the container and the body, we identified two practical methods during initial ideation: the bayonet mount and the hook. We created two prototypes using 3D printing for testing. Our findings showed that the bayonet mount offered a more convenient and stable connection between the main body and the container.



We considered the bayonet mount and the latch as potential methods for connecting the bottom plates and the container. Prototyping revealed that the latch design required more parts and had complex installation steps. In contrast, the bayonet mount was easy to install and provided excellent sealing.

Electronic Prototyping

Based on the nature of our product, our circuit design must meet the following criteria:

1. Compactness: As a handheld device, it is crucial to minimize the size of the top section. This not only enhances the device's stability but also improves the user's grip experience.
2. Cost-effectiveness: Considering our target market of young cooking beginners, the electronics must be affordable. Therefore, simplicity and low cost are key factors in the design process.
3. Sufficient Power: To ensure practicality, the actuator must be provided with adequate power to exert enough force for mashing ingredients effectively.

Given the advantages of the following components, they have been selected as the ideal choices for our design.

L298N



Supplies 12V to the actuator and 5V to the Arduino, while safely controlling the actuator as an H-bridge.

Arduino Uno



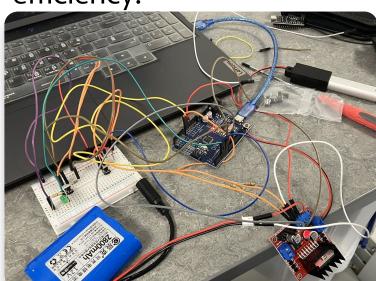
The Arduino Uno's compact size, affordability and reliability make it an ideal choice for handheld devices.

Linear Actuator



It is sturdy, compact, lightweight, and can provide sufficient force (150N) for our target food.

A breadboard and jumper wires were used during the initial circuit setup for the product. These components are simple and flexible, shortening the testing process and improving efficiency.



Initial circuit for testing



Jumper wires
Breadboard

Code logic and functionality: The product has two buttons to control the linear actuator. Hold the lower button to move the telescopic rod downward and click the upper button to retract it to the starting position.

```
Arduino IDE 1.8.2
File Tools Help
File: sketch.ino - 
void setup() {
  // put your setup code here, to run once:
  Serial.begin(9600);
}

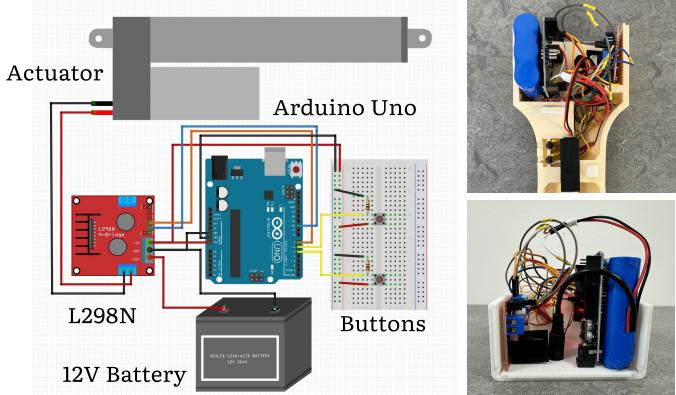
void loop() {
  if(button1.state == 1) {
    serial.write('d');
  }
  if(button2.state == 1) {
    serial.write('r');
  }
}
```

The code is written in C++ and executed on the Arduino IDE.

Power and component load calculations



Final Electronics



To save space and allow for more compact and efficient device designs, the wire lengths have been shortened and soldered together to improve reliability, thus eliminating the need for a breadboard. The final circuit diagram was also created.

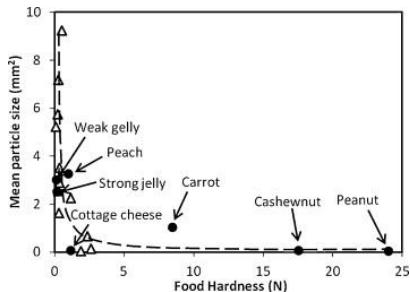
Bill of Electronic Components

Component	Quantity	Voltage	Current	Dimension	Specifications	Price
Arduino Uno	1	5V	92.6 ^[5] mA[1]	68.6x53.4 mm	ATmega328P, Digital I/O: 14	£9
Actuator	1	12V	6 ^[6] A [2]	129x43x22 mm	Linear-Stroke 50mm-4mm/s-150N	£22
L298N	1	5V-46V	36mA	43x43x27 mm	Dual h-bridge motor driver	£1.5
Battery	1	12V	N/A	68x55x19 mm	12V-2800mAh-Li-ion rechargeable	£5
Button	2	5V	50mA	6x6x5mm	Micro momentary push button	£0.1
Resistor	2	N/A	N/A	2.3x6 mm	Resistance: 10k ohms[3]	£0.1
Jumper wire	15	N/A	N/A	10cm length	Male to male and male to female	£0.6

Total Electronics Cost:

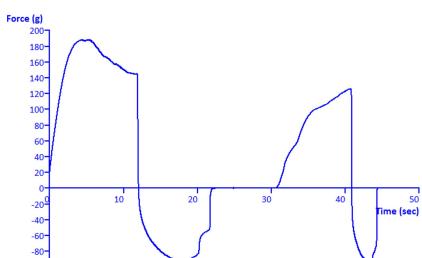
$$\begin{aligned} & \text{£9} + \text{£22} + \text{£1.5} + \text{£5} + \\ & \text{£0.1} + \text{£0.1} + \text{£0.6} = \\ & \text{£38.3} \end{aligned}$$

Loading Test



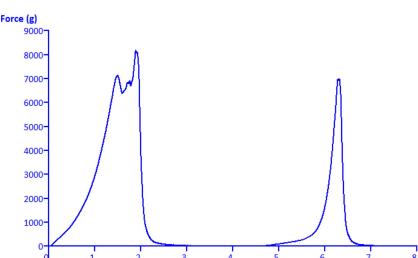
This report on how food hardness affects the particle size distribution of food bolus indicates that hardness determines the extent to which food needs to be mashed to achieve a texture safe for swallowing. The loads required for various foods, as shown in the charts, are all less than the 150N exerted by our chosen actuator, ensuring the food can be adequately mashed for safe and easy swallowing.[8]

Texture Profile Analysis (TPA) is a widely used double compression test for determining the textural properties of foods. Despite extensive research discussing various methods for food texture analysis, finding specific analysis results can be challenging. Consequently, TPA data for only a limited number of our target foods is available, serving as a reference for selecting the appropriate electromechanical components.[9] Based on the existing TPA test and research, the chosen 150N linear actuator provides sufficient force in most cases to achieve the desired functions.



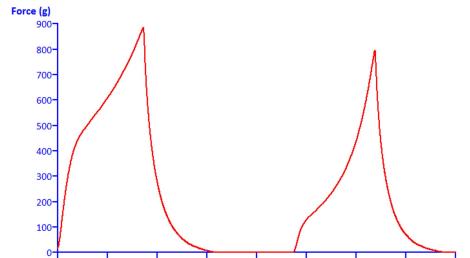
Firm Dough TPA

Maximum Force: 1.96 N



Stiff Hotdog TPA

Maximum Force: 78.48 N



Hard Wheat Bread TPA

Maximum Force: 7.85 N

Power and component load calculations



Power Calculation

Assumption

All power-consuming components:

Arduino (5V-92.63mA)	P=0.463W
Actuator (12V-2A)	P=24W
L298N (12V-36mA)	P=0.432W
Button (5V-50mA)	P=0.25W

All components are active during use. The resistors, battery, and jumper wires are neglected, as they consume little power compared to other components.

Battery Selection

The product consumes power quickly, so a rechargeable battery with a waterproof layer is recommended for sustainability and safety.

Minimizing battery weight and size improves user experience. Therefore, we chose to use a rechargeable Li-ion battery pack.

Battery Duration Calculation

Total average power consumption:

$$P_{\text{total}} = 0.463W + 24W + 0.432W + 0.25W = 25.145W$$

The battery is 12V with a 2800mAh capacity:

$$I_{\text{average}} = 25.145W / 12V = 2.0954A$$

$$\text{Battery Life} = 2.8Ah / 2.0954A = 1.336 \text{ hours}$$

The mashing process takes 30 seconds, allowing for about **160 mashes** per full battery charge. This number is higher in practice, as the actuator consumes less than 2A when returning.



Capacity	Dimension	Mass	Max Power
12V 2800mAh	68x55x19 mm	170g	<70W
12V 5600mAh	66x55x40 mm	320g	<90W
12V 8400mAh	66x59x55 mm	470g	<90W
12V 11200mAh	77x66x55 mm	620g	<90W

The smallest battery is the ideal choice for product.



Charging in progress



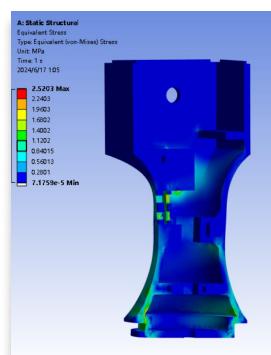
Battery fully charged

The 12V 2A charger fully charges the battery in about **1.5 hours** (assume 90% efficiency).

Finite Element Analysis

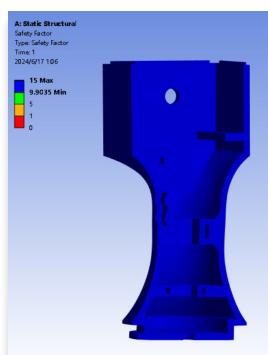
One half-shell receives an upward force of **75N** at the central support to counteract the 150N thrust exerted by the actuator. These forces are evenly distributed across the supports of both half-shells. Due to the identical structure of the two half-shells, a single half-shell is modeled to bear the 75N force in the simulation.

ANSYS Results



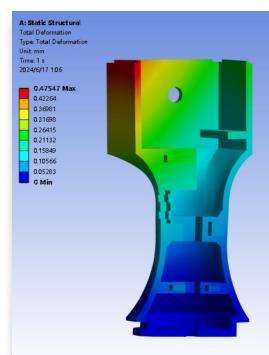
Max Stress

2.5203MPa



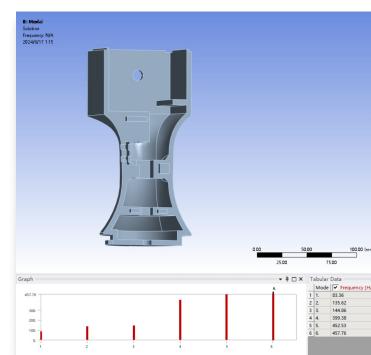
Safety factor

15



Max Deformation

0.47547mm



6 Natural Frequencies

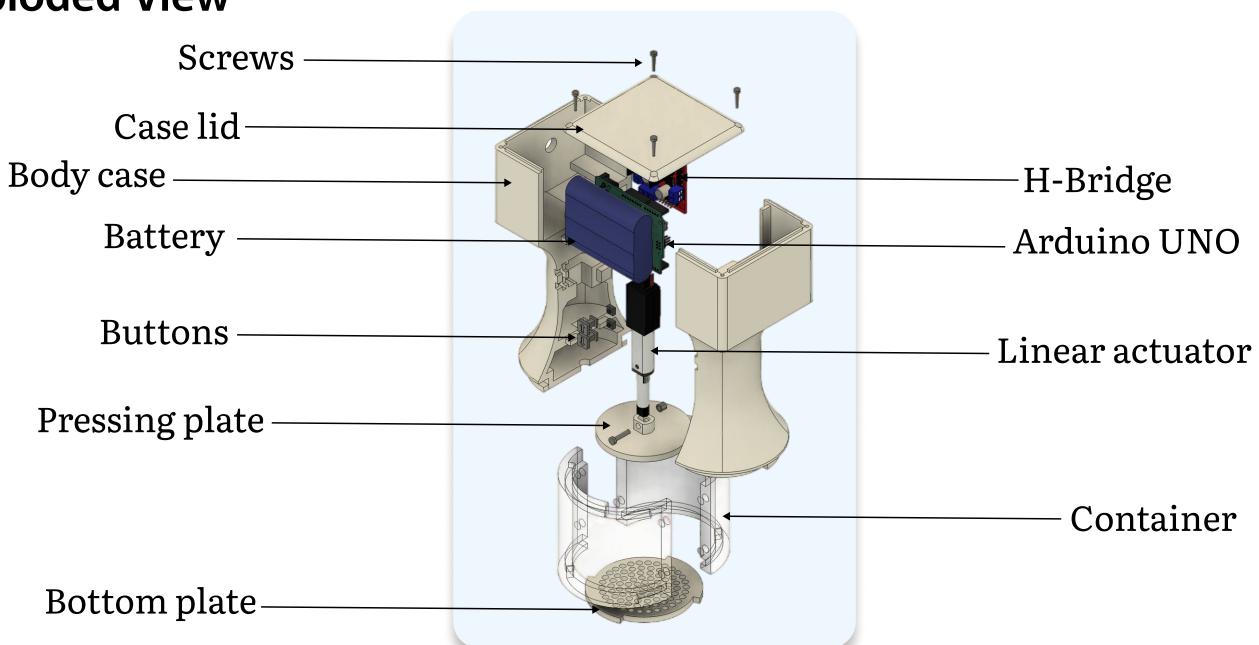
from 83.35Hz to 457.76Hz

Given that the ultimate tensile strength of the polypropylene (PP) material is 24.96 MPa, the observed maximum stress of 2.5203 MPa is significantly below this threshold, indicating that yielding is unlikely. The high safety factor of 15 suggests that the design is very safe, possibly over-engineered, ensuring reliability and stiffness. The maximum deformation of 0.47547 mm at the top of the shell is acceptable within the design specifications. Additionally, the actuator's low operational and excitation frequency of approximately 40 Hz is well below the lowest natural frequency of 83.35 Hz, preventing resonance.

Detail design (DFMA)



Exploded View



Design for Manufacturing

Our DFM focuses on making products easier and cheaper to produce by simplifying designs, reducing parts, and aligning with manufacturing processes.

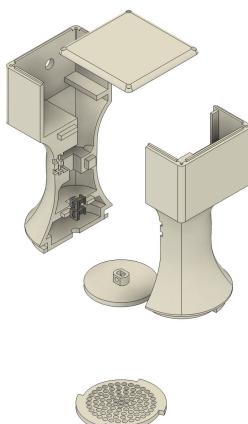
Our prototype components were 3D printed, but the final product would use injection molding. 3D printing allows rapid iteration and cost-effective design testing, while injection molding is better for mass production, offering cost savings, consistent quality, and durability. Injection molding also provides food-grade material options that 3D printing lacks. [10]

We use Arduino and jumper wires for flexible and rapid prototyping. For mass production, switching to an integrated PCB reduces assembly time and costs, enhances reliability, and results in a more compact, efficient design.

Manufacturing considerations [11]

- Material Selection:** Choose appropriate materials that meet product requirements, such as waterproof and food-grade standards.
- Mold Design:** Design molds to ensure proper flow of material, reduce defects, and enable easy removal of finished parts.
- Cooling Time:** Optimize cooling time to ensure parts solidify properly without warping. This is essential for both the aesthetic and functional aspects of our product.

Casing



Components:

Body case, lid, buttons, pressing plate and bottom plates.

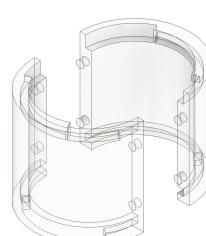
Material: Polypropylene(PP)

Method: Injection molding

Advantages:

cost-effective, food-grade, lightweight, dishwasher safe, heat & chemical resistance

Container



Components:

Food container

Material: Polycarbonate(PC)

Method: Injection molding

Advantages:

cost-effective, transparent, food-grade, lightweight, dishwasher safe, heat & chemical resistance, precision

Detail design (DFMA)



Design for Assembly

Our DFA focuses on making products easier and faster to assemble by simplifying the assembly process, reducing the number of parts, and ensuring parts are easy to handle and fit together. This approach minimizes assembly time and labor costs, enhances product reliability, and improves overall efficiency in the production line.

Design Objectives

Minimize Part Count

Ease of Assembly

Ease of Cleaning

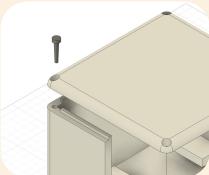
Splash Proof

Sustainable

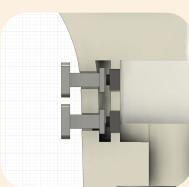
Facilitate Automated Assembly

Safe

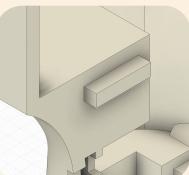
Detail Design



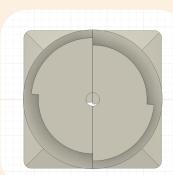
The **lid** is connected to the casing using standard M3 screws. The designed threaded holes in the casing ensure a tight fit between the lid and the casing.



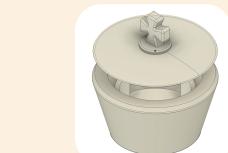
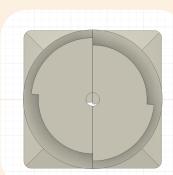
The **buttons** are placed in the center of the case. This structure allows for the quick assembly of waterproof buttons.



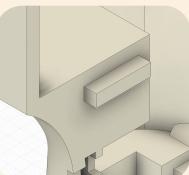
The **clasps** on the casing allow for a precise and tight connection while providing high strength.



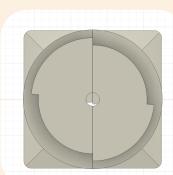
The **bayonet mount** at the bottom of the casing allows for quick assembly and a stable connection between the body and the container.



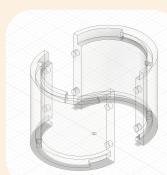
The chess head serves as a **storage box** for bottom plates, using a bayonet mount connection. To minimize box size, an embedded lid is used, with two internal clasps securing the bottom plates.



Interchangeable plates allow quick function changes and easier cleaning.



Boss joints reduce manufacturing difficulty and maintain secure connections.



