Artificial Intelligence
Mixed Reality
Emotional Design

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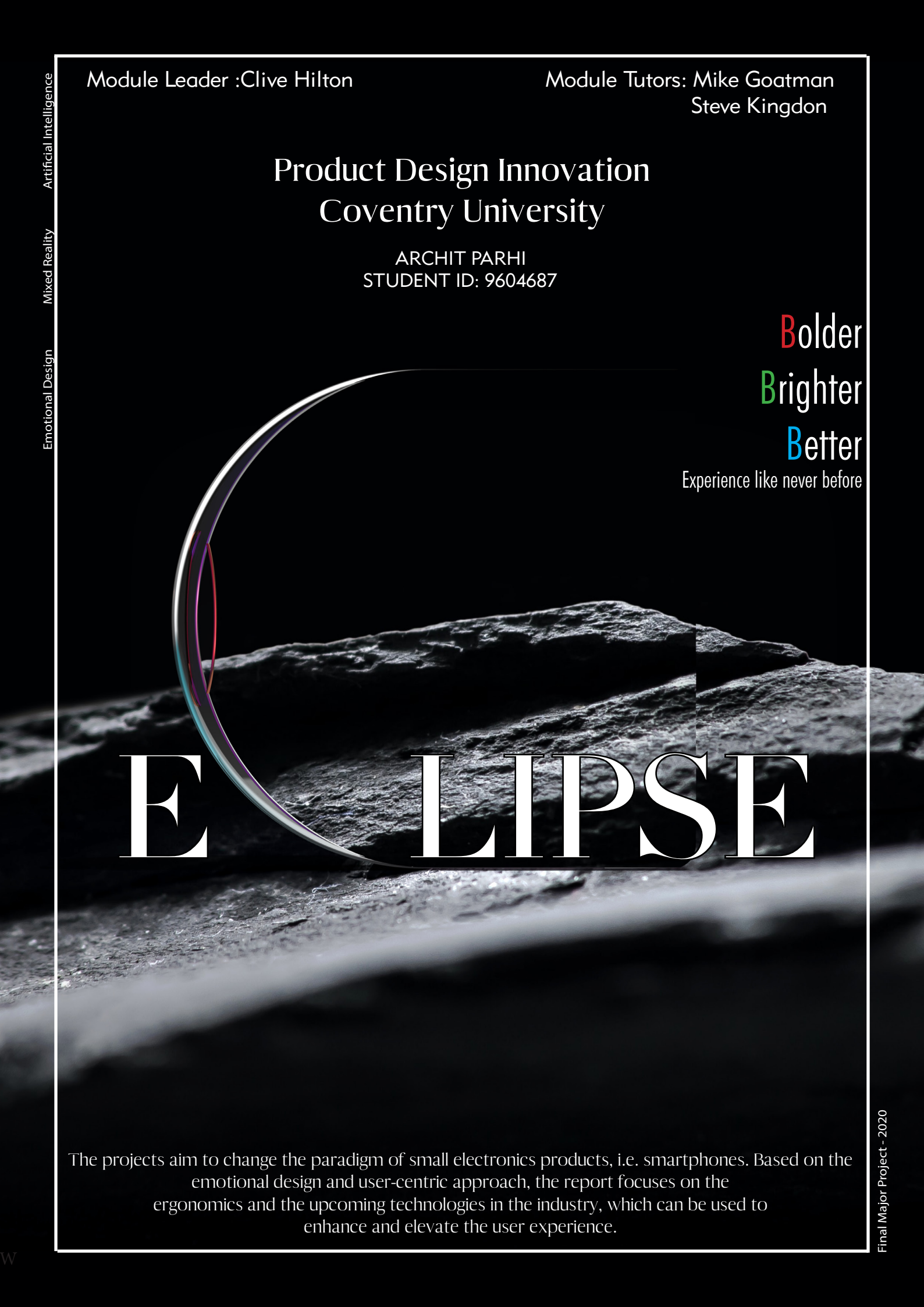
# Product Design Innovation
# Coventry University

ARCHIT PARHI
STUDENT ID: 9604687

Bolder
Brighter
Better
Experience like never before



# ECLIPSE

The projects aim to change the paradigm of small electronics products, i.e. smartphones. Based on the emotional design and user-centric approach, the report focuses on the ergonomics and the upcoming technologies in the industry, which can be used to enhance and elevate the user experience.

Final Major Project - 2020

# | ACKNOWLEDGEMENTS

I would like to express my sincere gratitude to Mr Clive Hilton for his guidance on the major question as well as his constant support for the final major project. Professor Hilton supported me with the research work and helped me with the proper management of time.

My sincere thanks to Mr Steve Kingdon for his patience, motivation and immense knowledge in the field of product design. Steve's experience as a product designer, helped me with the 3-D model, along with some valuable suggestion and changes for the design of the project.

I would also like to thank Professor Mike Goatman for his advice on critical points for the research work. His vast experience in the field of product design helped me with the research work, writing of thesis as well as the design of the product.

Lastly, I would like to thank my friends and family who supported me emotionally and stood as a strong motivation during these difficult times of global pandemic.



# | ABSTRACT

The design research project seeks to change and enhance the smartphone industry considering a user-centric approach and implementing upcoming technologies. Intensive research has been carried out to find the usages and problems faced by consumers using small electronic devices. The rapid change of technology and users moving forwards towards a digital world led to the research of the upcoming technologies which hasn't been introduced to the smartphone world yet. User-focused design being in the main focus, detailed design research was carried out on the ergonomics and emotional design of the product to establish a strong relationship between users and the product. The report describes each and every design implemented for the designing of the product, including the brand value and analysis of the usage of the products.

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(NASA, 2015)

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# | GLOSSARY OF TERMS

**AI**- Artificial Intelligence is a machine that perceives its world and takes steps to increase its probability of achieving its objectives.

**MR**- Mixed Reality (MR) is the convergence between physical and simulated environments to create new visualisations and interactions.

**AR**- Augmented Reality ( AR) is an immersive representation of a real-world setting where real-world artefacts are supplemented with computer-generated visual information.

**Deep Learning**- eep learning is an artificial intelligence (AI) system that imitates human brain activity when analysing data and creating patterns for use in decision taking.

**CC**- Cognitive computing (CC) defines development systems which are loosely focused on the artificial intelligence and signal processing research disciplines.

**Genetic Algorithm**- A genetic algorithm ( GA) is a metaheuristic motivated by the natural selection method.

**Full Nest 1 and 2**- A concept used to define the period in the traditional family life cycle at which the household consists of parents and raising children.

**Mechanochromic**- Color modification that exists when chemical compounds is tensioned in the solid state by mechanical scraping, crushing and friction.

# | 1.0 INTRODUCTION

## Consumer Electronics market

The consumer electronics market for small electronics product has seen exponential growth in recent times. According to surveys, the consumer electronics market is going to produce a revenue of US$365,538million (Consumer Electronics - worldwide | Statista Market Forecast, 2020) out of which the most used electronic products are mobile phones, tablets, OLED TVs and speakers. With the development in the field of Artificial intelligence and augmented reality, the electronics product has made the life of consumers comfortable and hassle-free.

Furthermore, the advantages of high-speed internet and organisation motivating users for digitalisation has encouraged consumers to use electronics products which have led to a 22.3% user penetration globally and expected to grow 32.5% by 2024 (Consumer Electronics - worldwide | Statista Market Forecast, 2020).

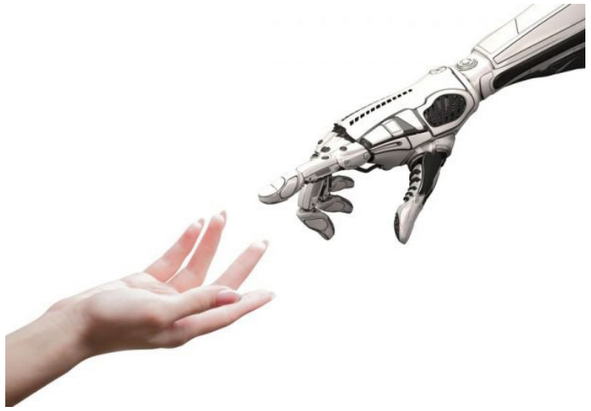


Figure 1.1 Illustration of a human and robotic hand (Ivy Exec, 2017)

One of the most significant points about these electronics devices is the design of the product. These small devices are very sophisticated objects which have lots of complexity involved in manufacturing them. In generic terms, most of these products are just a piece of glass, aluminium or metal boxes which can do almost every work of human beings. Comparing these with nature, we find a complex living organism which does not have any particular shape but has multiple functionalities which again led to the questioning of the design of consumer electronics products.



As there is a massive growth of small electronic devices, there is a considerable growth of e-waste globally. The rare earth metals, non-biodegradable semi-conductors cause a tremendous amount of air, water and soil pollution. Recycling and upcycling the products is a solution for reducing the e-waste, but it is a significant challenge for the companies as well as recyclers.

Figure 1.2 Woman worker at Guiyu re-cycling plant in China (businessinsider, 2015)

Figure 1.3 Largest Recycling plant in the world (businessinsider, 2015)

After analysing the two factors, i.e. existing design of the consumer electronic products and the wastage created by it, it led to forming the base of this design project. These factors created the question about the use of design and technology to change the existing paradigm of small electronics objects.

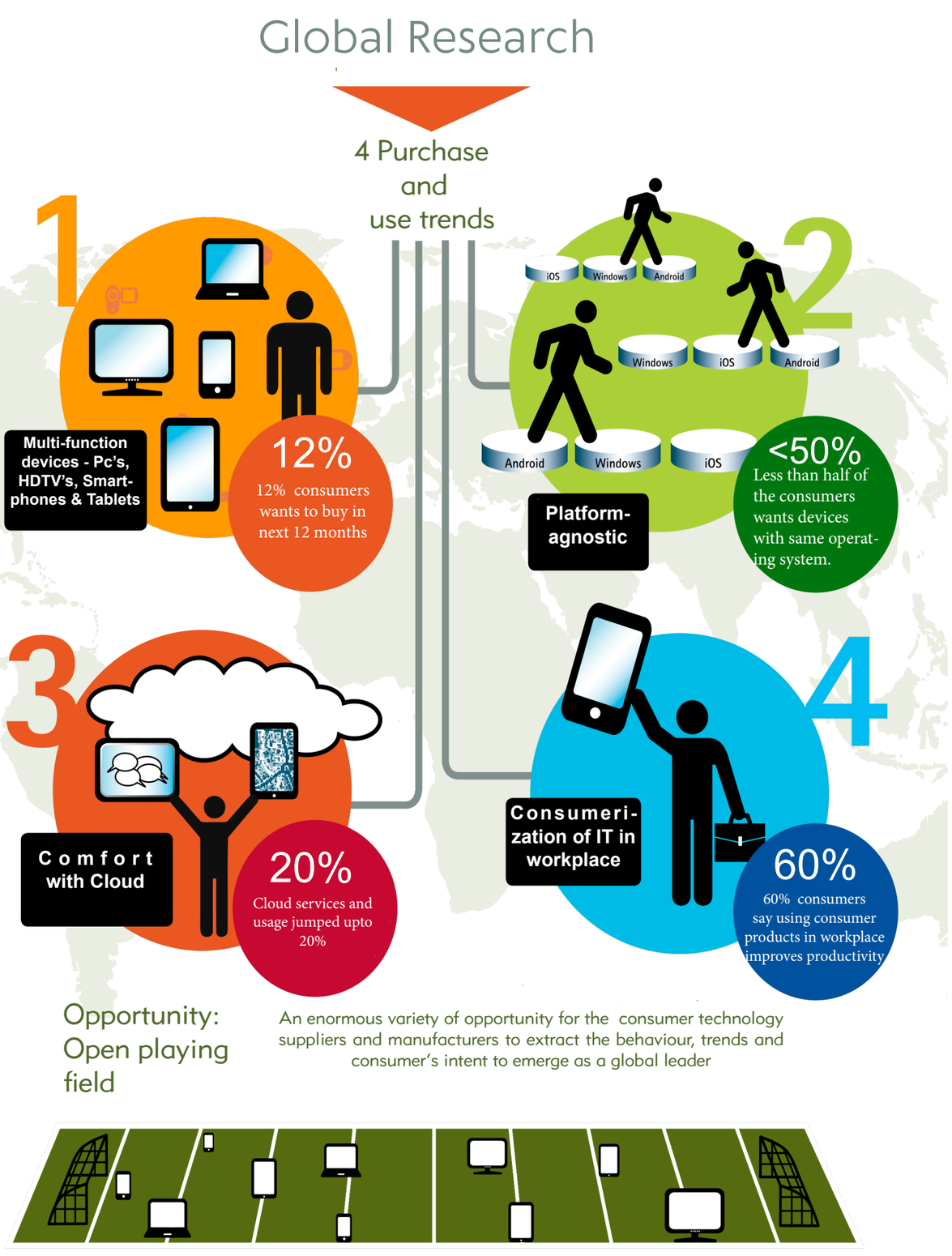



Figure 1.4 Purchase and usage trends of consumer electronics (author's own)(adopted)(edited (It's Anyone's Game in the Consumer Electronics Playing Field, 2015)

# PART ONE

## RESEARCH ACTIVITY

(Dimmock, 2017)

# | 2.0 DESIGN RESEARCH

## Why and how, radically changing the paradigm of small consumer electronics?

“Not long ago, when I was travelling from England to Scotland, I called my dad, who lives in Odisha, India. My dad is a person who loves to travel, and due to work, he hasn’t been to any new places lately. Speaking to him, I held my phone across the window of the car and showed him the beautiful countryside of Scotland. It felt like we were travelling together. Moments like this and for countless different memories, my phone plays a vital role.” Its plays the same position for many people around the world.

Over the past decade, smartphones have revolutionized in many ways which goes way beyond communication. It has yielded many benefits to society from personal banking to capturing rare moments. The present-day smartphones still lack a ton of things which can ease human life. Technology, along with Artificial intelligence and mixed reality, can be a boon for the humankind.

Let’s take the example of recent times, where lots of people are affected by their work; children’s have been affected by studies and many more challenges faced by the people.

Technology is the main connecting link between these problems. But still, there are places where primary education is difficult to access. People are getting mentally unfit for work due to improper surrounding. With the use of AI and mixed reality, students can get a proper education, as well as the office goers, can have the meetings in a virtual environment which gives a complete feel of the office.

Even the manufacturing sector can have a considerable advantage, with the help of mixed reality, users can easily construct 3-D models. Even for a layperson who struggles with the modern-day TV remote, they can use the technology to know the functionality of the product.

From a product design perspective, AI and MR can be helpful with visualizing and even constructing models. These technologies are highly useful and beneficial for the creative industry overall. As every human carries a smartphone these days, bringing these technologies into user’s fingertips can lead to a better experience of smartphones as well as changing the traditional way communication and usage of these small electronic devices.



# | 2.1 RESEARCH METHODS AND ETHICS

## Initial Approach

Emotional design among the millennials helping to reduce e-waste

The initial idea for the project was to create an emotional bonding between the users, specifically millennials and the electronics products, which will eventually help in reducing the e-waste all around the globe. There was also an approach of adding biodegradable and smart materials which help the process of recycling.

Instead of dealing with the waste generated from the past, it needs to be worked upon in the future. Sustainable materials and emotional design will help secure the future by preventing the e-waste produced all around the world.

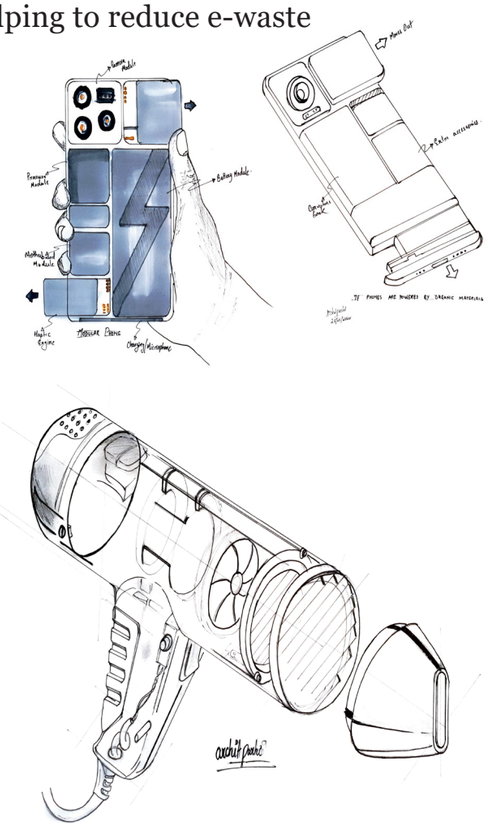


Figure 1.5 Design sketch of modular design (Parhi ,2020)

## Altered Approach

Radically Changing the paradigm for small electronics objects.

The most used electronics objects are smartphones and tablets. Even the forecast suggests that these products will grow in the future. The design of all the smartphone and tablet looks almost alike, which are a piece of glass or metal boxes. The users generally tend to change these products even if it works. The longevity of these electronic products, emotional design and new technology should be enhanced to achieve the growth in revenue as well as to reduce the e-waste. Durability and user experience have to be kept in mind to achieve the objective.

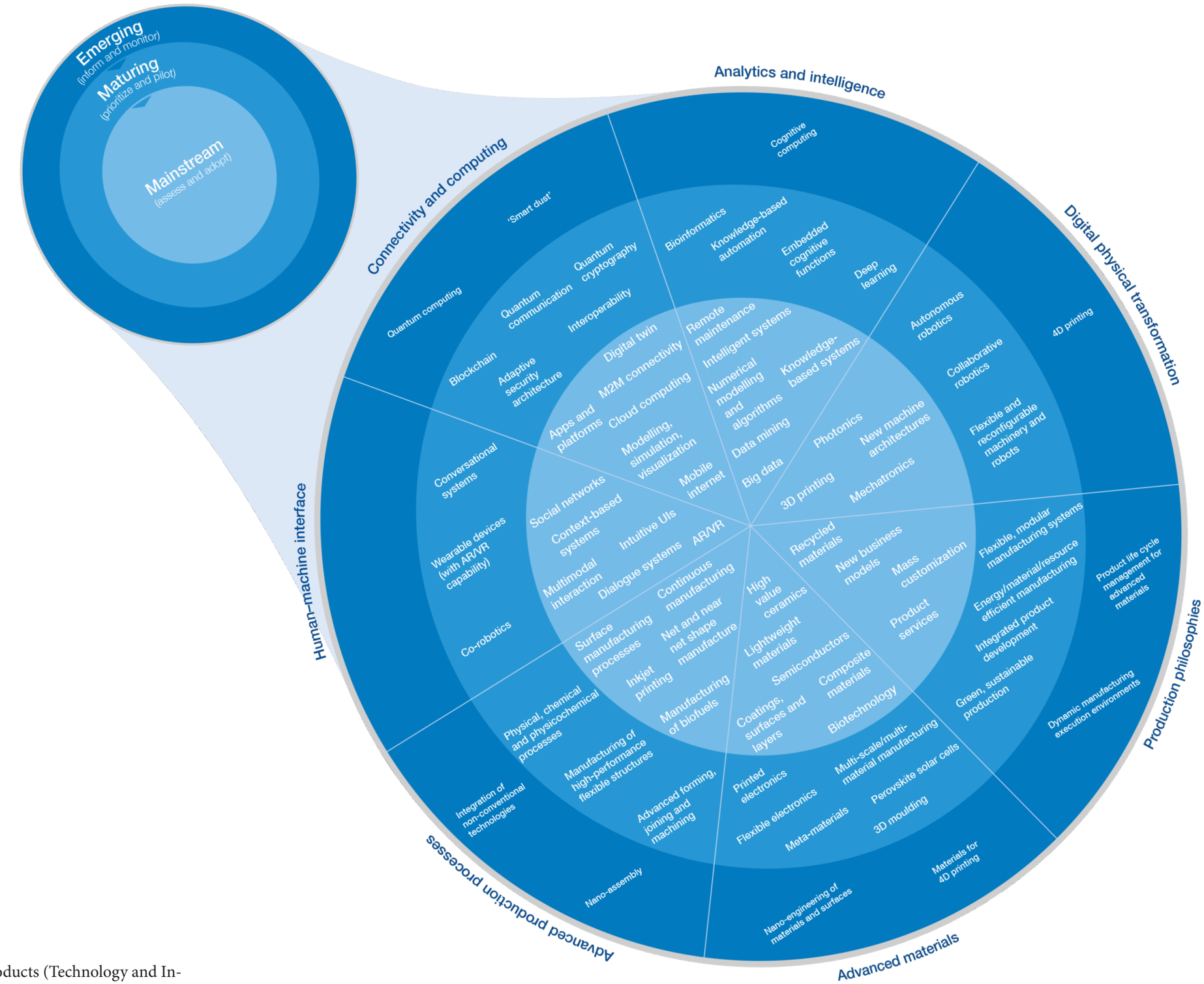



Figure 1.6 Technology for products (Technology and Innovation for the Future of Production: Accelerating Value Creation, 2020) (adopted) (edited)

# | 2.2 METHODOLOGY SELECTION

The primary strategy of the research work was to make a user-centric design, which requires a designer to apply the right design thinking and design methodology. Solving the design problem which the consumers face was even the main criteria for the research.

