JÖNKÖPING UNIVERSITY
School of Engineering

Industrial DESIGN

DEVELOPMENT OF A TOASTER FOR USE ON INDUCTION STOVES

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UTECKLING AV EN BRÖDROST FÖR INDUKTIONSSPISAR

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Abstract

This report covers the development process of an induction powered toaster for the company C3. This included its interior function as well as its exterior design.

The project resulted in a functional prototype of an induction powered toaster bearing a design language that fits into C3s existing product catalogue.

Keywords

Industrial design, product design, induction, toaster, stove

Sammanfattning

Den här rapporten beskriver utvecklingsprocessen av en induktionsdriven brödrost i samarbete med företaget C3. Detta inkluderade brödrostens funktion samt utsidans utformning.

Projecteket resulterade I en funktionell prototyp med ett designspråk som passar C3s nuvarande produktkatalog.

Table of Contents

1 Introduction

This project revolves around the development of an induction powered toaster, its operation, and the design considerations necessary for this product category.

1.1 C3

C3 Scandinavian Lifestyle is a Swedish brand. It was founded in 1997 and is owned by the company Empire Sweden AB. They develop kitchen appliances aimed at the Scandinavian home. These include toasters, blenders and notably percolators of which they have a leading position within the Swedish market. [1]

1.2 Toaster

A toaster is a device that toast bread.

The most common operation for toasting the bread uses nichrome wire that is heated by passing current through the wire. The wire then heats up and radiates the generated heat onto the bread. This is regulated by a timer to ensure that the desired toasting is achieved. This takes place in slots where a slice of bread is placed to be lowered into the device.

Toasters usually feature two slots in order to toast two slices of bread at once. Some slots are larger than average in order to fit either thicker bread or specialized toast bags.

1.3 Induction stoves

An induction stove is a stove that emits an oscillating magnetic field instead of heat. This magnetic field induces electric eddy currents that in turn generates heat by the way of resistive heating. The advantage of using induction as a heating mechanism is that heat is generated directly in the material of the kitchenware. This heat does therefore not need to be transferred into the kitchenware trough another material which results in higher efficiency. This however, requires a compatible material of sufficient thickness with sufficient resistance.

1.4 Problem description

The problem being studied is the creation of a toaster that is powered by, an induction stove and the several unknowns related to this product category. The project is intended to result in knowledge regarding how to design an induction powered toaster.

Solving this problem would bring new knowledge regarding this product category, potentially leading to a new product on the market and usher the way for induction powered kitchen appliances.

1.5 Purpose and research question

The purpose of the project is to create a functional prototype of an induction powered toaster.

This is a novel product that will have key differences as compared to a traditional wired toaster. What these differences are exactly are unknown and needs to be investigated. This is also true for how you would accommodate these differences design wise.

A core difference is the approach to powering the device. This affects heating and possibly electronics. How to power the device in an optimal way should also be investigated and evaluated as compared to a traditional toaster.

The effectiveness of induction is greatly dependent of specific material properties. Identifying materials with such properties, picking the most suitable one and applying it in a prototype is also a key subject of investigation.

Therefore, the questions that this thesis will investigate is:

- What design differences do an induction toaster have as compared to a traditional one?

- How should an induction powered kitchen appliance be powered to generate heat for the purpose of toasting bread?

1.6 Delimitations

The project is mainly an industrial design project. Thus, focus will be put on design. Research regarding electromagnetism and induction will be done to a practical degree. These are extensive subjects however and a comprehensive grasp will most likely not be achieved within the project's timeframe.

Electromagnetic computer simulation will not be conducted, as proper software is not available. Instead, experiments will be conducted in order to evaluate performance in this context.

1.7 Disposition

The report beyond this point is divided into the following sections:

- Theoretical framework. Here the theoretical framework that the project is based on will be described.
- Method. Where the methods used in the project is described.
- Approach and implementation describe how the previously mentioned methods is implemented into the project.
- Result. Here the result of the project is described.
- Conclusion and discussion. Here the project is discussed and answers to the report's questions are answered.
- References lists all sources that are referenced in the report.
- Appendices

2 Theoretical Background

2.1 Industrial design

Industrial design is a professional area which mainly looks at design of physical objects for industrial production. An industrial designer aims to optimize a products function, value, and appearance for the mutual benefit of product users and product producers. This is done mainly through the design and selection of the products shape and materials [2].

2.2 Design thinking

Design thinking refers to the way of thinking that a designer employs in their work as well as the mental process of design. The concept of design thinking originated in the 1960s where Herbert Simon first described it as a unique way of thinking. Separate, but not antagonistic to traditional scientific thinking.

Design thinking, compared to scientific thinking, is directly focused on applying knowledge in problem solving instead of simply creating knowledge for later use. Design thinking has been shown to excel at this, especially at solving so called cursed or wicked problems. These are problem that lack definition and precedent and often have many interlinking factors. Design thinking also differentiates itself from scientific thinking in that it is specifically a human-centered approach. This comes from the assertion that all design activity is inherently social in nature and that the target of any design is ultimately human.

One key component of design thinking is divergent thinking. This is mainly used in idea generation in order to produce multiple innovative solutions to an idea. This allows for less obvious solutions to come to light, which in turn could produce a better solution. It's important to note that divergent thinking, as the term implies, is spontaneous and nonlinear in nature and that logical connections resulting from divergent thinking are often hard to predict [3].

2.3 Design process

The design process is the process on which design thinking structures around. There are many formalized versions of the design process. But it is generally composed of five phases.

Empathetic discovery:

Here research is made into the nature of the problem and the people affected.

Problem definition:

Here the research from the previous step is consolidated and formalized into a problem description that can be easily digested and therefore approached.

Idea generation:

Here divergent thinking is applied and solutions to the problem is generated.

Creation:

Here prototypes are created. These can then be evaluated to see if they manage to satisfy the problem description.

Evaluation:

Finally, the prototypes are evaluated in regards to whether one manages to solve the problem at hand.

[4]

2.4 Design knowledge

Design knowledge refers to a specific kind of knowledge set related to design and ways to approach the design process. This includes ways to solve a specific design problem but also an understanding of the needs of the many different parties that tend to be affected by a design project, be it the clients, users or legal bodies. [5]

2.5 Gestalt laws

Gestalt is a phycological model, created in Germany, that aims to explain visual perception. This includes being able to recognize object without them being fully visible as well as being able to identify how object belong to each other.

The laws are as follows:

Similarity:

Similar object are seen as having a connection.

Continuity:

A line tends to continue even if visually obstructed.

Closure:

Shapes tend to be seen as closed even if borders are partially obstructed.

Proximity:

Objects in close visual proximity are grouped together.

Figure:

An object can be visualized in positive space, but this is also true for negative space.

[5]

2.6 Design Brief

A design brief is a document or presentation that describes the premise of a design project. This includes the design problem, design goals, the projects time frame as well as other relevant information. It is important to disseminate as much useful information as possible in a brief to give the designer the best opportunity to produce a satisfactory design solution.

The design brief also plays the role of communicating expectations that different parties have towards each other. This can be the adherence to legal boundaries and expected results from the designer.

Design briefs also may need to be updated if the conditions of a project change during its execution. [6]

2.7 Bootcamp bootleg

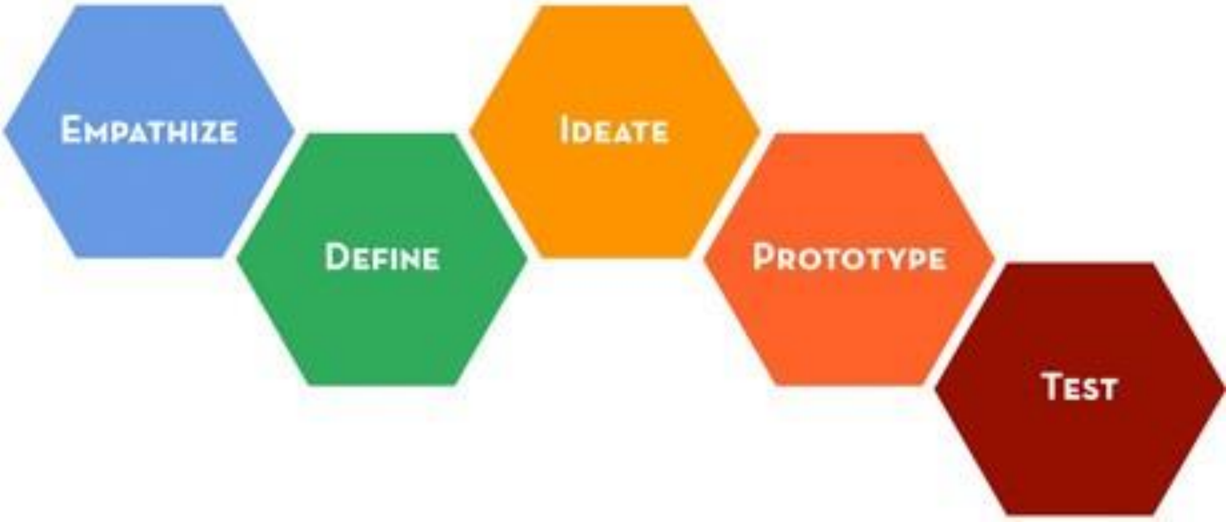


Figure 1 A visualization of the phases of Bootcamp Bootleg.

Bootcamp bootleg is a design process used for structuring a project.

Bootcamp bootleg is divided into five phases:

Empathize

The empathize phase aims to create a human-centered understanding of the problem at hand. This relies on three pillars:

-Observe. To Observe the user's behavior within the context of their lives and relevant use cases.

-Engage. To probe the user for information through both formal interviews and spontaneous questions asked before, during or after an activity.

-Immerse. To immerse and possibly participate in said activity to more directly experience the issues that need to be addressed firsthand.

Define

In the define phase the information gathered is used to converge on an actionable problem statement as well as a vision for what the final product should be like. This will serve as a basis for future work to refer back to.

Ideate

In the ideation step design alternatives are generated. The objective of this step is to explore as many different possibilities as possible. This is meant to serve as a foundation for the prototype step.

Prototype

In the prototype step ideas from the ideation step are manifested in a physical manner. This is not limited to the production of a prototype as the name suggests, but any physical manifestation of an idea. Examples of this is a mock-up, post-it notes displaying the idea or storyboards. This allows the designer to present ideas to an outside party or to let the designer reprocess the information.

Test

In the test phase a design concept is evaluated to estimate its viability. The feedback gained from testing would then be recycled into another iteration of the process unless a concept would be good enough to be brought into a production mode.

[7]

2.8 Semantics and semiotics

Logic, meaning and purpose. Semantics and semiotics denote the study of signs and meaning and provides a framework used for communicating meaning with a design. Signs in semiotics are impressions on the five senses produces by a product of the user's interaction with a product.

A product should communicate meaning to a user about how it should be used. It is also beneficial to communicate a mood to the user to enhance the user's experience. This communication can be divided into four different categories:

Description: Description provides context for a product. This can be done through the title of a product. For example, a "floor tile", it is placed on the floor and its tileable. Context is also communicated through shape. A floor tile again is flat and well suited for stepped on and has a shape that can fit into a pattern.

Expression: Expression is how a product can communicate properties and feelings about itself. This can be that a car either looks fast and light or heavy and sturdy. This is often used to communicate to the user what attitude is deemed to be appropriate when interacting with the product.

Exhortion: Exhortion is a call to action for the user, an indication for the user to interact with the product or to elicit a reaction from the user. These can be direct, as a phone signaling an incoming call, or they can be more subtle like a piece of furniture looking good in a certain context therefore suggesting that it should be places in such a context.