Tolerances

For a tight fit, such as casing clasps and lid screws, aim for a clearance gap of 0.127 mm. For a standard fit, like the bayonet mount, which allows movement and secure fixation, it's typically around 0.254 mm. For a loose fit, such as frequently pressed buttons, it should be about 0.508 mm.[12]

Outcomes

The precise tolerances for casing clasps and lid screws ensure a tight fit, enhancing structural integrity and providing splash-proof and dust-proof protection (IP53 level)[13]. The embedded lid and internal clasps securely store pattern plates, offering user convenience. The use of minimal parts and recyclable materials makes the design environmentally friendly.

Product Assembly Process



Casing Assembly:



1

2

3



[15]



[16]

4



5



1. Mix the PP/PC pellets and color masterbatch together in a specified ratio.
2. Dry the mixture of PP/PC and color masterbatch to improve the success rate of injection moulding.
3. Using injection moulding to manufacture parts based on CAD files.
4. Collect all the parts and progressively polish them to achieve a smoother surface finish.
5. Inspect the casing to ensure consistency, surface smoothness, and structural integrity.

10 min finishing, 2 min checking

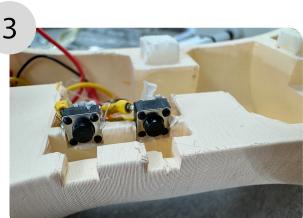
Electronics Assembly:



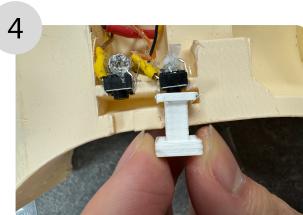
1



2



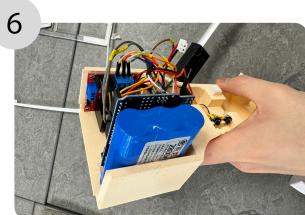
3



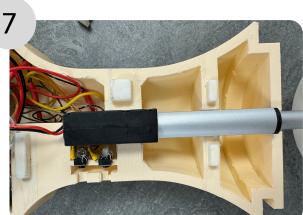
4



5



6



7



8

1. Cut the wires to the appropriate length.
2. Solder the H-bridge, wires, linear actuator, buttons, resistors, and the Arduino UNO board together according to the circuit diagram. During soldering, place insulating rubber rings over the solder joints to ensure the circuit does not short out due to contact with the solder joints during use.

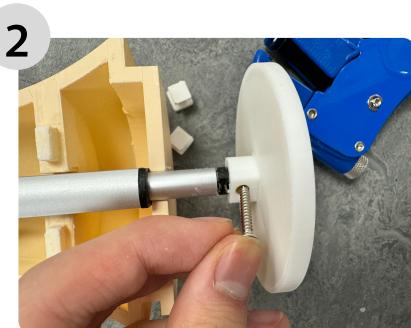
Product Assembly Process



3. Place the micro switch into the designated slot for the button on the left side of the casing.
4. Place the button into the slot in front of the micro switch.
5. Insert the battery charging port into the designated position on the casing.
6. Place the battery, Arduino UNO, and H-bridge into their designated positions on top of the casing.
7. Place the linear actuator into the designated central position within the casing.
8. Merge the left and right casings together, ensuring the wires are not pinched between the two halves.

27 min wiring

Integration:



1. The top cover is connected to the casing not only through mortise and tenon joints but also secured with four screws at the corners of the top cover, further enhancing structural stability.
2. Secure the pressing plate to the linear actuator using screws.
3. Final product fully assembled

6 min assembly

Total Assembly Time and Cost

Calculating assembly time and cost during product design ensures budget adherence, optimizes production efficiency, and maintains high quality. This section calculates manual operation and assembly costs, excluding machine production time and costs.

Collecting and polishing parts takes approximately 10 minutes, with an additional 2 minutes for inspection. Soldering and assembling the electronics require about 27 minutes. The final integration takes 6 minutes.

Total assembly time: 10min + 2min + 27min + 6min = **45 minutes**

According to the U.S. Department of Labor, the federal minimum wage for covered nonexempt employees is \$7.25 per hour.[17]

Total assembly cost: $\$7.25 * 0.75 \text{ hour} = \5.44

Brand Selection



Benchmarking Analysis by Brand:

Our target audience are students who just starting to cook, and the three keywords for our brand are: affordable, high quality, and trustworthy.

Reasons for choosing these three brands: Ikea, Joseph Joseph, and Neo Direct all sell kitchenware. Many of their products are priced within a range that is affordable for students. By offering a wide variety of products, these brands provide comprehensive kitchen solutions, from basic utensils to advanced gadgets, which support students as they develop their cooking skills.

Comparison between brand



IKEA is globally recognised and highly popular, with affordable prices. IKEA offers nearly every type of household product. Since our users are students, we aim to choose a brand that is familiar to most students. Moreover, products of Ikea are available for purchase both in-store and online, so students can easily access to Ikea no matter their location. IKEA emphasises the use of environmentally friendly materials and processes. From sourcing renewable materials to implementing recycling programs. Ikea's products are widely recognized and accepted.



Joseph Joseph has few electronic products and is not well-known among many overseas students. The prices are higher compared to similar brands, and some users report that their products are not durable.



Neo Direct has mixed reviews regarding product quality, which may pose a risk to consumers. Additionally, it has no physical stores, so purchases can only be made online, which can be inconvenient for some students.

Affordable

Affordable for students. Price of most products are not too high.

Trustworthy

The brand takes into account the needs of student groups during the product development process and is well-known and trusted by students from various countries. The brand has a good reputation and considers the environmental impact of manufacturing materials.

High quality

Product is safe, Long-lasting with excellent craftsmanship and attractive appearance

Affordable

IKEA



Joseph
Joseph



Neo direct



Based on our research on three brands and considering the three key attributes of our brand, IKEA aligns most closely with our brand concept.

High quality

Trustworthy

Branding Considerations and Implementations

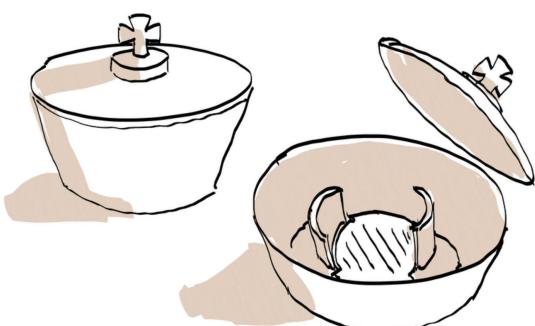


IKEA's kitchen products

- IKEA focuses on combining practicality and aesthetics. Designers will conceive the function and appearance design of kitchenware based on the research results, ensuring that the products can meet users' actual needs and are attractive.
- IKEA believes in a collaborative design process, from working with established designers and students to looking at new ideas like open source.

Implementation of Branding on Physical Products:

Ikea offers many smart and affordable small-space solutions to transform a student's place into their dream home[18]. Users can achieve different product functions by assembling different crush plate which are small and easy to store. The product has a slim shape and further shrinks the space it takes.

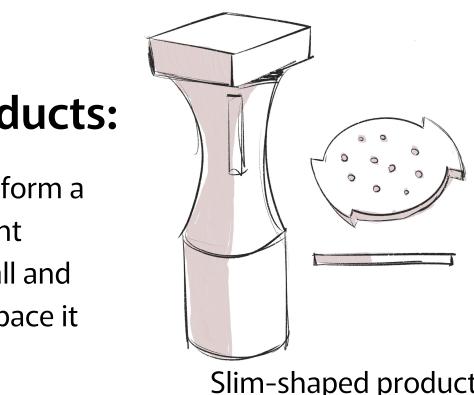


Storage box for bottom plate

Ikea pays special attention to student life, designing various types of room appliances especially for students[19]. By closely interacting with students and receiving their feedback, we have designed a food crusher with a chess-look appearance. Many students mention that they often forget where they have placed small kitchen utensils, so we design the chess piece's top functions as a box, which can help students store the bottom plate.

Considering that most students live in dormitories or rent their own apartments, where kitchen colour schemes typically feature black and white, IKEA's design for student room products usually involves no more than two colours. These are always either black and white, white with a pop of colour, or black with a pop of colour. Drawing inspiration from the colours of the chess, we selected off-white as the primary colour and light teal for the buttons, ensuring that the product blends seamlessly into the student kitchens without standing out.

The plastic parts of the product are made of polypropylene(PP) and polycarbonate (PC), materials commonly used in food processors due to their durability, strength, and transparency. Students often use dishwashers to clean kitchenware because they are busy with their studies. Both PP and PC can withstand high temperatures, making them suitable for dishwasher cleaning. While mashing food, users need to hold the product, and these low-density plastics are lighter than glass, ensuring easy handling.



Slim-shaped product



IKEA's kitchen products made from PP and PC

[20]

Product Compliance



ChessMash, a handheld, 12v battery-powered food masher, is designed for sale in the UK and EU regions. Before it can be sold in the market, it must adhere to specific laws, directives, and standards. These regulations pertain to general product safety, electronics, and food safety.

Laws Complied[21]

General

1. The General Product Safety Regulations 2005

- Ensure that the product is safe under normal and reasonably foreseeable conditions of use.
- Provide consumers with relevant risk assessment information.
- Enable traceability by indicating information on the product or its packaging.

2. Consumer Protection from Unfair Trading Regulations 2008

- Require that packaging and labeling must not mislead consumers about the product's nature, composition, or quantity.

Electronics

1. Restriction of Hazardous Substances (RoHS) Directive (2011/65/EU)

- Comply with the RoHS directive, which restricts the use of certain hazardous substances in electrical and electronic equipment.

2. REACH (Registration, Evaluation, Authorisation, and Restriction of Chemicals)

- Ensure that any chemicals used in manufacturing comply with REACH regulations, which restrict the use of certain hazardous substances.

3. Waste Electrical and Electronic Equipment (WEEE) Regulations

- Includes proper labeling and providing disposal information to consumers.

4. Battery and Accumulator Regulations 2008

- Includes safety, performance, and recycling requirements.
- Properly label the battery to provide information about its specifications and safe usage.

5. EMC/EMF (Electronic Magnetic Compatibility/ Electro Magnetic Fields)

- Ensure that electronic devices operate correctly without causing or being affected by unwanted electromagnetic interference.

Food Safety

1. Food Contact Materials Regulations

- **Regulation (EC) No 1935/2004:** This regulation covers materials and articles intended to come into contact with food. It ensures that materials do not transfer their components into food in quantities that could endanger human health or bring about an unacceptable change in the composition of the food or a deterioration in its taste, smell, or texture.
- **Commission Regulation (EU) No 10/2011:** This regulation concerns plastic materials and articles intended to come into contact with food. It sets out the requirements for the composition, production, and use of such materials.

2. Good Manufacturing Practices (GMP)

- **Regulation (EC) No 2023/2006:** This regulation ensures that materials and articles intended to come into contact with food are manufactured according to good manufacturing practices. This includes maintaining proper documentation, implementing quality control systems, and ensuring traceability.

Product Compliance



Directive Complied:

- Directive 2011/65/EU
- Directive 2001/95/EC
- Directive 2006/42/EC
- Directive 94/62/EC
- Battery Directive (2006/66/EC)
- Regulation (EC) No 1935/2004
- Commission Regulation (EU) No 10/2011
- Regulation (EC) No 2023/2006
- ERP (EU Ecodesign Directive)
- EcoDesign Directive

Standard Complied:

- | | |
|---------------------|-------------------------|
| • EN 50564:2011 | • EN 62133-2:2017 |
| • EN 50370-1:2005 | • EN 60335-1:2012+A13:2 |
| • EN 50370-2:2003 | 017 |
| • EN 55014-1:2017 | • EN 60335-2-14:2006+A |
| • EN 55014-2:1997 | 11:2012 |
| • EN IEC 63000:2018 | • EN 60529:1991+A2:2013 |
| • EN ISO 12100:2010 | • EN ISO 12100:2010 |
| • EN 13427:2004 | |
| • EN 13429:2004 | |
| • EN 13431:200 | |

The product compliance covers a range of directives and standards to ensure safety, environmental responsibility, and quality. It includes adherence to EU regulations on the restriction of hazardous substances, general product safety, machinery, packaging waste, battery directives, and materials in contact with food. Additionally, it follows good manufacturing practices, eco-design directives, and numerous EN standards related to electronic and mechanical safety, environmental impact, and quality assurance.

After ensuring compliance with all relevant laws, directives, and standards, our product must include both a **UK Declaration of Conformity** and an **EU Declaration of Conformity**. These declarations certify that the product meets the necessary regulatory requirements. Once these documents are in place, the UKCA and CE marks can be affixed, indicating that the product is eligible to be sold in the UK and EU markets, respectively.

As quoted from the Technical Documentation and EU Declaration of Conformity (5), the technical documentation should include at least:

- The name and address of the manufacturer or any authorized representatives
- A brief description of the product
- Product identification details, such as the product's serial number
- Names and addresses of the facilities involved in the design and manufacture of the product
- Name and address of any notified body involved in assessing the conformity of the product
- A statement of the conformity assessment procedure followed
- The EU Declaration of Conformity
- Labels and instructions for use
- A statement of relevant regulations to which the product complies
- Identification of technical standards with which compliance is claimed
- A list of parts
- Test results

UKCA and CE Marking



The UKCA marking functions similarly to the CE marking and applies to most products that previously required a CE mark. The UKCA marking will become mandatory from 31st December 2024, but the CE marking will still be recognized until then.

Product Labeling



Product Labeling



UKCA & CE Marking

These labels indicate that the product has followed the product conformity and are eligible to sell in UK and EU area.



Food Contact Safe

This product is certified as food contact safe, ensuring that all materials used are suitable for contact with food and do not transfer harmful substances.



Dishwasher-safe

The bowl wall and bottom plates of this product are dishwasher safe, making cleaning convenient and ensuring hygienic food preparation.



PP Recycling

This product contains parts made from Polypropylene (PP), a durable and recyclable plastic, marked with the PP recycling symbol for proper disposal and recycling.



Other Plastic Recycling

The Transparent Food Container is made from Polycarbonate (PC), a versatile and recyclable plastic, marked with the plastic resin code 7 for proper identification, disposal, and recycling.



WEEE

This product comes with a 12V battery and complies with the Waste Electrical and Electronic Equipment (WEEE) Directive. The symbol on the product signifies that it should be sent to separate collection facilities for recovery and recycling.



Age warning symbol

This product contains a small charging port rubber seal, which may pose a choking hazard. The symbol on the product indicates that it is not suitable for children under 3 years of age.

Package Labeling



Mobius Loop

The Mobius Loop indicates that the packaging is recyclable and should be disposed of in appropriate recycling bins to promote environmental sustainability.

Forest Stewardship Council Logo



Ikea is currently collaborating with the Forest Stewardship Council to protect and strengthen the world's forests. The FSC logo confirms that the paper or cardboard used in the packaging comes from responsibly managed forests, guaranteeing sustainable forest management practices.

User Guide Design



User Guide Form: Trifold Leaflet

User guide for CHESSMASH includes

- UKDeclaration & EU Declaration
- safety guide
- Cover

UK DECLARATION OF CONFORMITY

1. Product Identification
- Product Name: CHESSMASH Electronic Food Crasher
- Model Number: EK-34-Airsoft, Green
- Type: Electronic Food Crasher with Rechargeable Battery and USB Charging Port

2. Product Safety
- Manufacturer: Address: Tukangpandan 6, 343 34 Alorset, Dodong, Indonesia
- Address: Tukangpandan 6, 343 34 Alorset, Dodong, Indonesia

3. This declaration of conformity is issued under the sole responsibility of the manufacturer.

4. Declaration of Conformity
- The object of the declaration described above is in conformity with the following harmonized standards and/or technical specifications:

5. Applications of CE Marking
- The Electrical Equipment of Safety Standard IEC 60065:2013
- The Electrical Equipment of Safety Standard IEC 60065:2013
- The Electrical Equipment of Safety Standard IEC 60065:2013
- The Electrical Equipment of Safety Standard IEC 60065:2013
- The Electrical Equipment of Safety Standard IEC 60065:2013
- The Electrical Equipment of Safety Standard IEC 60065:2013

6. Applications of RoHS Directive
- The Electrical Equipment of Safety Standard IEC 60065:2013
- The Electrical Equipment of Safety Standard IEC 60065:2013
- The Electrical Equipment of Safety Standard IEC 60065:2013

7. Harmonized Standards
- IEC 60065:2013 - Technical documentation for the test report of RoHS compliance

8. Additional Information
- The declaration is issued on behalf of the product developer above, provided that they conform to the technical file supplied by the manufacturer.

EU DECLARATION OF CONFORMITY

1. Product Identification
- Product Name: CHESSMASH Electronic Food Crasher
- Model Number: EK-34-Airsoft, Green
- Type: Electronic Food Crasher with Rechargeable Battery and USB Charging Port

2. Product Safety
- Manufacturer: Address: Tukangpandan 6, 343 34 Alorset, Dodong, Indonesia
- Address: Tukangpandan 6, 343 34 Alorset, Dodong, Indonesia

3. This declaration of conformity is issued under the sole responsibility of the manufacturer.

4. Object of the Declaration
- The object of the declaration described above is in conformity with the following harmonized standards and/or technical specifications:

5. Applications of EU Legislation
- Directive 2014/35/EU on Low Voltage Equipment (LVD)
- Directive 2014/30/EU on Electromagnetic Compatibility (EMC)
- Directive 2012/19/EU on the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment (RoHS)

6. Applications of Standards
- EN 60065-1:2013 - Basic safety and essential performance requirements for household appliances, similar apparatus, and similar articles - Part 1: General requirements
- EN 60065-2-23:2013 - Electromagnetic compatibility and safety of household appliances, similar apparatus, and similar articles - Part 2-23: Specific requirements for household food processors and similar apparatus

7. Harmonized Standards
- EN 60065-1:2013 + A11:2014 - Harmonized standard for general requirements for household electrical apparatus and similar apparatus

8. Additional Information
- The declaration is issued on behalf of the product developer above, provided that they conform to the technical file supplied by the manufacturer.