The research started with defragmenting the question:

Method 1: To find the details about consumer usage and problems faced during the usage period

Method 2: Analysing the existing technology and upcoming technology which can be used to enhance the user experience.

Method 3: How can the design ideas benefit the consumers and even help in building a better and sustainable society.

# | 2.3 ETHICS AND RESEARCH METHODS

The following methods were applied for the initial phase of secondary research for the design:

Research Method 1:

Various case studies were analysed to know about the behaviour of the consumers. Statistics and graphs were used, which was found out during the secondary research. These helped to see the extent up to which the consumer electronics are used.

After the market usage study, the adverse effects of the usage were found out, which led to the problems faced by consumers. The difficulties gave an insight into the design solution, which can be implemented before the manufacturing of the products.

Research Method 2:

The technology which might help to solve the problems faced by the consumers were analysed through various research papers and journals. Few of the existing technology was investigated to improve the potential and performance. Apart from the used tech, different new technology was researched to solve the problems and enhance the performance of small electronic devices. Biodegradable and green electronics were emphasised for sustainable design.

Research method 3:

Depth analysis was done on a few of the technologies which are not used in the market right now. Design thinking was done in order to find the correct usage to solve the problems faced by consumers.

(Freepik, 2018)

# | 2.4 QUALITATIVE RESEARCH

## Case Study

"Scott Rose is gaga for his iPod. "Imagine being in a romance so perfect, you wonder how you ever managed to survive before this person came into your life," said Rose, a 33-year-old Los Angeles computer consultant. "That's how I feel about my iPod." Rose's passion for his digital music player stems less from the mysterious chemistry of human devotion than from the calculating precision of Apple Computer Inc. engineers, who designed the iPod to elicit the same sort of warm, gooey feelings most people associate with love. The tiny player's curves, for instance, are baby smooth. "It really begs to be caressed," said Apple's Greg Joswiak. Its reflective stainless-steel back demands constant polishing. "People use it as a mirror," Joswiak said. "It becomes a reflection of them and their unique taste in music." Its white plastic case is "pure." All that rhapsody for something that is essentially an unromantic hard drive and a few silicon chips?" (PHAM, 2005)

## Data and Analysis

In reference to the case study, it was found out that people have a special connection, an emotional bonding with the electronic products. When a person loses a mobile phone on a train, it might be traumatising. In our day to day life, we use these products so often that when we lose them, we realise the importance of it. This emotional bond between consumer and products is present due to various factors, as follows:

a) Aesthetics
b) Novelty
c) Materials
d) Forms
e) Colour and textures

Generally, the emotional stages of a user while using a product divided into the following categories:

**First, impression**: Value judgments, including aesthetics preferences, that shape the first impression of a product is directly influenced by emotions (O'Shaughnessy J. and O'Shaughnessy N.J. 2002). These value judgments are influential upon purchase decision.

**User satisfaction**: User satisfaction is an important part of the product experience. Emotion is an important part of the experience phenomenon (Csikszentmihalyi 1997).

**Longevity**: Longevity can be considered as the major success of a product. Long-term use could be possible only when the product manages to establish an emotional bond with the user. People attach to objects because of the feeling's objects present (Norman 2007). (ÜRGEN, 2006)

There was another test conducted to find out the aesthetics problems and how aesthetics helps in having emotional connectivity between users and product.

Figure 1.7 Three stages of Emotional Design (Baker, 2019)

***"Aesthetic engineering is the field of applying quantitative methods to aesthetics."***

## Experimental case study (HUMAN FACTORS and ERGONOMICS SOCIETY, 2012)

Before the experiment, a perfect hand-held device was designed keeping the length, breadth, ergonomics, screen area and corner radius in mind. Genetic Algorithm (GA), which is a computer-generated variable, for the aesthetic value and ergonomics of the design and Interactive genetic algorithm(IGA), which determines the human rate to select a design was used.

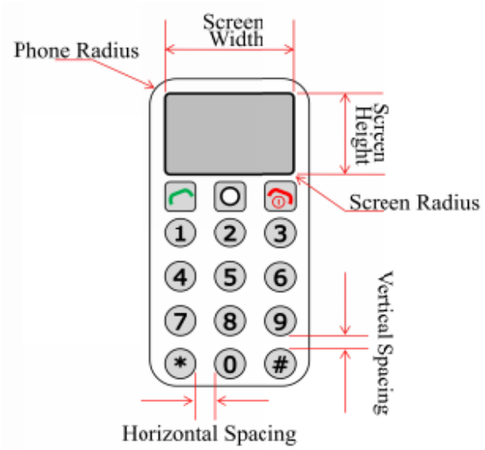


Figure 1.8 Independent dimension variables (HUMAN FACTORS and ERGONOMICS SOCIETY, 2012)

The objective was to test the aesthetic using IGA and physical ergonomics using GA. Various variables, like phone length and breadth, were set (as in figure 1.8). Participants trails were split into IGA which is first-generation and another into IGA plus GA, i.e. second generation. Statistically comparing (table below) there was a significant difference in both the generation.

Table 1: Paired t-test p-values comparing the first and last generations, and the difference between IGAs and IGAs with an ergonomic GA.

| | Buttons | | Screens | | |
|---|---|---|---|---|---|
| | Horizontal | Vertical | Horizontal | Vertical | Radius |
| First to last generation | 5.061e-13 | 5.51e-7 | 2.2e-16 | 1.615e-5 | 2.2e-16 |
| IGAs vs. IGA +GA | 0.08531 | 1.29e-7 | 3.848e-5 | 0.1521 | 1.061e-7 |

The presence of a Genetic Algorithm did not statistically, significantly alter the aesthetic score of the designs (p-value 0.1367), but did change the ergonomic score, p-value 6.904e-10 (Table 2). The difference in mean values can be seen in Table 3.

Table 2. Mean (and SD) aesthetic and ergonomic scores.

| | Aesthetic score | Ergonomic score |
|---|---|---|
| IGAs Alone | 80.4 (18.7) | 20.85 (7.5) |
| IGA with GA as well | 75.6 (20.7) | 75.6 (20.7) |

Table 3. Mean (and SD) values of selected designs in the last generation.

| | Button spacing | | Screens | | |
|---|---|---|---|---|---|
| | Horizontal | Vertical | Horizontal | Vertical | Radius |
| IGAs Alone | 6.62 | 3.32 | 43.40 | 35.91 | 6.62 |
| IGA with GA as well | 5.30 | 4.09 | 44.66 | 38.30 | 8.92 |



## Discussion

From the results, it's very well concluded that with the use of GA in Aesthetics, the score is high. Even using the IGA and GA together it shows a higher significant number. Overall aesthetics do play a vital role in determining the emotional connection between users and product and factors like length, breadth, and textures do help in the process.

## Observation

"I really get excited when is see a new electronic gadget. But after using it for several months, I get bored with the look, texture and colour of it. I tend to buy skins for the devices." The electronic product these days look very much alike each other. Silver, white, grey, flat, boxy, round and minimalistic which doesn't excite a consumer after repeated usage. Most of the design is inspired by Deiter Rams principle of minimalistic design which is dominating the market. It would be fascinating to see a quirky design in colourful shapes which was done way back by the famous Italian designer **Olivetti Divisumma**.

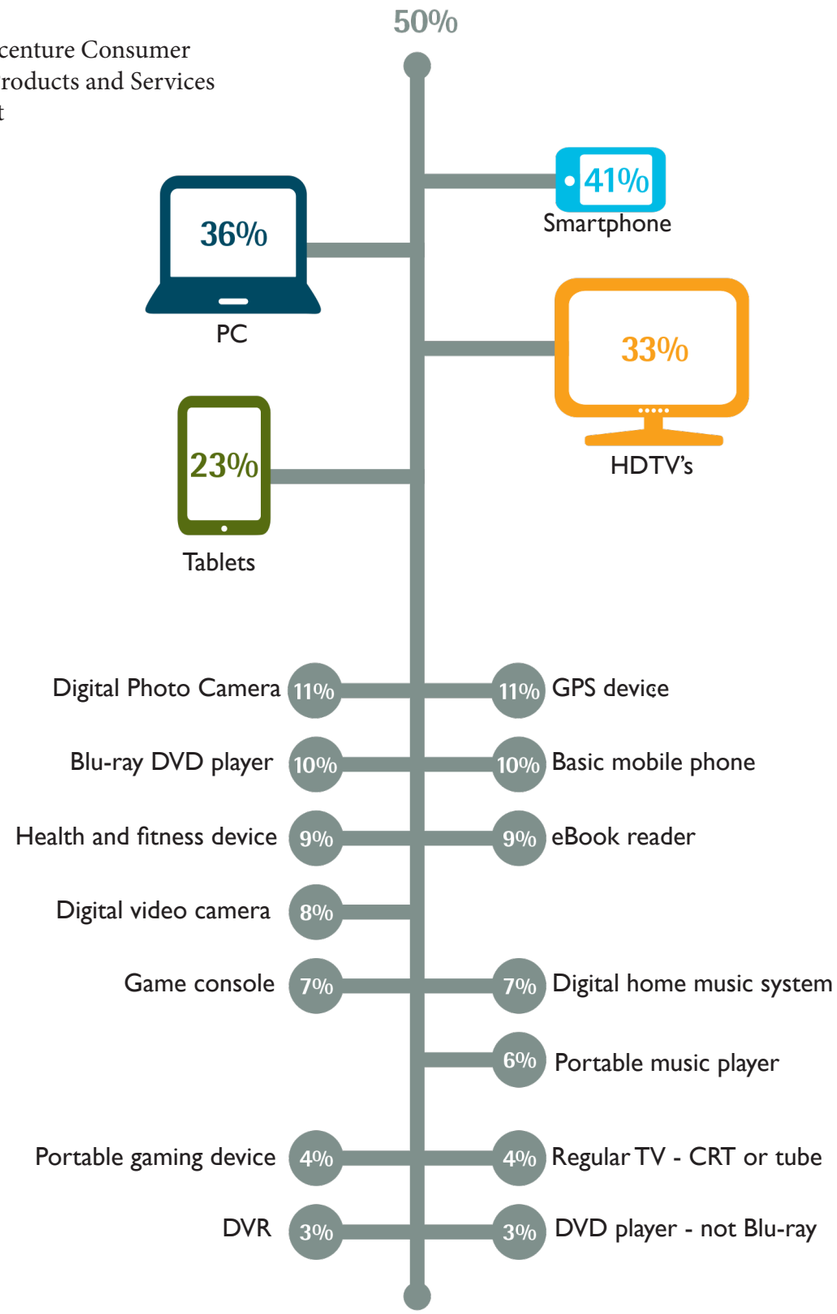
Figure 1.9 "Despite being 40+ years old at this point and by today's standards very crude for what it does, the Olivetti Divisumma 18 is a product that continues to make everyone who sees it smile and want to touch it." (mass made soul, 2020)

# | 2.5 QUANTITATIVE RESEARCH

Data produced by various Multinational firms were analysed to know the usage of consumers. Even the forecasting for small electronic devices was researched upon. This led to the finding of problems faced by consumers during usage.

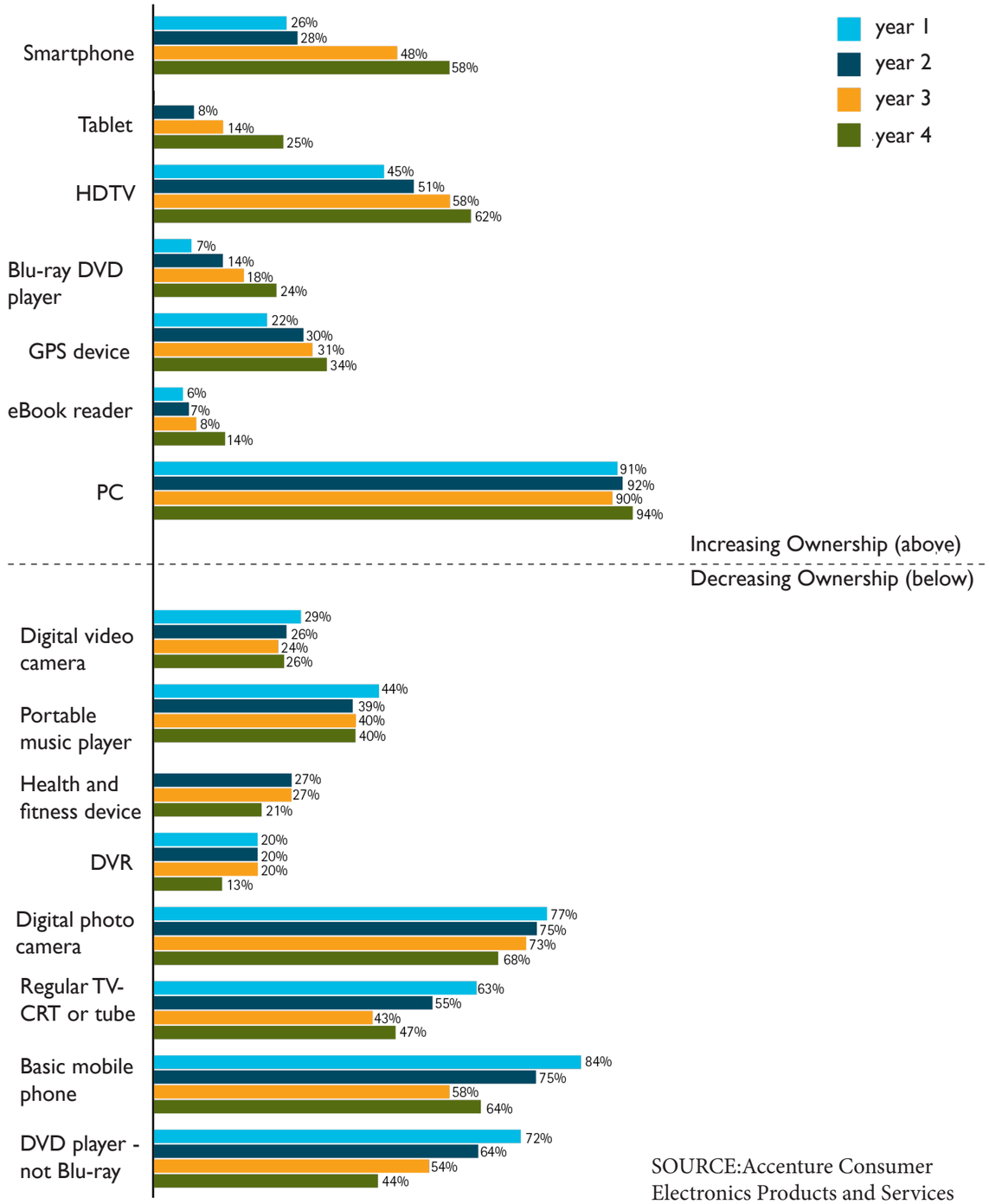
**Question 1**: Which of these consumer electronics do you plan to purchase in the next 12 months?

SOURCE:Accenture Consumer Electronics Products and Services Usage Report



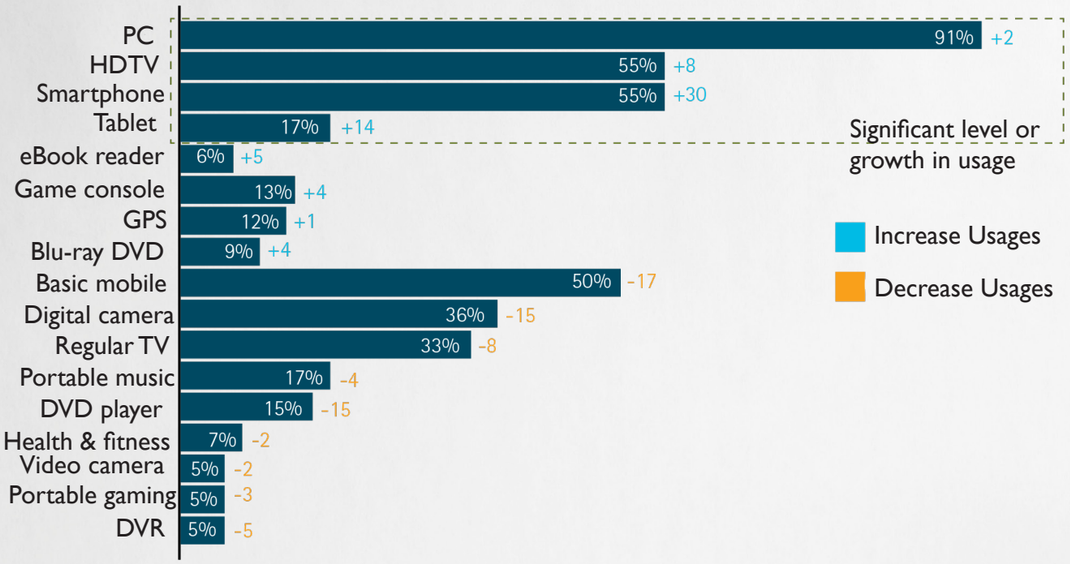



**Question 2**: Which of the following consumer electronics do you currently own?




SOURCE:Accenture Consumer Electronics Products and Services Usage Report

**Question 3**: Of the consumer electronics devices you currently own, please rank the top five that you use most often.







SOURCE: STATISTA

(Hdz, 2020)

## E-waste Research

Data produced by various Multinational firms were analysed to know the usage of consumers. Even the forecasting for small electronic devices was researched upon. This led to the finding of problems faced by consumers during usage.

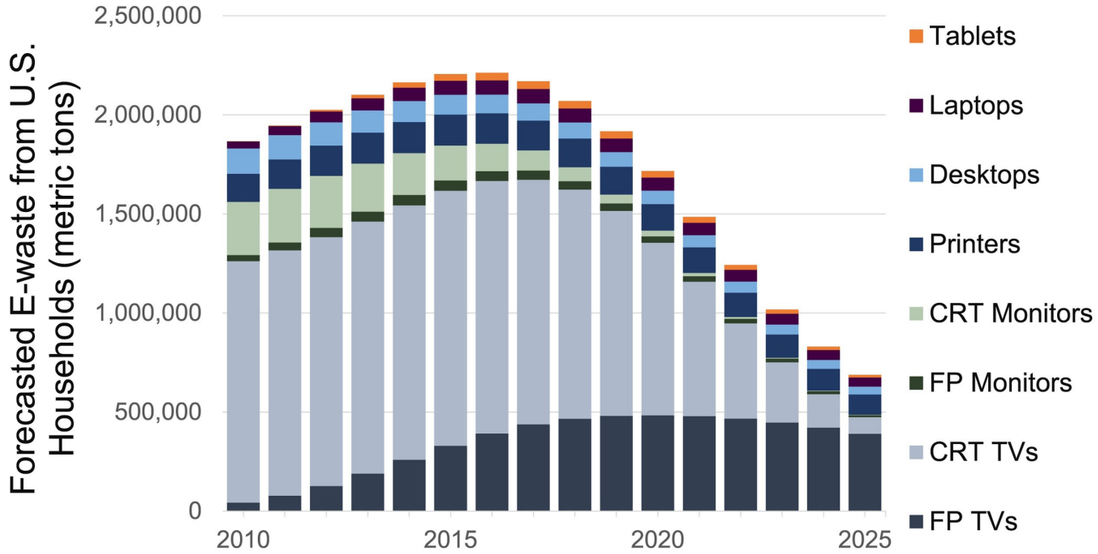



Figure 2.0 Forecasting of E-waste in U.S. household (Althaf, Babbitt and Chen, 2019)

The main issue of the waste is recycling which creates a difficult problem for both companies and recycles.