Identification: Identification lastly denotes things about products such as its origin, affiliation, and purpose. This can be what brand the product belongs to or what product category the product is a part of.

[5]

2.9 Ergonomics

Ergonomics is the study of human machine interfaces. This is divided into several areas:

Anthropometry: Anthropometry is concerned with body size and proportion variations within a population.

Biomechanics: Biomechanics looks at the applications of force from the body.

Environmental physics: Environmental physics regards environmental factors such as noise light or heat.

[8]

2.10 Design for manufacturing

Design for manufacturing denotes the principle that a given product should be designed to ease its manufacturing. [9]

2.11 Design for assembly

Design for assembly denotes that the parts of a product should be design for assembly in a viable and ergonomic way. [9]

2.12 Induction Cooking

Induction cooking refers to methods of cooking that utilize induction, mainly for the purpose of generating heat. This differs from gas and electric cooking that uses convection and heat radiation to heat the cooking vessel. [10]

Induction heating works by generating a magnetic field by running a current through a copper coil. This magnetic field then generates a current in the cooking vessel through the Joule effect.

The material to be heated requires certain material properties. Firstly, the material needs to respond to the magnetic field. This can be described by relative magnetic permeability, where a relative magnetic permeability of one corresponds to a vacuum. This allows currents to be generated in the material, but it is in resistance to these currents that generate heat. The rate at which current is resisted is described by the materials electrical resistivity, or electrical conductivity. This heat then spreads through the material at a rate that is described by the materials thermal conductivity. Materials with good electrical resistivity often don't have good thermal conductivity, or magnetic permeability, however. To circumvent this, the magnetic material is often paired with a more thermally conductive material that takes the role of distributing the generated heat. This can be seen in induction compatible copper cookware. These feature a steel plate in the bottom of the cookware. [11]

3 Method

3.1 Gantt schedule

The Gantt schedule was devised by Henry Gantt and is a planning system that lays out all the activities in a project along the time that they are to be completed at. The time aspect can be represented in days, weeks or whatever time interval that is required. The Gantt-chart is useful in that it allows the user of the chart to keep track of their progress and to easily know what they are supposed to work with at any given time. [12]

3.2 Function analysis

A function analysis is an analysis that looks at what functions a product does or needs to perform. These are most often used in order to determine what functions are desired for a product to perform. This information in turn is used to evaluate the merits of a design concept.

Functions are most often divided into tiers describing the importance of including them in a design concept. These tiers are:

Main: These are the purpose for which the product is designed. Without these functions you could not justify making said product. These are very limited in number and most products only have one.

Supporting: Supporting functions exist to facilitate the main functions. These include things such as being able to direct a tool to its proper use-place. These are the most numerus kind of functions that a product has.

Desired: Desired functions are functions that simply add value to a product but is not necessary for a product to properly function. They are desired because including them is not required when creating a design solution.

A common way of describing these functions in a function analysis is via the "Verb, noun and specification" method. This method describes a function in a table as an action via the use of a verb and a noun in different columns on the same row. An extra column called "specification" is also provided in case a functions range or otherwise needs to be specified.

[4]

3.3 Persona

A persona is a fictional profile of a person that serves to represent a demographic and their interests and attitudes relevant to the product being developed. Personas are used as a reference of design needs relevant to the target demographic.

3.4 Scenario sketches

Scenario sketches are sketches that describe a sequence of events related to the use of a product. These are made in order to map out possible scenarios related to the product and to identify emergent problems to be addressed when designing the product.

Scenario sketches are utilized early in the development project. But at a point where an abstract idea of the product being made exists. Therefore, the subject product is depicted in an abstract way which allows solutions to problems found in the scenario sketches to be envisioned. [13]

3.5 Brand analysis

A brand analysis is an analysis which aims to identify common elements and themes within a product catalogue. These common elements can then later be applied onto a design to make it fit in with the product catalogue that was analyzed. [14]. These elements give the product identity [5] as they are applied.

3.6 Moodboard

A moodboard is a series of images that together communicate a mood or theme. Moodboards are used in order to establish and communicate what mood or theme that should be pursued when designing a product. This mood informs what expression [5] the product should convey. The result of the design process can also be evaluated against the moodboard in order to aces the products compliance with it. [15]

3.7 Sketching

Sketching is a very versatile tool that is used recurrently within many parts of the design process. Sketching allows an idea to be presented or evaluated. It also serves as documentation of an idea to be referred to at a later time. There are many different purposes for sketching, and this in turn affect how the sketch will look.

Presentation sketches: Presentation sketches are created in order communicate a design decision or concept. Visual clarity and presentation are important, but a certain amount of ambiguity can be useful in order to encourage input from the viewer of a presentation drawing.

Experiential sketches: Experiential sketches are drawings created for the purpose of visualizing and idea for the designer. These are often low fidelity sketches and do not illustrate more elements than necessary to allow the designer to evaluate a specific idea. This can include proportions of a product or the distribution of graphical elements. These are used in most of the ideation phase.

Visionary sketches: Visionary sketches are sketches meant to present a design in an as favorable light as possible. This in turn is often used to promote the concept or otherwise convince someone of the concept's viability. Identified flaws in a design are often hidden or otherwise suppressed in these sketches in order for them to fulfil their purpose to a higher degree. These sketches are often of very high fidelity but does not have to be.

[13]

3.8 Computer Aided Design

Computer aided design denotes the usage of computer software in the design process. Most prominently in order to create a 3D-model of a design concept. These 3D-models gives the designer feedback regarding its proportions, size etc. If a concept utilizes electrical components, then the model can confirm whether or not the needed components can be places where needed. The same goes for confirming whether different parts of the design itself can be assembled or not. There are many different types of software used for these purposes and sometimes different programs needs to be used in conjunction with each other to achieve the desired result.

3.8.1 Solidworks

Solidworks is a so-called parametric modeling program which uses solid bodies. It operates around a history framework of features which allows the user to go back to an earlier point in the modeling process to make changes. From there the modeler can either change variables that affect the final model or discard the decisions made after the specific point and take alternate modeling decisions. Most features and dimensions of a model in solidworks are governed by parameters which specify their dimensions. This makes the software suitable modeling the interior components of a product [16] [17].

3.8.2 Alias

Alias is a so-called surface modeling program. This means that models are created through surfaces and not solid bodies. This focus on surfaces allows alias to create models with a very high surface quality which is most useful on the exterior of a given product. [18]

3.9 Prototyping

Prototyping is creating a high-fidelity model of your design and is often one of the final stages in the initial design process. These prototypes can be functional, although this is not strictly necessary depending on the goal and limitations of the project. [4]

3.10 Go/no-go matrix

A go/no-go matrix is an objective evaluation method for product concepts with the aim to evaluate whether to proceed with a given concept. This method does not compare concepts against each other and should therefore be complimented with an evaluation method that does that.

3.11 Pughs matrix

Pughs matrix is a comparative evaluation method for product concepts with the aim of determining the best possible concept amongst the ones being evaluated. [19]

4 Approach and Implementation

4.1 Gantt schedule

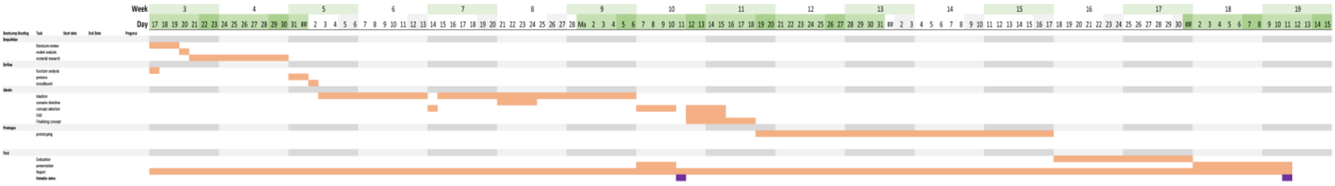


Figure 2 A Gantt schedule.

The Gantt schedule was altered several times due to shifting due dates.

4.2 Function analysis

Class	Verb	Noun	Specification
M	Toast	Bread	
S	Recieve	Power	From induction
S	Regulate	Time	Of toasting
S	Facilitate	Adjustment	Toast time
S	Facilitate	Portability	
S	Store	Breadcrumbs	
S	Allows	Removal	Of breadcrumbs
S	Facilitate	Cleaning	
S	Cancel	Toasting process	
S	Facilitate	Removal	Of inserted bread
S	Hold	Bread	Or toastbags
S	Generate	Heat	
S	Dissapate	Heat	Into bread

The function analysis was based on functions that are present on regular toasters. These were also supplemented with functions perceived in order to be able to operate on an induction stove.

4.3 Market analysis

For the market analysis, toasters and inductions stoves were in focus. These two product categories were put in focus due to their relevance to the project. For toasters the following factors were noted:

- Price in Swedish crowns.
- The number of slots on the toaster.
- The brand of the product for organizational purposes.

Properties regarding the toaster performance were uniform and not seen as notable. The most distinguishing qualities was aesthetic and the quality of the toasters design which is hard to quantify.

The analysis shows a couple of notable placements on the market. There are the low-cost ranges of roaster ranging from 100 to 700 SEK. These are cost optimized toasters with simple, modern design elements. Most toasters inhabit this section. Some brands extend their product range in price to 1200 SEK. Finally, a couple of brands exclusively focus on more pricy toasters, ranging from 1200 to 3300 SEK. These toasters often feature a chrome exterior and aims to evoke a retro style aesthetic. The number of slots on the toaster does not correlate with these market sections. It does however correlate with a price increase within the brands product range.

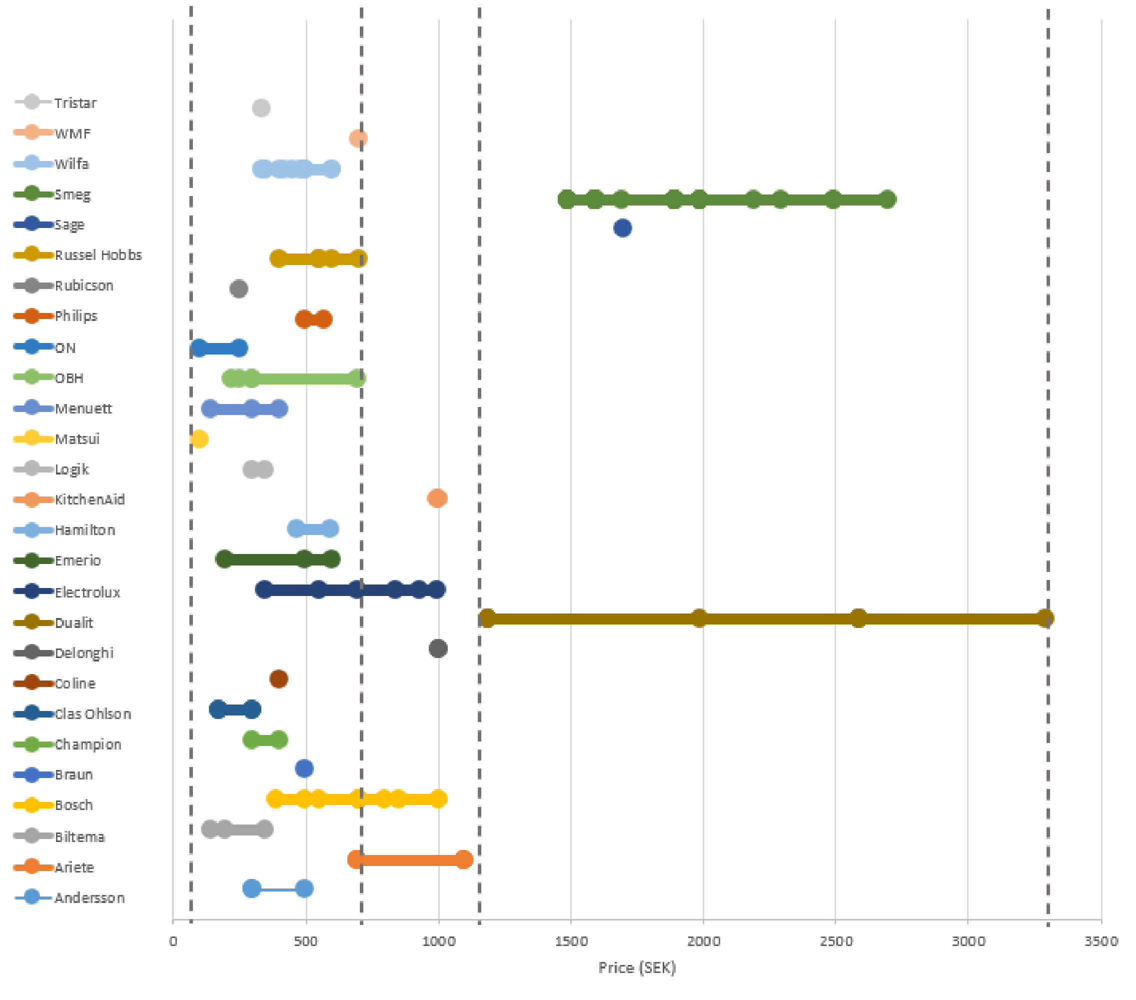


Figure 3A graph of the price ranges of different toaster brands

For induction stoves, the following factors were noted.