SAFETY GUIDE

Important Safety Instructions

1. Read Instructions: Please read all safety instructions thoroughly before using your IKEA Chessmash food crashing machine.
2. Keep Dry: Do not place heavy objects on top of the machine as it may cause damage.
3. Keep Dry: The machine should be kept dry at all times and should not be submerged in water or other liquids.
4. Model Name: IKEA Chessmash food crusher
5. Model Number: EK-34-Airsoft, Green
6. Compliance: CE, UL/CUL

Packaging Compliance

We ensure that all relevant safety and environmental standards are adhered to during our packaging process. In the unlikely event of a recall, please contact us for further information.

Electrical Safety

1. Proper Grounding: Ensure the machine is properly grounded to avoid electrical hazards.
2. Power Cord: Do not use the machine if the power cord or plug is damaged. Contact IKEA customer service for repair or replacement.

Fire Hazard Prevention

1. No Covering During Use: Avoid covering the machine while in operation to prevent overheating and fire risk.

CHESSMASH
Multi-Foodcrush

- Assembly process: Storage, cooking, charging and washing.

Storage

① Take off the head for storage
② Store pattern plates in storage head

Cooking

① Take off the head for cooking
② Insert pattern plates into the head

Charging

① Place the head on the base
② Charge the base

Washing

① Take off the head for washing
② Wash the pattern plates
3. Take care when cleaning to prevent damage to the pattern plates

Cover:

- Provides a clear illustration depicting the components of the product.
- Highlights the product's name and its primary function.
- Features the IKEA logo.

Assembly process:

- How to store pattern plates.
- How to use CHESSMASH for cooking.
- How to safely charge CHESSMASH.
- How to wash pattern plates.

Safety guide

- The safety way to use the compliance.
- Product labeling details
- Packaging compliance
- Electrical safety tips
- Fire hazard prevention

Recipe Manual

To assist cooking beginners with food preparation using ChessMash, we provide recipes for dishes the product can help prepare, including:

- Smashed potatoes
- Strawberry jam
- Mooncakes/Wagashi
- Noodles

MOONCAKE

Food ingredients:
1. Moon cake
2. Water

SPÄTZLE

Food ingredients:
1. Flour
2. Salt

STRAWBERRY JAM

Food ingredients:
1. 3 cups fresh strawberries
2. 1 cup sugar

CLASSIC FRENCH POTATO PUREE

Food ingredients:
1. 3 large russet potatoes
2. 1/2 cup milk
3. Butter
4. Salt
5. Pepper
6. Chives
7. Creme fraiche

TABLE OF CONTENT

COOKING RECIPE

From Novice to Pro
- Checkmate Your Cooking Challenges with Ease

Product Packaging



Packaging inspiration

IKEA has been using cardboard for its flat packs for decades to ensure the packaging of its products is both sustainable and cost-effective[22]. According to Erik Olsen, IKEA's manager of packaging and identification, effective packaging should adequately protect the product by using only as much material as necessary, no more and no less. Additionally, it should be easy for customers to open.

The packaging design of Ikea is simple, usually consists of several parts:

1. Product name.
2. Name of product designer.
3. Dimensions of the product.
4. Contents Information, including number of items inside and power of product.
5. Barcodes and Item Number.
6. Safety and Compliance Icons.
7. IKEA's icon.

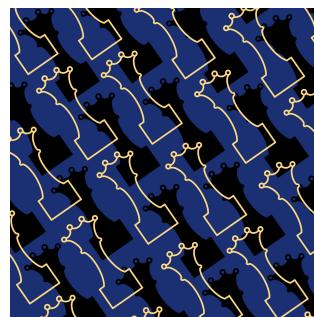


Ikea's packages [23]

Graphic design



Front view



Left/right view

To enhance the package's appeal, we've incorporated a yellow and black chess pattern on both the right and left sides. Our packaging layout draws inspiration from Ikea's design. Targeting students, we've opted for dark blue and light yellow colors instead of black and white to make the design more engaging.

Internal design

To positively impact both people and the environment, IKEA is eliminating plastic from its consumer packaging[24]. The packaging is a slide-out cardcard box. Since the product includes electronic parts and small items like crush plates, additional stabilizing materials are necessary. We primarily uses black cardboard to support and secure internal components within the package. The upper layer of internal box is for user guide and cooking recipe



Final Design

Chessmash is a handheld food masher designed to help young cooking beginners quickly and easily mash ingredients to the desired texture. With interchangeable plates of various shapes at the bottom (e.g., for mashing fruits into purees and cooked potatoes into mashed potatoes), it reduces the effort and time beginners spend on mashing, sparking their interest in cooking.

The stylish chess piece design not only adds aesthetic appeal but also brings vibrancy and trendiness to kitchen tools, representing the aspirations and creativity of young people. The crown-shaped storage box effectively addresses the storage space issues common among young people.

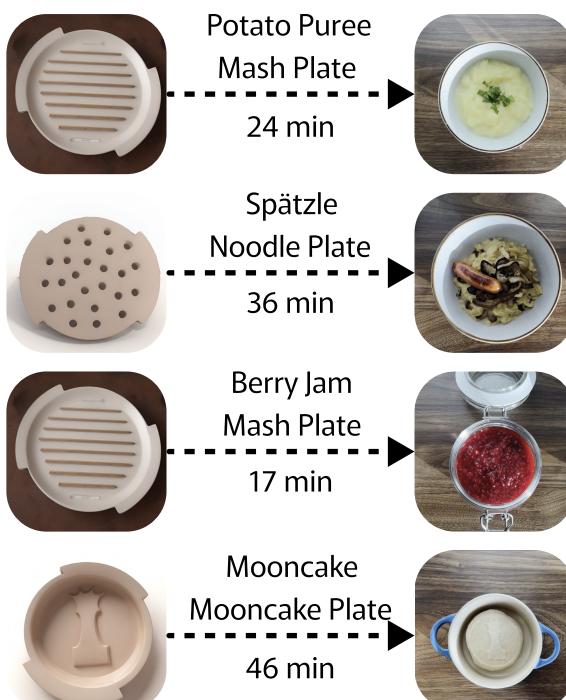


Branding



IKEA is known for high-quality, affordable products with straightforward, user-friendly designs that combine aesthetics, aligning with our core values and focusing on our target users. Its global warehouses and stores ensure our product is widely available

Features



Pricing

Due to differences between the prototype and final production, only a rough calculation is provided here.

Assuming:

Manufacturing: £2.5

Electronics: £38.3

Assembly: £4.3

others: £2

Net profit margin: 10%

Selling price:

$(£2.5 + £38.3 + £4.3 + £2) * (1 + 10\%) \approx £52$

Video Link: <https://imperiallondon-my.sharepoint.com/>

Project Plan

Division of Work



Xiangsong Zhang
Chief Information Officer

Developed internal structure, assembly processes, and appearance; created models for the handheld and bowl wall parts; led detailed design and production data package; and performed circuit welding.



Miaoyan Tang
Chief Creative Officer

Led branding, logo, and packaging design; managed user guide, portfolio, and report layout; designed and modeled storage components; and conducted prototyping, function testing, and video editing.



Warren Tie
Chief Technical Officer

Developed and tested the electro-mechanical system, managed system coding, performed power and load calculations, and conducted function testing.



Qinxuan Li
Chief Operational Officer

Recorded meeting minutes, managed finances, handled compliance and labeling research, organized concept development, and created modeling video rendering and recipe book design.

Project Timeline

User Feedback:

We gathered user feedback to identify their needs and defined the product features based on this feedback.

Prototyping:

We prototyped the product's features and appearance, then refined our prototype based on testing results and user experience feedback.

Brand Implementation:

After conducting market research, we selected a brand that aligns with our target audience and philosophy. We also studied the brand's design language and common color schemes to ensure our product matches the brand's characteristics.

Product Compliance:

We researched product compliance to ensure our product meets relevant laws and regulations, aligning with other products in the market.

DFMA:

We designed our product for ease of assembly, disassembly, and manufacturing. Additionally, we collected estimates on the production time and cost.

Product Report and Demonstration:

We documented our product journey in a report and portfolio. We conducted a presentation to demonstrate its functionalities and created a video to showcase its practical application in real life.

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ChessMash



Group 24

Miaoyan Tang

Qinxuan Li

Steven Zhang

Warren Tie

IKEA were not engaged in any consultancy or collaborative capacity with this project and the outcome is in no way endorsed by them. Any publicity is limited to personal and academic use

CONCEPT DEVELOPMENT

Selection Rationale

Target group: young cooking beginners struggling with cutting tasks.

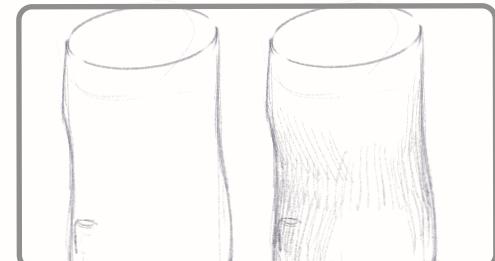
Chosen design: Handheld, battery-powered, and electro-mechanical, focusing on innovation and feasibility.

The matrix led us to the Shell & Hole Processor.

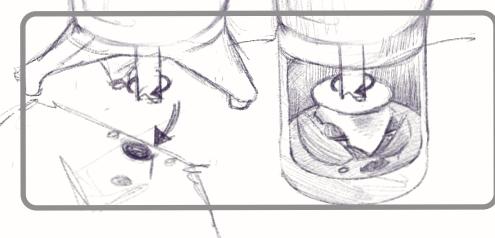
Selection Criterion	Multifunctional Chopping Board	Egg Breaker	Automatic Alert Cutting Board	Shell & Hole processor	Conveyor Chopper	Knife Dryer Block	Knife Sharpener & Cleaner
Electronic	✓	✓	✓	✓	✓	✓	✓
Mechanism	✗	✓	✗	✓	✓	✓	✓
Feasibility		✗	✗	✓	?	✓	✗
UIUX				✓	✓	✓	
Innovation				✓	✗	✓	

Shell & Hole Processor
Modular Design

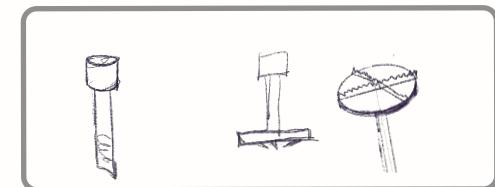
Main Body



Food containers
for processing food



Processing tools

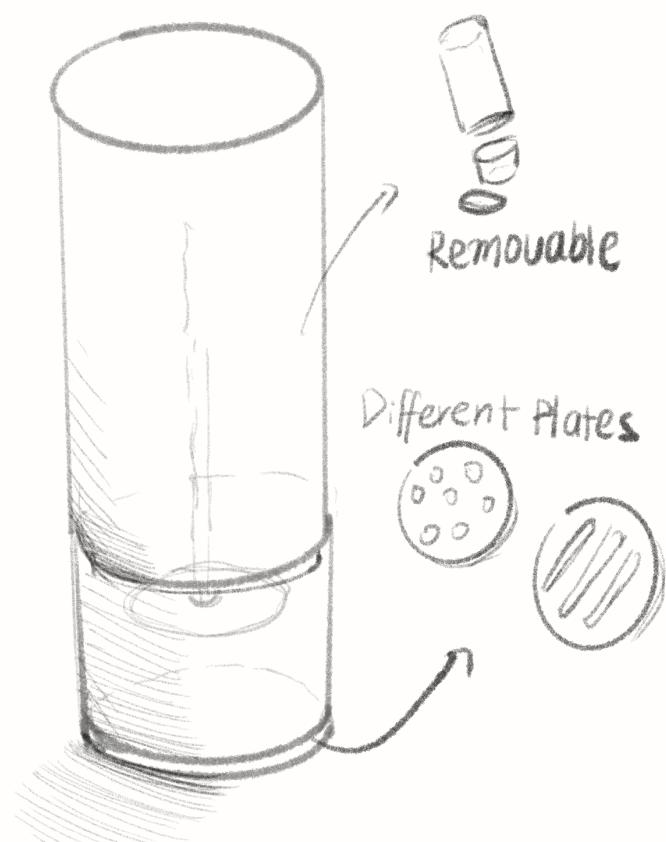


Concept transformation

Stage 1: Refocused on potatoes due to their popularity and ease of preparation. Targeting novice cooks with a potato-smashing tool.

Stage 2: Expanded the tool to a multi-functional smasher for vegetables, fruit jams, noodles, and desserts.

Stage 3: Designed a modular unit for easy cleaning and storage, featuring electronic controls, a round bowl wall for attachments, and various pattern plates for mashing, squeezing, and molding.



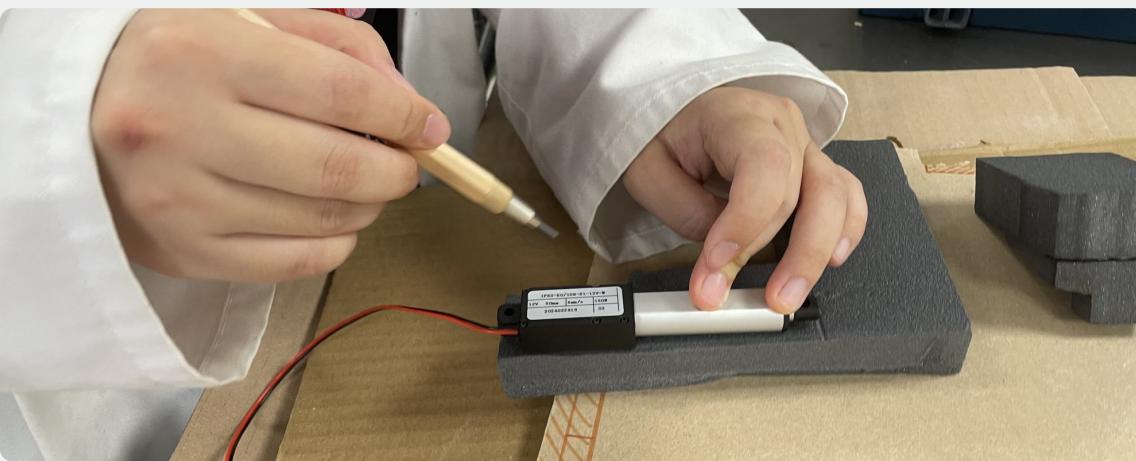
To ensure easy cleaning and minimal storage, our product features a modular design with three components:

1. Body: Houses electronic components, includes up and down buttons, a charging port, and is designed for handheld use.
2. Food Container: Connects the main unit to various bottom plates and provides food storage.
3. Bottom Plates:
 - Flat with Holes: Varying sizes and shapes for smashing food and making noodles.
 - Curved with Holes: For squeezing fruits like lemons.
 - Dessert Mold: For making desserts like mooncakes and wagashi.