# | 2.6 DESIGN SPECIFICATION

**Sustainable Factors**: Using green and biodegradable electronics parts which are easy to disassemble and can be reused.

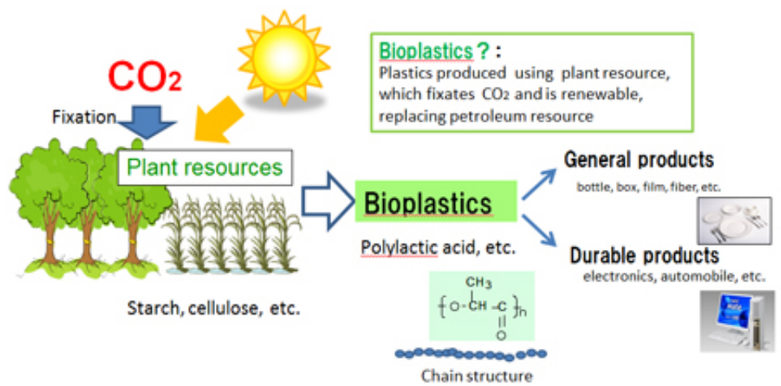



Figure 2.1 Bioplastics and its source (NEC, 2016)



**Technical Factors**

a)Designing to withstand shock & impacts

b)Structural strength

c)Rigidity

d)Materials to withstand high temperature

e)Outer shell bad conductor of heat

f)Less power consumption

**Data** (Hughes et al., 2018)-

a)Outer material-
Youngs Modulus-71700 MPA approx..
Poisson's ratio-0.22

b)Support Structure-
Youngs Modulus-210000 MPA approx..
Poisson's ratio-0.33

c)PCB Main-
Youngs Modulus-69500 MPA approx..
Poisson's ratio-0.34

d)Speakers-
Youngs Modulus-69500 MPA approx..
Poisson's ratio-0.34

**Human Factors**

The region of the adult male was **146.50 cm2**, while for a female the area was **132.42 cm2**. Mean hand area for both male and female was **139.46 cm2 .**

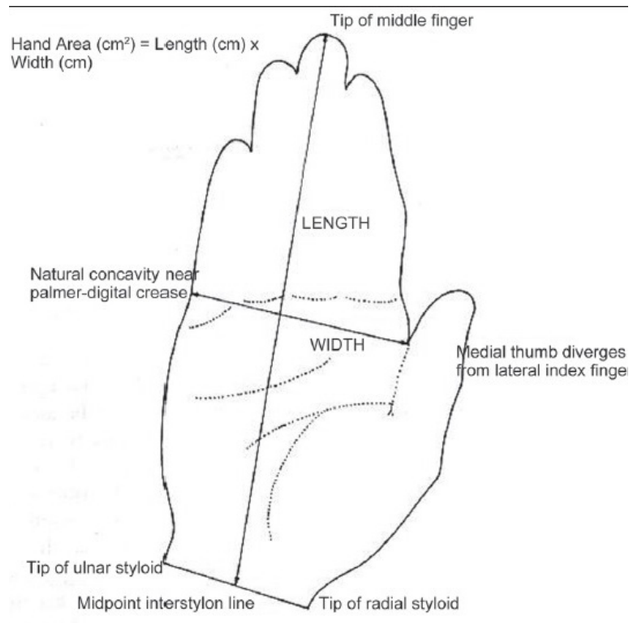



Figure 2.2 Hand area calculation (Agarwal and Sahu, 2010)

# | 2.7 DESIGN BRIEF

## Introduction

There is an increase in consumer electronics every year. Specifically, the smartphones industry has seen a consistent rise in the last decade. Introduction of new technologies like the Internet of Things, Mixed Reality and artificial intelligence are getting used in many unique forms by the consumers. These technologies have made human life easy and comfortable. While almost every human on earth uses a smartphone, how can these technologies be introduced in those devices? Adding these technologies will not only help humans to change the way they communicate, but it will also change the way, how smartphones and smart devices are used in the field of entertainment, education, work etc.

The increase in consumer electronics has led to various types of pollution like soil, water and air pollutions. Companies have started using various sustainable materials for manufacturing consumer electronics, but even after the usage of bioplastics, there is a significant issue of proper recycling of these products. Adding to the worries of recyclers are the humans who discard those devices even if it works perfectly fine. Generally, users get bored after using those devices for a certain amount of time. How can the longevity and recycling of these products be enhanced by using emotional factors of design?

## Design Aim

Introducing emotional design and upcoming technologies like IoT, AI and MR to a smartphone which will eventually change the way these products used, in a sustainable way.

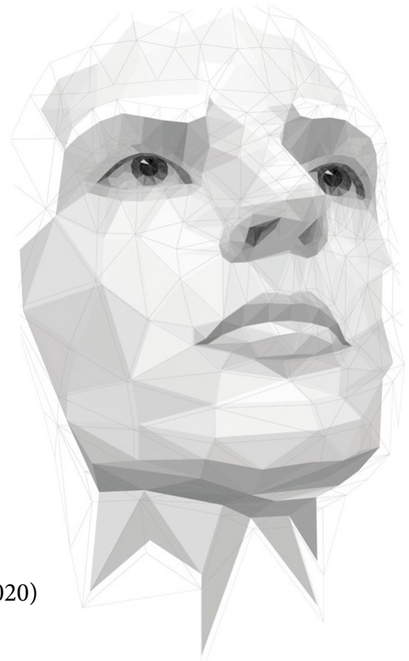


Figure 2.3 Computer Generated virtual face (adopted) (Archit,2020)



## Design Objective

a)Adding artificial intelligence and mixed reality to smartphones to enhance the productivity and usage in the field of education, construction, medical etc.

b)Providing a positive and technologically rich and productive user experience with the help of technologies which have not been introduced to smartphone industries.

c)Emotional design increasing the user experience as well as the longevity of the product.

d)Sustainable and green design for the upcoming future.

## Target Audience

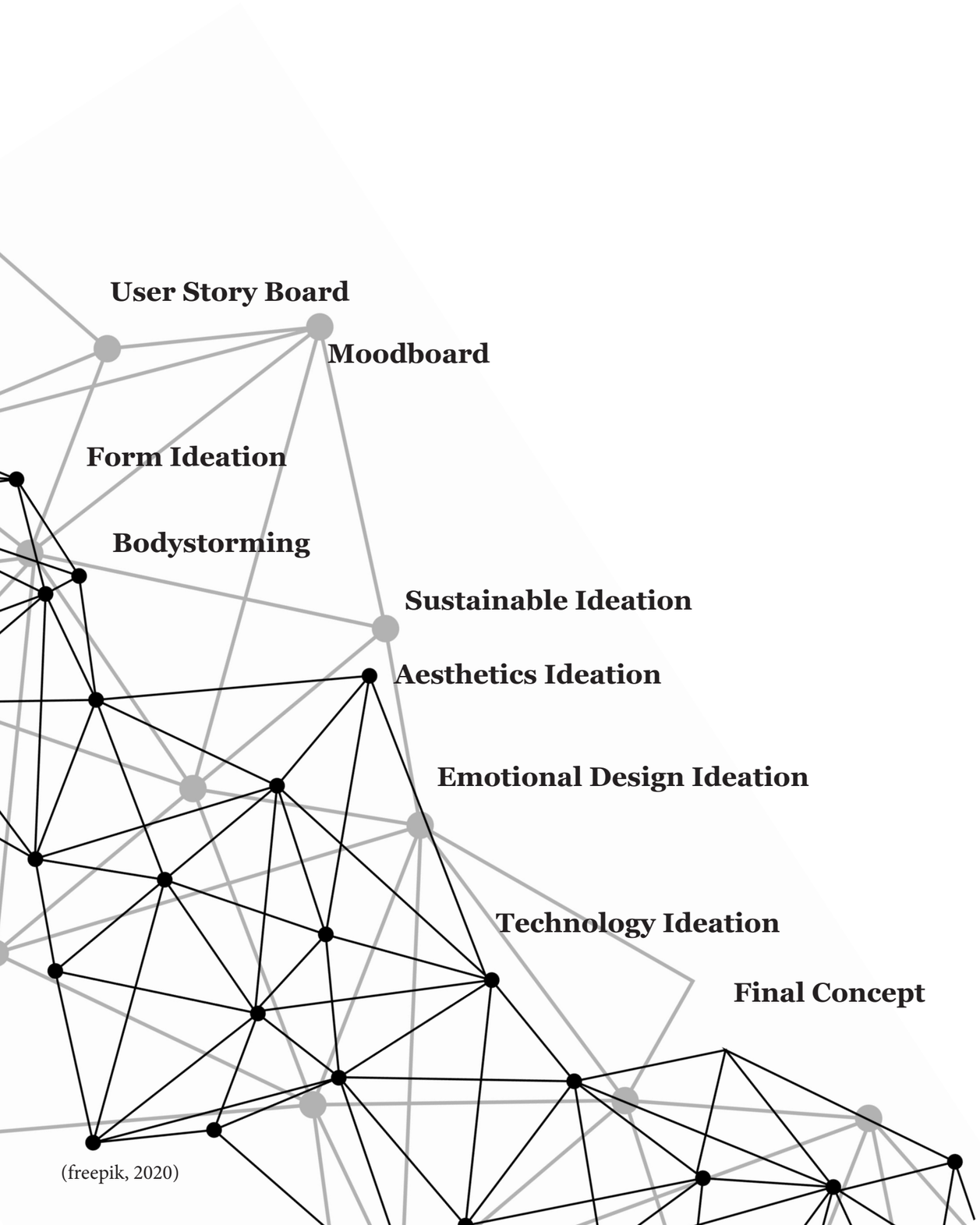
| Segmentation type | Criteria of Segments | Target segment |
|---|---|---|
| Geographic | Region | International |
| | Density | Urban |
| Demographic | Age | 20-55 |
| | Gender | All gender |
| | Life Cycle Stage | Bachelor<br>Married<br>Full Nest I<br>Full Nest II |
| | Income | High and middle earners |
| Psychographic | Social Class | Middle class and above |

# PART TWO

## DESIGN OUTCOME

(Photos, 2019)

# | 3.0 DESIGN PROCESS




(freepik, 2020)

# | 3.1 USER STORY BOARD

## Low-fidelity storyboard

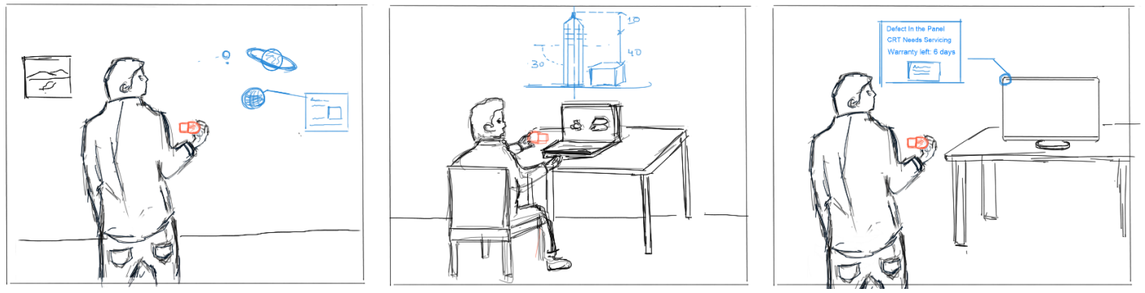


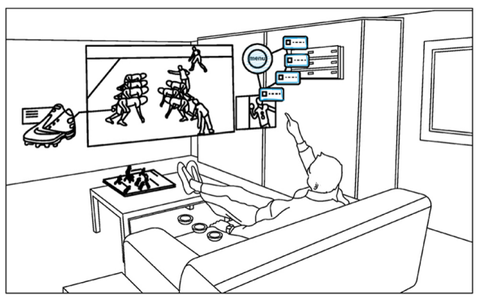

Figure 2.4 Usage of Technology: Education, Work, Smart Detection (Archit,2020)

The best method for conveying the ideas and concepts of proposed experience depends on the intended audience,as well as the type of feedback the next iteration requires. When presenting new ideas to members, low fidelity re-enactments of bodystorming can be enough to bring someone up to speed (Mixed reality microsoft, 2018).

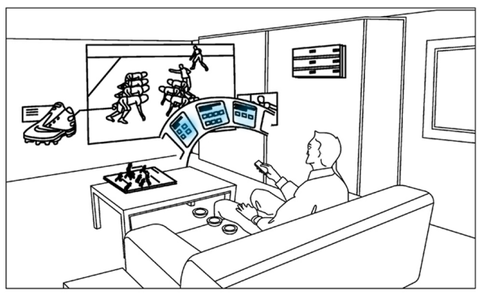
High Fidelity storyboards are a powerful tool which combines the insights of ideation and body storming of an idea. It is used to visualize the idea of a designer.

(CLIPART, 2019)

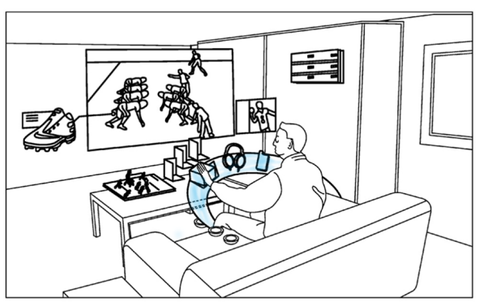
## High-fidelity storyboard



Watches TV,online shopping and work

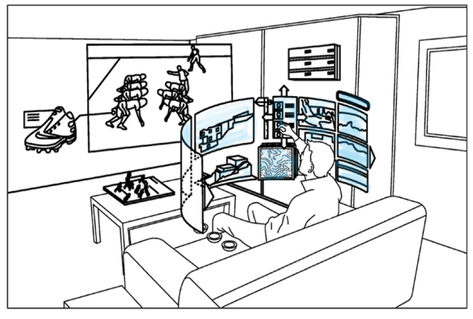


Browse through internet

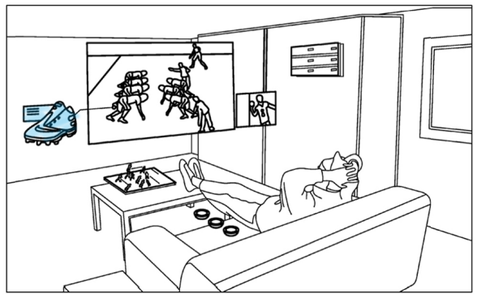


Plays video games

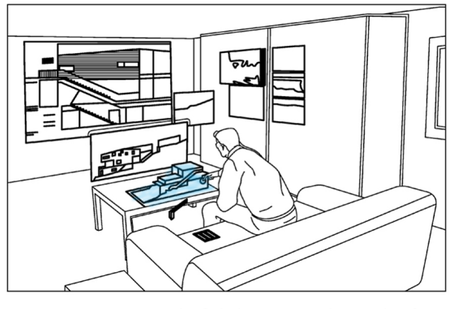

Uses Social Media and reads news



Works Online



Relaxes and watches TV again



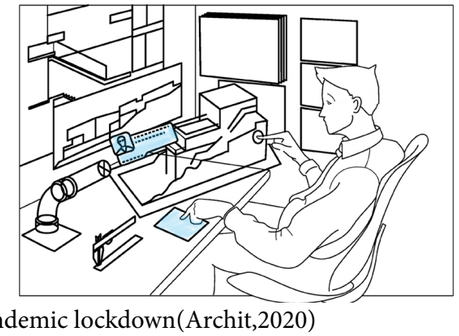


Figure 2.5 High fidelity storyboard of a user during the global pandemic lockdown(Archit,2020)



## Storyline

The user illustrated in figure 2.5 was used to show the day to day life a consumer during the global pandemic lockdown. Due to the current coronavirus lockdown, most of the users are at home. Technology is the means of communicating between humans.

From the start of the day, the user uses his smartphone to check out the missed notifications. He then grabs a cup of coffee and goes through the news form his smart device. After having a heartful breakfast, he watches TV and browses through his work files. He then looks for various articles related to work and in-between surfs through various shopping sites. During lunch hours he grabs his lunch and the plays video games for a while. As the workload is less, he goes through different social media websites to increase his connection. During evening time he relaxes by watching his favourite tv series. He then prepares food using the internet. After dinner time, he works in his current project and does research work surfing through various journals. It eventually makes him tired for which he goes to bed early.


Figure 2.6 Share of time spent per day in percentage(Archit,2020)


# | 3.2 MOODBOARD

Figure2.7 : MoodBoard (published images)
Fur(Nie, 2019)
IOT(Richardson, 2020)
Colour Pallete(Urban, 2016)
3-d Images(www.netclipart.com, 2020)
Squid(Calvar, 2020)
(Webb, 2020)
(Pantone, 2019)
Calculator & Typewriter(paessler, 2019)
Frosted Glass(Texture.com, 2019)
Cactus(brainden.com, 2019)

## Moodboard Explanation & Analysis

The initial observation regarding the FMP was about various texture, patterns, and colours involves. Texture, pattern and colour play a vital role in defining the aesthetic value as well as increasing the emotional bonding of users with the product. The fur of the highland cattle was a major inspiration because of the involvement of touch. Along with the texture, the butterfly was a significant inspiration as it is vibrant and has lots of symmetrical pattern on its wings.
A squid was also taken as an inspiration as it changes its colours and skin texture which is the main feature of the back of the device. Apart from all the biological objects, the products of the famous Italian designer Olivetti Divisumma.Even in today's standard, the design made by Olivetti stands out in the market in terms of the colour pallet and the sensation of touching the products.

Various 3D Images also played a significant motivation for the mood board as the final product was visioned to be made using holographic 3D images. Lastly, diverse colour pallet inspired by corals, rose quartz and ultraviolet was taken for the mood board.

# | 3.3 FORM IDEATION

Considering the user-centric design, the ergonomics of hands were studied to design the form of the product. Due to the rectangular, boxy shapes of the modern-day phones, the corners tend to prick consumers hands and even sometimes it isn't easy to use with one hand.

**Solution:**
To make the form of the phone in such a way that the consumers don't face many difficulties while holding it. It can also be used with a single hand which is highly essential when traveling in public transport. The device should also fit in a consumer pocket and should be highly portable.