- Price in Swedish crowns.
- Minimum power output for an induction plate in watt. This is important to keep in mind when designing the circuitry in the toaster that will draw power from the induction plate.
- Maximum power output for an induction plate in watt. This is important to keep in mind when designing the circuitry in the toaster in to make sure it could handle this power input.
- Total size of the stove along two axes. Area was then calculated from these axes.

- The brand of the product for organizational purposes.

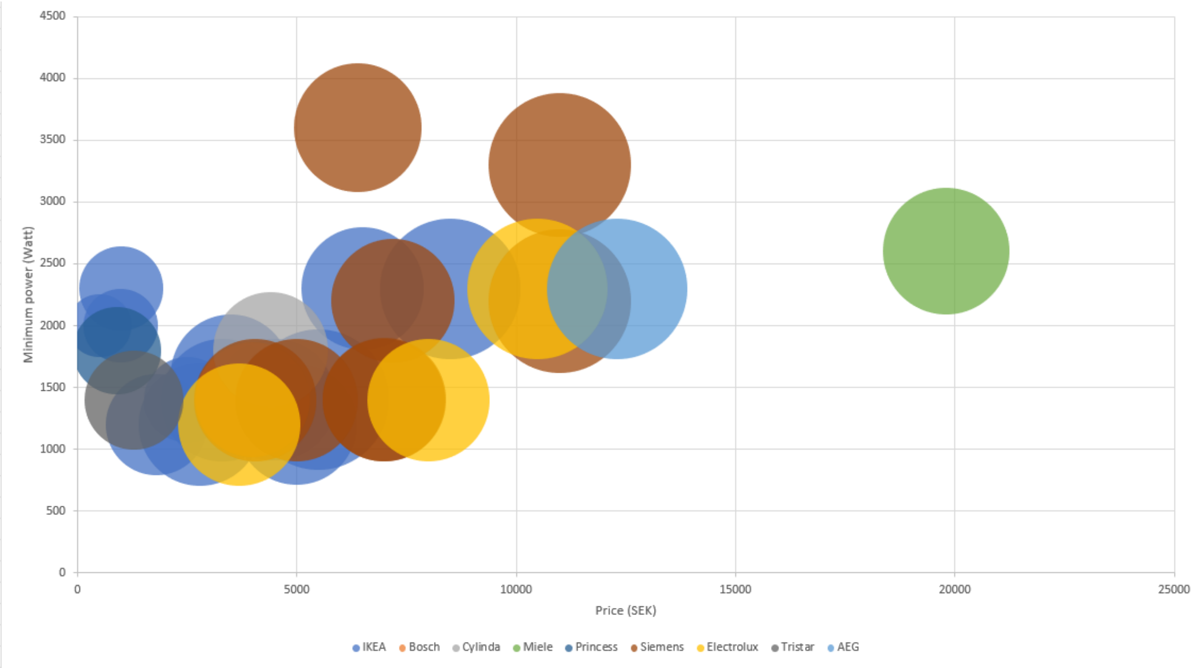


Figure 4 A graph relating power output and price of different induction oven brands.

There are three main ranges on the market. Small and portable, featuring only a single plate. These are the cost optimized versions, starting out at about 500 SEK. Basic stationary versions follow. These are the most comparable to traditional electric stoves with stationary cooking zones. These range in price from 1200 SEK to 6000 SEK. Above that there are the advanced stationary versions. These often feature smart functions such as temperature keeping and dynamic cooking zones. Some also feature inbuilt ventilation. The size of the stove and additional features seems to be the main determinants of price. Minimum and maximum power only seems to slightly correlate with price. The strongest correlation with price is the total size of the stove.

4.4 Persona

Personas were aggregated from a collection of interviews that were made, available in appendix 3. Common themes in these interviews were then identified and condensed into persona sheets.

Portraits used ai generated images from www.generated.photos. This was done due to the neutral nature of the portraits available and to not use real likenesses in the project.

Personas can be found in appendix 4.

4.5 Scenario sketches

Six scenario sketches were produced. The scenarios depicted were:

- Moving the toaster from a cupboard to the stove.
- Starting the toasting process.
- The toaster finishing and the toast being removed.

- Cancelling the toasting process.
- Moving the toaster from the stove onto the table.
- Moving the toaster from a surface into a cupboard.
- Starting another toasting when the dinner table is close to the stove.
- Starting another toasting when the dinner table is far away from the stove.

The sketches pointed out the importance of ergonomics related to moving the product, both when it is just coming out of storage as well as when it is freshly used.

They also mapped out how the product should be operated. The toaster needs to be prepared, settings adjusted, and bread inserted, before you turn on the stove. Therefore, the toaster needs to be able to stay in its ready position even if the stove is not turned on.

It was also shown that the stoves distance from the dinner table matters, since this is where the toaster must reside to operate. This implies also that the toaster would be best suited for a smaller household or apartments where distances are shorter.

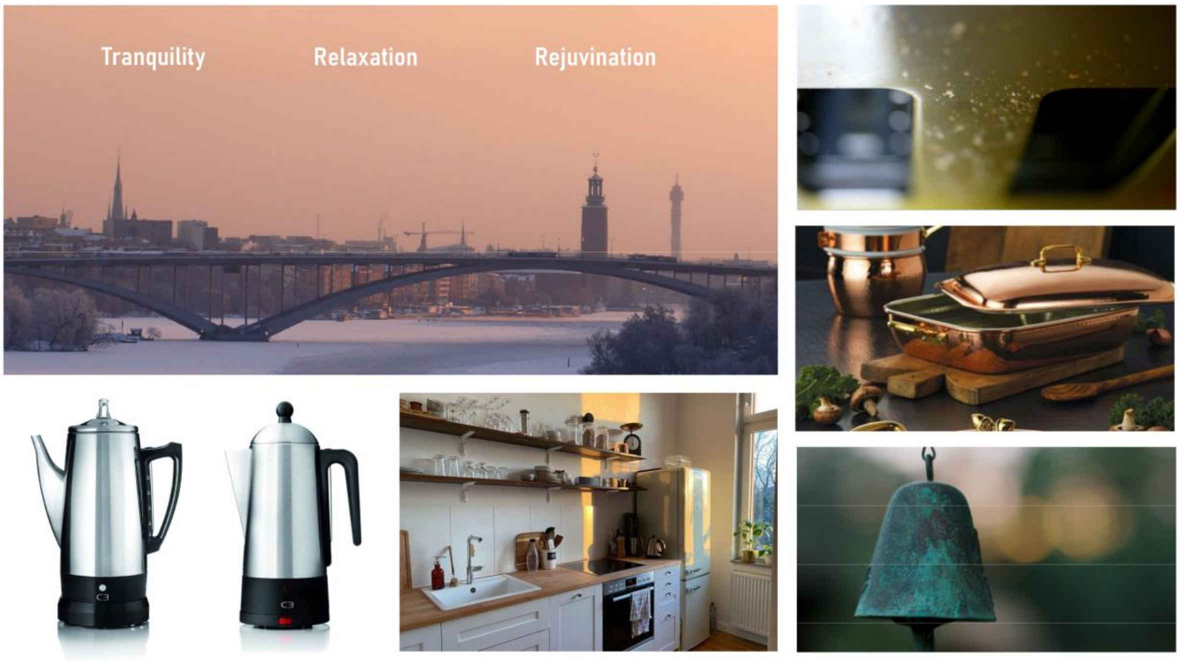
Scenario sketches are available in appendix 6.

4.6 Brand Analysis

C3s brand identity was analysed through the product catalogue available on their website [1]. It is evident that many products are not in-house designs but rather bought products that are being resold. Still, there are some common design elements that can be identified amongst them. Firstly, most products feature a static and calm design expression [5]. A common colour scheme was also black paired with a metallic colour, although most common was silver. The more iconic product in the catalogue, such as the C3 basic and C3 design, where given special consideration within the analysis. Notable features from these products are their black bottom and power plate as well as the Basics unique shape language on the top, spout, and handle.

The logo was mostly placed on the side of the product or near a settings panel and was either in white or red. Although red was only found on some "Mix&Go" products.

4.7 Moodboard



Moodboard aimed to capture a desirable mood for the kitchen and for C3 as a part of the daily routine.

Moodboard is available in appendix 5.

4.8 Ideation

Ideation started with looking at the mechanical function of the toaster.

For this, two main approaches were identified.

-The first approach would simply rely on heat generated from the stove. For the timer function, either a fully mechanical solution would be required, or a solution that is driven by heat.

Bimetallic strips were identified as potentially useful in this application as they change curvature as heat increases. This could be used to do work mechanically. Most existing bimetallic strip however are used in electrical applications and are not strong enough for mechanical work. Several prototypes were created in order to ensure that a strip could be made that satisfied the design needs, which it was.

-The second approach would take advantage of the magnetic field an induction stove generates to generate electricity. The toaster would then operate as a toaster normally would using this power. The biggest problem with this approach is all the different power settings that an induction stove can be set to. Ideally the toaster would need to accommodate all of these without the circuitry being overloaded or functioning sub optimally.

One mechanical design for each of these approaches were generated.

Both of the solutions implement a double carriage system where the heating element (or induction coil) is pushed down by the bread carriage. This is done because the heating element only need to be moved 27mm away from the induction plate in order to deactivate it.

Combinations of these approaches were contemplated. But they turned out to accentuate the drawback of both approaches whilst eliminating most of the benefits of them.