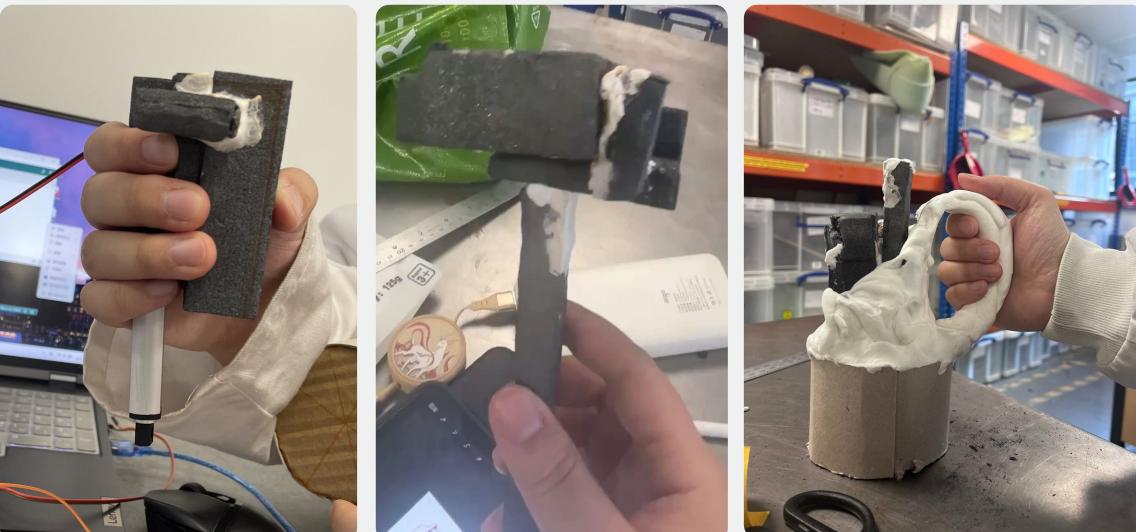
CONCEPT DEVELOPMENT

Form Design

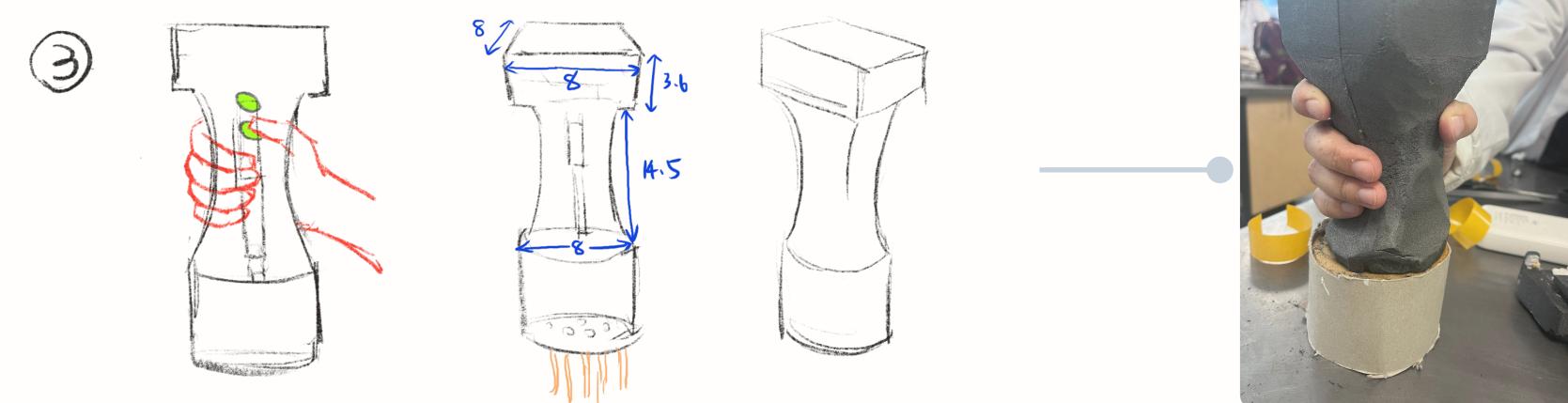
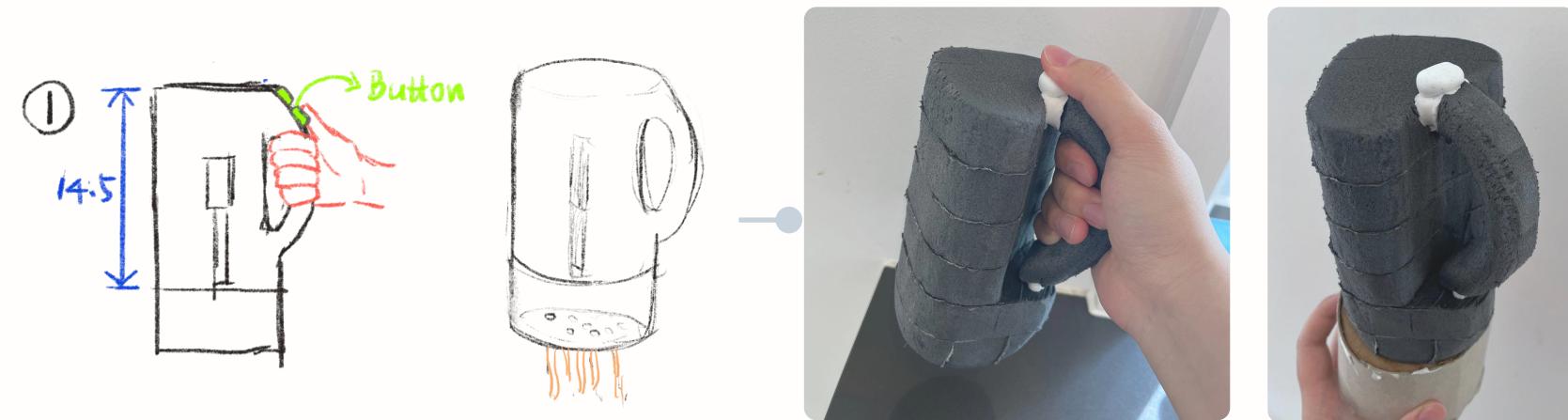
To design a compact, handheld device, we identified essential electrical components and tested their placement with foam models. From initial sketches, three forms were chosen for foam prototyping. A selection matrix helped finalize the design based on manufacturing feasibility, aesthetics, and user preferences.



We first used foam to replicate the shape and size of an electronic module.



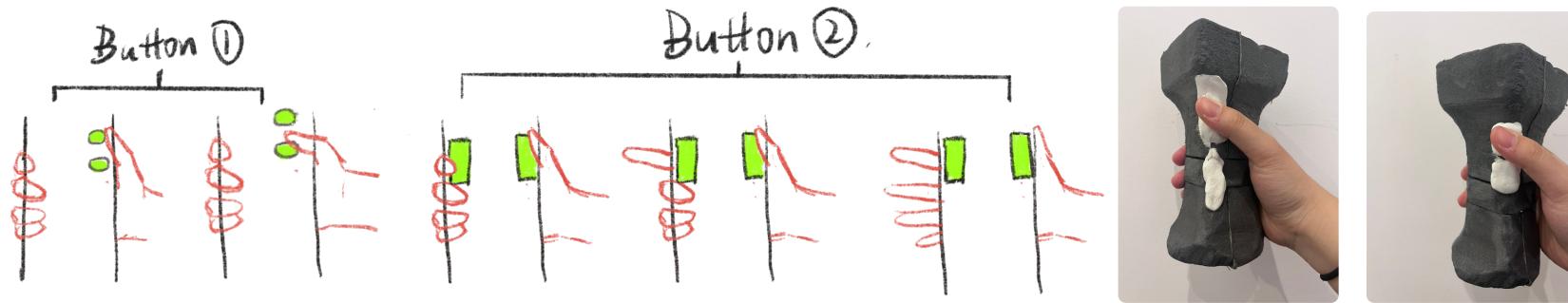
We explored possible placements of the electronic components and adopted configurations that are easy and comfortable to hold, using these as inspiration for the form design.



Concept 3 is chosen due to its ease of manufacturing, geometric elegance, and user preferences.

CONCEPT DEVELOPMENT

Control System Button Design

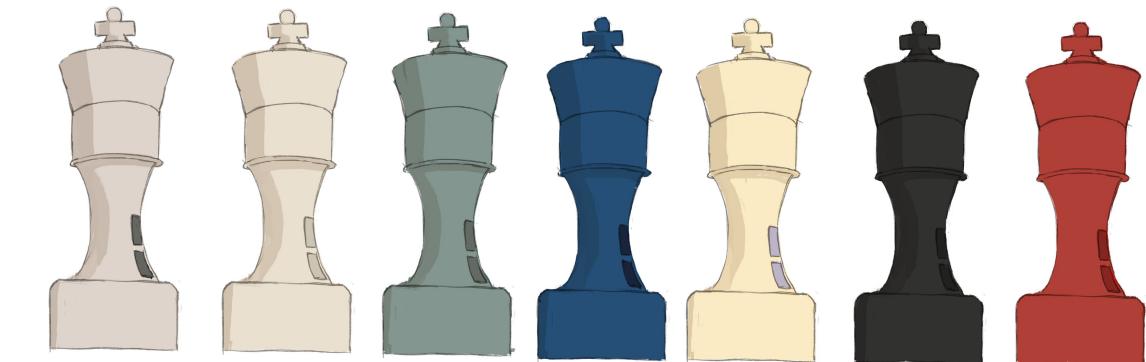


We tested two button control systems:

1. Button Logic 1: Press button A to smash food, release to stop; press button B to retract the push head.
2. Button Logic 2: Press both buttons to smash food; release one to stop, release both to retract.

Despite its innovation and better grip, Button Logic 2 required repeated explanations for users to understand. To ensure ease of use, we chose Button Logic 1 and designed a thinner grip for a tighter hold. We also reduced the button size for easier switching between buttons.

Color Selection

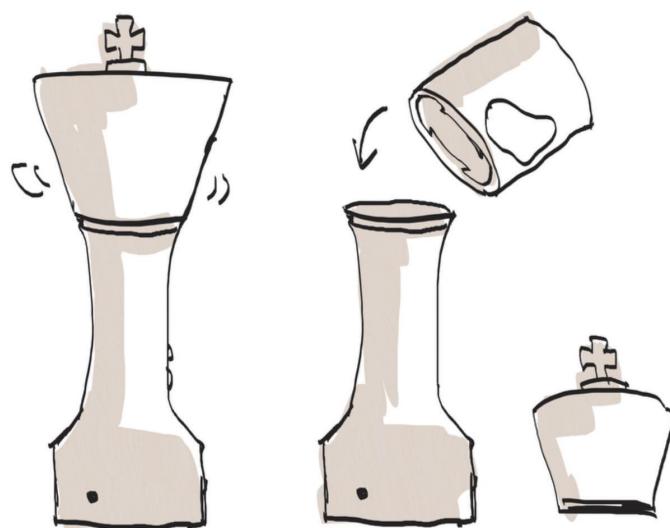


We explored several colors and found that people prefer white tones (warm white, grey white) as they match kitchens better and are less likely to become tiresome.

Material

We chose polycarbonate for the transparent, food-contact safe, and dishwasher safe container. For the rest of the product, we opted for recyclable polypropylene (PP) due to its cost-effectiveness and environmental benefits.

ChessMash — plates storage design and product name creation



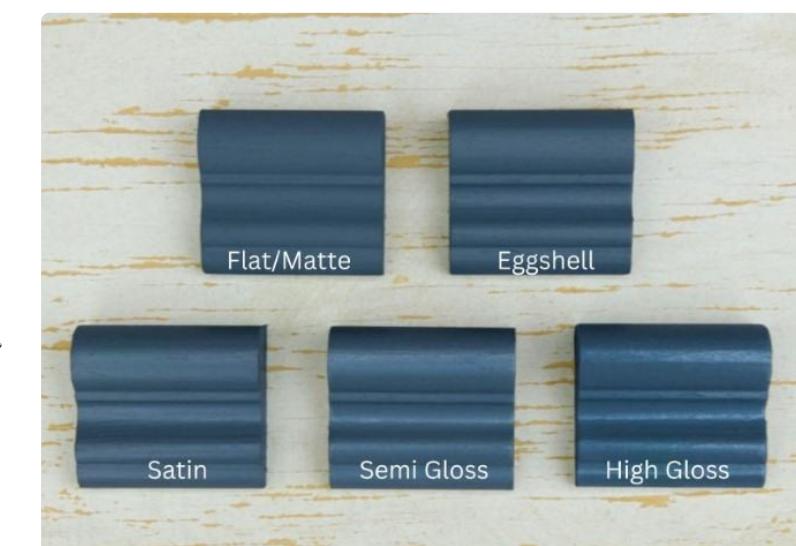
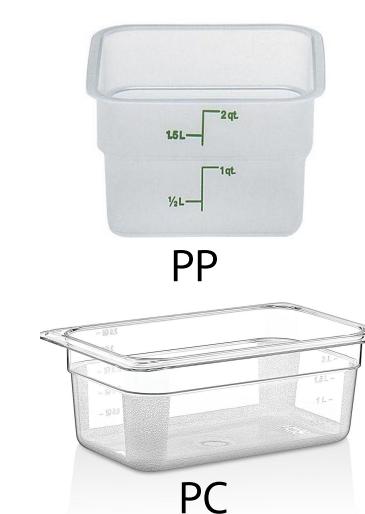
The flat pattern plates are thin and easy to misplace, so we designed a small storage box.

To make the design more engaging, we created the multi-functional smasher in the shape of a chess piece, named ChessMash.

ChessMash is a compact smart kitchen tool aimed at simplifying cooking for beginners with limited kitchen storage space.

Finish

To achieve a high-quality, durable, and damage-resistant finish that always looks clean, we decided to use a matte surface finish.



Benchmarking Analysis of relevant products by Brand



IDEALISK
Potato press, stainless steel
£9

Brand summary

- Globally recognized for its affordability
- A familiar choice for students
- Available both in-store and online
- Emphasizes environmentally friendly materials.

Joseph Joseph®



Helix Yellow Citrus Juicer
£ 19.49

Brand summary

- Well -shaped and high quality
- No electronic products
- Not well-known among many overseas students
- Prices are higher compared to similar brands

BRANDING CONSIDERATIONS

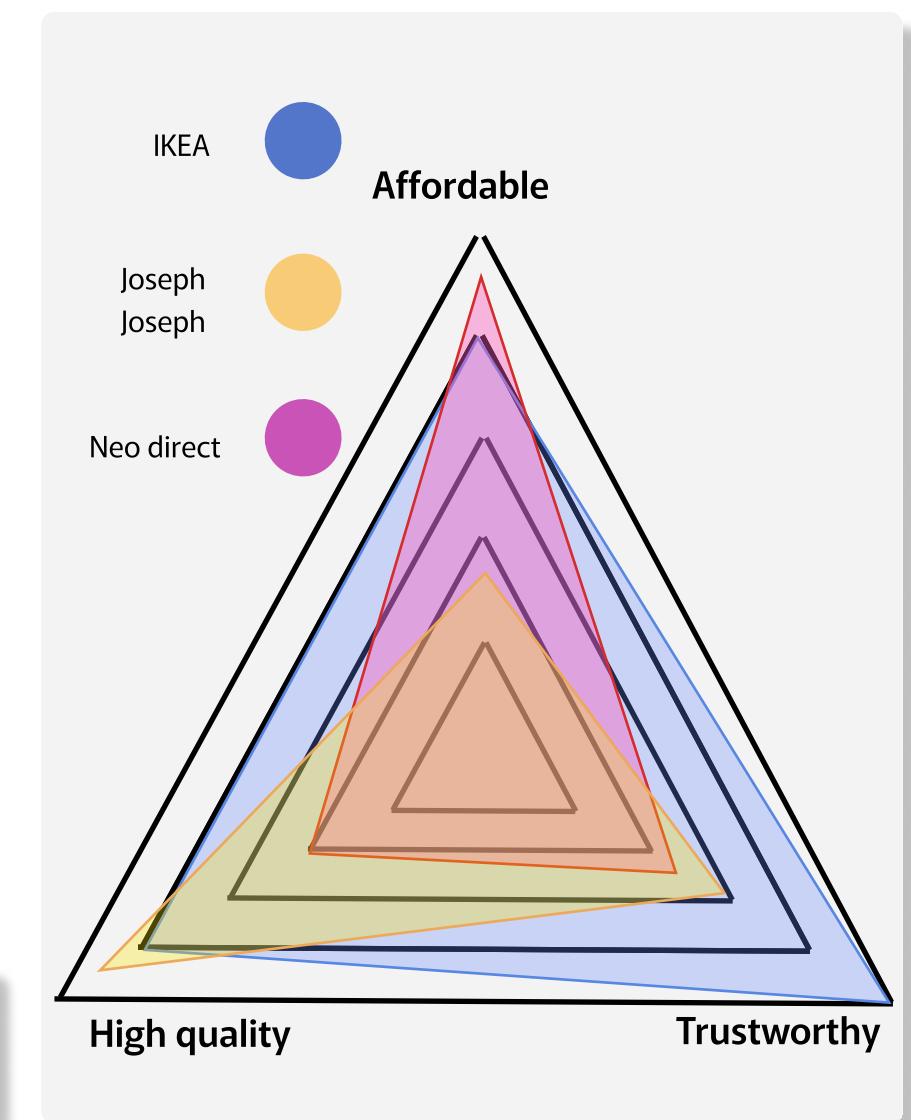


**Neo 4 in 1 Stainless Steel
Digital Soup Maker**
£59.99

Brand summary

- Price are relatively low.
- Has mixed reviews regarding product quality
- No physical stores.

Brand selection



IKEA aligns most closely with our brand concept.

IMPLEMENTATION OF BRANDING ON PHYSICAL PRODUCT

ChessMash with
IKEA's concepts

Three keywords
for our brand
are:
Affordable
High quality
Trustworthy

Time saving

- Materials are polypropylene (PP) and polycarbonate (PC)
- Dishwasher safe
- lightweight nature and easy to handle



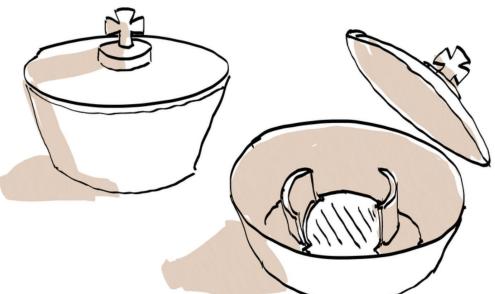
Products in IKEA's
room for students



Space saving
Wardrobe
combination:
drawers and
clothing racks

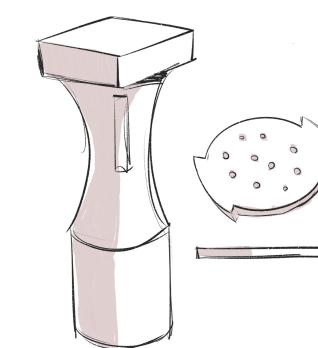


Simple color
schemes like
black and white.



Time saving

Top box for storing
bottom plates, avoiding
misplaced kitchen
utensils.



Space & money Saving

- Slim shape
- Users can customize product functions by changing bottom plates

PHYSICAL PROTOTYPING

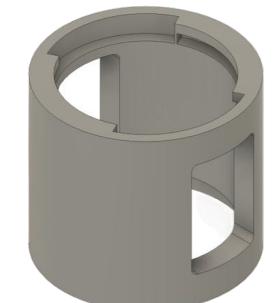
Main Body



- Upper Cubic Part: The initial prototype underestimated the space for electronic components, leading to an upgraded design with increased height.
- Grip Area: Height was increased for user comfort, and the diameter was reduced for better ergonomics based on user feedback.
- Button: A smaller, square-shaped button replaced the long strip press button to make switching easier for users.

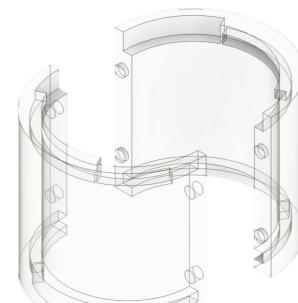
Food Container

Initially, we planned a container with a solid PP wall and two transparent PC parts for visibility. However, this complex design was unsuitable for injection molding, making it challenging and costly.



Material: PP+PC
Partially transparent

Instead, we've opted for a fully transparent PC container. This new design is divided into two parts assembled using a boss structure, facilitating injection molding while maintaining visibility and reducing costs.



Material: PC
Full Transparency

Bottom Plates

Different plates with various hole sizes are being printed to test their effectiveness on our target foods, including potatoes, noodle dough, mooncakes, lemons, and fruits.