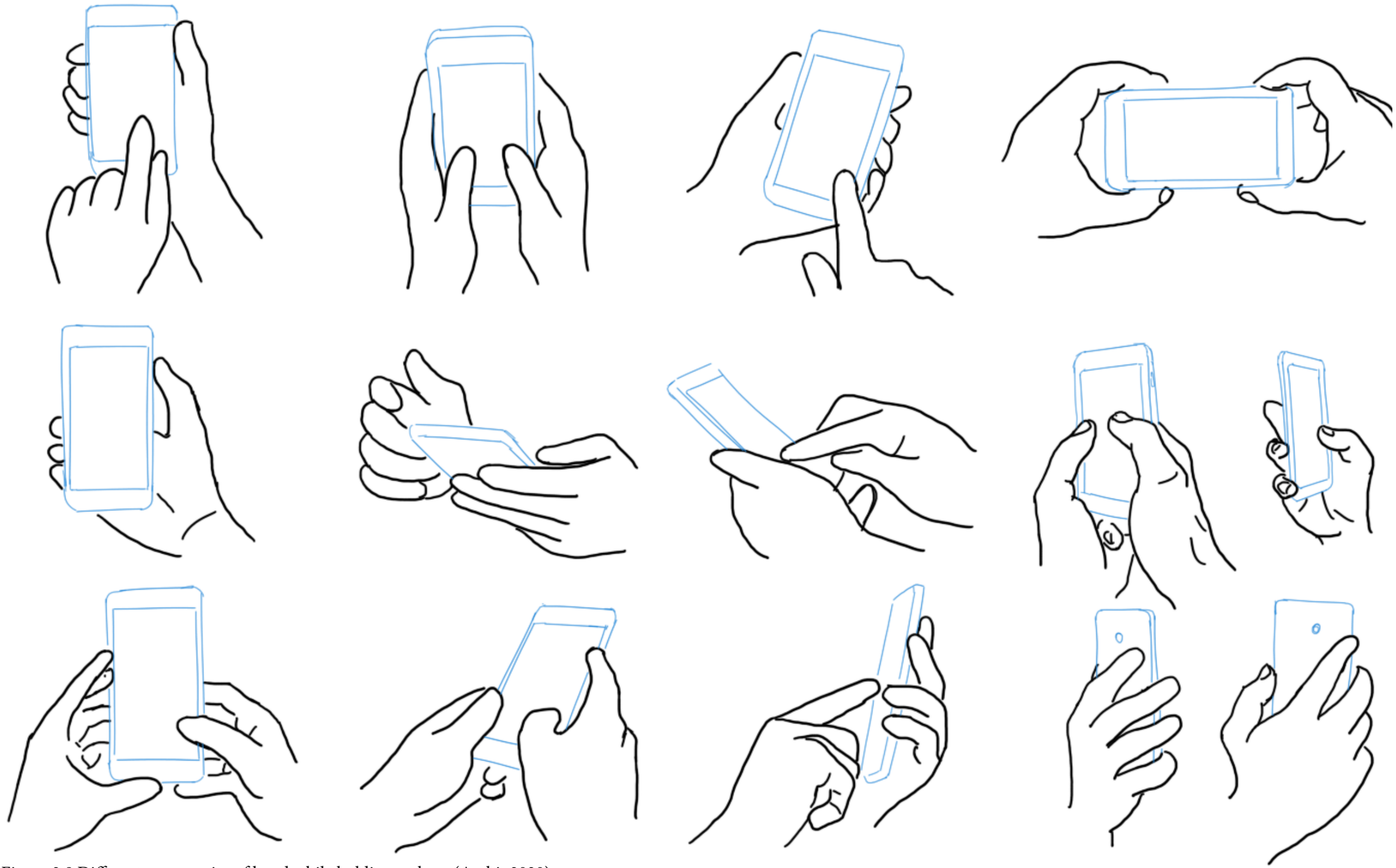


Figure 2.8 Different ergonomics of hand while holding a phone(Archit,2020)

## Brainstorming of various forms

Figure 2.9 Different forms of the device (Archit,2020)

Generally, with rectangular, boxy designs the edge of the phone pierces the palm of the consumers.

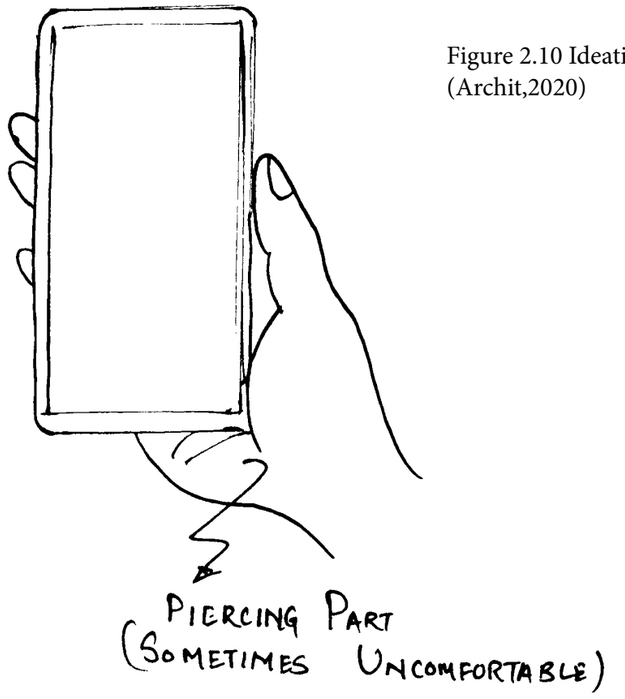
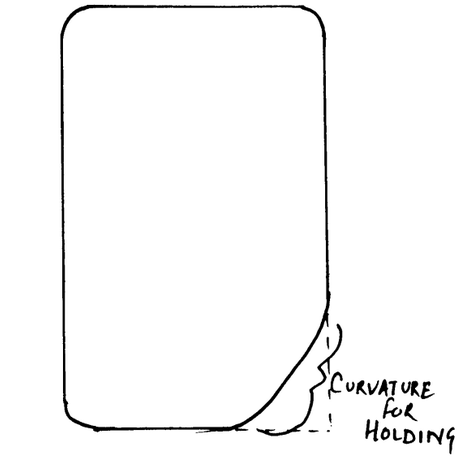
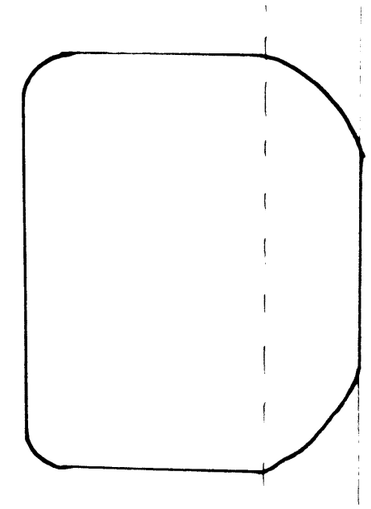


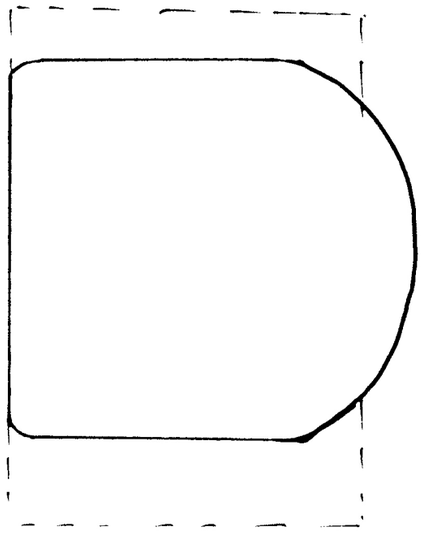

Figure 2.10 Ideation of form (Archit,2020)




To avoid the discomfort of the generic forms of mobile devices, a curvature introduced for comfortable grip.

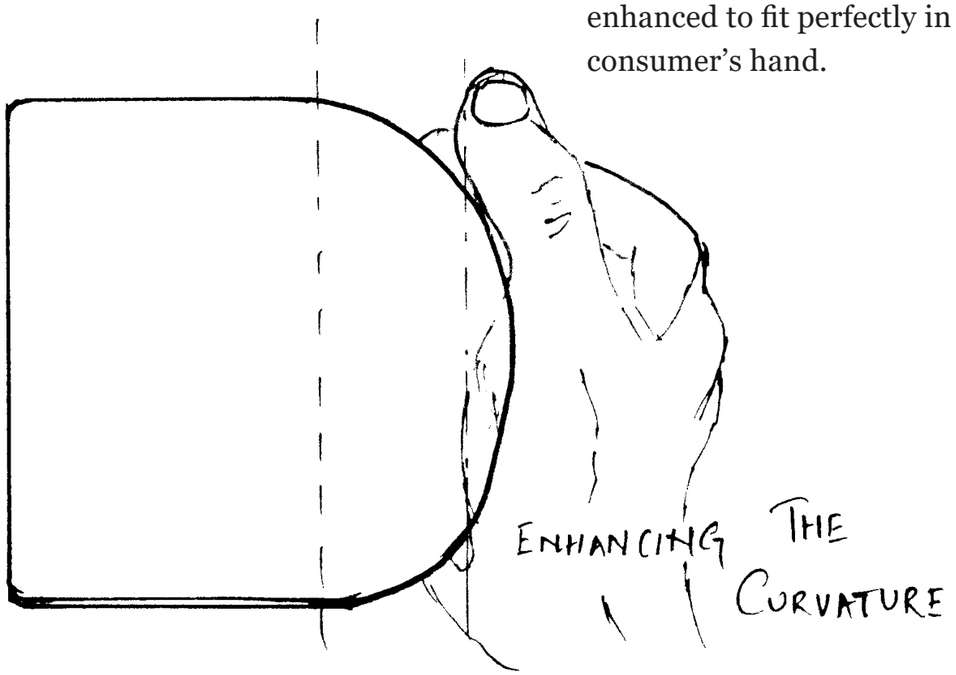


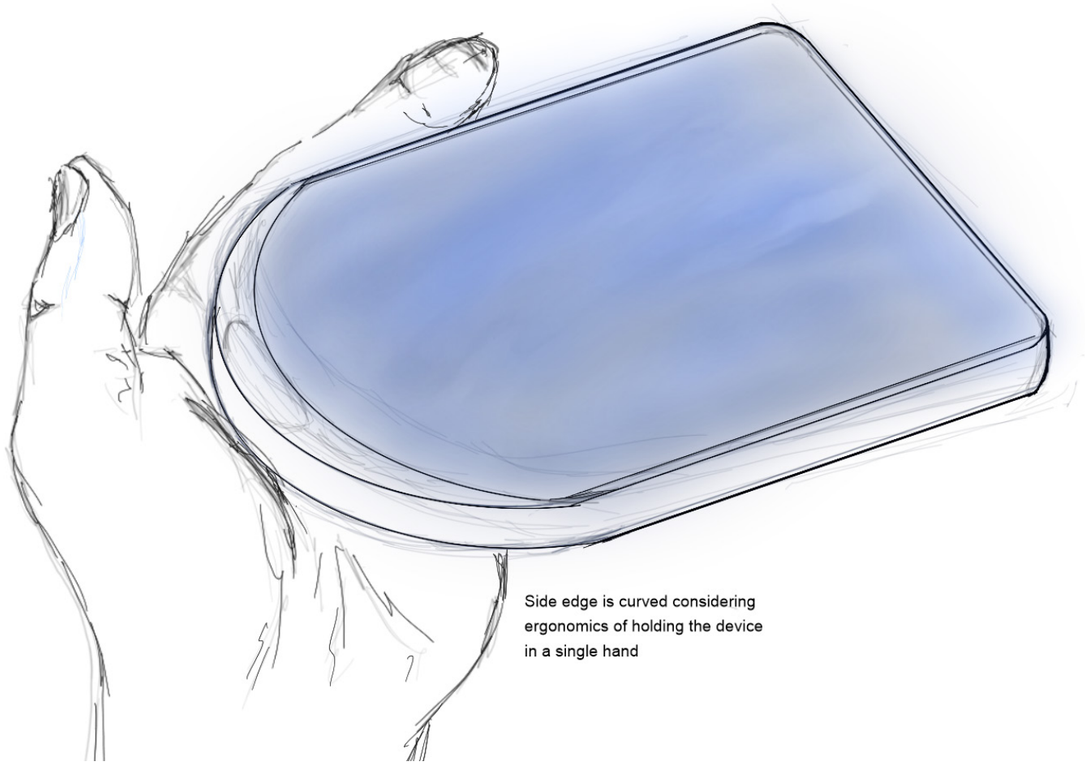

The curvature was introduced on both the edges to make it symmetrical.



The size of the device was then reduced to fit in the palm perfectly. It was done in order to access the device easily with one hand in crowded places.

The form was further enhanced to fit perfectly in a consumer's hand.






# | 3.4 BODYSTORMING

An emerging design practice developed by natural extension of the mode of participatory design known as "bodystorming" is often considered a form of prototyping in context, and is enacted instead as a technology directly supporting collaborative embodied cognition. (Bodystorming as embodied designing | ACM Interactions, 2010)

## Process

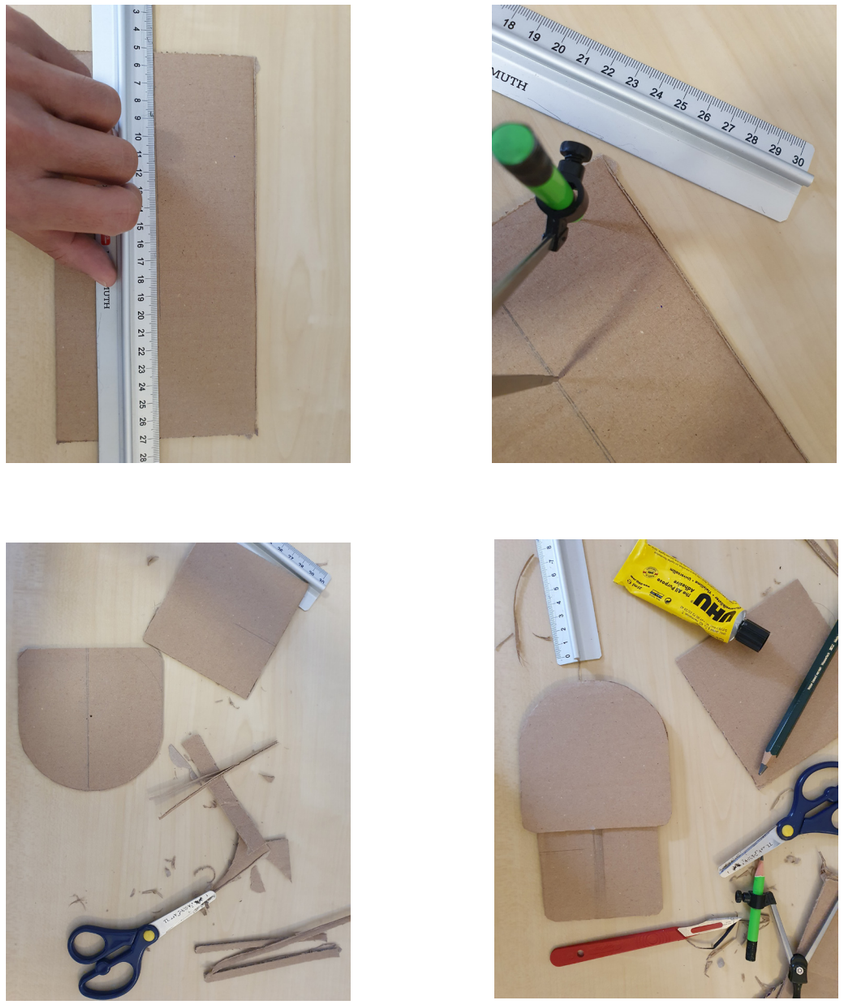


Figure 2.11 Process of making the model (Archit,2020)

Figure 2.12 Experimenting with various body ergonomics to find defects in the form (Archit,2020)



# | 3.5 SUSTAINABLE IDEATION

The primary issue with electronic products is the ability to recycle and reuse. In recent times designers have been trying hard to use biodegradable materials in their electronic products. But still, the electronic product tends to be a significant issue because it is difficult to separate the biodegradable and non-biodegradable materials present in the product.

**Solution**:The smart device has a special adhesive lining which joins the PCB with the frame of the device. The lining is known as a programmable magnetic soft composite material.

It contains two components, i.e. active and passive component which gets stimulated by magnetic excitation. The active part is created by embedding fine neodymium–iron–boron (NdFeB) particles that have an average size of 5 μm (MQFP; Magnequench) into a soft silicone rubber (Ecoflex 00-10; Smooth-on, Inc.). The passive component is created by embedding aluminium (Al) powder with an average particle size of 5 μm into the same type of silicone rubber(Lum et al., 2016).

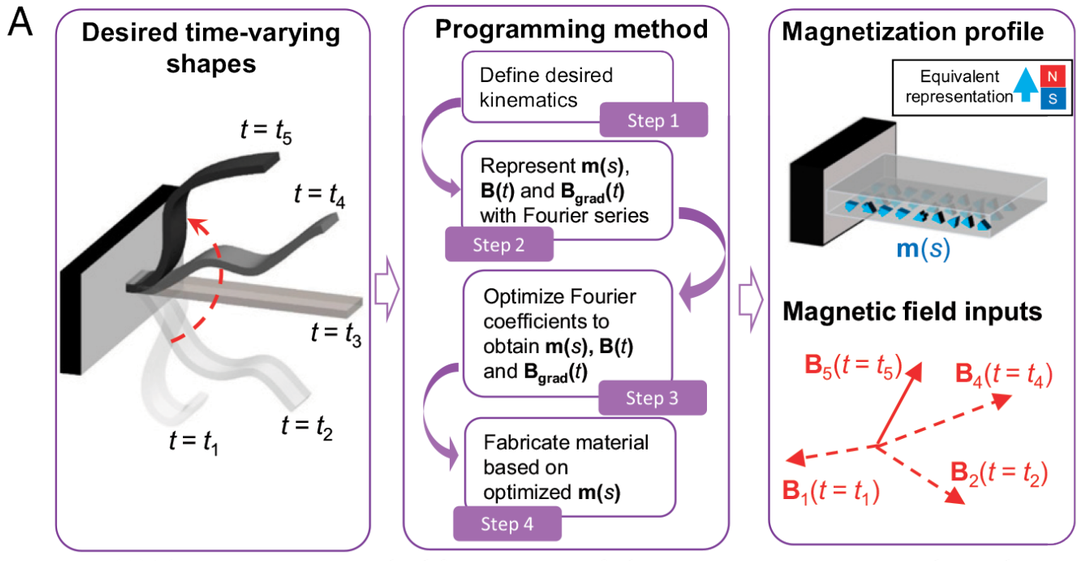



Figure 2.13 (A) The programming method for magnetic soft elastomeric composite materials to achieve the desired time-varying shapes. We illustrate this concept with an arbitrary beam that can be programmed to achieve the desired shapes shown on the Left. By using our proposed programming method (shown in the Center), we can automatically generate the required magnetization profile, mðsÞ, and magnetic field control inputs, BðtÞ, for the material (shown on the Right). The given mðsÞ and BðtÞ are only used as an illustration. (Shape-programmable magnetic soft matter, 2016)

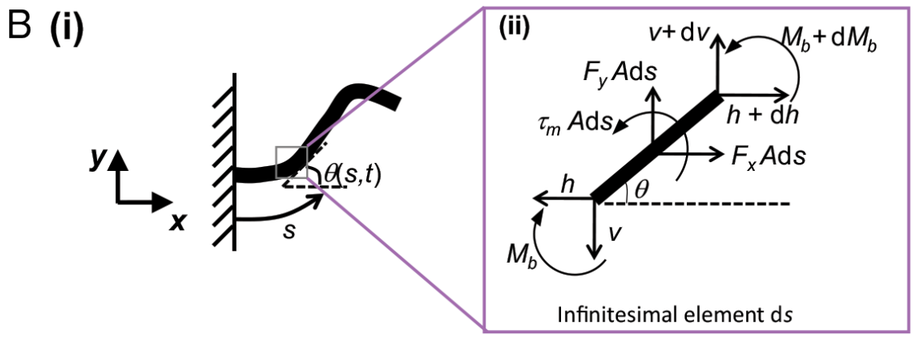



Figure 2.14 (B) A graphical illustration for the theoretical formulations. Based on the desired kinematics in i, a quasistatic analysis can be conducted on ii. (Shape-programmable magnetic soft matter, 2016)