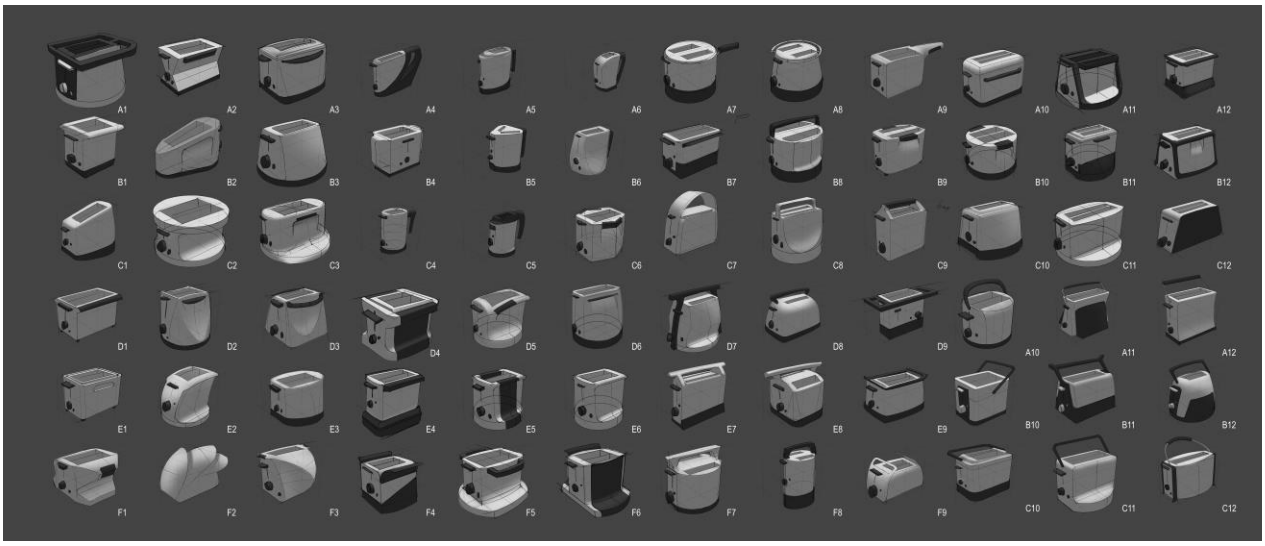


Figure 5 The Generated concepts.

Once these were created, 70 concepts for the exterior were generated. These explored different design expressions as well as different grip configuration for the toaster. These were also given a rough render for presentation purposes.

These were then presented to the contact at C3.

The feedback received from the presentation was that the mechanical solution was preferred, but he was not convinced that the bi-metallic strip would work. He also picked out a selection of exterior concepts that he preferred.

To accommodate this feedback, a third function concept was created, this one based on a wind-up mechanism.

This operates by winding up a gear with a spring that is initially locked with a ratchet. This gear is connected to another gear, a clutch and finally a “gear and pallet”. This slows down the mechanism significantly when it is allowed to unwind. The ratchet is disengaged when the bread cart is pressed down, this also lock the bread cart with another latch. This latch is then disengaged when the mechanism fully unwinds. Witch takes different amount of time depending on how far you wound the mechanism up.

To abort toasting or reset your wind up. You press the cancel button. This disengages the clutch and releases the ratchet, which results in the mechanism unwinding quickly.

After this, the selection process was conducted in order to pick a concept to finalize.

4.9 Go No go

The go no analysis removed 11 concepts from the selection. Leaving 22 concept to select from.

The most common reason for elimination was not facilitating cleaning. This judgement was made based on the concepts having hard to reach crevasses and complex geometry with many different surfaces to clean. Other common reasons were not facilitating portability.

4.10 Pugh's matrix

Criteria for the matrix were conceived based on desirable product qualities that were identified previously. These were:

- Popularity: How well the concepts were received.
- Ease of handling: How well the concept can be picked up and placed where it is needed.
- Visual communication – Stability: How stable the concept is perceived to be.
- Visual communication – Portability: How portable the concept is perceived to be and how well this portability is exhorted [5].
- Visual communication - C3: How well the concept fits the visual identity [5] of C3.
- Potential for heat issues: At first glance. How well/poorly would the concept handle accumulating heat.
- Cleanability: How well the concept facilitates cleaning.

These were then weighted based on their perceived importance. 'Potential for heat issues' was given a negative weight as it is a negative trait for the concept to possess.

The existing C3 toaster was used as a reference concept for the Pugh's matrix. This was done due to its status as the only toaster from the company.

The matrix showed concept E5 to score the highest. It was therefore chosen as the base for the final concept.

4.11 Finalizing

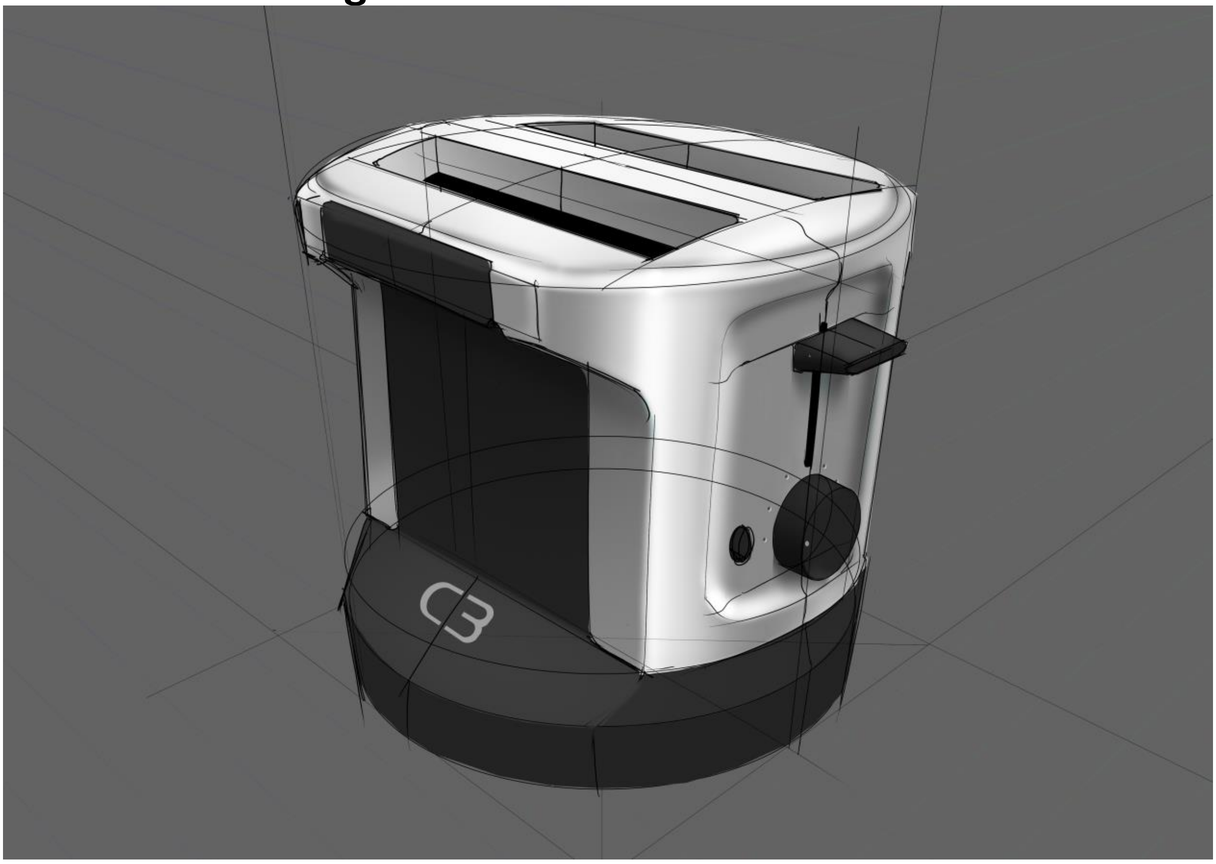


Figure 6 A sketch of the final concept design

Before moving on CAD work and prototyping. Some final detailing and slight modifications were applied to the selected concept. This was done due to the concepts from the selection being low detail, a consequence of their quantity. The concept E5 (see figure 5) was chosen as the base for the final concept. Details from B10 and A3 were also integrated into the design. Namely the level shift on the top and the curvature on the bottom sides. Certain details related to the bottom and side elements were also altered. The sides receded from the top and the bottom encompassed the entire circumference. Frame elements were also added around the interface in front and around the toaster slots in order to highlight them. Finally the C3 logo was placed on the concept.

4.12 CAD

After a final concept was selected, work was started on creating a cad model of said concept. An initial reference model was made to make sure there was enough space for internal components. The model was then based of this reference.

Some of the curves on the sketch turned out to produce more complex geometry than anticipated.

Some issues also occurred regarding split lines on the model.

4.13 Mock ups and tests

Some crude mock-ups were conceived in order to explore the what heating configuration would give a favourable toasting result.

The objective of the first test was simply finding if you can toast bread. This was set up using a cast iron pan, an oven grate and initially aluminium foil with regular holes made in it. The reasoning behind this was that heat convection would drive the toasting. This was however erroneous.

Figure 7 The setup of the first test

Initially the induction plate was used for this test. However, an error was thrown by the device, most likely as overheat protection. A conventional stove was used as a substitute.

Figure 8 The result of the second test, and its setup behind it.

The test proved successful. Toasting the bread at normal temperatures for a pan.

Testing continued, this time testing if a conventional toaster configuration. This was done by stripping the bread compartment of anything that could melt or catch fire. It was then placed in a cast iron pan. Everything was then covered in aluminium foil in order to funnel a maximum amount of heat onto the bread.

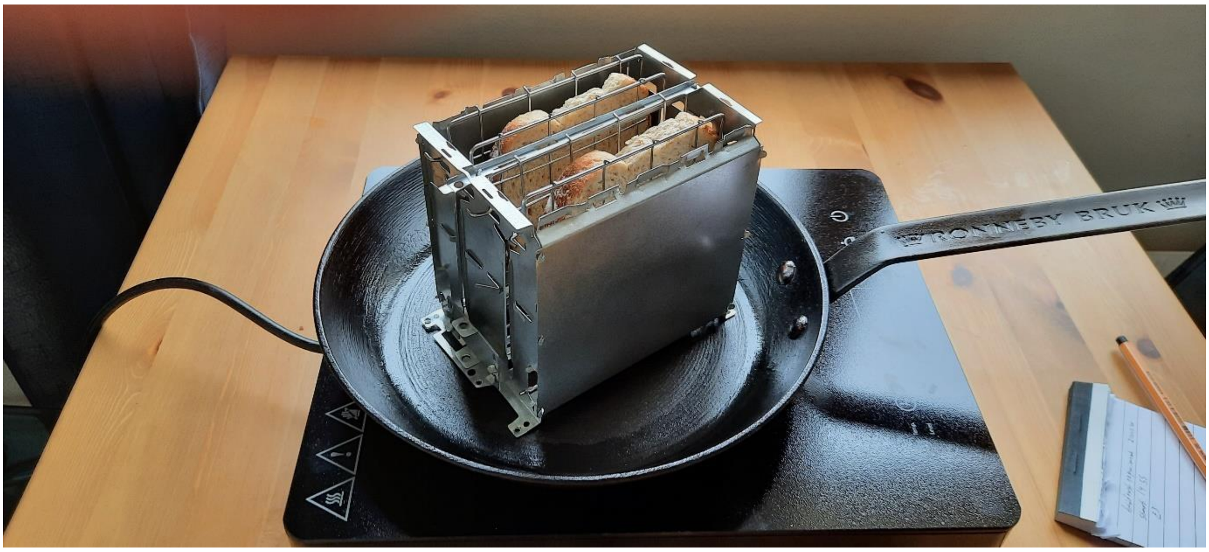


Figure 9 The setup for the third test.