Initial printed plates



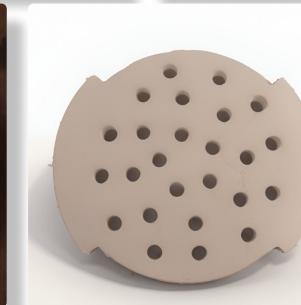
Lemon squeezing test



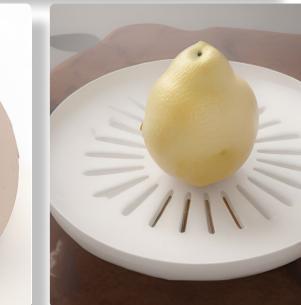
Dough extrusion test



Mash Plate



Noodle Plate

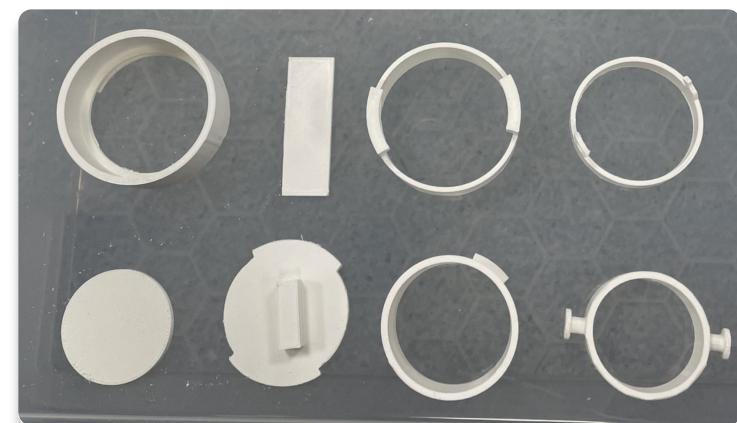


Lemon Plate



Mooncake Plate

Connection



Initial 3D printing for testing



Latch 1



Latch 2



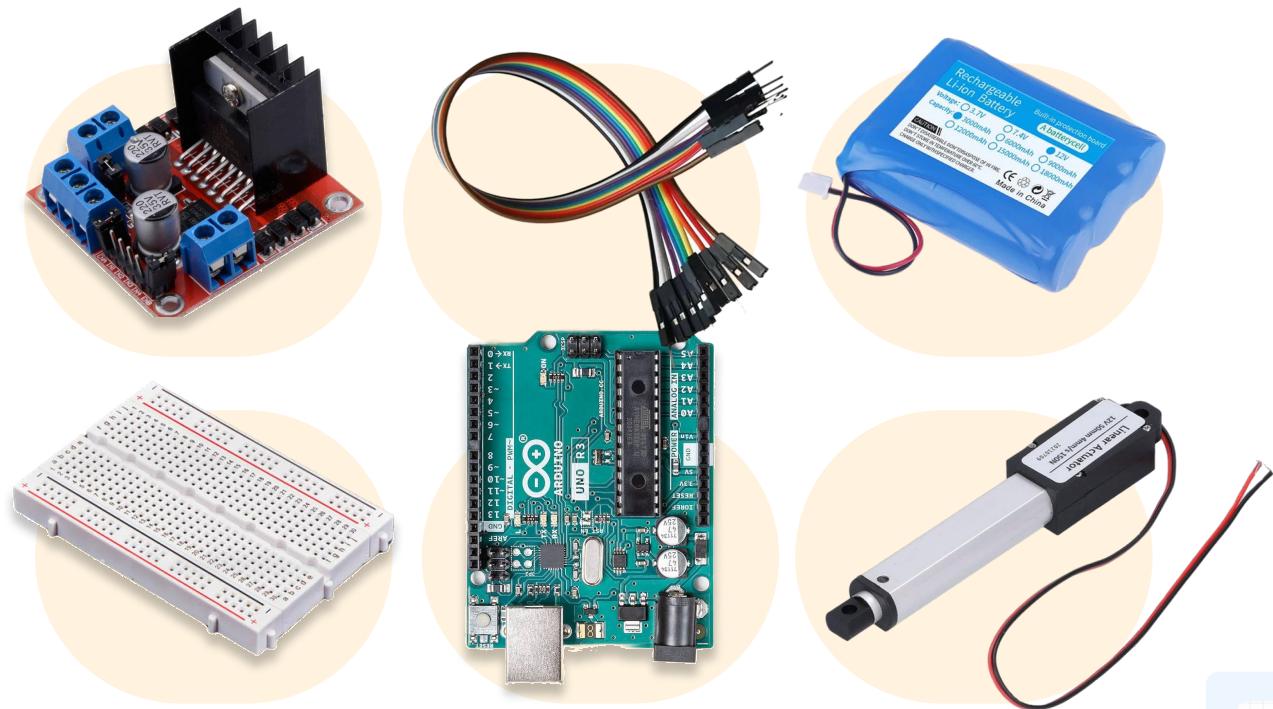
Bayonet mount

For connecting the container and body, we tested two methods: the bayonet mount and the hook. 3D-printed prototypes showed the bayonet mount was more convenient and stable.

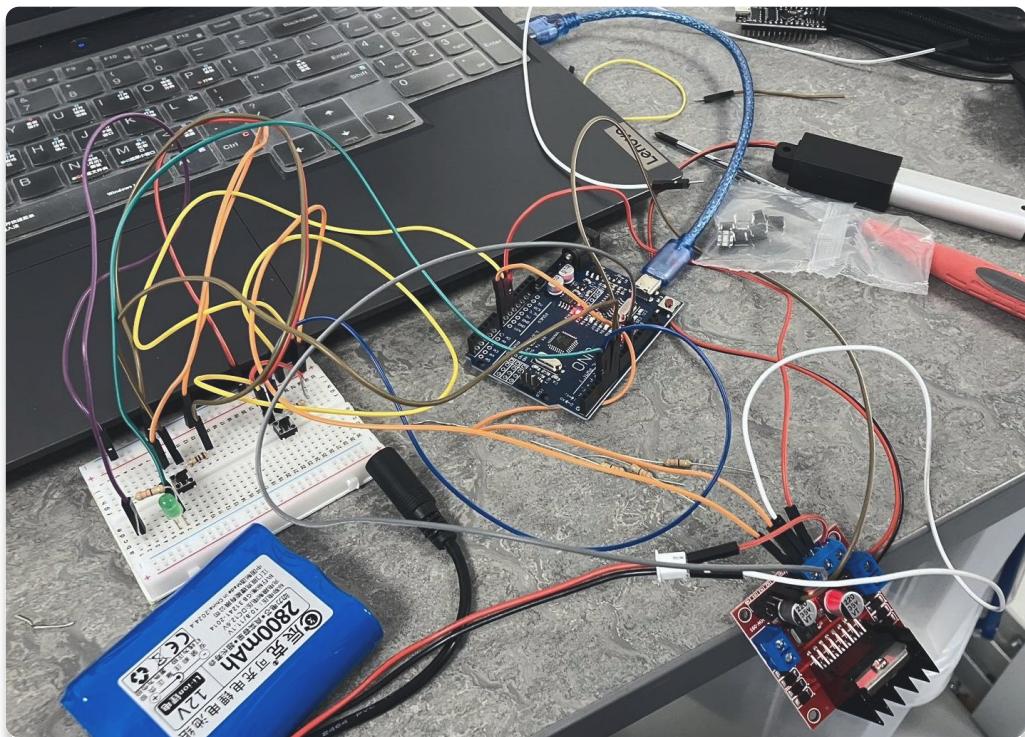
For connecting the bottom plates and container, we compared the bayonet mount and latch. Prototyping revealed the latch required more parts and complex installation, while the bayonet mount was easier to install and provided excellent sealing.

ELECTRICAL PROTOTYPING

Prototyping Components



Initial Prototype



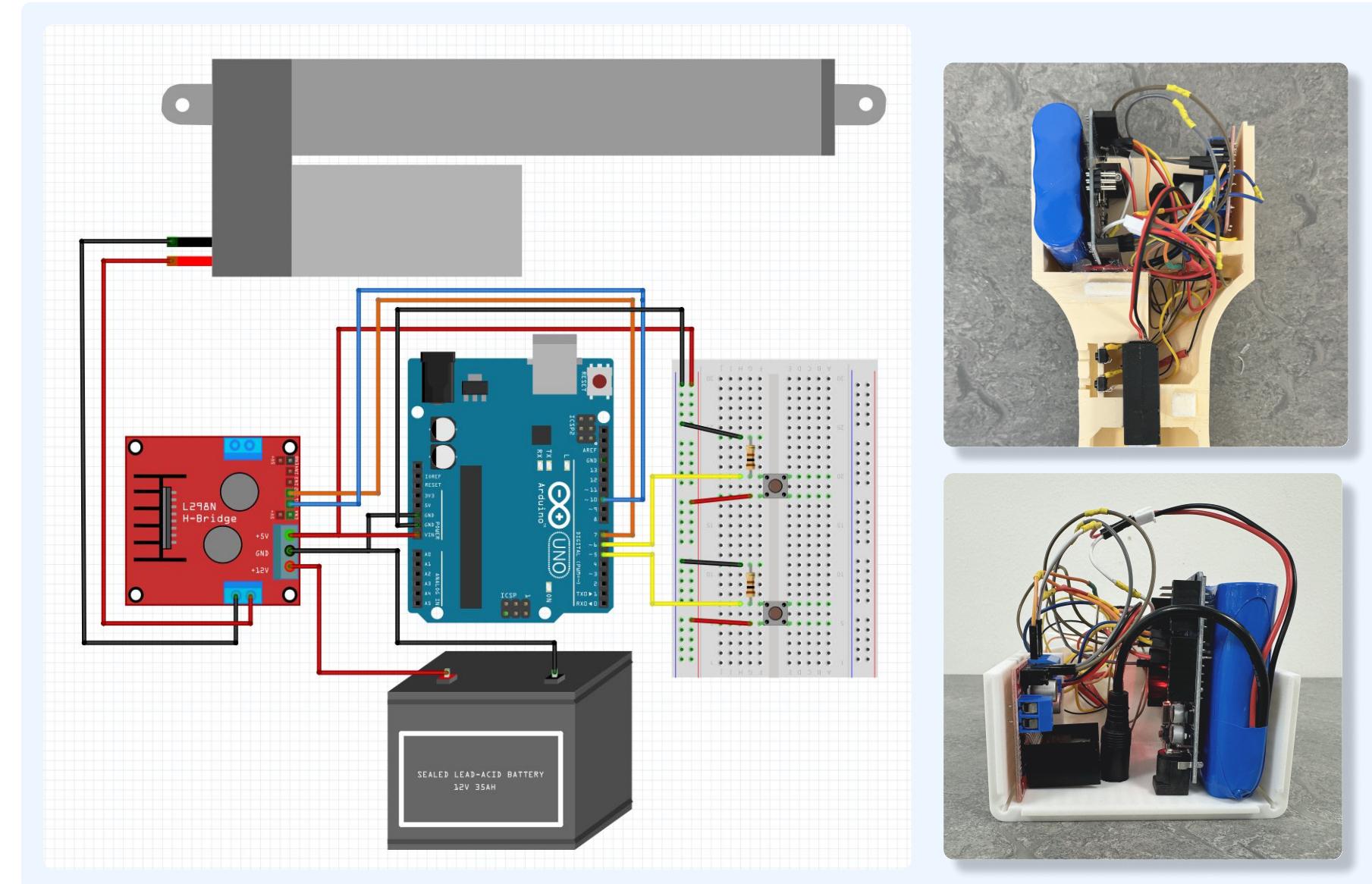
A breadboard and jumper wires were used for the initial circuit setup. These simple and flexible components shortened the testing process and improved efficiency.

Based on our product's nature, our circuit design must meet the following criteria:

- **Compactness:** Minimize the top section size to enhance stability and improve the user's grip experience.
- **Cost-effectiveness:** Ensure the electronics are affordable for young cooking beginners, emphasizing simplicity and low cost.
- **Sufficient Power:** Provide the actuator with enough power to effectively mash ingredients.

Final Prototype

To save space and improve reliability, wire lengths were shortened and soldered, eliminating the need for a breadboard, and the final circuit diagram was created.



POWER AND LOAD CALCULATIONS

Power Calculation:

All power-consuming components: $P = VI$

Arduino (5V-92.63mA) $P=0.463W$

Actuator (12V-2A) $P=24W$

L298N (12V-36mA) $P=0.432W$

Button (5V-50mA) $P=0.25W$

Battery Duration Calculation:

Total average power consumption:

$$P_{\text{total}} = 0.463W + 24W + 0.432W + 0.25W = 25.145W$$

The battery is 12V with a 2800mAh capacity:

$$I_{\text{average}} = 25.145W / 12V = 2.0954A$$

$$\text{Battery Life} = 2.8Ah / 2.0954A = 1.336 \text{ hours}$$

Capacity	Dimension	Mass	Max Power
12V 2800mAh	68x55x19 mm	170g	<70W
12V 5600mAh	66x55x40 mm	320g	<90W
12V 8400mAh	66x59x55 mm	470g	<90W
12V 11200mAh	77x66x55 mm	620g	<90W

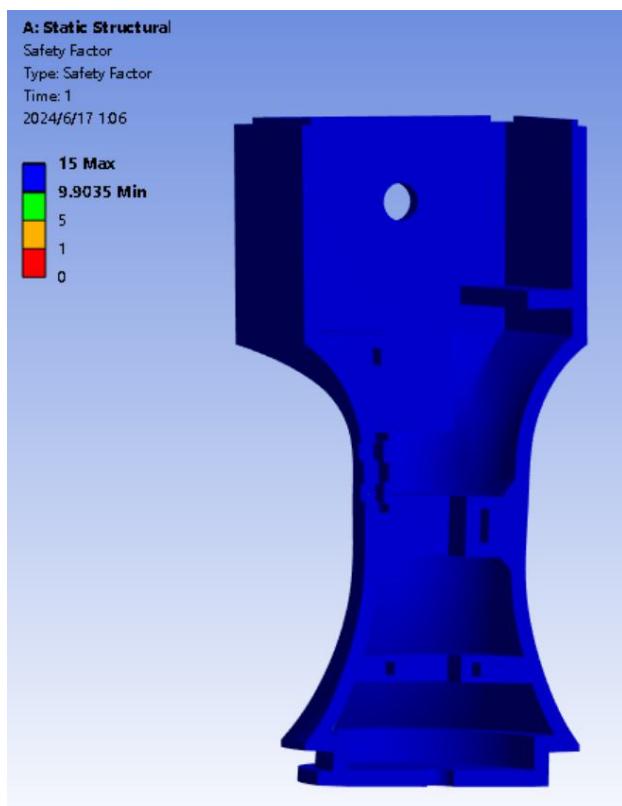
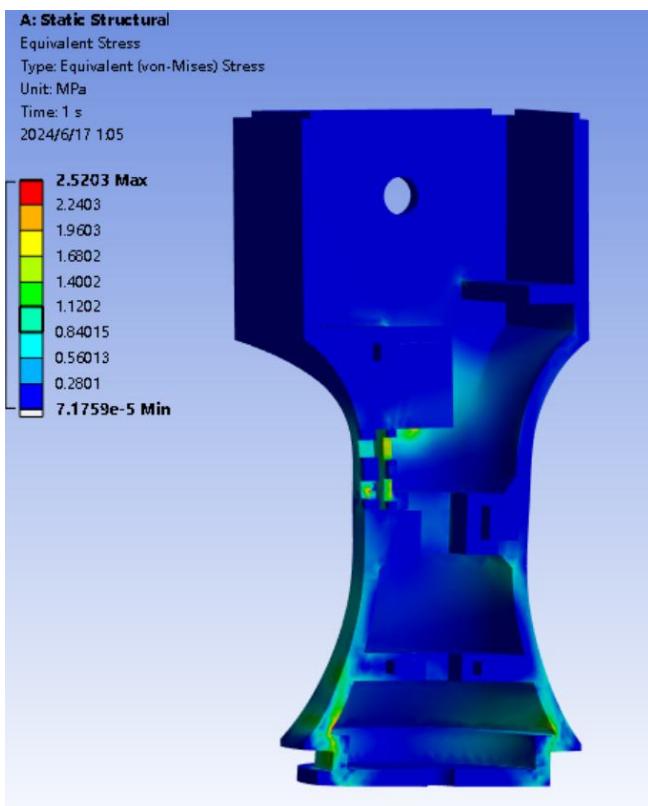
Finite Element Analysis:

Material Strength:

- UTS of PP: 24.96 MPa
- Observed maximum stress: 2.5203 MPa (no risk of yielding)

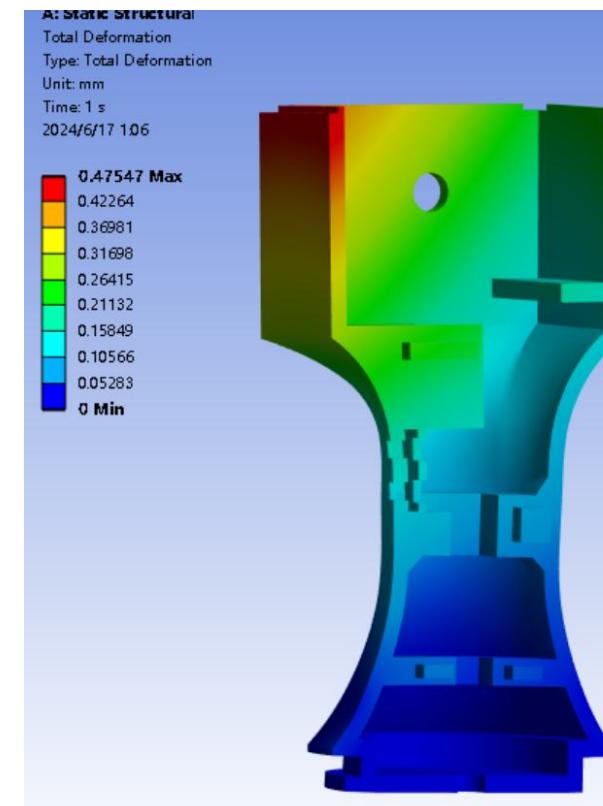
Design Reliability:

- Safety factor: 15 (ensuring reliability and stiffness)