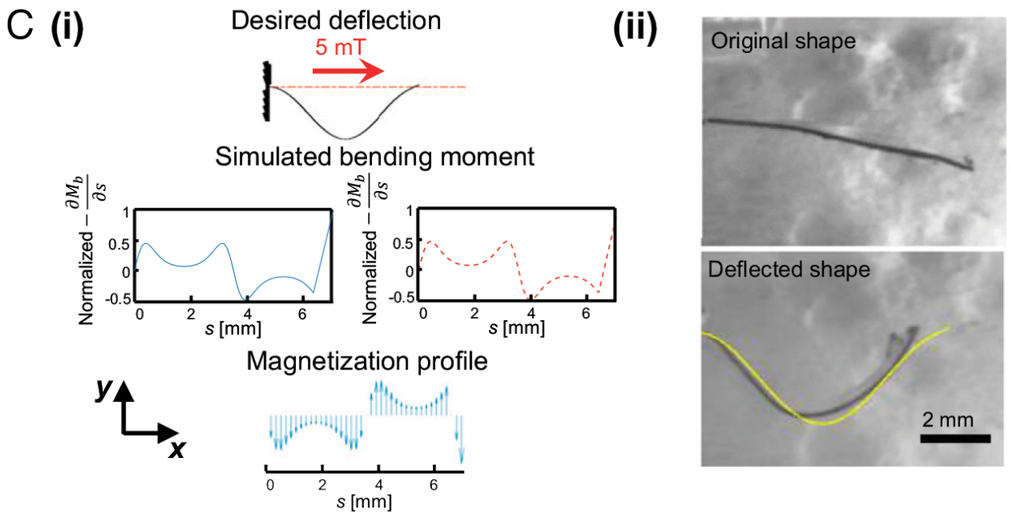



Figure 2.15 (C) A simple proof of concept of the proposed method in which a beam is programmed to create a shape resembling a cosine function when it is subjected to a 5-mT uniform magnetic field input. (i) Desired shape simulated first derivative of the bending moment, and necessary magnetization profile along the beam. The desired first derivative of the bending moment is represented by the blue curve, whereas the dotted red curve represents the first derivative of the bending moment generated by magnetic actuation. As the blue and dotted red curves will totally overlap one another, they have been separated into two plots for clarity. The plotted magnetization profile is along the predeformed beam (see Fig. S6 for a more quantitative representation for the magnetization). Additional parameters for this device can be found in S9. Parameters for Each Case and Table S1. The obtained experimental results are shown in ii. The yellow line represents the desired programmed shape for this demonstration. The beam achieved its programmed shape when it was subjected to a 5-mT magnetic field. (Shape-programmable magnetic soft matter, 2016)`



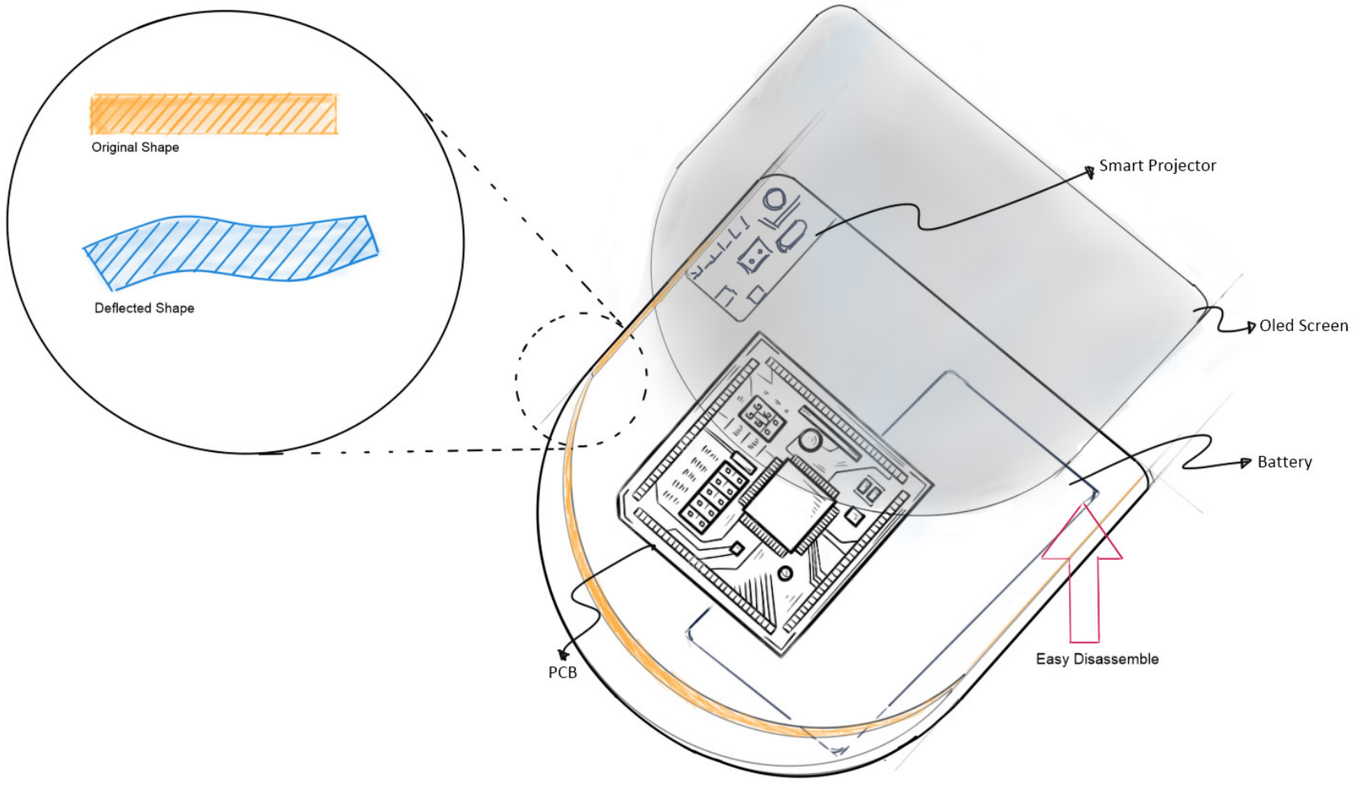
With the use of the programmable material, the smart device can be easily disassembled during servicing as well as during the process of recycling.

The programmable materials require a magnetic activation. Magnetic activation can be done by giving the content a magnetic field control input on which the material can deform its shape.

After the shape deformation, it can be easily disassembled and repaired or can be further used in recycling.

The working procedure is explained in the diagrams. It is based in the mathematical calculations and experiment conducted on a magnetized beam, i.e. a magnetized soft elastomeric composite materials.

Figure 2.16 Ideation of shape programmable magnetic soft composite material(Archit,2020)



# | 3.6 AESTHETICS IDEATION

The small electronics product that we see in the market tend to have a similar-looking front side. The real game-changer is the backside of the devices which has direct contact with consumers. Having the same look and aesthetics of the device can sometimes be boring for the consumer. Some consumers even discard their devices as they are bored of using it even though it works perfectly fine.

**Solution:** Mechanochromic devices inspired by nature with capabilities ranging from changing transparency, switchable luminescence, to altering colouration, revealing and concealing patterns in response to mechanical stimuli. The key to accomplish these optical properties is establishing strain-induced control over longitudinal crack-opening and transverse invaginated folds. The folds and cracks capable of strongly trapping and scattering light can endow the originally transparent samples with opacity.

To obtain a sensitive and reversible transparency change mechanochromism(TCM), the device is designed to contain a transparent rigid film (made of polyvinyl alcohol (PVA)/laponite composite) tightly bonded to soft polydimethylsiloxane(PDMS), as shown in the figure. The device can reversibly exhibit conspicuous visual change between a transparent state and an opaque state upon stretching and releasing within 40% strain. (Zeng, Zhang, Huang and Wang, 2016)

***"Design is the method of putting form and content together. Design, just as art, has multiple definitions; there is no single definition. Design can be art. Design can be aesthetics. Design is so simple, that's why it is so complicated."***

***— Paul Rand, Art director & graphic designer famous for logos such as IBM's***



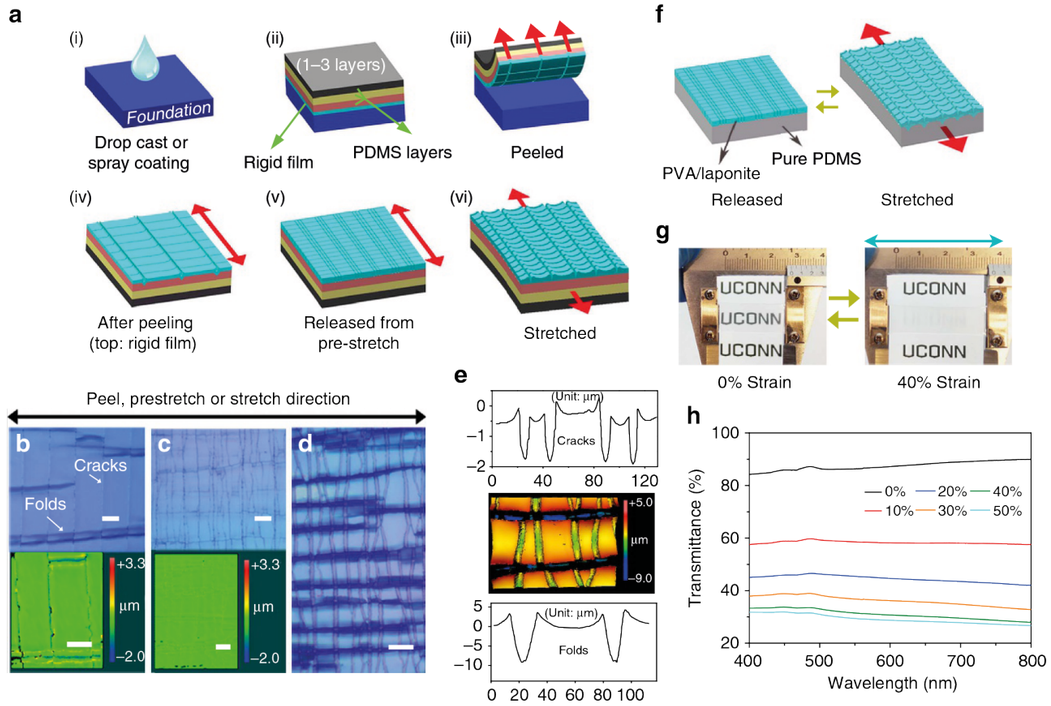



Figure 2.17 Preparation of mechanochromisms and strain responsive properties of TCM. (a) General preparation approach for all the mechanochromisms (the red arrows indicate the peel, pre-stretch or stretch direction); (b–e) optical microscope images and surface profiles of the topmost rigid layer of the TCM; (b) immediately after being peeled from the foundation (corresponding to step (iv)); (c) release from 60% strain pre-stretch (corresponding to step (v)), (d,e) stretched at 40% strain (corresponding to step (vi)); (f) design scheme for the TCM; (g) digital photos demonstrating the TCM; (h) straindependent transmittance of the TCM. Scale bars, 20 mm. Objects in the schematic diagram are not drawn to scale (Zeng, Zhang and Huang, 2020).

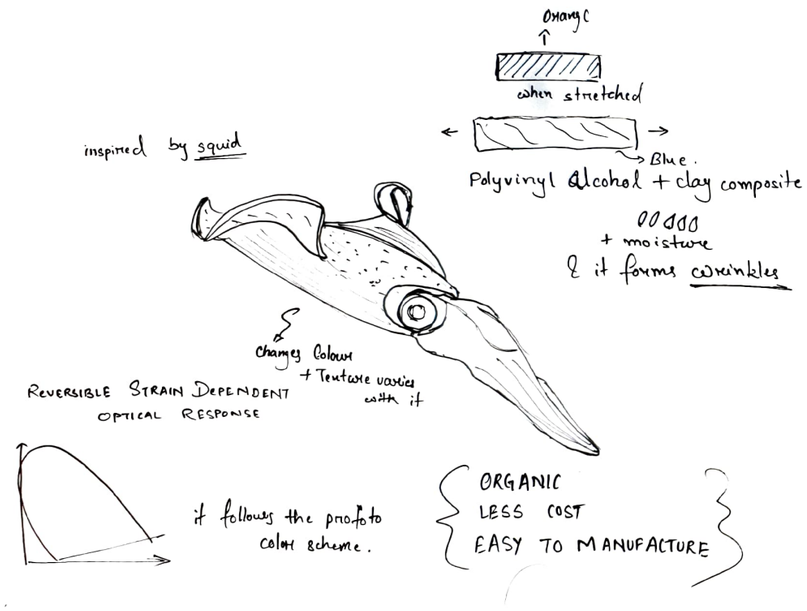



Figure 2.18 Explanation of colour and texture changing material (Archit,2020)

## Ideation

**Concept 1:** The polyvinyl is stored at the bottom and top edge of the device, which creates a problem for the speaker and charging module.

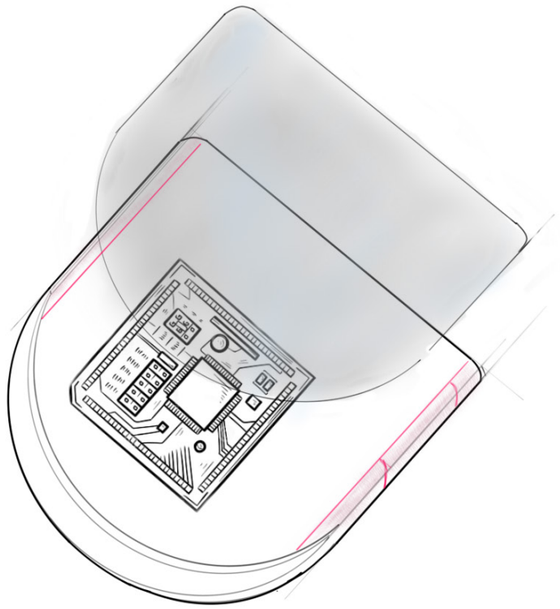
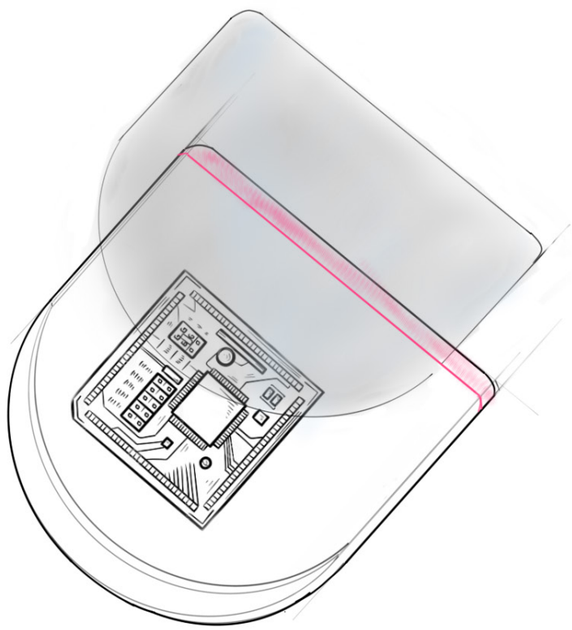


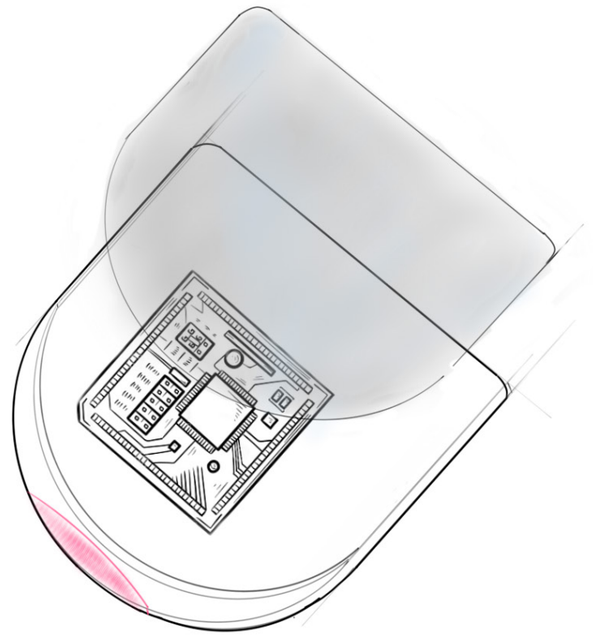
Figure 2.19 Ideation for the polyvinyl storage (Archit,2020)

**Concept 2:** The storage of the polyvinyl alcohol is at the side of the device, which creates a problem for the rollable displays.

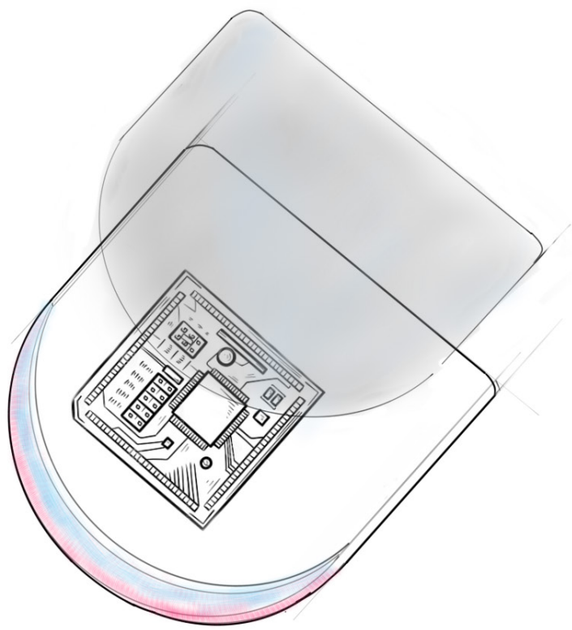




**Concept 3:** The polyvinyl alcohol is stored at the side edge, which creates an issue of the amount of alcohol stored in it.



**Concept 4:** The storage area is fixed in the side, but the volume is increased. The inspiration is from the lunar eclipse.



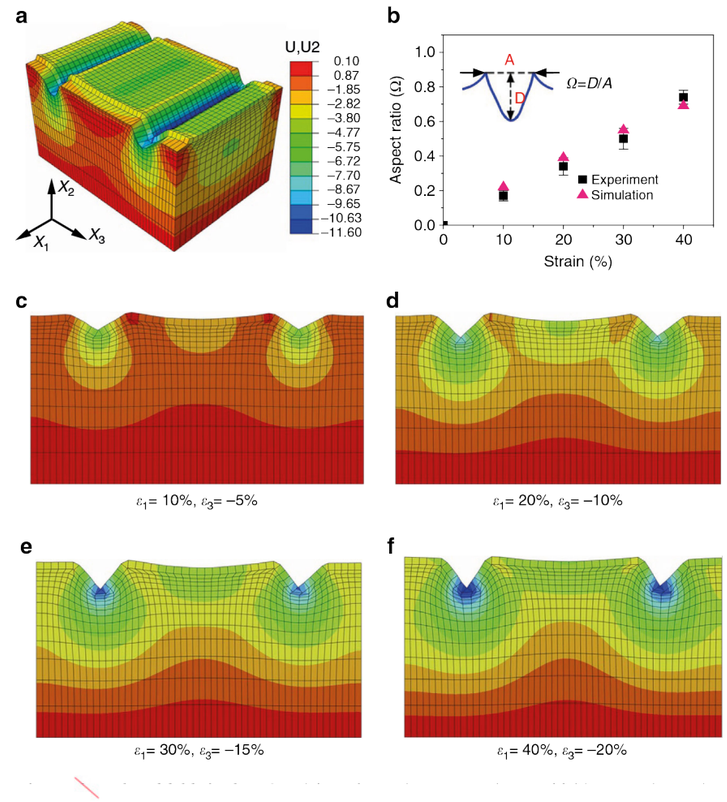



Figure 2.21 Simulated or experimental results of folds in the TCM. (a) 3D finite element simulation of folding as subjected to 40% tensile strain in the X1 direction, accompanied by 20% compression in the X3 direction due to the Poisson effect (unit: mm); (b) experimental and simulated results of the folding's aspect ratio with different applied tensile strains; error bars are defined as s.d.; (c–f) simulated evolution of folding (visualized as two-dimensional crosssection in the X1 direction), with increasing tensile strain in the X1 direction. All figures use the same stress scale bar as applied in a.
(Zeng, Zhang and Huang, 2020).

**Final Concept:** The final idea is to place the storage of polyvinyl alcohol on the side of the device. The curvature is inspired by the lunar eclipse. Now considering the durability of the material, it is resistance to a high amount of strain and doesn't break easily.