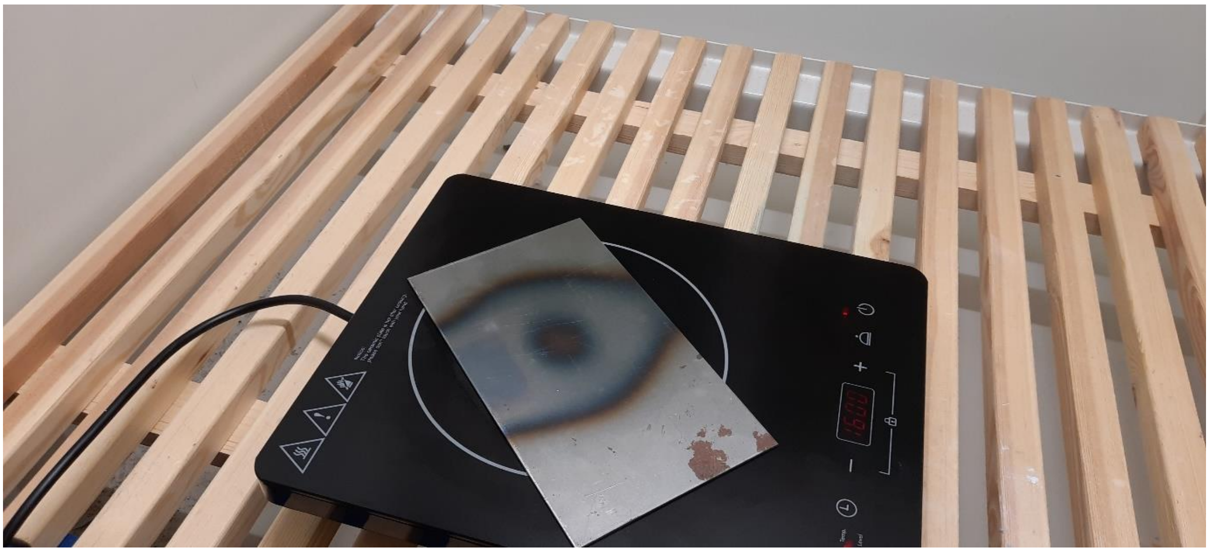


Figure 10 The result of testing the stove with a metal sheet.

Figure 11 The setup of the fourth test.

The toast from this test was heavily toasted on the bottom. This was expected. It also shows that the heating elements need to apply heat from the sides and radiated heat needs to be minimized from the bottom.

Testing proceeded with finding a piece of sheet metal that could be used as a heating element. This proved easier than anticipated. The metal heated up and the stove only turned off from overheating protection. A part of the metal seemingly started glowing, although this could simply have been odd coloration on the piece that fooled the eye.

These test show that heat must be transferred away from the main element. The power needed is definitely there however.

Initial tests of the clockwork mechanical concept were conducted as well. Pieces were constructed using laser cut acrylic and aluminium pins. It did however become apparent that a compact escapement mechanism was not practical to produce. Neither was adapting the escapement mechanism from existing products. It was therefore decided to switch over to the mechanism based on the bimetallic strip.

To remedy the power transfer issue of the previous test, an aluminium plate was attached to the main plate in order to transfer heat away from it as quickly as possible. An element that goes along the bread's sides were also added. This was then tested at 2000W effect.

The changes made stopped the stove from overheating, and heat from the main element was eventually transferred up the side elements. The resulting toast was however underwhelming, with it taking a long time to produce results and the toast being more dried than toasted. To improve the toasting abilities of the element, iron plates will be added to the side elements as a way to generate heat directly in those elements. This is however limited in range and power transfer needs to be maximized in order to guarantee even toasting.

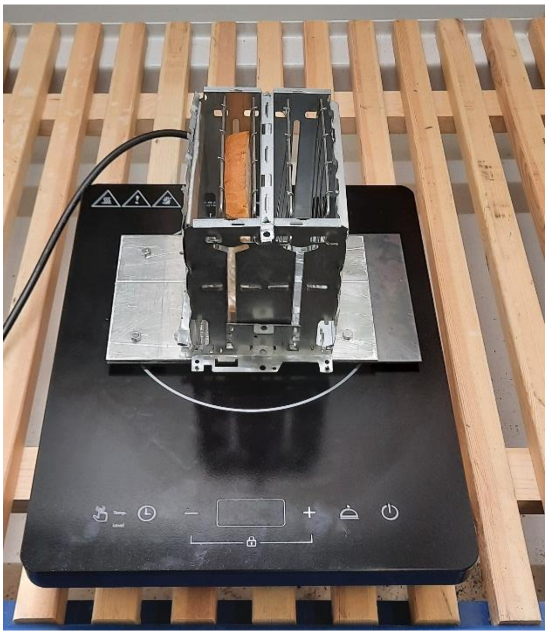


Figure 12 The setup of the fifth toasting test.

Attaching the iron and metal plates directly together also showed to be an error, as they would for a kind of bi metallic strip as the metals heat up and expand. This resulted in both the main heating element bending away from the stove as well as gaps forming between the iron and aluminium plates. Both things that decrease the efficiency of the device. To remedy this, a maximum of one fixed attachment point should be used. And other attachment points needs to have a little play to accommodate thermal expansion and prevent bending.

Testing continued by looking for improvements to the toasting result. First, whether the entire base plate was required without the stove turning off was tested. This was not the case, so continuing texts did not use it. Instead a iron piece in the shaped around the walls of the toasting slot was used. Variations on this was investigated.

Figure 13 An above view, displaying the aluminum inserts in the sixth toasting test.

First, a configuration that had aluminum plates on the inside of the slot was tested. The reasoning behind this was that the aluminum would distribute heat more evenly along the bread slice. This did however not yield any significant improvements.

What did however, was exposing the iron directly to the bread. The iron piece alone however led to the stove overheating. Adding these back to the outside allowed the heating to continue indefinitely, as well as yielding the best result.

This result does however not match what is expected from a conventional toaster, and would require further work.

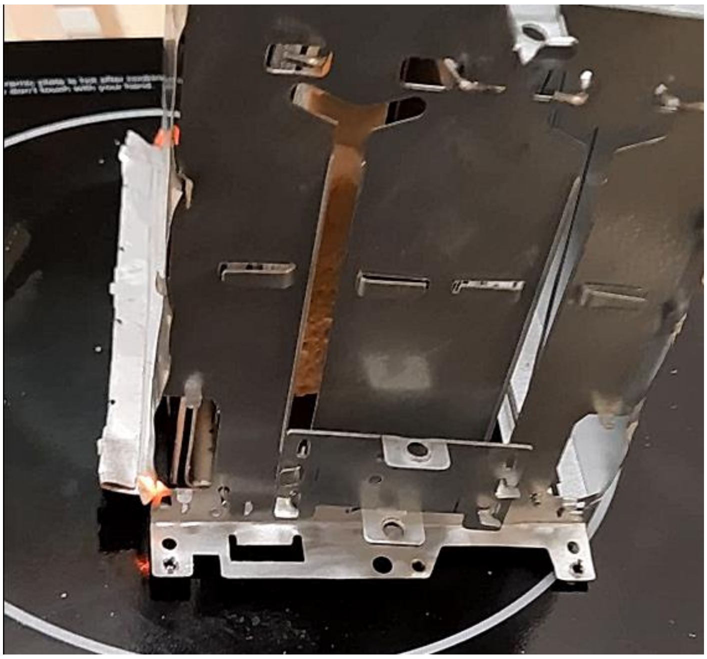


Figure 14 An image of the phenomenom described below. note the orange glow of the metal in the top and bottom left corners.

A phenomenon that could help with this was observed on the casing used for the tests. The lower corner joints of the aluminum sheets reached glowing temperatures. This could be attributed to increased resistance at the surface contacts or electric arcs forming in those areas. Sufficient knowledge of electromagnetics was however lacking within the project to explain how the current formed there in the first place. However, utilizing this effect could greatly assist with toasting the bread and should be further investigated if possible.

Significant progress was uncertain within the timeframe of the project, so it was put aside until other tasks had been completed.

4.14 Prototype

The project moved on to constructing the exterior and internal prototype. This included making a final version of the interior as well as creating the exterior that could fit over top of that.

4.14.1 Interior

Initially, concept 3 had been the interior concept for the final prototype. There were however issues producing the concept and after some reflection it was decided that it had to be abandoned in favor of the first interior concept.

The prototype of the interior was constructed using sheet metal joined by screws and rivets. Modularity was key in order to account of unforeseen issues. It was also done to allow for changes later on, especially for the heating element or reasons described in section 4.7. There are often issues translating sketches and CAD-models to a real-life prototype. This much more so when working with unfamiliar materials. Witch was the case when constructing the interior.

Issues occurred with friction between some parts, mainly between the body and the bread holder, heating element and breadcrumb tray. This was redeemed by filing down imperfections in the slot of the different sheet metal parts.

The adjustment plate was 3D-printed in PLA. The guide rod had a side filed down to allow it to fit. The from was also threaded to fit screw and facilitate attaching the exterior knob.

The latch was initially cut out of aluminum, it had issues with friction and precision in its construction, however. A version made out of laser cut acrylic was tested instead. After some sanding to reduce friction, it performed its function to a satisfactory degree.

The bread holder had a tendency to slip behind the latch which would prevent it from returning up, even if the latch was released. A guide plate was inserted to redeem this issue. This plate was then adjusted in order to not obstruct the heating element.

Many similar adjustments were made many times during the prototyping process.

Finally, springs were attached to the bread holder, heating element, latch, and adjustment plate.

4.14.2 Exterior

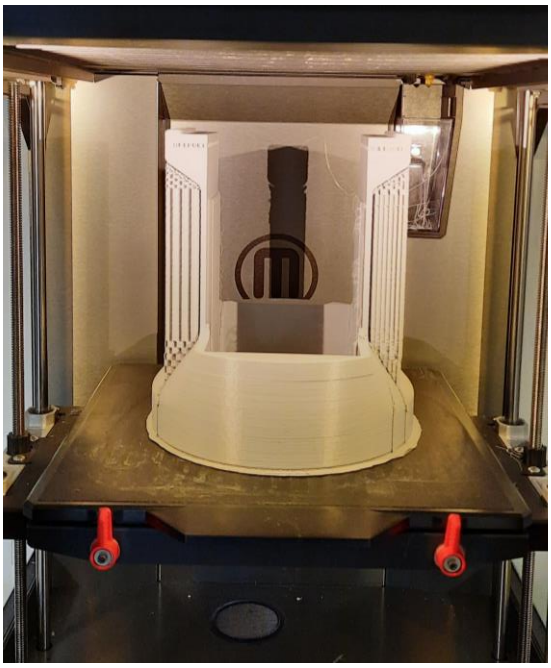


Figure 15 An image of the first 3D-print of the base.

The exterior was made using 3D-printed parts. The CAD model was divided into the top, silver colored part and the bottom black part. There were initial attempts to print this part in one piece. This was however not viable. In order to have the print finish in a reasonable time, the infill and shell thickness had to be minimized which left the model fragile. This caused the model to break and prompted another approach to the part to be devised. This version divides the tall side parts and the "base" in to separate parts. These parts became smaller than the original part and could be printed on multiple separate printers, reducing the total print time. The numerous printer failures also only affected the specific part instead of ruining the entire part.

When these parts were finished, they were joined with plaster and glue. To further reinforce the tall side parts, holes were created in the model that could fit stiff metal wires.

Along the way several mismatches regarding how the exterior fit on the interior was also encountered. These were either remedied when iterating on the 3D-prints or remedied by carving into the print using a Dremel. Some adjustments needed to be done on the interior, however. This was the case for parts that went outside the confines of the exterior model, such as the edges of the base plate.