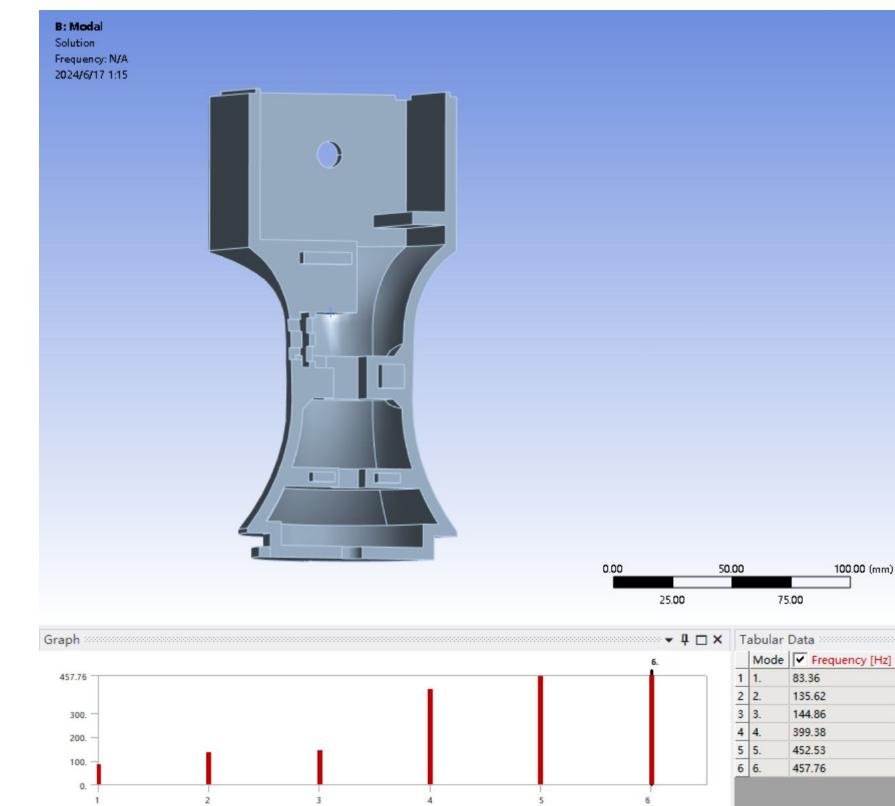
Deformation:

- Maximum deformation: 0.47547 mm (within design limits)

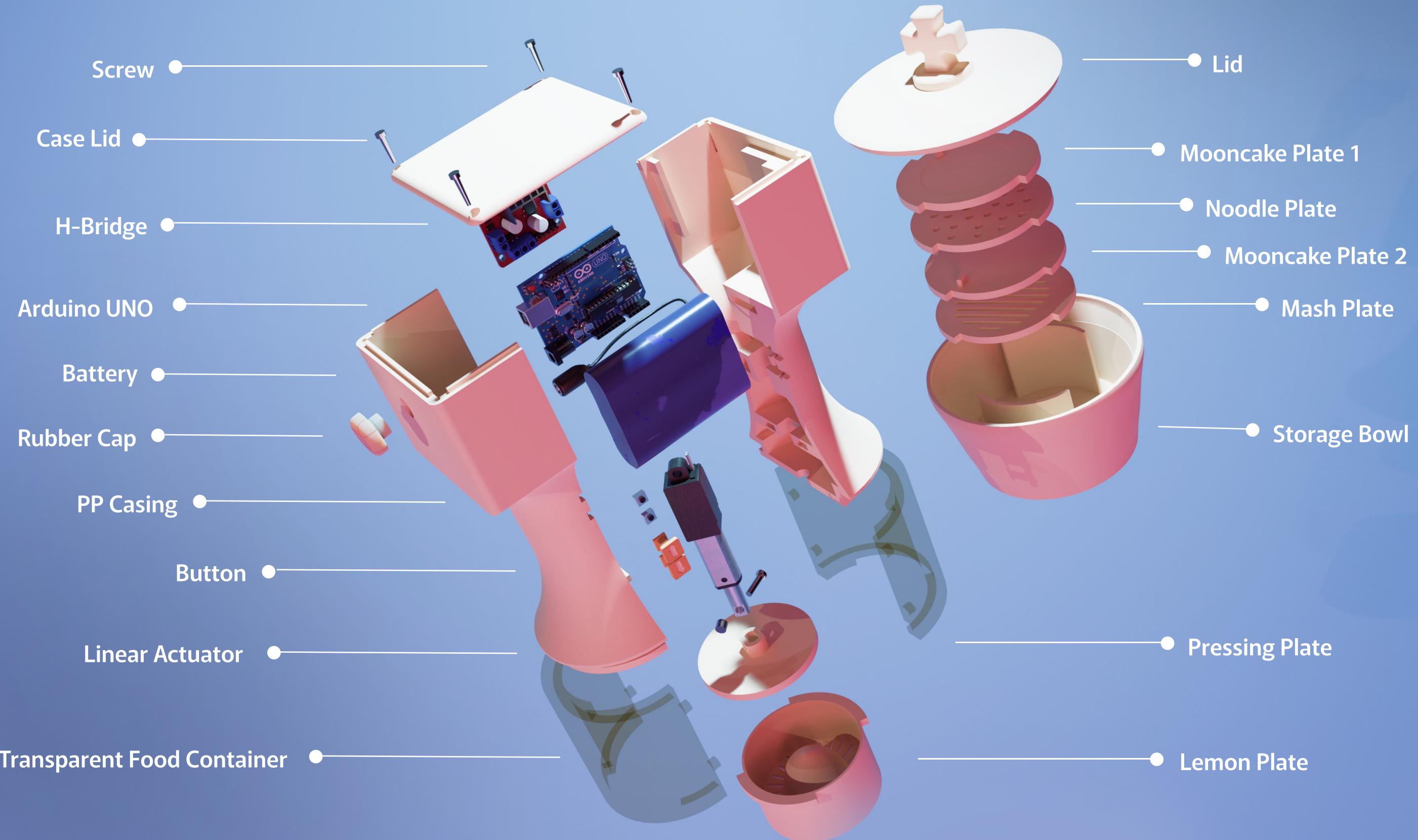


Frequency:

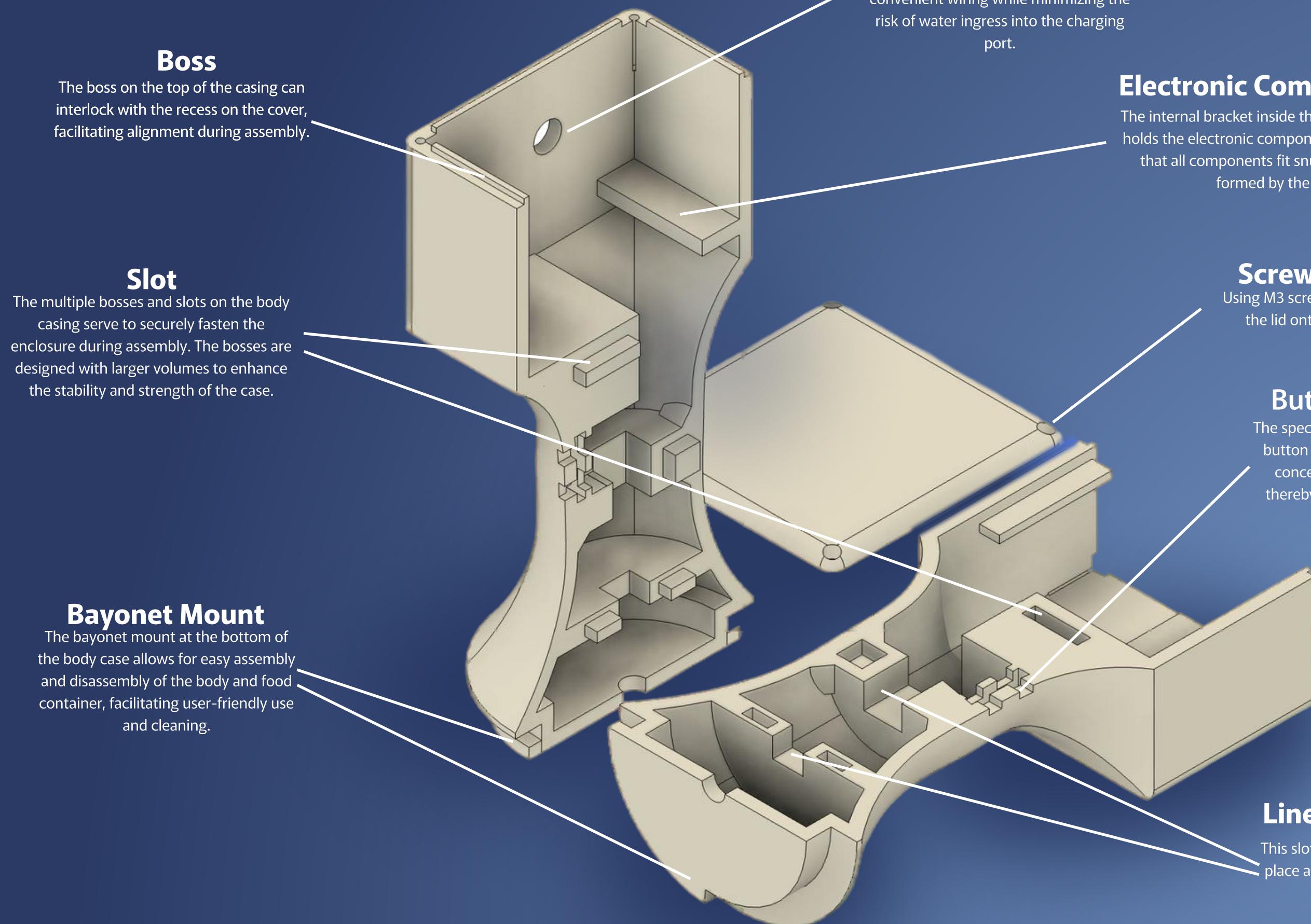
- Actuator operational frequency: 40 Hz
- Lowest natural frequency: 83.35 Hz (preventing resonance)



DETAILED DESIGN (DFMA)



DETAILED DESIGN (DFMA)



PRODUCT ASSEMBLY PROCESS

Preparation



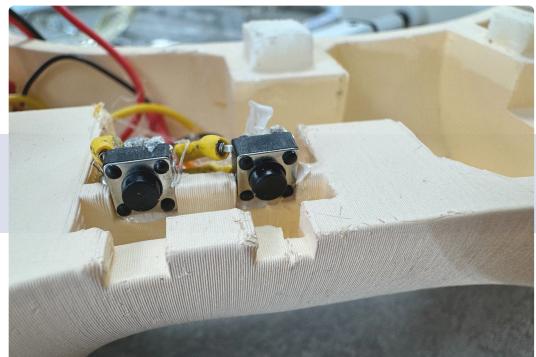
Finishing



Checking

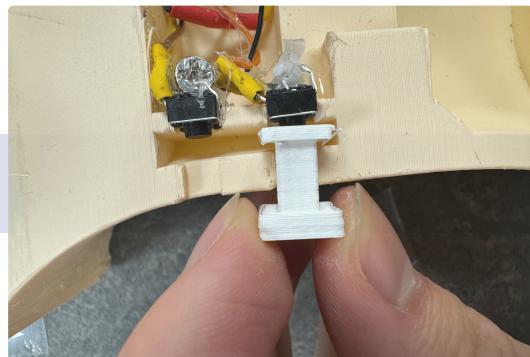
2 min

Electronics Assembly



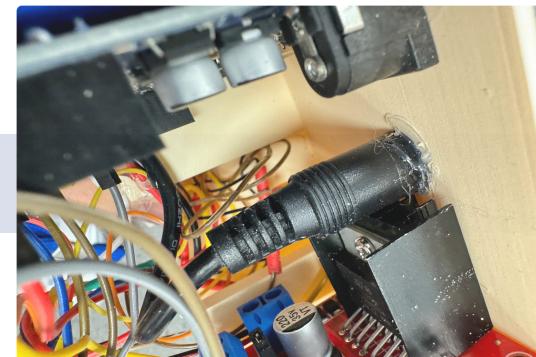
Button

2 min



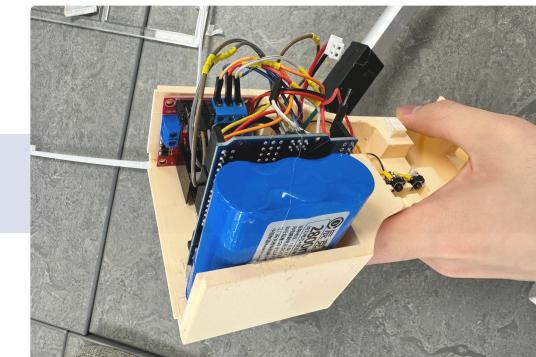
Button Cap

1 min



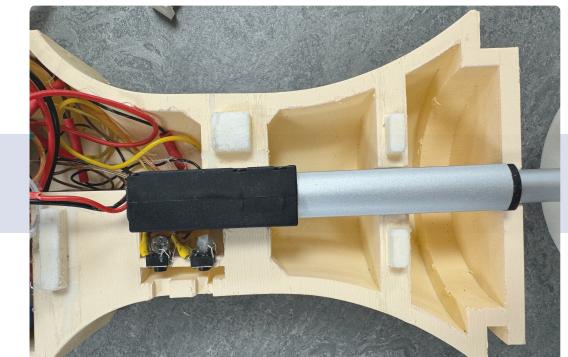
Charging Port

1 min



Circuit

4 min



Linear Actuator

2 min

Final Assembly



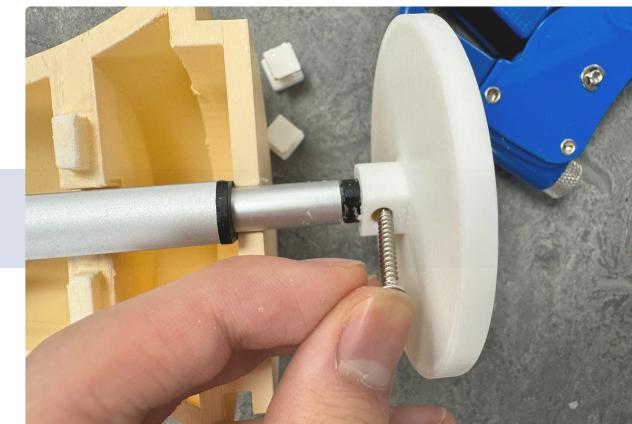
Body Case

1 min



Case Lid

2 min



Pressing Plate

3 min



Finished

Total Assembly Time: 28 min

PRODUCT COMPLIANCE

To ensure that ChessMash, our multifunctional food smasher, can be sold in the UK and EU markets, it must adhere to specific laws, directives, and standards. These regulations ensure product safety, prevent foreseeable misuse, and maintain environmental responsibility.



CE Marking: Required for products sold within the European Economic Area (EEA).

UKCA Marking: Required for products sold within the UK.

General Product Safety

The product should comply with The General Product Safety Regulations 2005 and Consumer Protection from Unfair Trading Regulations 2008, ensuring safety, accurate labeling, and traceability.



Traceability



Consumer Protection



Electronics

The product should adhere to RoHS Directive (2011/65/EU), REACH regulations, WEEE Regulations, and Battery and Accumulator Regulations 2008, ensuring safe chemical use, proper labeling, recycling, and electromagnetic compatibility.



Food Safety

The product should meet Regulation (EC) No 1935/2004 and Commission Regulation (EU) No 10/2011 standards, ensuring safe materials in food contact, and follow GMP Regulation (EC) No 2023/2006 for high manufacturing standards.



Compliance Reflections in ChessMash

- Battery Safety
- Signal Safety
- Packaging and Proper Labeling
- Sustainability
- Child Safety
- Food-Contact Safety & Dishwasher Safety

Packaging

The product should comply with Directive 94/62/EC, ensuring environmentally friendly packaging with a recycling rate of 25%-45% and proper disposal labeling.



Other Regulations

Fire safety regulations ensure all materials in ChessMash, especially foam filling, pass ignitability tests. The use of lithium batteries is carefully evaluated to minimize health risks, particularly to children and pets.

PRODUCT COMPLIANCE

After gaining sufficient compliance information, we assumed a basic process for compliance testing and created our own product's conformity declaration.

Process of Checking Compliance:

1

Identify Applicable Directives and Standards:

Determine the relevant directives and harmonised standards that apply to ChessMash.

2

Review Product-Specific Requirements: Ensure that ChessMash meets all specific compliance criteria for safety, electronics, and food contact materials.

3

Determine Need for Independent Assessment:

Check if an independent conformity assessment by a Notified Body is required.

4

Conduct Comprehensive Testing: Test ChessMash for safety, electromagnetic compatibility, and food safety to ensure it meets all standards.

5

Prepare Technical Documentation: Compile and maintain all necessary technical documentation for ChessMash.

6

Marking and Declaration of Conformity: Affix the CE and UKCA markings to ChessMash and issue the Declaration of Conformity to certify compliance.

Declaration of Conformity

English UK	UNOFFICIAL
UK Declaration of Conformity	by IKEA of Sweden AB. the following EU the Restriction of the Use ment Directive (2011/65/ Directive, The Battery) No 1935/2004, articles intended to come nufacturing practices, and
General Product Safety: <ul style="list-style-type: none">• EN 50564:2011• EN 50370-1:2005• EN 50370-2:2003• EN 55014-1:2017• EN 55014-2:1997	nes, United Kingdom, MK9 ch comply with good been applied:
RoHS: <ul style="list-style-type: none">• EN IEC 63000:2018	
Health and Safety: <ul style="list-style-type: none">• EN ISO 12100:2010	
Packaging and Labeling: <ul style="list-style-type: none">• EN 13427:2004• EN 13429:2004• EN 13431:2004	
Food Contact Materials: <ul style="list-style-type: none">• EN 1935/2004• EN 10/2011	



For UKCA and CE compliance, the product must include documentation that provides the manufacturer's name and address, details about the product, and information about the conformity assessment body.

In the user guide, we have reformatted the Declaration of Conformity to fit our trifold leaflet. The content has been made concise and simple, ensuring it is easy for customers to read, understand, and check online.