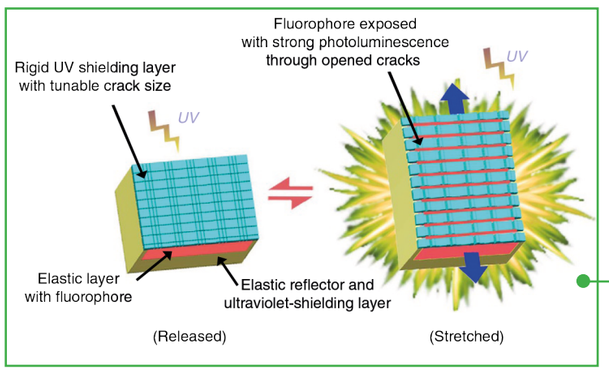
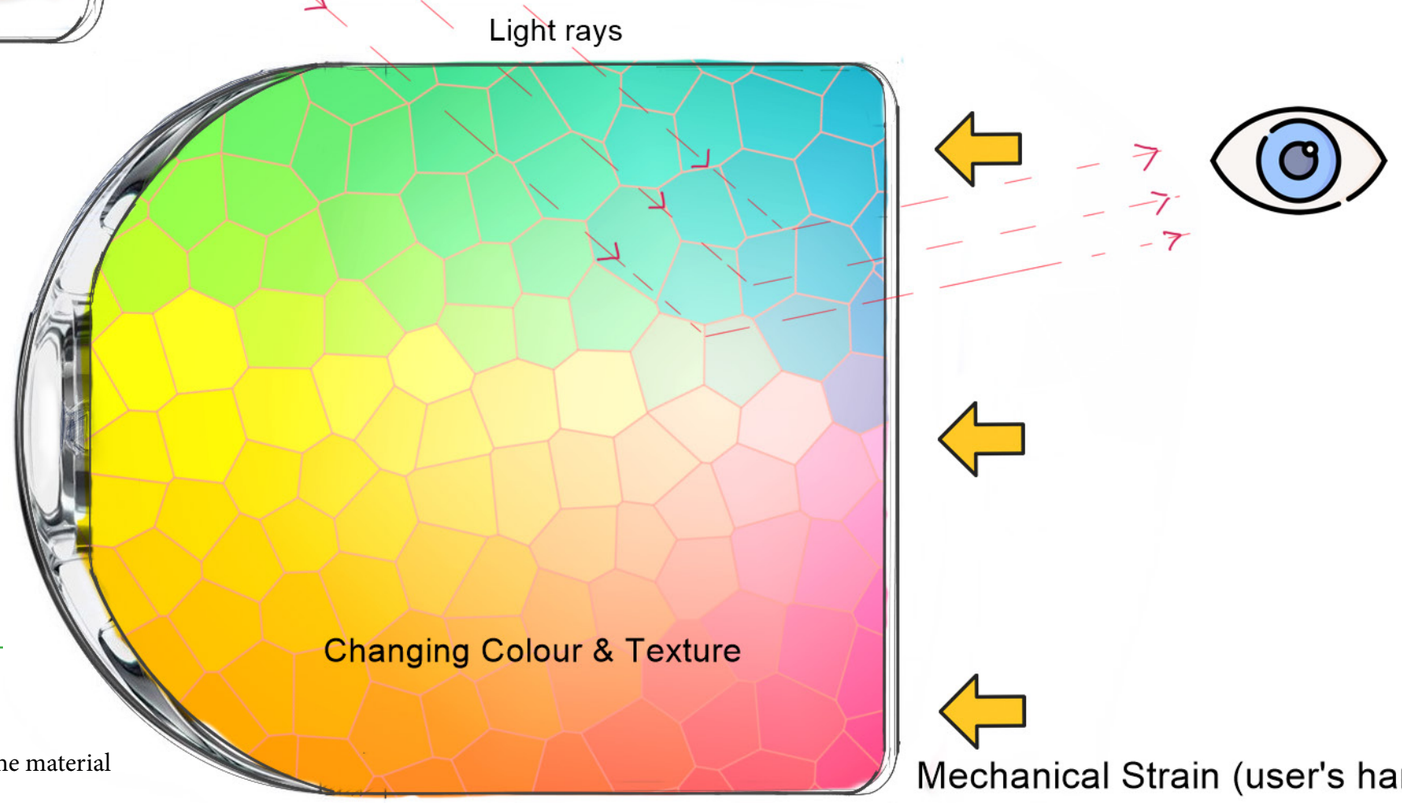



Figure 2.20 Final working of the material (Archit,2020)



# | 3.7 TECHNOLOGY IDEATION

## Rollable Display

The future of display, flexible rollable display helps in reducing the space as compared to traditional displays. These displays have better durability, lighter in weight and thinner dimension. The significant advantage is it can be bigger than the device itself but takes a minimal space.

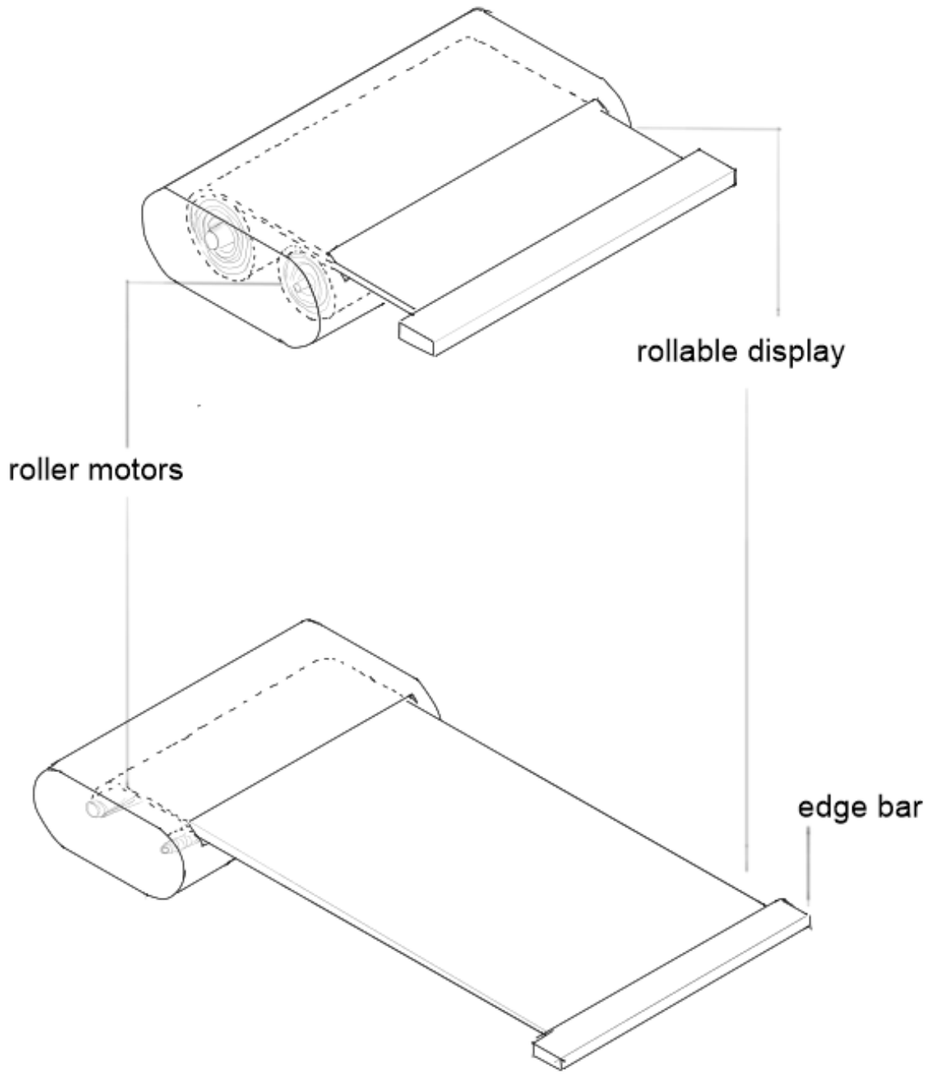



Figure 2.22 Rollable Display Technology
(Archit,2020)



## In-Display Camera

The camera is placed behind the OLED display of the device to give a seamless screen for enhanced user experience. The display present over the camera is a transparent glass. While viewing the display, it diffuses the pixel present near the camera transparent glass for a full AMOLED display. When a consumer takes a selfie or uses the front camera, then the camera capture lights coming through the transparent part of the screen.

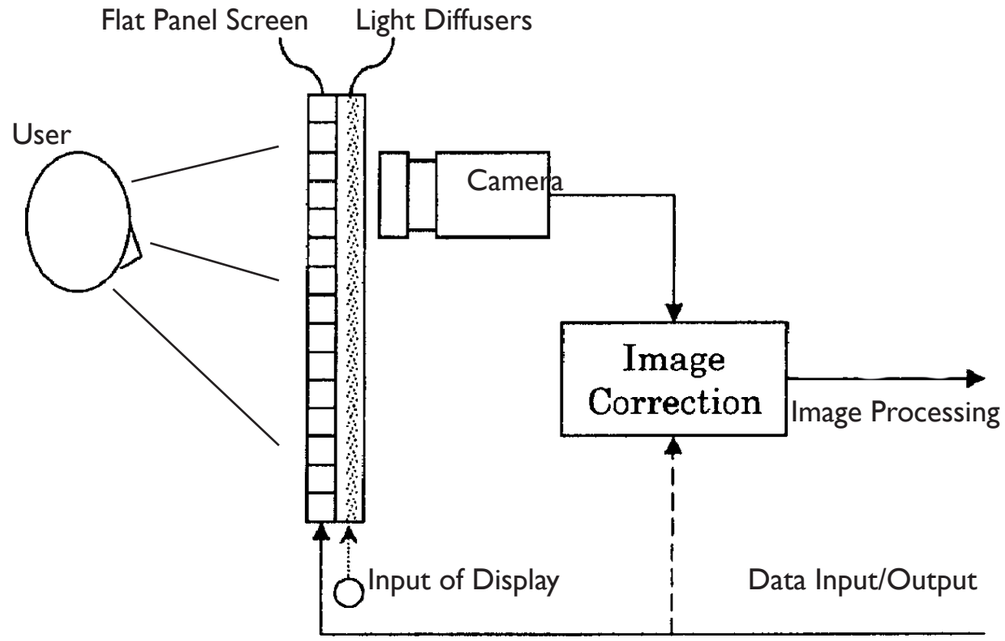



Figure 2.23 Block diagram of combined camera and display system
(Kanade, 2020)(edited)(Archit,2020)

## Physical button on the glass surface

The physical buttons present in a various small electronic product does give a satisfactory experience on the push of it. But with time, these buttons tend to get loose and even stop functioning after rigorous usage.

**Solution:**Physical buttons present on the glass surface which hide from the plain sight but work as a physical button upon pressing is the solution for traditional buttons.

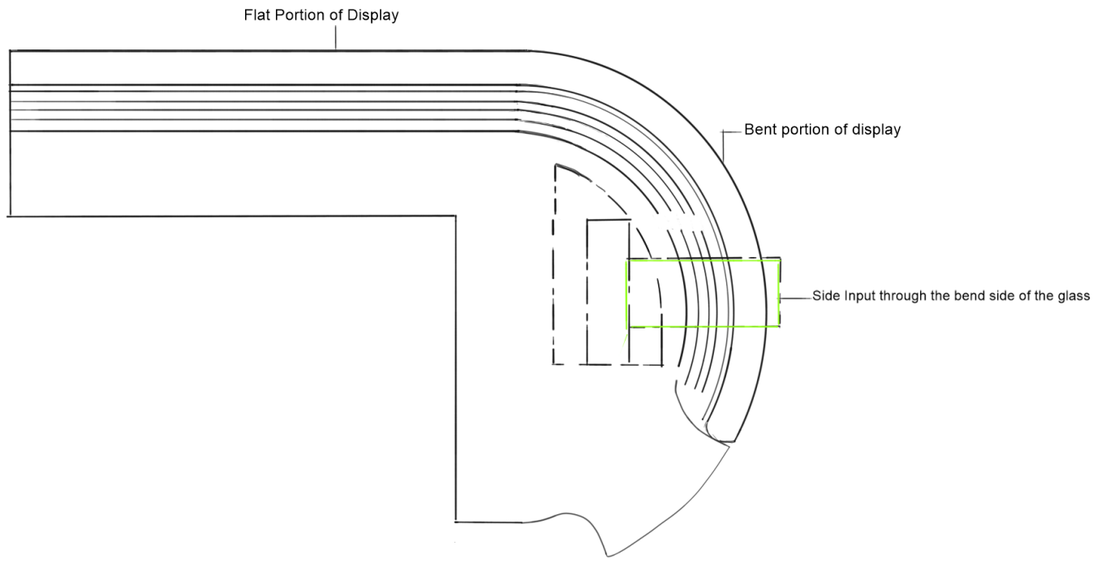


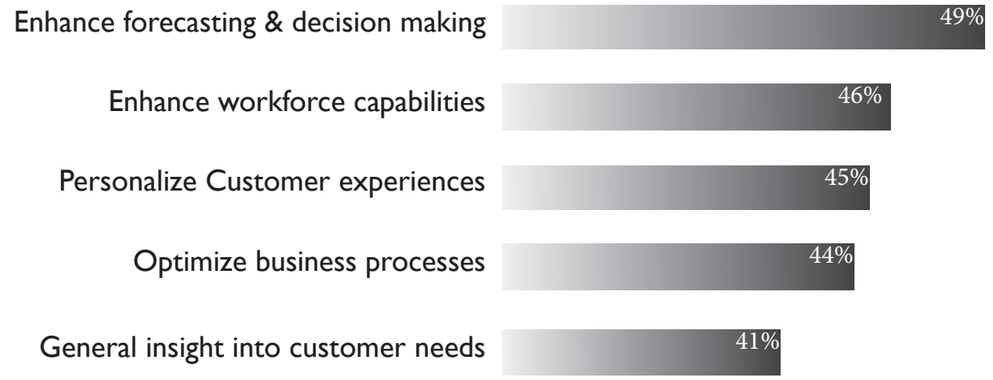

Figure 2.24 Physical Button on glass edge design(Archit,2020)

## Mixed Reality

When it comes about new possibilities of learning and reasoning by machines without the intervention of humans, there are lots of options. Artificial intelligence (AI) explains and give a chance to the machine, for helping humankind by understanding humans. AI is the development of a computer system that can perform tasks that would require human intelligence (Nones, Palepu and Wallace, 2020).



**How will AI help your electronics company compete in the next 2–3 years?** (Kienzle, 2020)




In our increasingly digital world, new emerging innovation in the field of artificial intelligence, mixed reality and the Internet of Things have changed human life, the way we work and live.

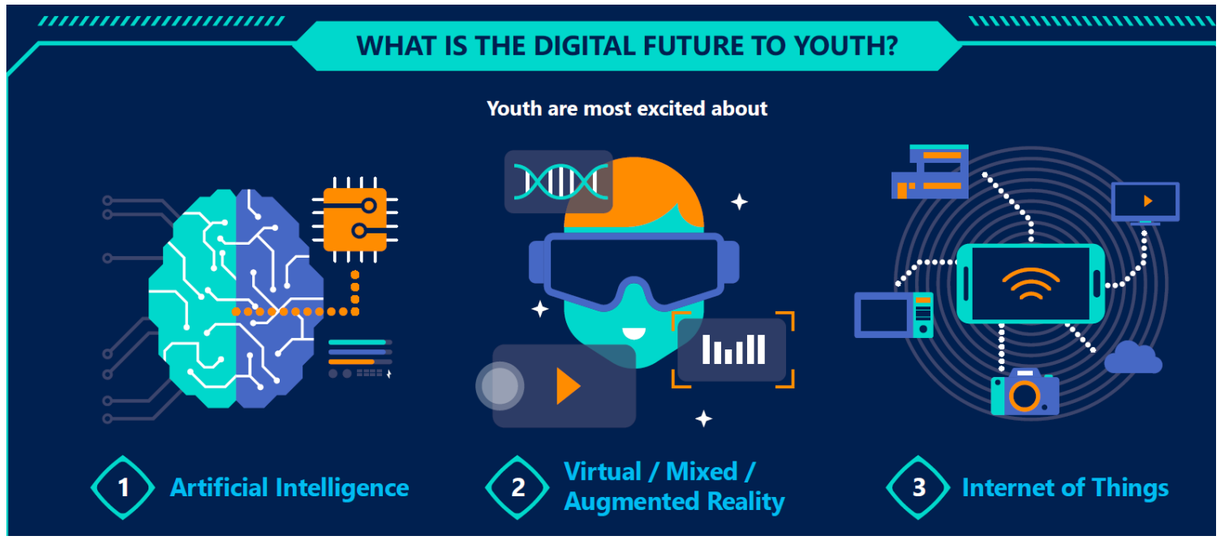



Figure 2.25 Youth across Asia Pacific rank artificial intelligence as the most exciting technology innovation that will affect their lives. (Microsoft, 2017)

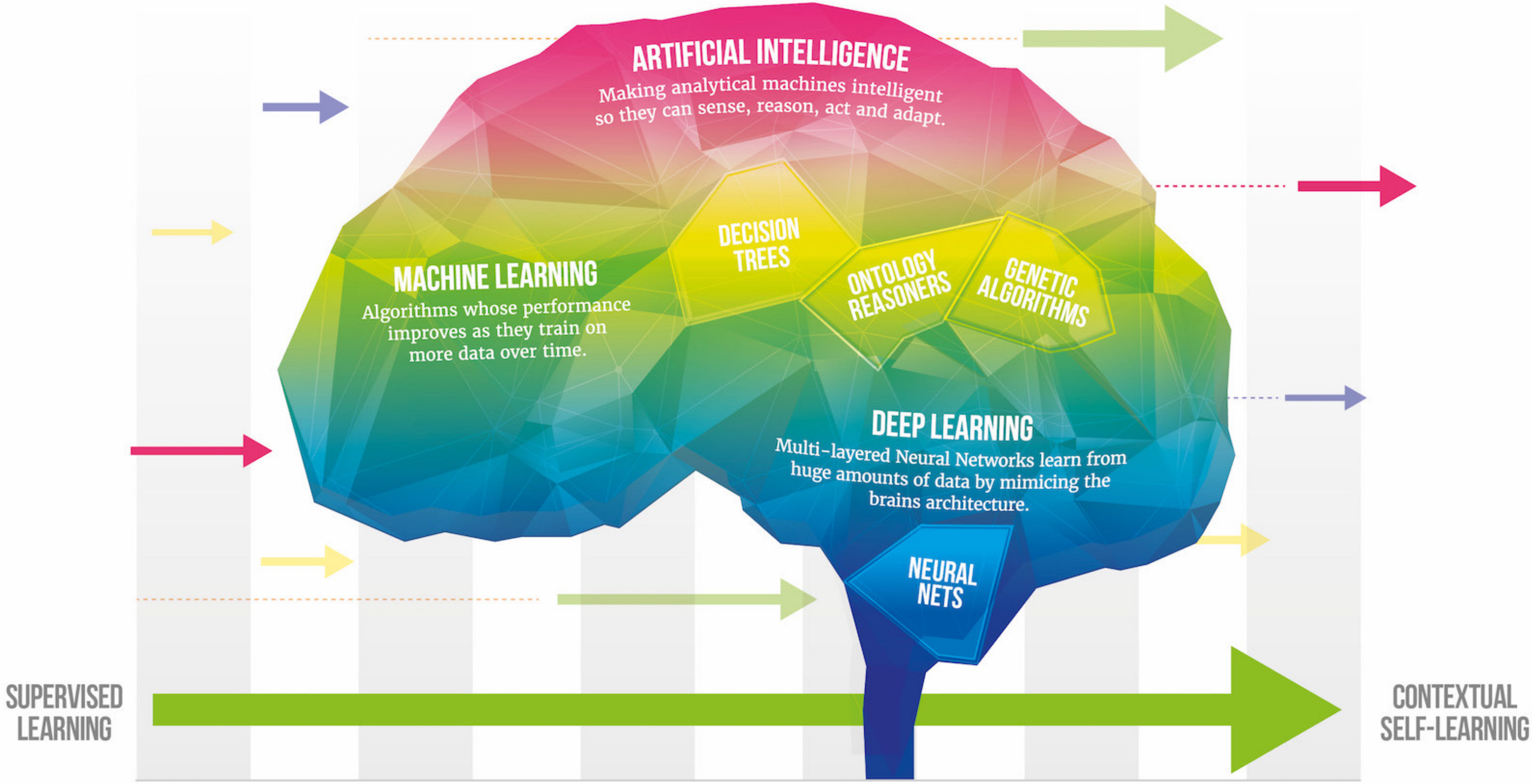



Figure 2.26 AI Technology and its categories (memoori, 2018)

With the increase and innovation in technology, the experience of consumers needs to be elevated. A single touch in the glass can bring your food as well as turn of your light. These features are getting mundane. Smartphones are limited to features, and with the increase in technology, there has not been a considerable growth in technology associated with smartphones.