The top parts had experienced some warping when 3D-printing which affected the split line between them. Plaster was applied on the model and pressed on a MDF board to remedy this. After the excess plaster had been sanded away, spray putty was applied in order to create a viable sanding surface. This surface was then polished, and additional plaster was applied to any imperfections that were found. The plaster and polishing method were repeated until the surface was deemed satisfactory. Then primer was applied and after this, the final coat of paint.

4.15 Evaluation of prototype

Finally, the prototype was evaluated regarding its performance and ergonomics of the product.

4.15.1 Ergonomics

The ergonomics of the products were deemed to be satisfactory. It can be picked up and moved with comfort using the handles on the sides. And where and how it should be placed is clearly indicated through its circular bottom. The products functions are easy to interface with they can be interacted with without fear of tipping the product. There are however some issues:

Moving the product rapidly causes the internal components such as the heating element and bread crumb holder to move. This in turn alters the center of gravity, making the product feel less stable. This would most likely be remedied with lighter parts that don't challenge the strength of the springs to the same extent.

The angle of the handles could also have been made slightly deeper in order to give the product a more secure grip.

4.15.2 Toasting performance

Toasting performance was not notably different from the test setups. The get dry and warm, but not toasted. Time to reach this result was slightly longer, however. This can be attributed to the heating element being further away from the bread, leading to some heat loss.

5 Result

The project resulted in a functional prototype of an induction powered toaster.

To operate the toaster:

- You insert bread into the toaster.
- Adjust the toasting settings.
- Lower the bread into the toaster using the handle.
- Start the induction stove.

Then after the toasting is finished. The bread pops up and the stove automatically turns off.

Figure 16 A sequence decribing the use of the toaster.

5.1 Function

The prototype functions by inducing heat in the heating element for a period of time then removing the element from the induction stove to stop power output from it. This is done using 6 elements:

- The bread carrier, which hold bread and connects to the handle in front.
- The Heating element, which is placed around and beneath the bread carrier.
- The latch.
- The adjustment plate, which pushes on the latch.
- The cancel button, which pushes on the adjustment plate.
- The bimetal strip, which is mounted on the heating element and also pushes on the adjustment plate.

To start toasting bread. You insert bread into the slots and push down on the handle. This engages the latch and locks both the heating element and bread carrier beneath it. As the heating element gain temperature, this heat spreads to the bimetallic strip which begins to bend. As it does this is pushes on the adjustment plate which eventually unlocks the latch which pops the bread up. The adjustment plate has different thicknesses along its radius, so how far it has to be pushed by the bimetal strip. This adjustment is done by turning the knob in front. To cancel the toasting manually, you press the cancel button which pushes on the adjustment plate directly.

In between the bread carrier and the heating element there is a removable breadcrumb tray that catches crumbs from the placed bread and allows them to easily be disposed of.

5.2 Design

Figure 17 An image of a render of the final design concept.

The design incorporates the most recognizable elements present in C3s current product catalogue as well as communicate its novel use and function. It does this firstly by incorporating their color scheme of black and silver.

The toaster features a black base with a silver body on top as many of C3s kitchen appliances do. The interactive elements such as the handles and buttons are kept black as to follow the color scheme. The main cluster of these interactive elements area framed in by a level shift that transitions to a flat surface to facilitate these elements [2]. These elements share similarity [5] with each other by having the same color, protruding in a similar manner. Their proximity [5] also denotes their shared task of adjusting the settings on the toaster.

A sister feature to the frame resides on top, a protruding level shift. in reference to the top of the C3 basic percolator. The top edge of the toaster also features a similar radius to the C3 basic. This identifies the product as a part of C3s catalogue.

By this edge two handles can be found on the toaster. They connect to the bottom and follows the side contour along the way. These handles allow for applying grip-pressure in all angles which promotes a firm and ergonomic grip. [8]

Figure 18 Three side views of the final design concept.

The design features static and calm elements such as soft radiuses without much visual noise. This is intended to express [5] calm with its use, as might be necessary with such a novel product. In addition, it goes in line with C3s catalogue and facilitates easy cleaning.

The products affordances are much like the ones of a normal toaster, with 2 slots a handle, knob and cancel button. To adapt to the stove, it also has handles for moving the device around and a circular bottom to exhort [5] its optimal placement.

Figure 19 The prototype placed on an induction stove.

6 Conclusion and discussion

6.1 Discussion of method and implementation

The methods chosen were tried and true and proved themselves once again in this project. The method of generating concepts, selecting, then refining, proved successful in the project.

The prototype, especially the interior, took a long time to device. This was predicted and planned for. Sight of this bigger picture was however lost at times which worsened the experience of conducting the project. This most likely comes from the experience that a specific segment of the project taking significantly longer than the others. Resulting in the experience of being stuck or static.

Utilizing reflection in action allowed this to be minimized, with the heating element for example. Progress on its effectiveness had halted and it was therefore determined that it should be put aside for a later date. That date did not occur within the project, but putting it aside allowed more important tasks to be completed on time. The expertise within electromagnetics required was unavailable anyways. It was however enough to explore the related research question and to give it a satisfactory answer.

If the project was to be performed again, its scope should have been delimited further, solely focusing on the design aspect of the project. This does not mean that this part was dissatisfactory. Rather that it would have been for the benefit of the health of the project's practitioner.

6.2 Discussion of findings

As the purpose of the project was to create a functional prototype of an induction powered toaster and investigate certain topics related to this, the question asked were:

- What design differences do an induction toaster have as compared to a traditional one?
- How should an induction powered kitchen appliance be powered to generate heat for the purpose of toasting bread?

6.2.1 What design differences do an induction toaster have as compared to a traditional one?

An induction powered toaster, as compared to a normal one, is wireless and used by placing it on a stove. These are defining features of the device and informs its design. As the stove is used with many things, the toaster has to be able to be placed on and removed from the stove with ease. This implies some kind of handle arrangement or extremely light weight.

Where exactly the toaster should be placed needs to also be communicated through the design affordances. In the current stove market that predominantly features round cook plates, a round bottom would best serve this purpose. Familiar elements found on regular toasters, like their handles and knobs, inform the user in how to operate the device.

When it is placed is also needs to be sturdy and not tip when interacted with. Its center of gravity needs to therefore be moved as far down as possible. Increased weight improves the stability but worsens its portability. So, these qualities need to be balanced against each other.

6.2.2 How should an induction powered kitchen appliance be powered to generate heat for the purpose of toasting bread?

Toasting bread is primarily done by radiating heat onto the sides of the bread. It can however be done to some extent by exposing it to heated air. Both methods have been proven to be possible by induction heating metal.

6.3 Further development

The heating element still needs attention. The toasting result is still not comparable to that of a traditional toaster. Bread can be toasted by simply heating metal and letting the heat radiate onto the bread. So, making sure that the sides of the heating elements reach temperatures needed for that would be necessary. To get that to happen however, thorough knowledge or eddy currents and how they form in the material would be needed. This was simply not the case in the project. Simulation software for electromagnetism could also be useful for achieving this. The phenomenon observed in *Figure 11* could be useful in optimizing the amount of energy needed for toasting. To improve performance short term, the bread should be moved downwards in the toaster, closer to the heating element. The breadcrumb tray would however need to be placed differently as to not obstruct the heating element or bread carrier.

Ultimately, an electric engineer, not a mechanical engineer, would be best suited for this specific task.

An alternative to this would be to use the electrical approach to simply adapt the proven functionality of a normal toaster and draw its power from an induction stove.

Also, work on making the product production ready would also be necessary.

7 References

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8 Appendices

Appendix 1 Project brief

Appendix 2 Gantt Schedule

Appendix 3 Survey for persona

Appendix 4 Personas

Appendix 5 Moodboard

Appendix 6 Scenario sketches

Appendix 1

C3 Induction Toaster

Beskrivning av projektet

Scandinavian lifestyle

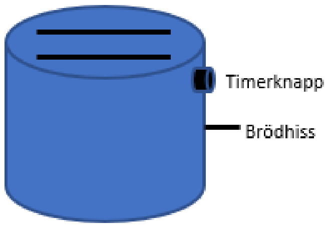
Principen

- Vi känner all till hur en induktionsspis fungerar.
- Vi känner till hur en brödrost fungerar.
- Uppgiften är följande;

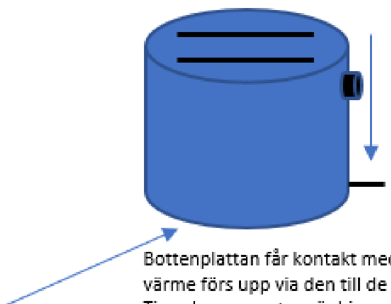
Skapa en prototyp som visar funktionen. Prototypen innehåller följande delar:

- Maskinhus av lämpligt material.
- Brödfack för 2 rostbröd.
- En bottenplatta i magnetisk metall med bra värmedistribution (stål/aluminium?)
- Värmeplattor (stavar) i ett material med bra ”glödförmåga” för att rosta bröd och bra värmedistribution för att fånga upp energin från botten plattan.
- Hissmekanik som kan lyfta bröd och bottenplatta när timern löser ut.
- Nästa slide visar den tänkta funktionen

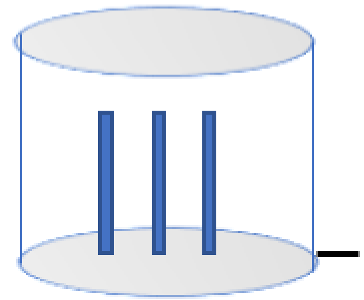
Induction toaster



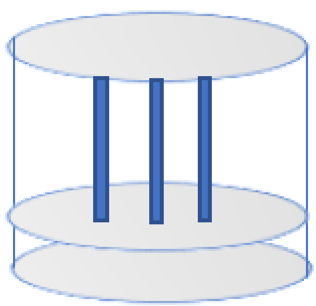
Principen:
Brödrosten står på metall ben på hällen.
När man satt i bröden slår man på spisen och drar ned "hissen"



Bottenplattan får kontakt med induktionshällen och värme förs upp via den till de element som rostar brödet. Timerknappen styr när hissmekanismen släpper upp brödet.



I igenomskärning, nedsänkt läge. En bottenplatta av magnetiskt material som får konduktion mot hällen. Värmen sprids upp i "stavarna" i (vilket material för bra rostning?) och rostar brödet.

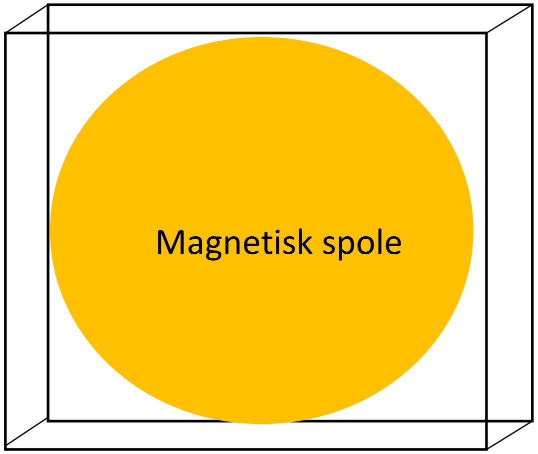


I igenomskärning, uppfällt läge. Då en brödrost styrs av en timer skall mekaniken lyfta plattan och brödet när rostningen är klar, och produkten tappar kontakten med induktionshällen, som då stängs av.