LABELING

Package Labeling

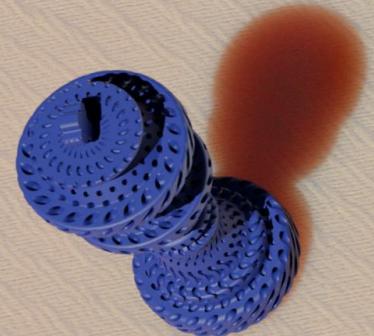


Product Labeling

UKCA & CE Mark	Indicates that the product conforms to UK and EU standards, respectively.
WEEE Mark	Signifies that the product should not be discarded with general waste but must be taken to separate collection facilities for recovery and recycling.
Product Name	Displays the name of the product.
PP Recycling & Other Plastic Recycling Mark	Indicates that the product is made from recyclable materials, specifically polypropylene (PP) and polycarbonate (PC).
Company	Shows the name of the company and the location of manufacture.



USER GUIDE



SAFETY GUIDE

Important Safety Instructions

1. Read Instructions: Please read all safety instructions thoroughly before using your IKEA Chessmash food crushing machine.
2. Supervision Required: This machine should not be operated by children or persons with reduced physical, sensory, or mental capabilities unless they are supervised by a responsible adult.
3. Avoid Overloading: Do not exceed the recommended amount of food to be crushed at one time to avoid damaging the machine.
4. Hot Surfaces Warning: Some parts of the machine may become hot during use. Exercise caution to avoid burns.
5. No Metal Objects: Do not insert metal objects into the machine to prevent damage and avoid injury.
6. Avoid Contact with Moving Parts: Keep hands and utensils away from the crushing mechanism during operation to prevent injury.
7. Proper Cord Handling: Ensure the power cord is kept away from hot surfaces and is not pinched or tangled.
8. Unplug When Idle: Always unplug the machine when it is not in use, and before cleaning or performing maintenance.

Caution

1. Avoid Heavy Loads: Do not place heavy objects on top of the machine as it may cause damage.
2. Keep Dry: The machine should be kept dry at all times and should not be submerged in water or other liquids.

Product Labeling

1. Model Name: IKEA Chessmash food crusher
2. Input Voltage: Rechargeable battery (12V)
3. Compliance: CE, UKCA

Packaging Compliance

We ensure that all relevant safety and environmental standards are adhered to during our packaging process, in line with IKEA's commitment to sustainability.

Electrical Safety

1. Proper Grounding: Ensure the machine is properly grounded to avoid electrical hazards.
2. Check for Damage: Do not use the machine if the power cord or plug is damaged. Contact IKEA customer service for repairs or replacement.

Fire Hazard Prevention

- No Covering During Use: Avoid covering the machine while in operation to prevent overheating and fire risk.

CHESSMASH

Multi-Foodcrush



1



PRODUCT PACKAGING DESIGN



IKEA is eliminating plastic from its consumer packaging. So the packaging is a slide-out cardboard box. We primarily uses black cardboard to support and secure internal components within the package.

Internal design



LAYER 1

- Recipe
- User guide

LAYER 2

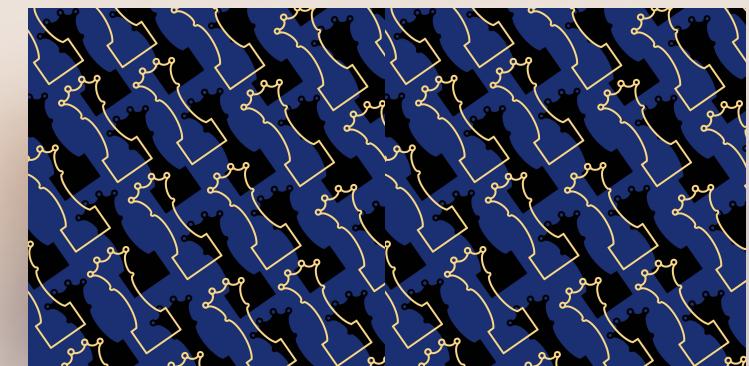
- Product
- Bottom plate
- Charging cable