Mixed reality, which is a combination of virtual reality and augmented reality, has opened many doors for the innovation in the small electronic object as well as to enhance and solve user problems. Modern-day smartphones are incapable of mixing both the physical world and the virtual world during their usage. With the help of mixed reality, the gap between virtual and physical world can be reduced. These will elevate the human senses of communication and experience the virtual world.

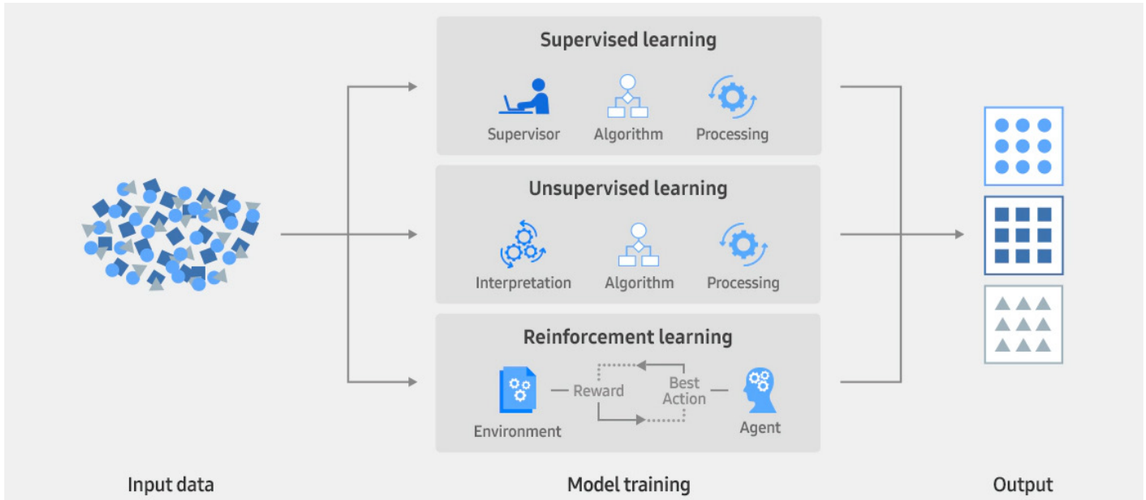



Figure 2.27 Working of the AI Model (Microsoft, 2019)

AI and Deep Learning fundamentally alter the way Virtual Reality systems view their environments. Indeed, the addition of intelligence to applications will contribute to providing an experience that is truly engaging (AI-Powered Mixed Reality, 2020).



## Three Dimensional display technology

The physical world around us is three-dimensional (3D), yet traditional display devices can show only two-dimensional (2D) flat images that lack depth (i.e., the third dimension) information. This fundamental restriction dramatically limits our ability to perceive and to understand the complexity of real-world objects. (Geng, 2020). Computer vision enhances our 3D visualization. There are four major depth cues which our brain uses for 3D visualization-

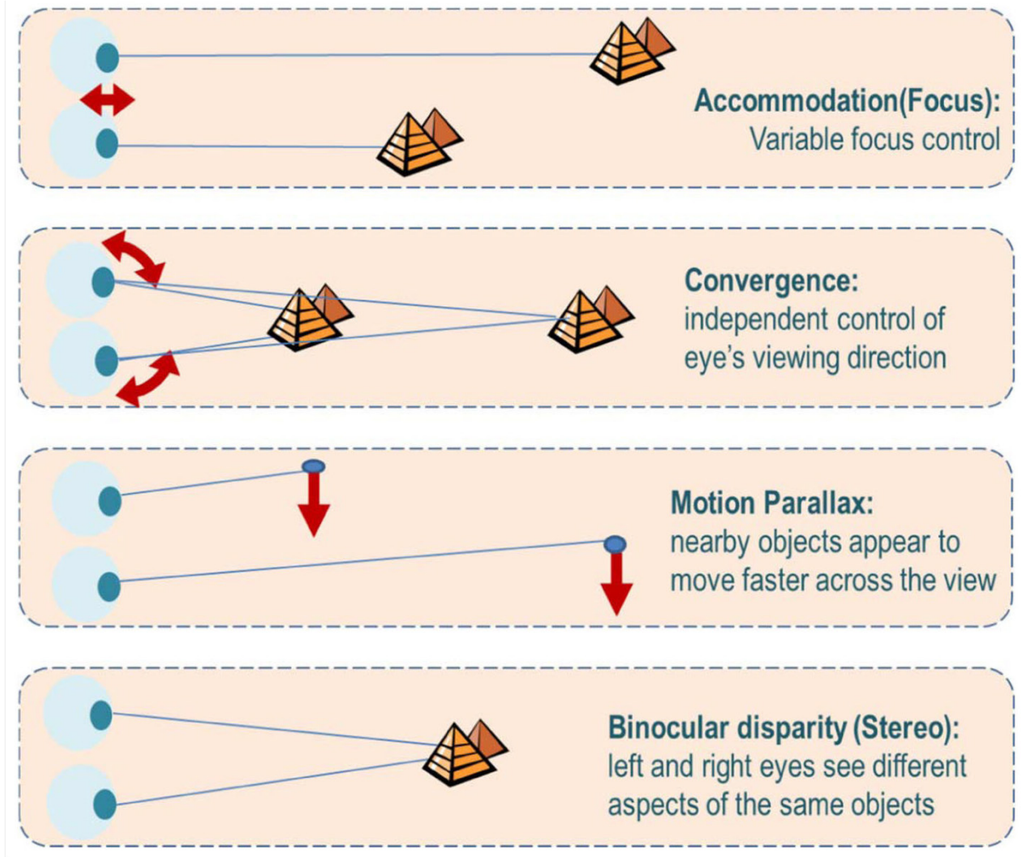



Figure 2.28 Illustration of four major physical depth cues. (Geng, 2017)

**Solution:** The use of the rollable display and 3-D technology in it will enable the user to experience and communicate in a 3-Dimensional way.

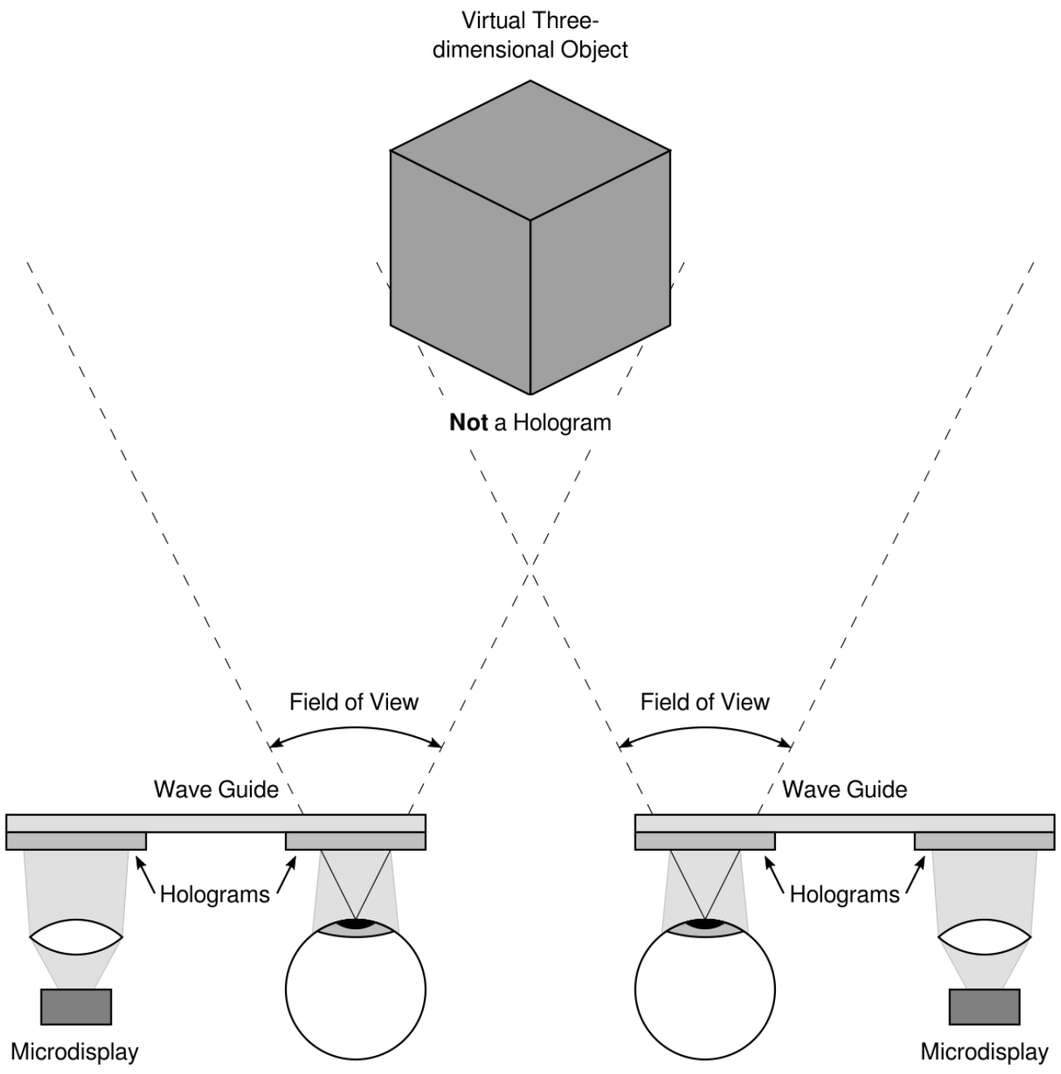



Figure 2.29 Working of the 3-D display (authors own)(adopted)

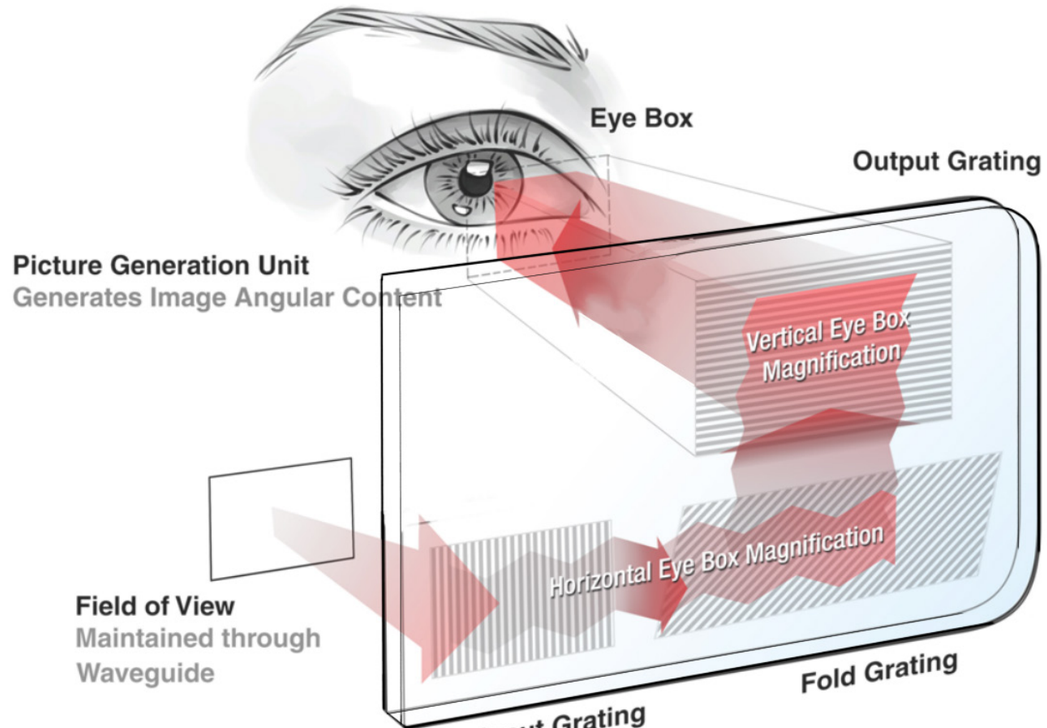



Figure 2.30 Working of the holographic display (GRAYSON, 2017)(edited)(archit,2020)

**Concept 1:** Placing the 3-D picture generation unit at the bottom of the device creates a placement problem for the charging module.

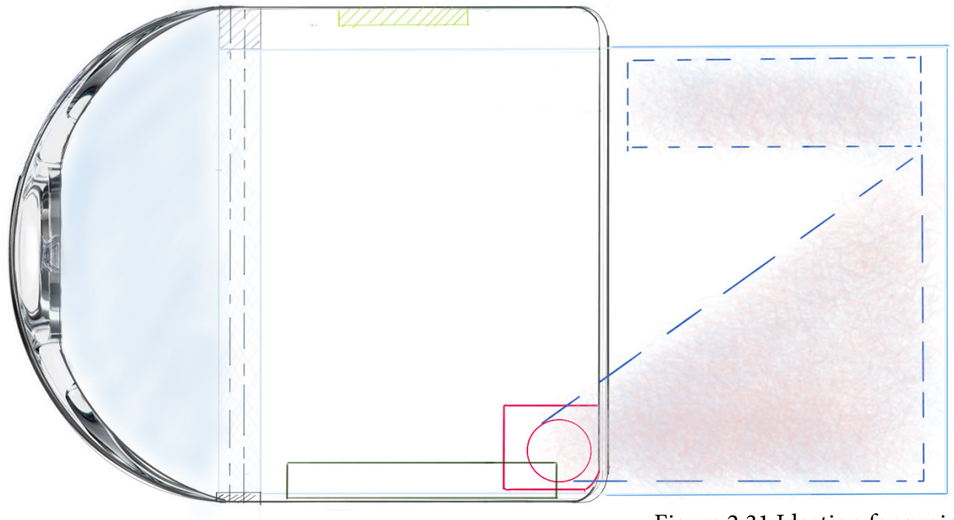
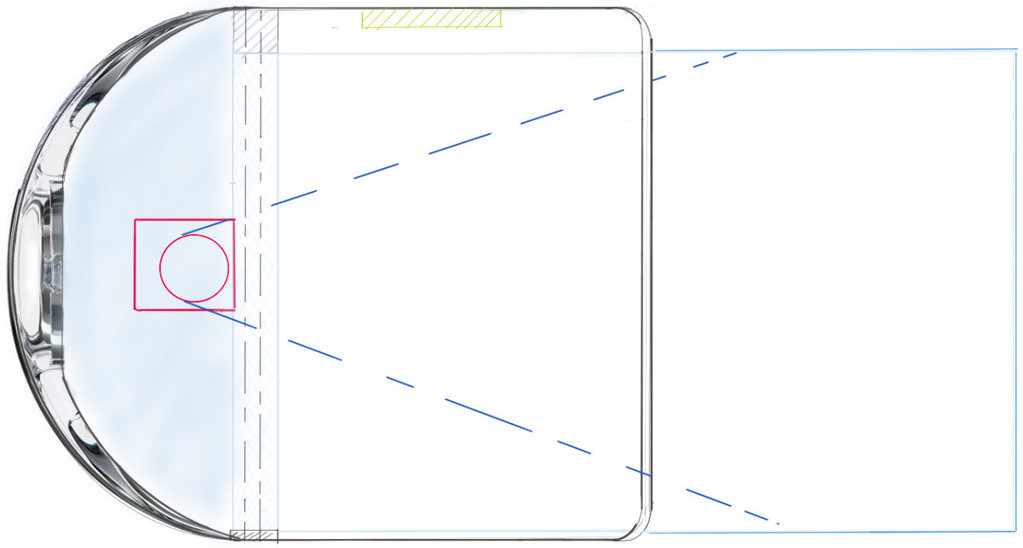
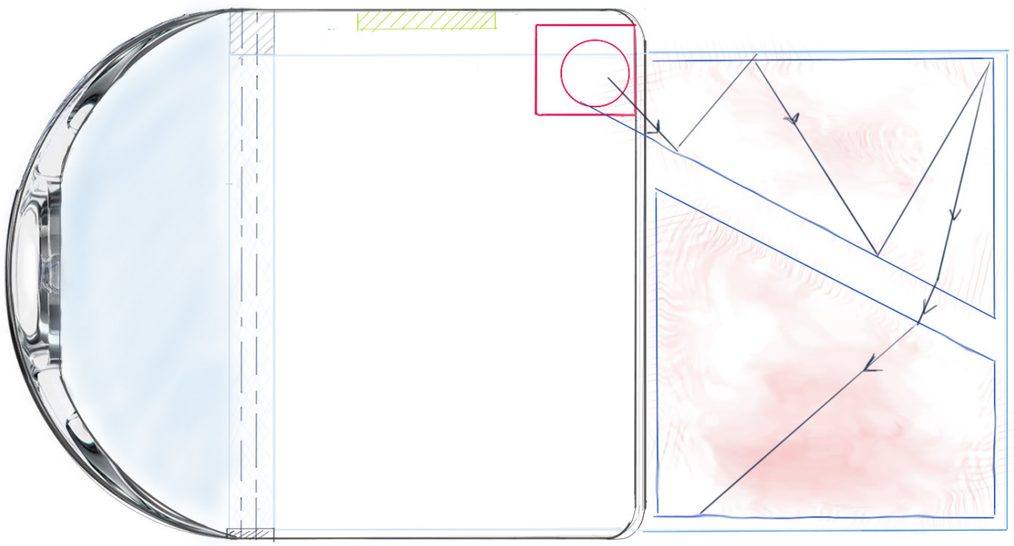


Figure 2.31 Ideation for projection of 3-D Display(Archit,2020)

**Concept 2:** Placing the picture generation unit before the rollable display isn't effective in generating images.



**Concept 3:** Placing the picture generation unit at the top of the device helps in correct placement and even proper image generation which is possible due to the refractive index of the light.





# | 3.8 BRANDING

A brand is a feature or set of features that distinguish one organization from another. A brand is typically comprised of a name, tagline, logo or symbol, design, brand voice, and more. It also refers to the overall experience a customer undergoes when interacting with a business — as a shopper, customer, social media follower, or mere passerby. (Decker, 2020)

***"Branding is the process of connecting good strategy with good creativity"***

***— MARTY NEUMEIER, AUTHOR OF "THE DESIGNFUL COMPANY"***

The idea behind branding the device came from its shape, which looks like an eclipse.