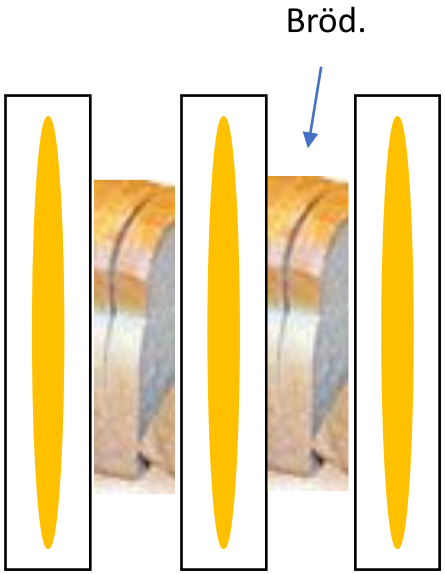
Kom ihåg begreppet "stavar"

Idé uppslag:

- TEXT; En **spis** med **induktionshäll** bygger på att elektrisk ström går genom en spole under kokplattan som skapar ett magnetfält. Detta i sin tur skapar en elektrisk ström i grytans botten och tack vare det elektriska motståndet blir metallen i grytan varm
- De elektriska spolar som nämns i texten ovan; Om man använder samma sorts spolar i ”stavarna”, torde de kunna aktiveras av den magnetism som skapas i hällens platta och generera värme inuti brödrosten?



”Stav” i genomskärning från sidan.



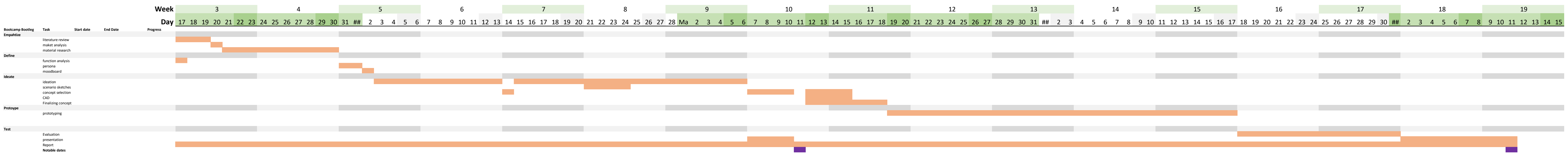
”Stavar” i genomskärning.

Fler ”uspar”

- Vi vill ha breda brödfack, så man kan lägga bröd i s.k. ”Toastabags” med fyllning, dvs; Ost och tomat t.ex. så man kan göra varma mackor i rosten.
- Den skall vara lätt att rengöra, dvs; kunna tömma ur brödsmulor etc.
- Höljet (maskinhuset) lär bli varmt. Fundera på hur snabbt den kan smalna av, alternativt att den står på ngn typ av fötter som INTE blir varma under processen. Skäl? Jo; Man skall kunna ställa upp sin snygga induktions-brödrost på hyllan eller bänken i köket efter användning.

Toastabags

Appendix 2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Test
Evaluation
presentation
Report
Notable dates

Appendix 3

Age: 52

Gender: male

Relationship status: married

Occupation: printing services

What do you usually do in your kitchen?

Cook meals, prepare lunchboxes, hang out/socialize

Do you consider your useable kitchen area big enough for your needs?

How big is your kitchen area? (optional)

yes

Do you own an induction stove?

yes

Do you own a toaster? How often do you use it?

When do you use it? (Optional)

Yes, 3-4 times a week, in the morning

Age: 25

Gender: female

Relationship status: in relationship

Occupation: student

What do you usually do in your kitchen?

Prepare lunch boxes, cook meals

Do you consider your useable kitchen area big enough for your needs?

How big is your kitchen area? (optional)

Yes, a lot bigger than needed

Do you own an induction stove?

no

Do you own a toaster? How often do you use it?

When do you use it? (Optional)

Yes, every evening

Age: 27

Gender: male

Relationship status: single

Occupation: student

What do you usually do in your kitchen?

Cook meals, prepare lunchboxes

Do you consider your useable kitchen area big enough for your needs?

How big is your kitchen area? (optional)

No, tiny

Do you own an induction stove?

no

Do you own a toaster? How often do you use it?

When do you use it? (Optional)

no

Age: 23

Gender: male

Relationship status: single

Occupation: student

What do you usually do in your kitchen?

Cook meals, prepare lunchboxes

Do you consider your useable kitchen area big enough for your needs?

How big is your kitchen area? (optional)

Yes, 60cmX210cm

Do you own an induction stove?

yes

Do you own a toaster? How often do you use it?

When do you use it? (Optional)

Yes, every evening

Age: 25

Gender: male

Relationship status: in relationship

Occupation: engineeer

What do you usually do in your kitchen?

Cook meals, prepare lunchboxes, bake

Do you consider your useable kitchen area big enough for your needs?

How big is your kitchen area? (optional)

yes

Do you own an induction stove?

no

Do you own a toaster? How often do you use it?

When do you use it? (Optional)

Yes, ocasionally

Age: 40

Gender: female

Relationship status: married

Occupation: cook

What do you usually do in your kitchen?

Cook meals, prepare lunchboxes, bake

Do you consider your useable kitchen area big enough for your needs?

How big is your kitchen area? (optional)

yes

Do you own an induction stove?

yes

Do you own a toaster? How often do you use it?

When do you use it? (Optional)

Yes, 1-3 times a week in the afternoon

Age: 30

Gender: female

Relationship status: single

Occupation: HR

What do you usually do in your kitchen?

Cook meals, prepare lunchboxes

Do you consider your useable kitchen area big enough for your needs?

How big is your kitchen area? (optional)

No, 60x200

Do you own an induction stove?

no

Do you own a toaster? How often do you use it?

When do you use it? (Optional)

Yes, seldom

Age: 45

Gender: female

Relationship status: married

Occupation: teacher

What do you usually do in your kitchen?

Cook meals

Do you consider your useable kitchen area big enough for your needs?

How big is your kitchen area? (optional)

yes

Do you own an induction stove?

yes

Do you own a toaster? How often do you use it?

When do you use it? (Optional)

Yes, every morning and evening

Age: 23

Gender: male

Relationship status: in relationship

Occupation: student, consultant

What do you usually do in your kitchen?

Prepare lunchboxes, hang out

Do you consider your useable kitchen area big enough for your needs?

How big is your kitchen area? (optional)

yes

Do you own an induction stove?

no

Do you own a toaster? How often do you use it?

When do you use it? (Optional)

Yes, not very often

Age: 77

Gender: female

Relationship status: widowed

Occupation: retired

What do you usually do in your kitchen?

Cook meals, read

Do you consider your useable kitchen area big enough for your needs?

How big is your kitchen area? (optional)

yes

Do you own an induction stove?

no

Do you own a toaster? How often do you use it?

When do you use it? (Optional)

Yes, a couple of time a week

Age: 32

Gender: female

Relationship status: married

Occupation: accountant

What do you usually do in your kitchen?

Cook meals

Do you consider your useable kitchen area big enough for your needs?

How big is your kitchen area? (optional)

Yes, 100x200

Do you own an induction stove?

yes

Do you own a toaster? How often do you use it?

When do you use it? (Optional)

Yes, each morning

Age: 37

Gender: male

Relationship status: single

Occupation: retail

What do you usually do in your kitchen?

Lunchboxes, cook meals

Do you consider your useable kitchen area big enough for your needs?

How big is your kitchen area? (optional)

Yes, but just about

Do you own an induction stove?

no

Do you own a toaster? How often do you use it?

When do you use it? (Optional)

Yes, every night

Age: 21

Gender: male

Relationship status: single

Occupation: "lager"

What do you usually do in your kitchen?

Make lunchboxes

Do you consider your useable kitchen area big enough for your needs?

How big is your kitchen area? (optional)

yes

Do you own an induction stove?

no

Do you own a toaster? How often do you use it?

When do you use it? (Optional)

Yes, although I never use it.

Age: 26

Gender: female

Relationship status: in relationship

Occupation: student

What do you usually do in your kitchen?

Make lunchboxes, make dinner, play games

Do you consider your useable kitchen area big enough for your needs?

How big is your kitchen area? (optional)

yes

Do you own an induction stove?

no

Do you own a toaster? How often do you use it?

When do you use it? (Optional)

Yes, 1-2 times a week

Age: 26

Gender: female

Relationship status: in relationsship

Occupation: teacher

What do you usually do in your kitchen?

Cook dinner

Do you consider your useable kitchen area big enough for your needs?

How big is your kitchen area? (optional)

yes

Do you own an induction stove?

yes

Do you own a toaster? How often do you use it?

When do you use it? (Optional)

yes, most weekdays

Age: 40

Gender: male

Relationship status: married

Occupation: manager

What do you usually do in your kitchen?

Prepare lunchboxes

Do you consider your useable kitchen area big enough for your needs?

How big is your kitchen area? (optional)

yes

Do you own an induction stove?

yes

Do you own a toaster? How often do you use it?

When do you use it? (Optional)

Yes, most mornings

Age: 33

Gender: female

Relationship status: in relationship

Occupation: teacher

What do you usually do in your kitchen?

Cook dinner, make lunchboxes

Do you consider your useable kitchen area big enough for your needs?

How big is your kitchen area? (optional)

yes

Do you own an induction stove?

yes

Do you own a toaster? How often do you use it?

When do you use it? (Optional)

Yes, prettymuch never

Age: 20

Gender: male

Relationship status: single

Occupation: student

What do you usually do in your kitchen?

Make dinner, make lunchboxes

Do you consider your useable kitchen area big enough for your needs?

How big is your kitchen area? (optional)

yes

Do you own an induction stove?

no

Do you own a toaster? How often do you use it?

When do you use it? (Optional)

Yes, every day

Age: 29

Gender: male

Relationship status: in relationship

Occupation: retail

What do you usually do in your kitchen?

Cook, make my lunchboxes

Do you consider your useable kitchen area big enough for your needs?

How big is your kitchen area? (optional)

yes

Do you own an induction stove?

no

Do you own a toaster? How often do you use it?

When do you use it? (Optional)

Yes, a couple of times a week

Age: 55

Gender: female

Relationship status: married

Occupation: consultant

What do you usually do in your kitchen?

Cook dinner, prepare lunchboxes

Do you consider your useable kitchen area big enough for your needs?

How big is your kitchen area? (optional)

yes

Do you own an induction stove?

no

Do you own a toaster? How often do you use it?

When do you use it? (Optional)

Yes, on the weekends

Appendix 4

Sara Karlsson

"It will be done before you know it…"

Age: 28
Occupation: economist
Relationship Status: single
Location: Stockholm

Likes

-The weekend
-A job well done.

BIO

Sara is a newly examined economist, making her way in the world. Early mornings and late night leave little time to cook, so even this time of her day needs to be optimized.

Dislikes

-When the bus is late.
-Tough workdays.

Aaron Svensson

"I'll get on it…tomorrow…"

Age:	21
Occupation:	student
Relationship Status:	single
Location:	Växjö

Likes

-CSN
-Parties
-Friends to study with

Dislikes

-Lectures before 10
-Re-exams

BIO

Aaron is a student studying civil engineering. He lives in a container of a student accommodation a couple of kilometres from the university. The apartment is tiny, but tiniest of it all is the kitchen. At least they put in an induction stove.

Henrik Wahlsten

"Alright alright, who had it first…"

Age:	38
Occupation:	manager
Relationship Status:	married
Location:	Linköping

Likes

-His family.
-Going to the park.
-Floor ball.

BIO

Henrik is the father of three of the wall kids, 5, 8 and 10 years old. The breakfast table can be chaotic, but it is also his favourite time of the day. During the day he work in management , and in the evenings he works as a cook for his family.