Graphic design

Front



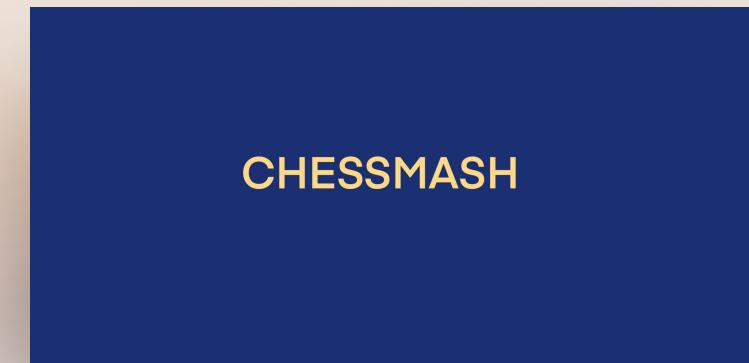
Left/right



Back



Upper part





ChessMash





ChessMash



PROJECT PLAN

Xiangsong Zhang

Warren Tie

Miaoyan Tang

Qinxuan Li

1 2 3 4 5 6 7 8

Concepts Discussion

User Feedback

Concept Selection

Feature Finalisation

Foam Prototyping

Code & Circuit Testing

Brand Consideration

Power and Load Analysis

CAD Prototyping

FEA

CMF

DFMA

Technical Drawings

Product Compliance

Labelling

Packaging Design

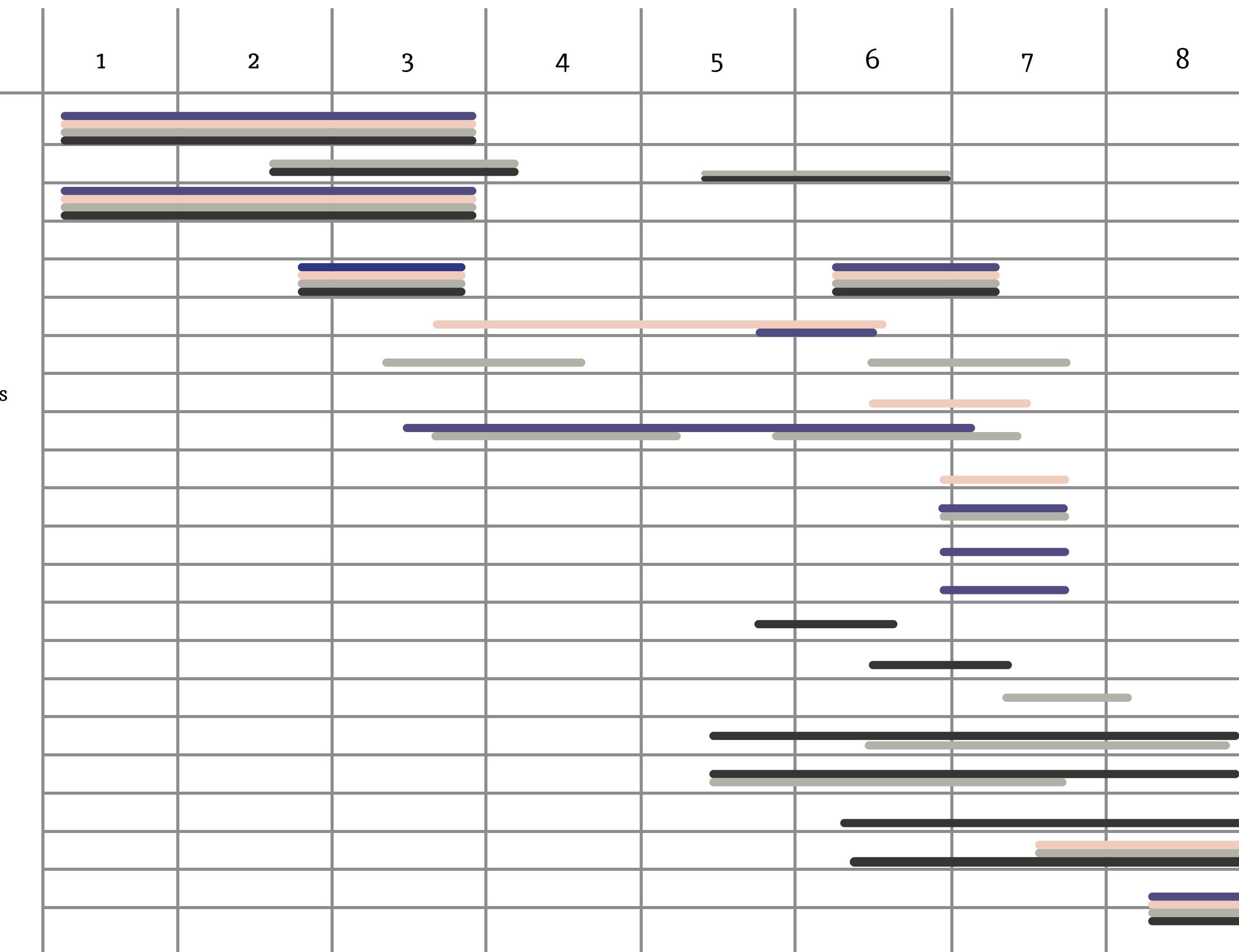
Report

Portfolio

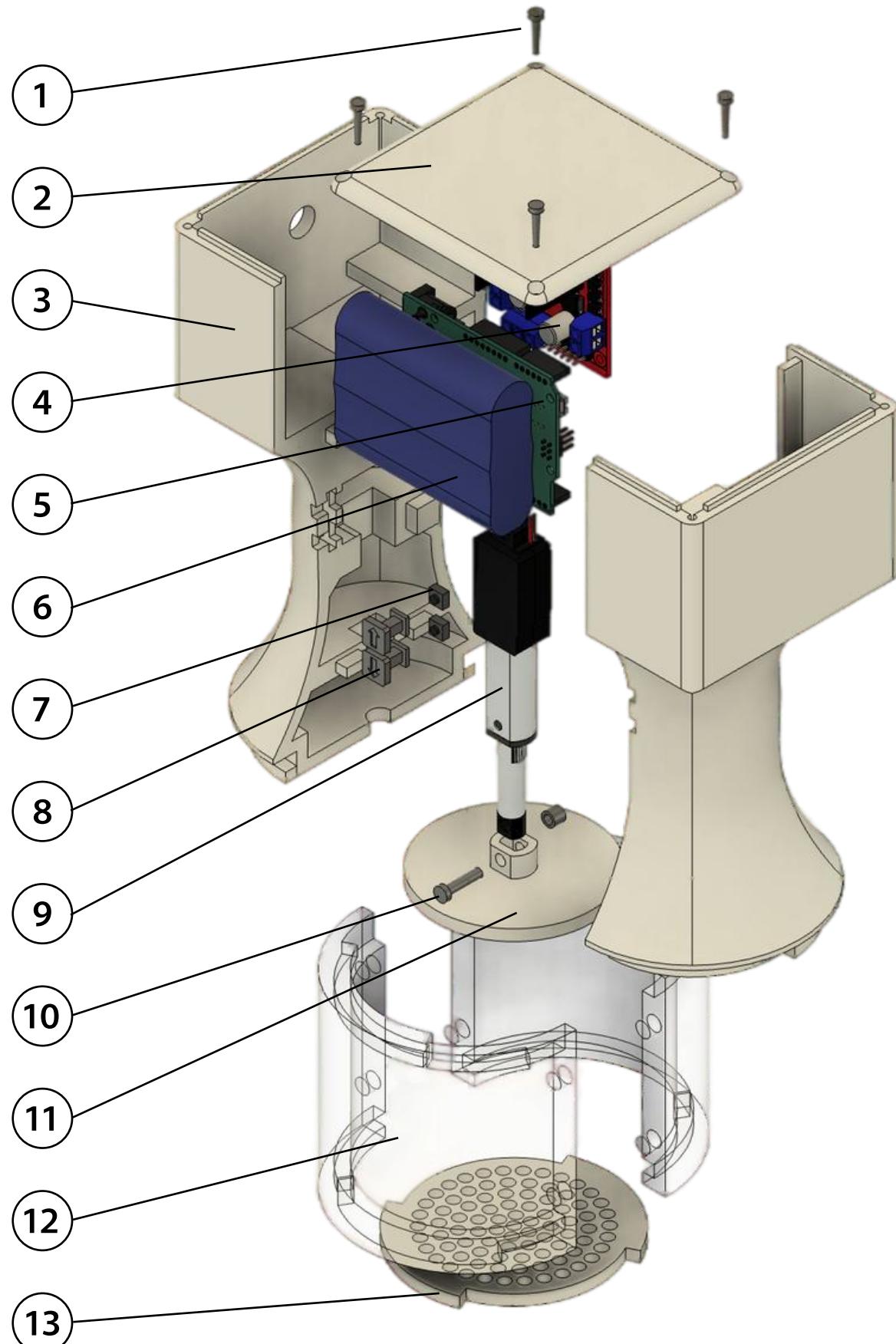
Model Rendering

Video

Presentation & Demo

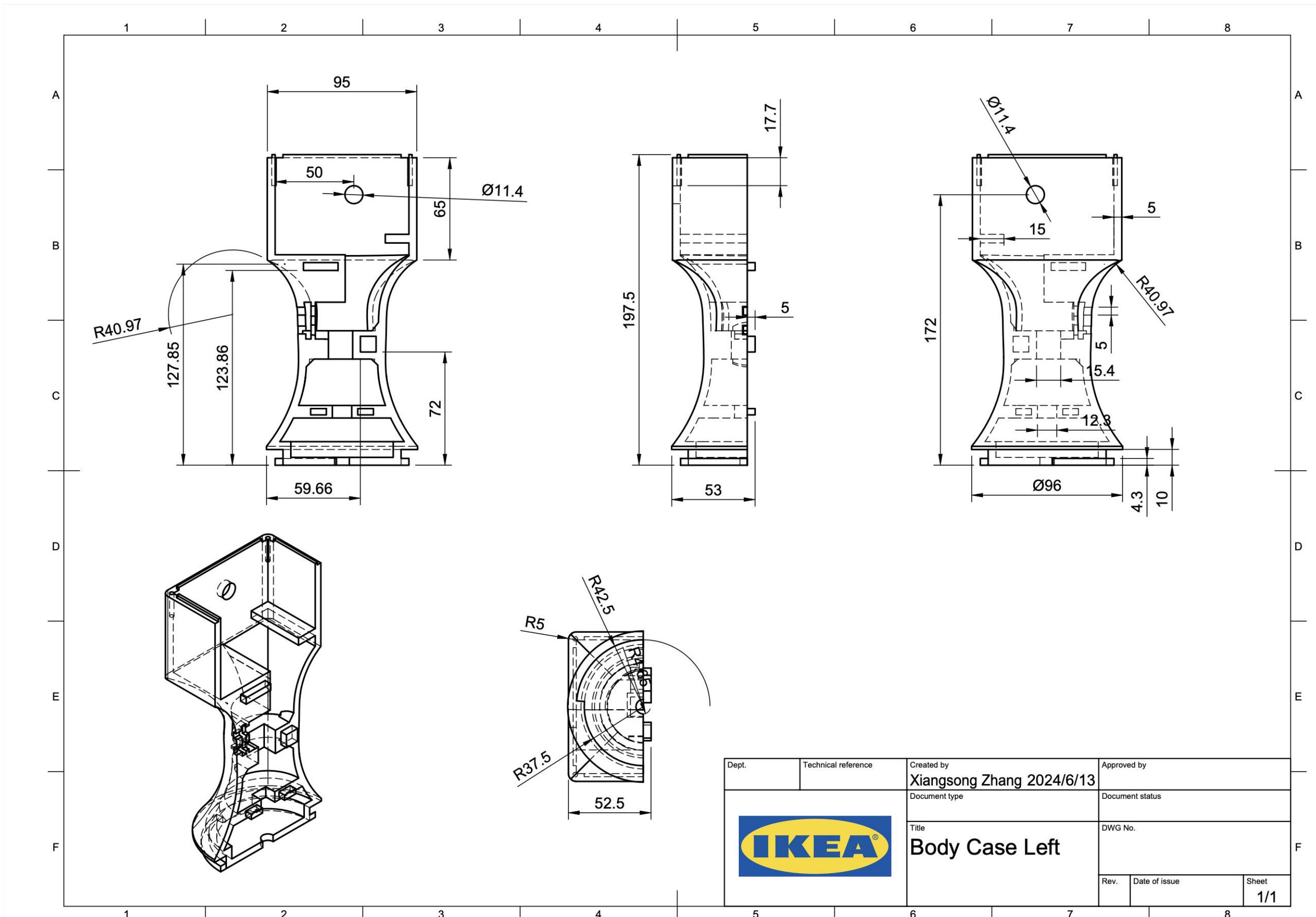


PRODUCT DATA PACKAGE

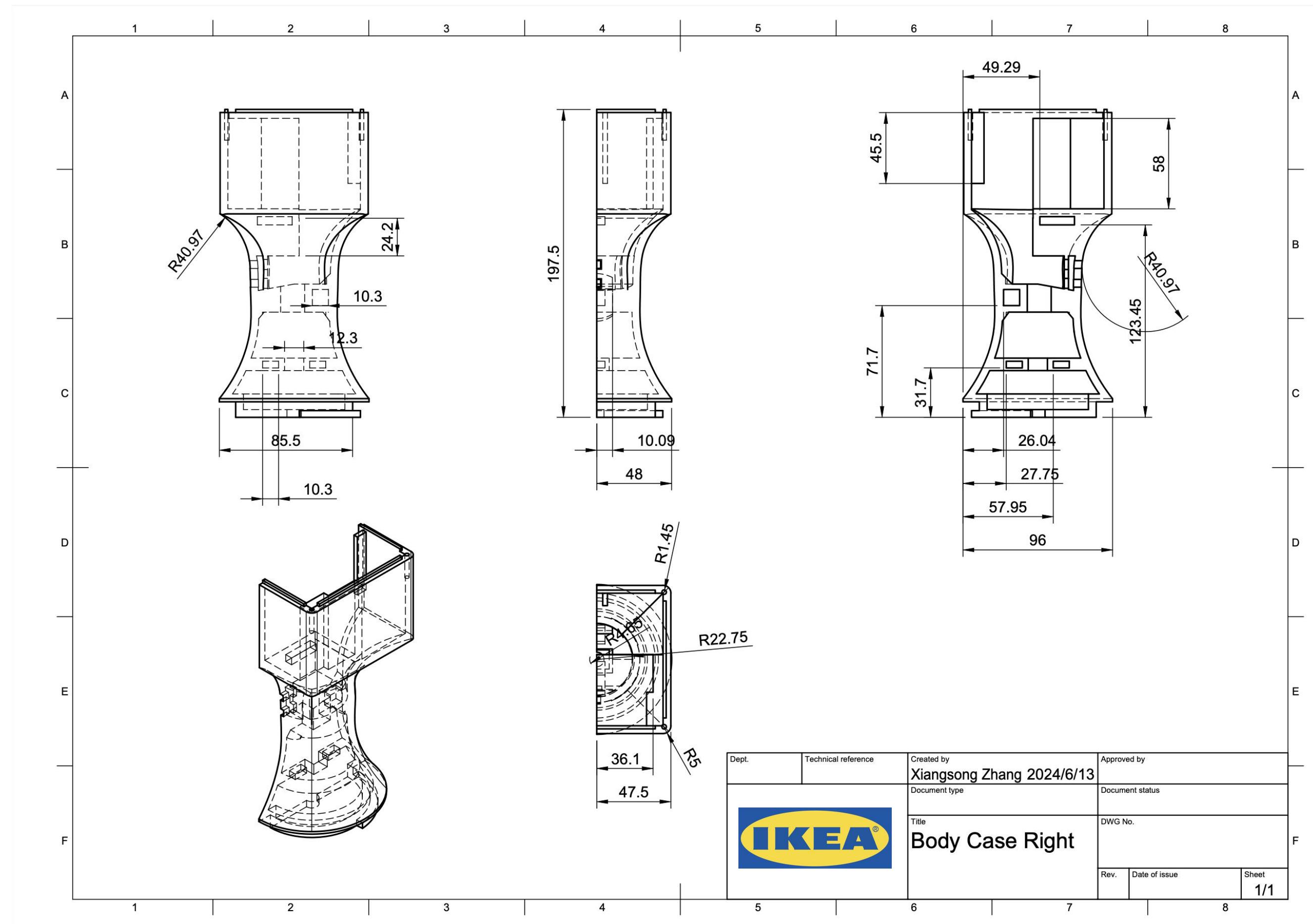


No	Component	Purpose	Quantity	Total Price (£)
1	Screw	keep the case fixed	4	0.34
2	Case Lid	cover all components from top	1	0.53
3	Body Case	hold the components inside	2	2.57
4	H-bridge	control the motor in linear actuator	1	1.5
5	Arduino UNO	control electrical components	1	9.4
6	Power Bank	provide power for electrical components	1	5.3
7	Button	control the movement of the linear actuator	2	0.2
8	Button Cap	enhance the button's operability	2	0.03
9	Linear Actuator	press the food that need to be processed	1	22
10	Screw	keep the pressing plate fixed	1	0.08
11	Pressing Plate	press the food uniformly	1	0.57
12	Food container	connect the body and the bottom plate	1	2.67
13	Bottom Plate	provide the product different functions	5	1.66
				46.85

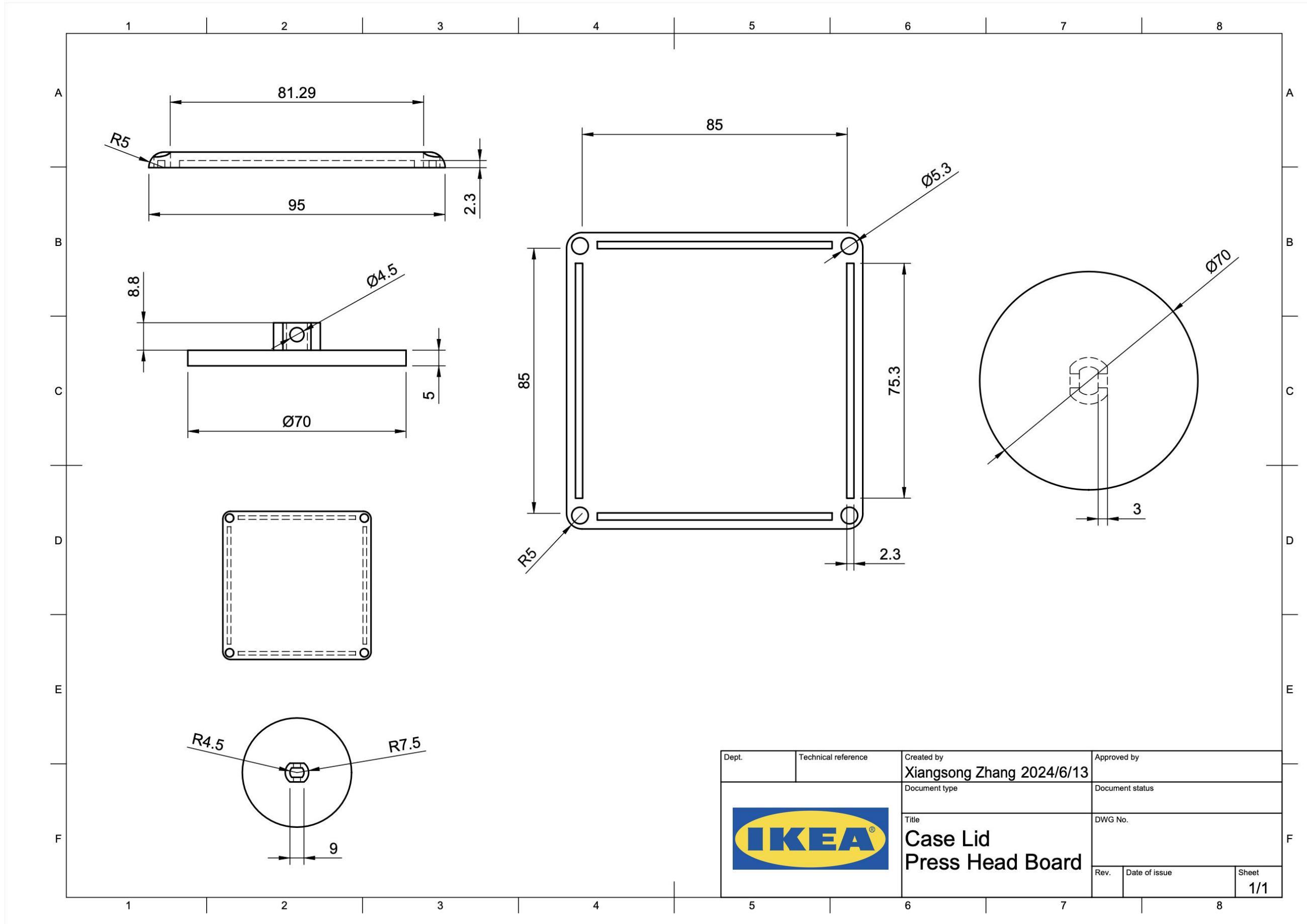
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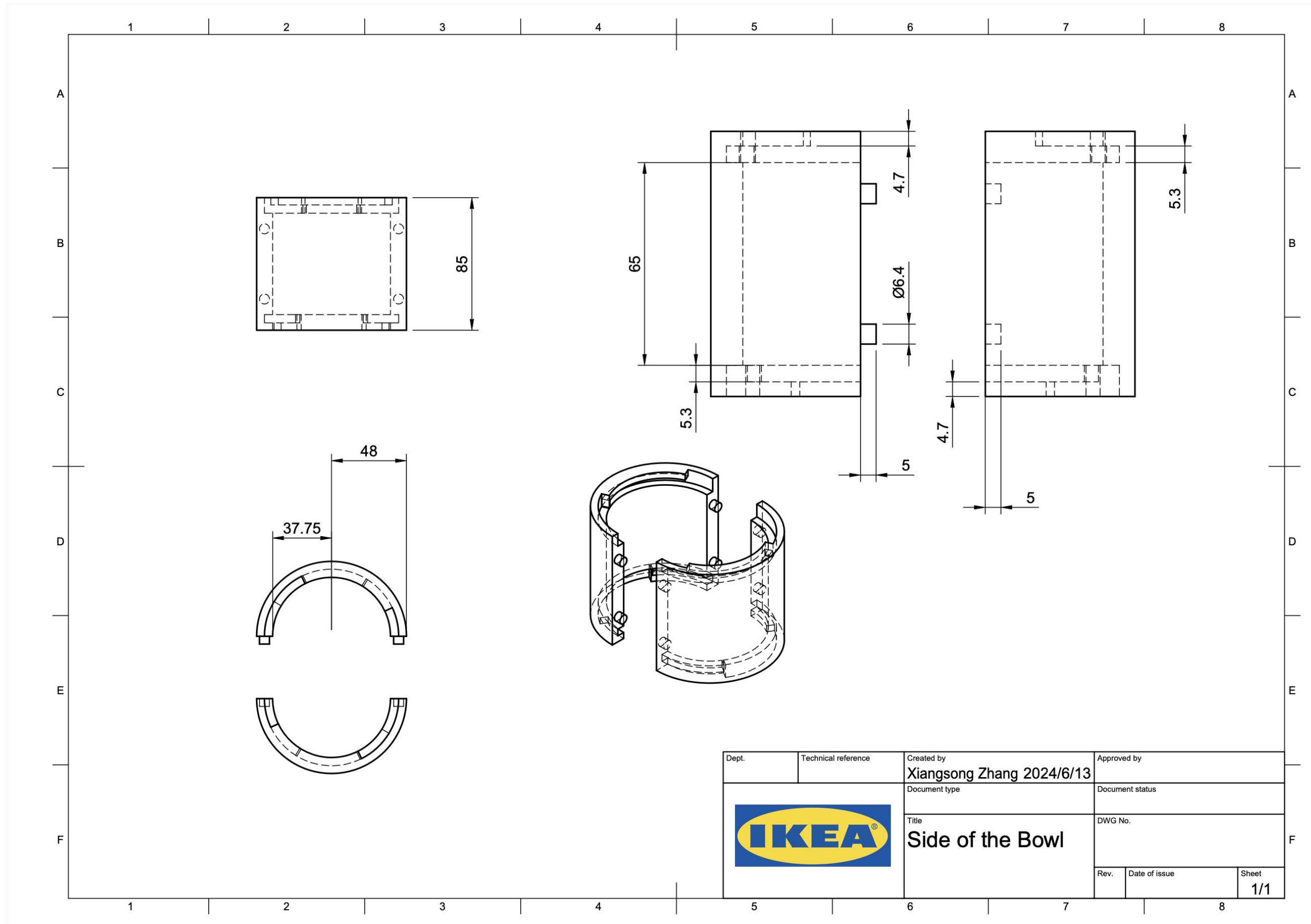
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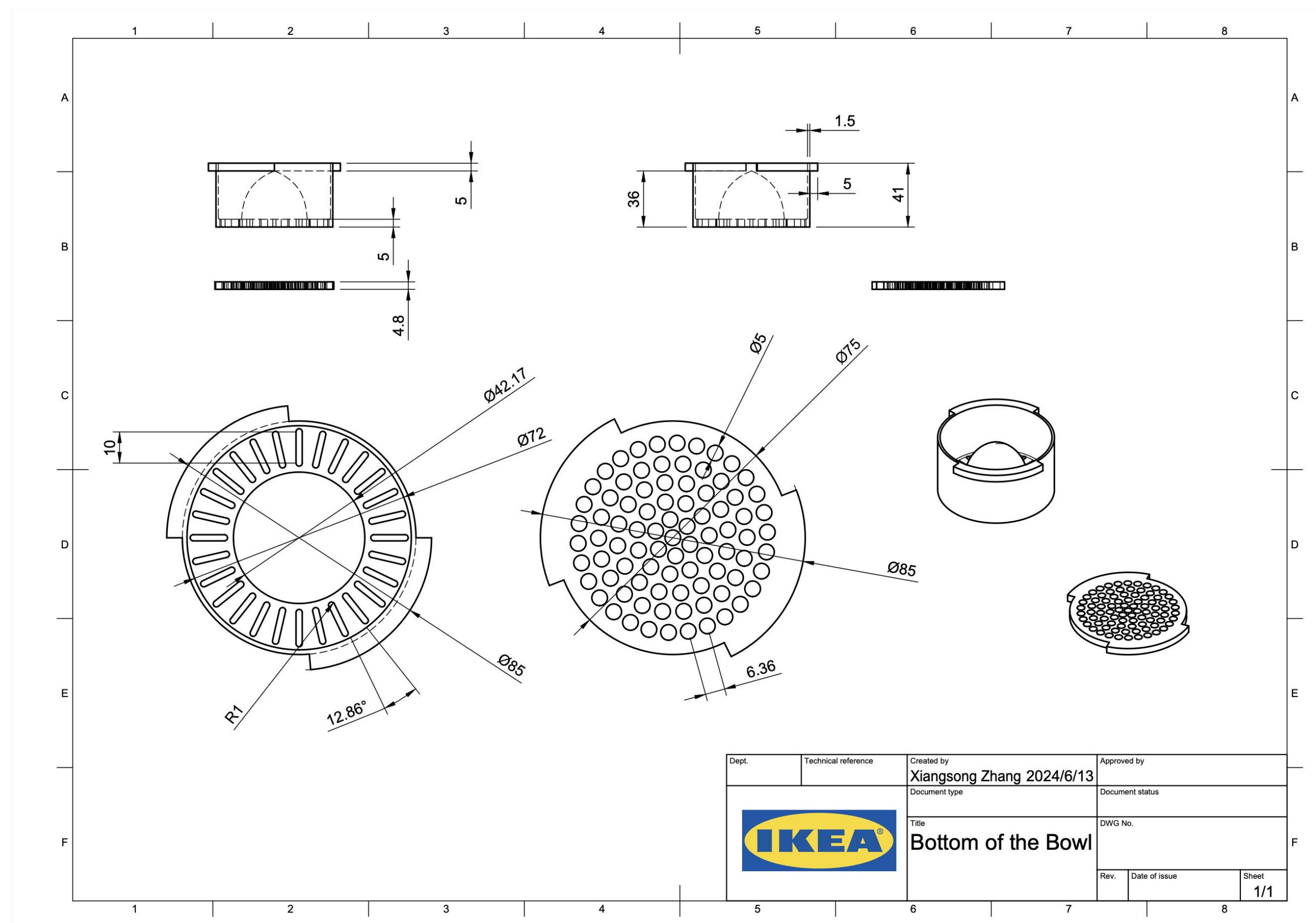
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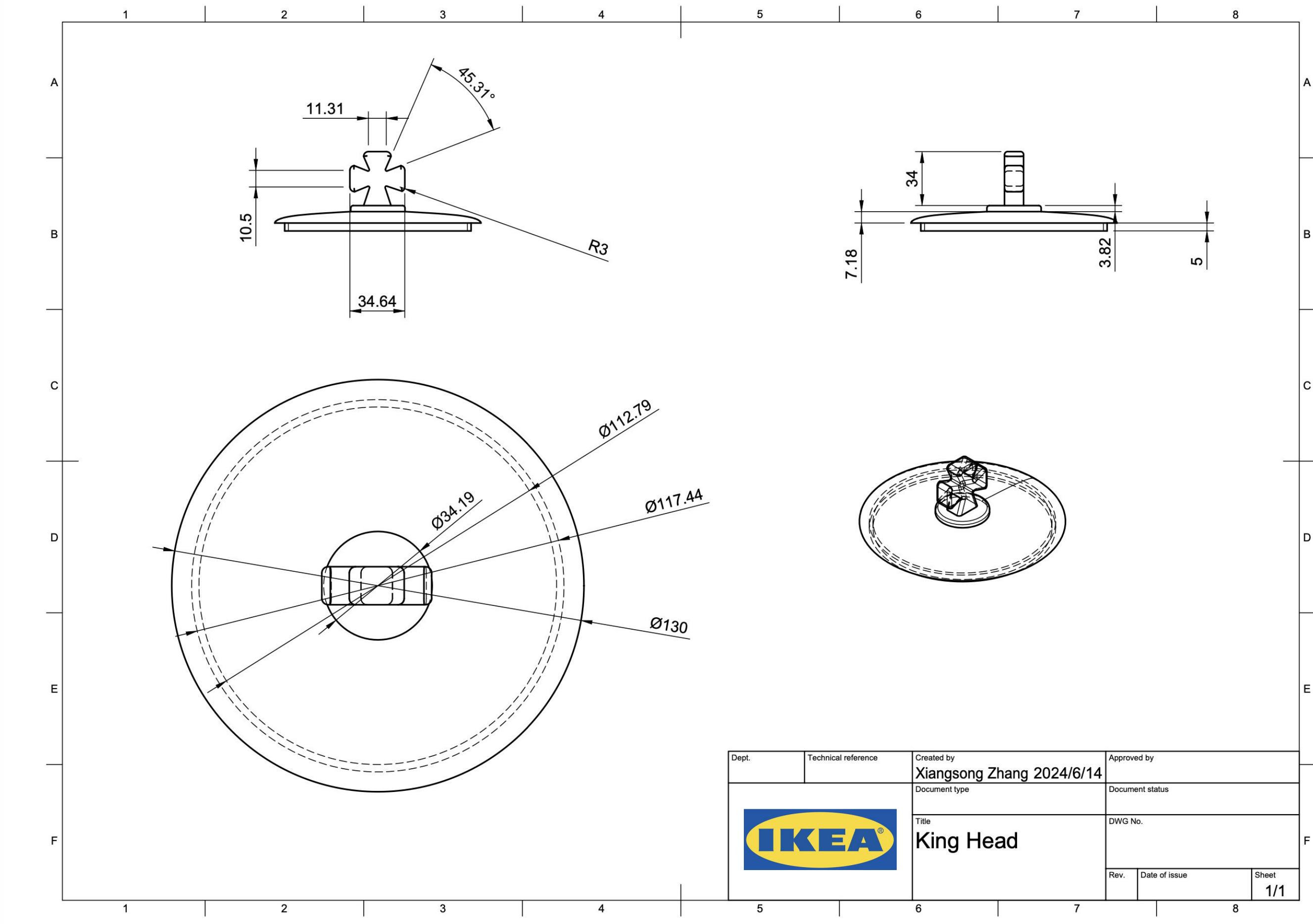
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