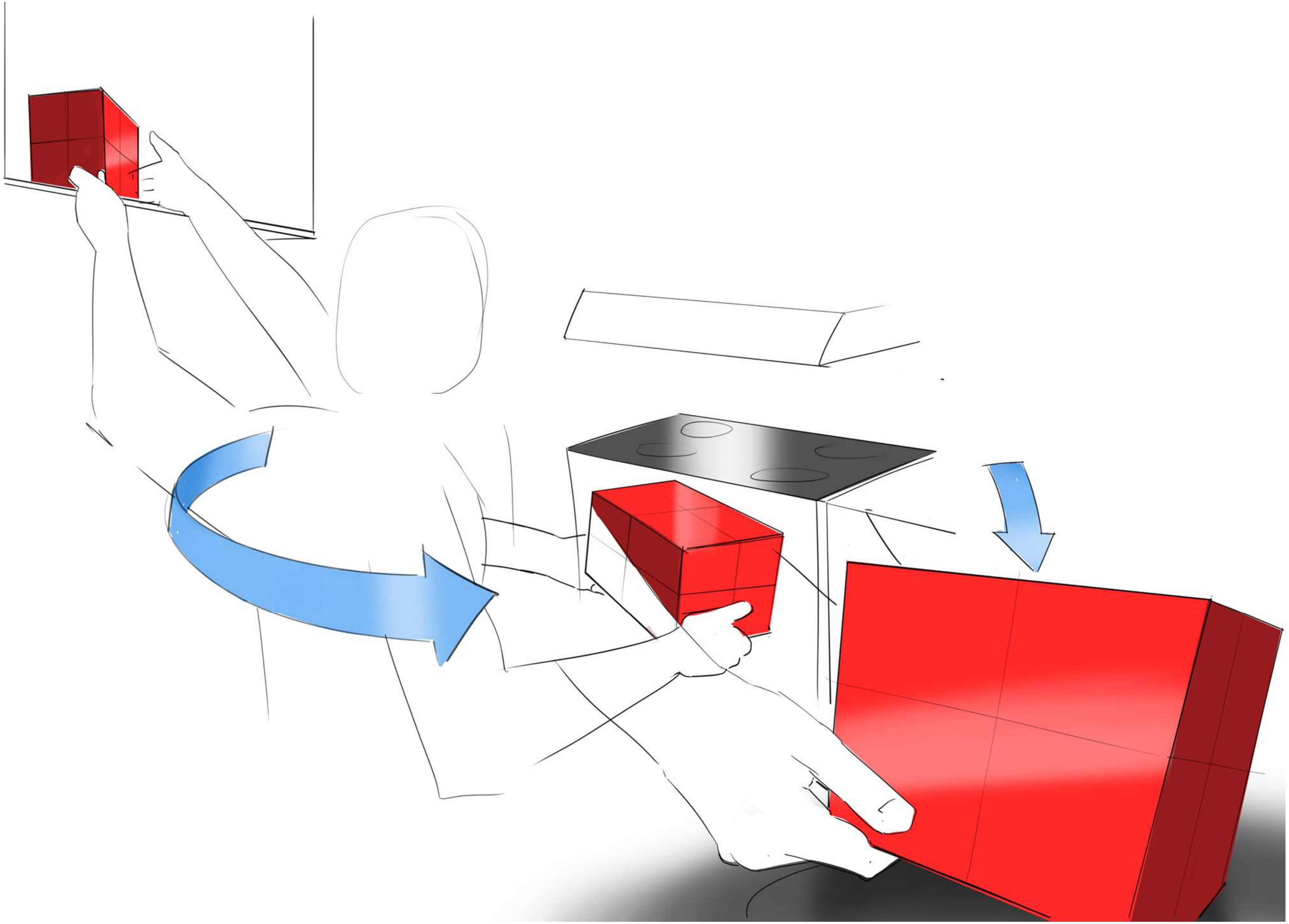
Dislikes

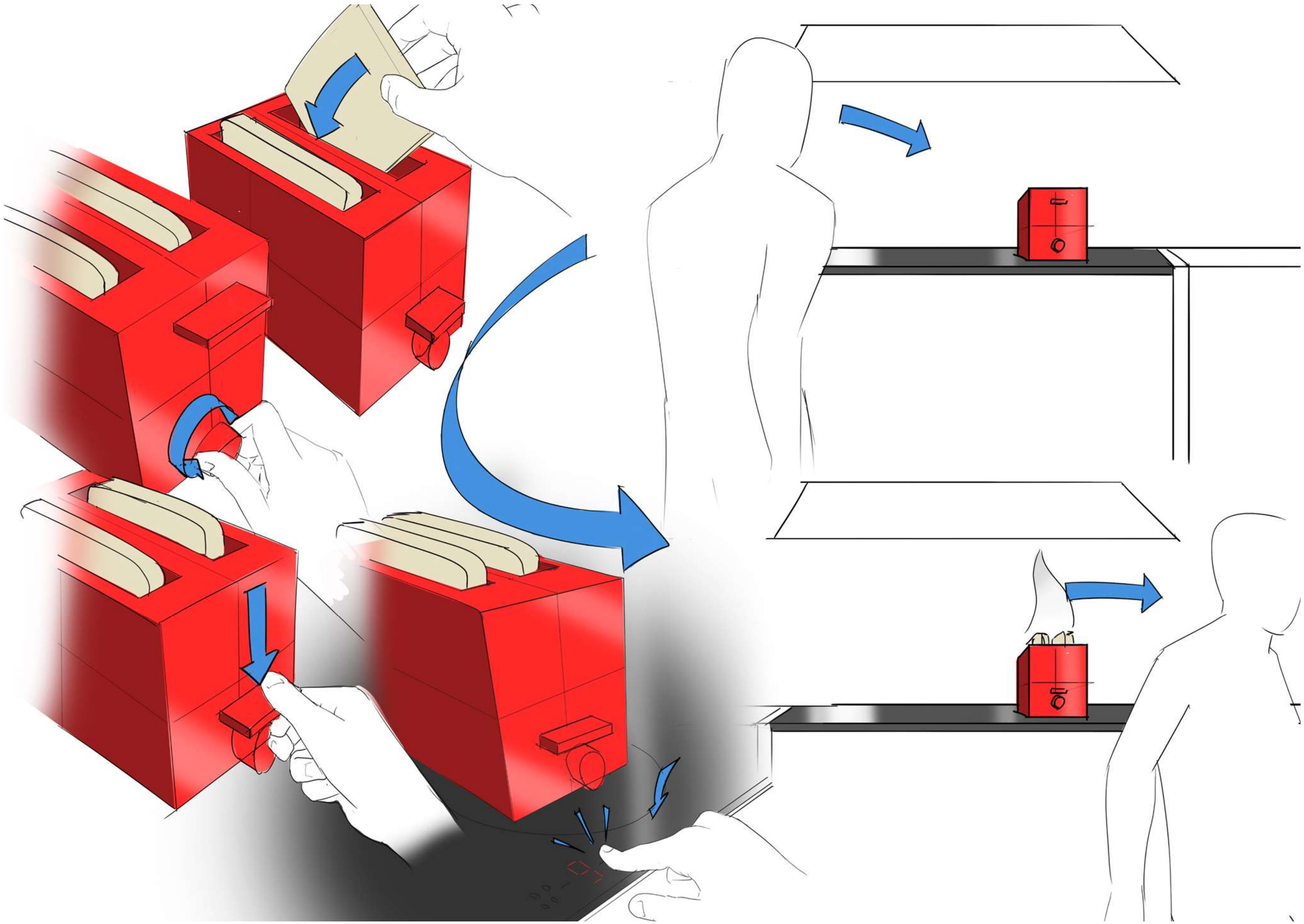
-When things are not returned to their rightful place.

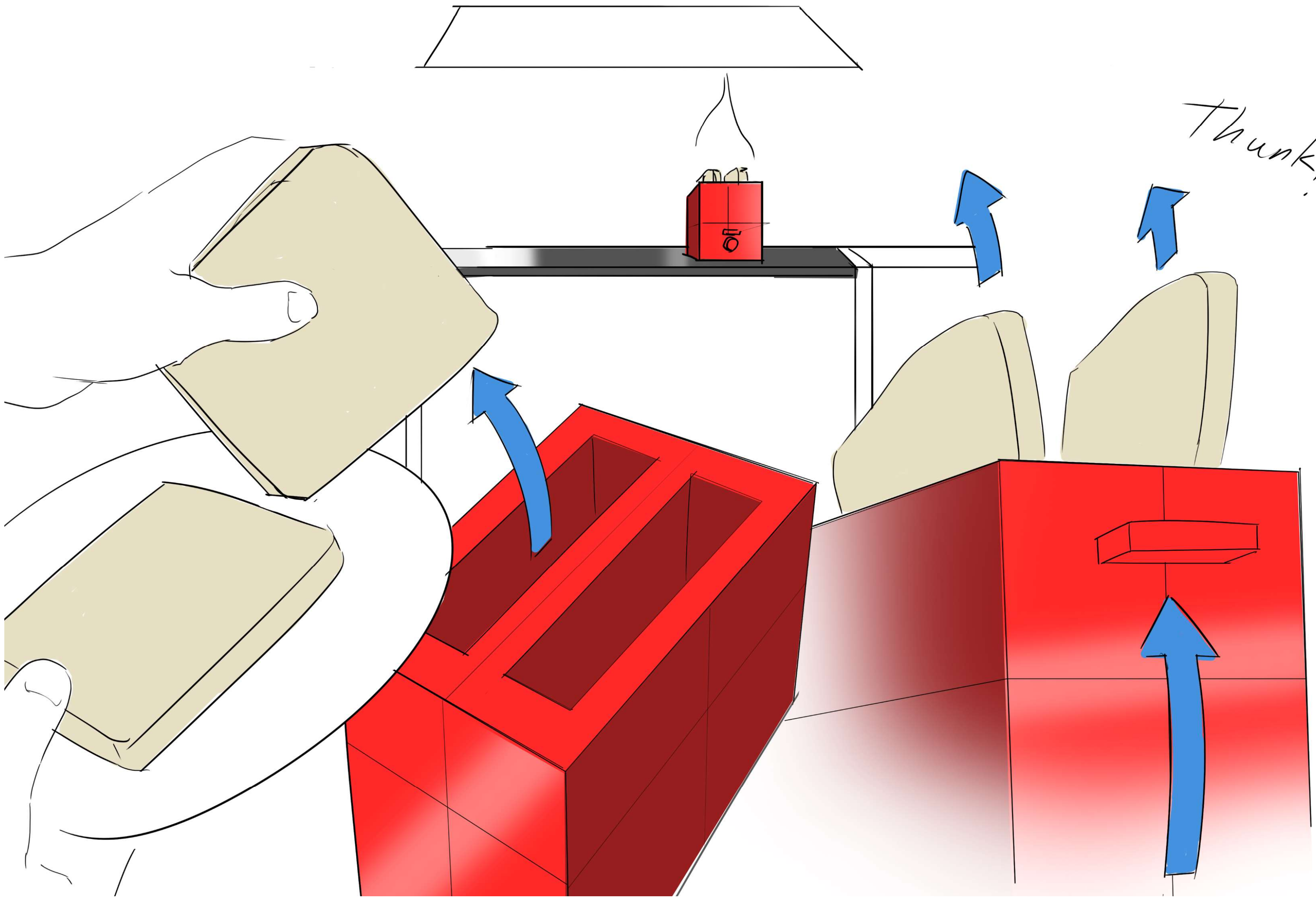
Appendix 5


Tranquility
Relaxation
Rejuvination

Appendix 6






Thunk!