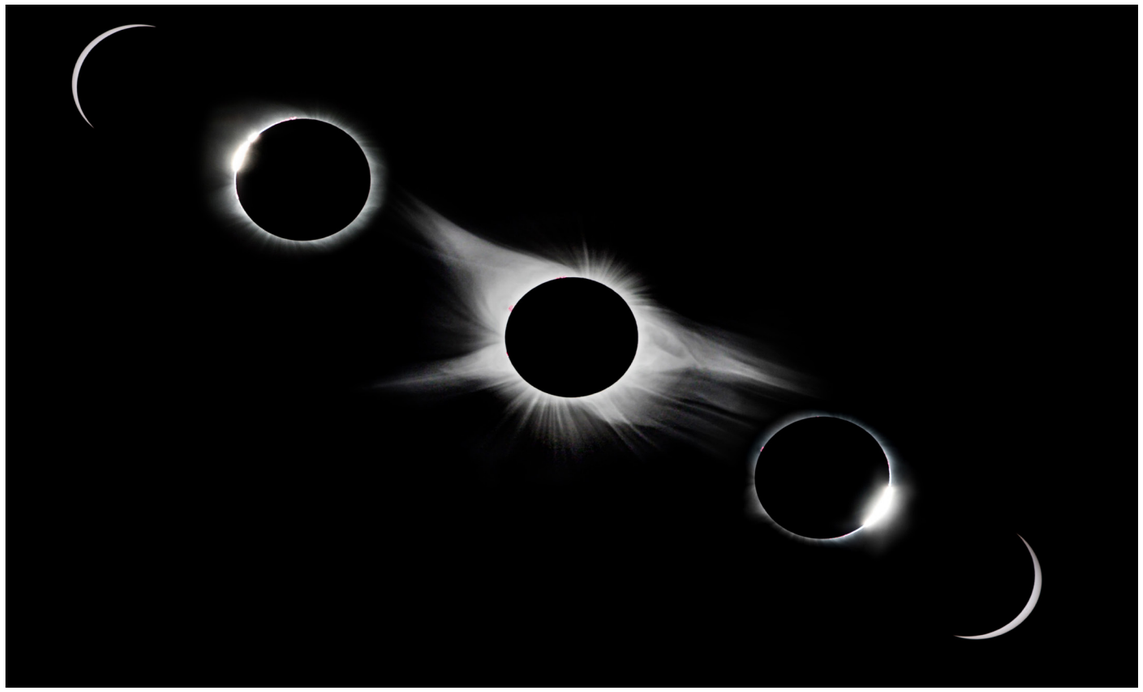


Figure 2.32 ECLIPSE(Parker, 2019)

Figure 2.33 Half moon(Walker, 2020)

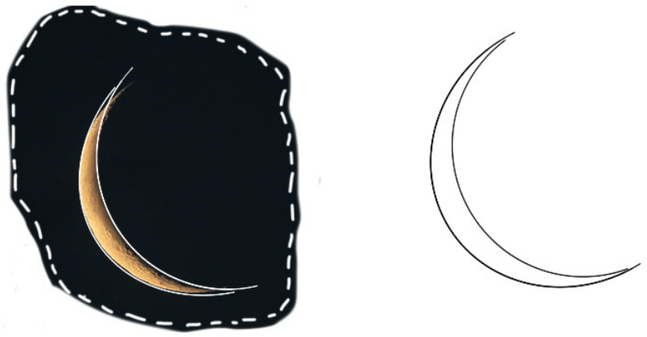
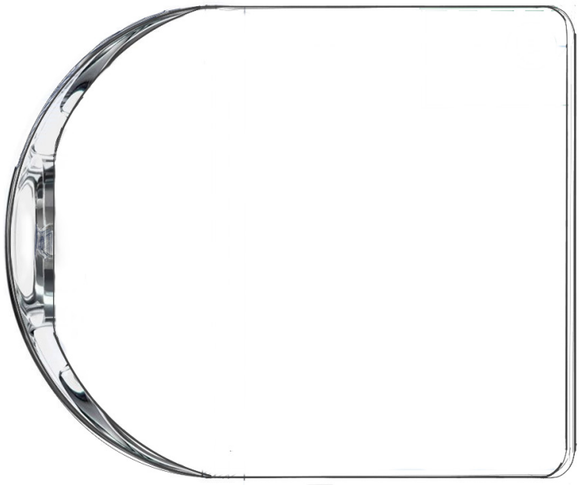
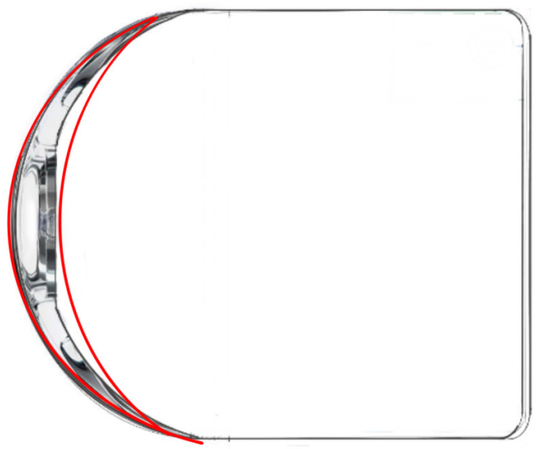


Figure 2.34 Ideation of brand logo(Archit,2020)

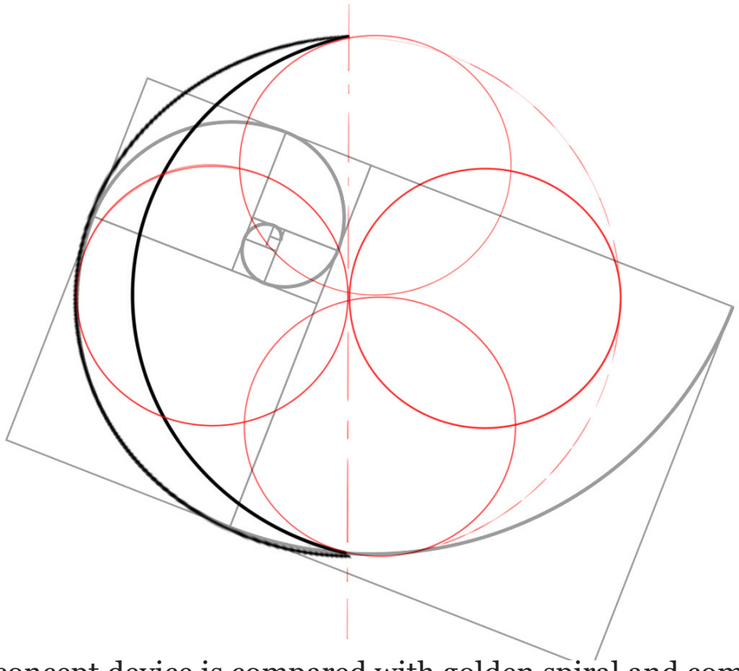
Deriving the shape from the shape of the moon



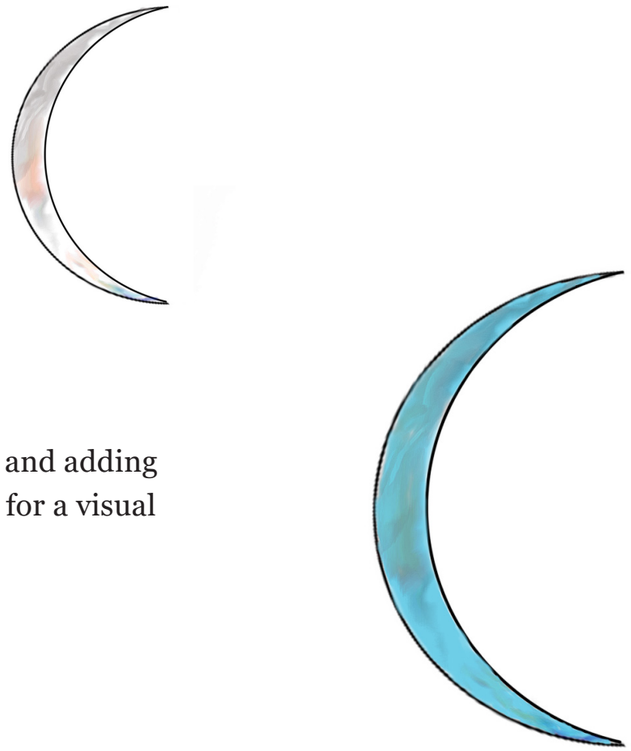
The base shape of the concept device which looks precisely like the moon during an eclipse



Comparing the outline of the moon and the concept device.



The logo of the concept device is compared with golden spiral and composed with symmetrical circles. The inner and the outer ring which forms the outline of the logo fits perfectly in the golden ratio.



Refining the logo and adding multiple textures for a visual aesthetics.

Figure 2.35 Final ideation of brand logo(Archit,2020)



# | 3.9 FINAL CONCEPT SELECTION

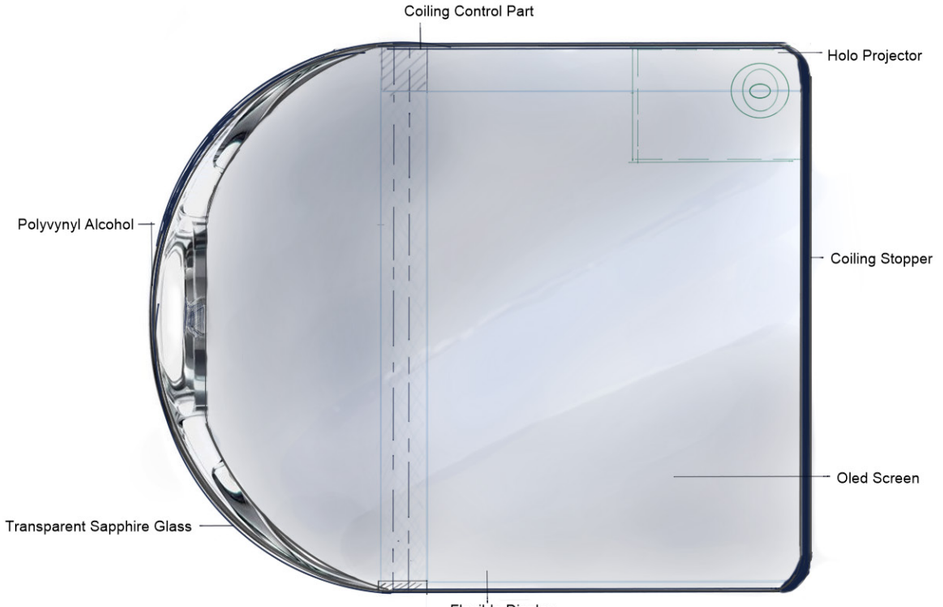



Figure 2.36 Front view of the device(Archit,2020)

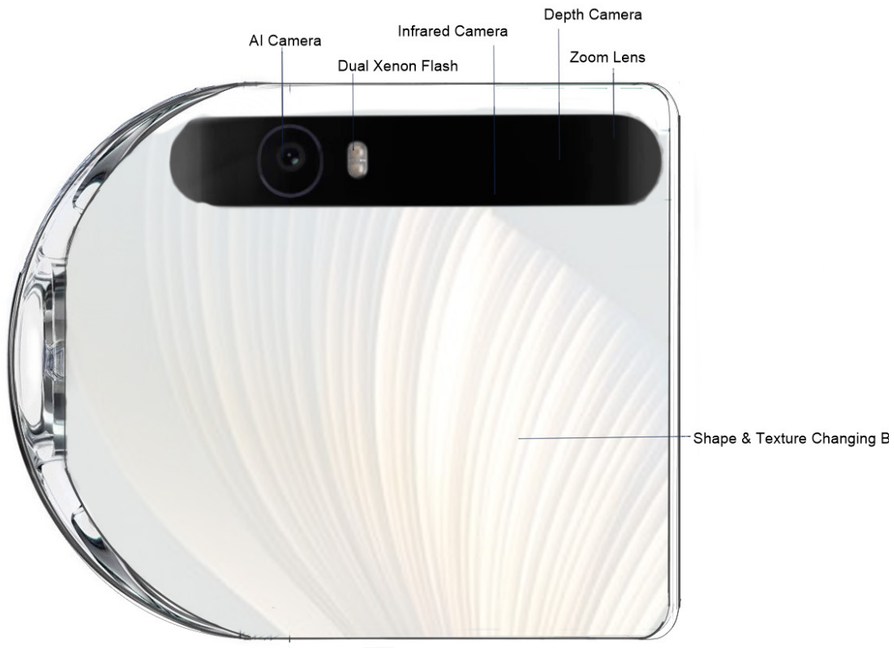



Figure 2.37 Bottom view of the device(Archit,2020)


Figure 2.38 Final vision of the device(Archit,2020)

# | 3.10 ANALYSIS

After selecting the final concept, the demerits and cons of the design were analysed. Low-quality renders were made to visualise the design. It was found that the rear camera was getting blocked by users hands when a user switches his/her hand.

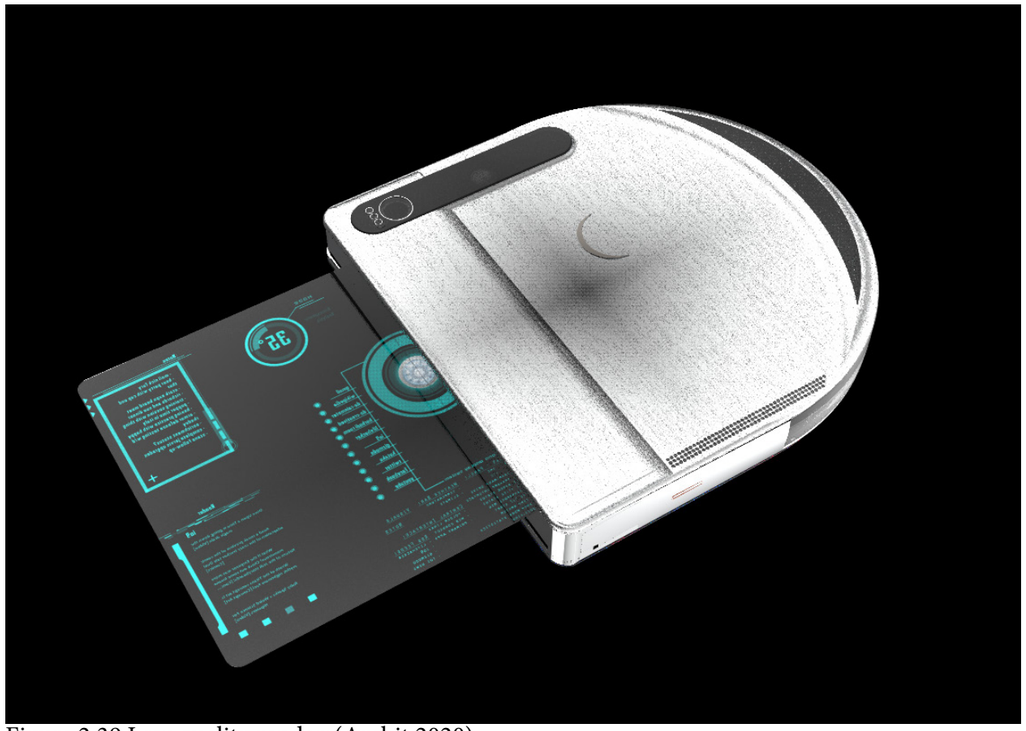


Figure 2.39 Low quality renders(Archit,2020)

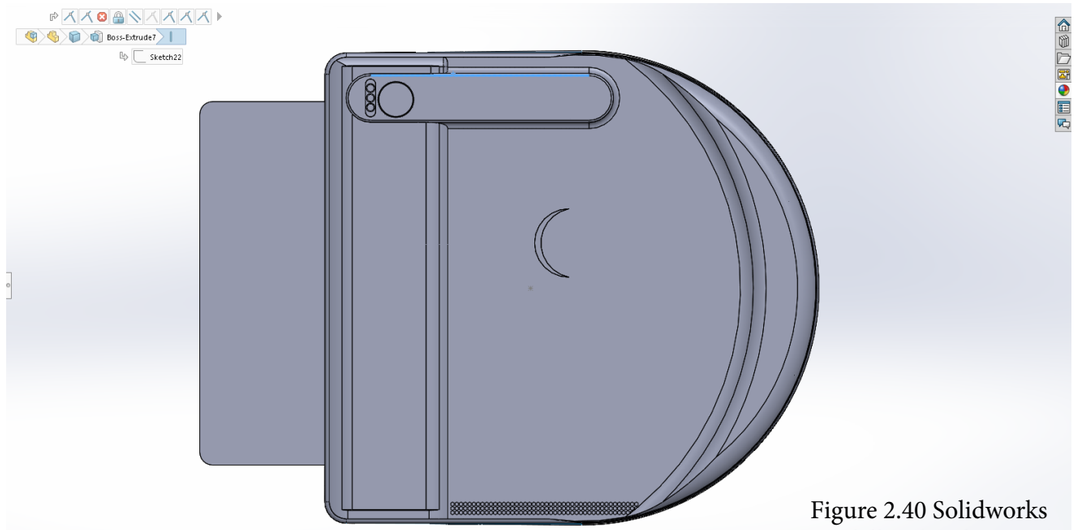
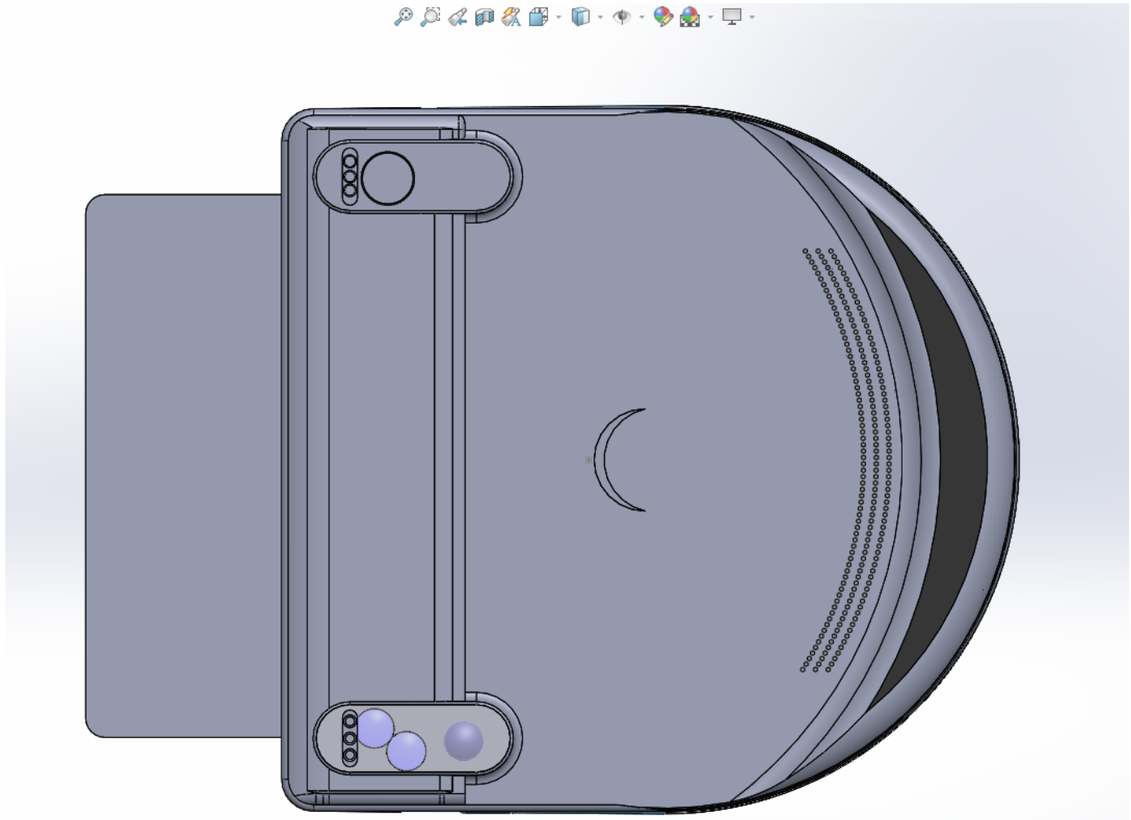



Figure 2.40 Solidworks modelling(Archit,2020)



v

The final position of the camera was changed, and dual positioning was done. Considering the ergonomics, the new location of the camera makes it more ergonomic to the user's hands.

# | 4.0 THE ECLIPSE

The final solution is to provide a complete customer experience with the help of mixed reality technology and emotional design, which will elevate the user interaction with Eclipse.

Rendered Image (Archit,2020)

The device is made up off the rollable display and with the help of a picture generation unit, 2-D shapes and images can be visualised in 3-D. In addition to the holographic display, it has a colour and texture changing back cover which a user can customise. With the most ergonomic form of the device, it is a perfect companion for a user.

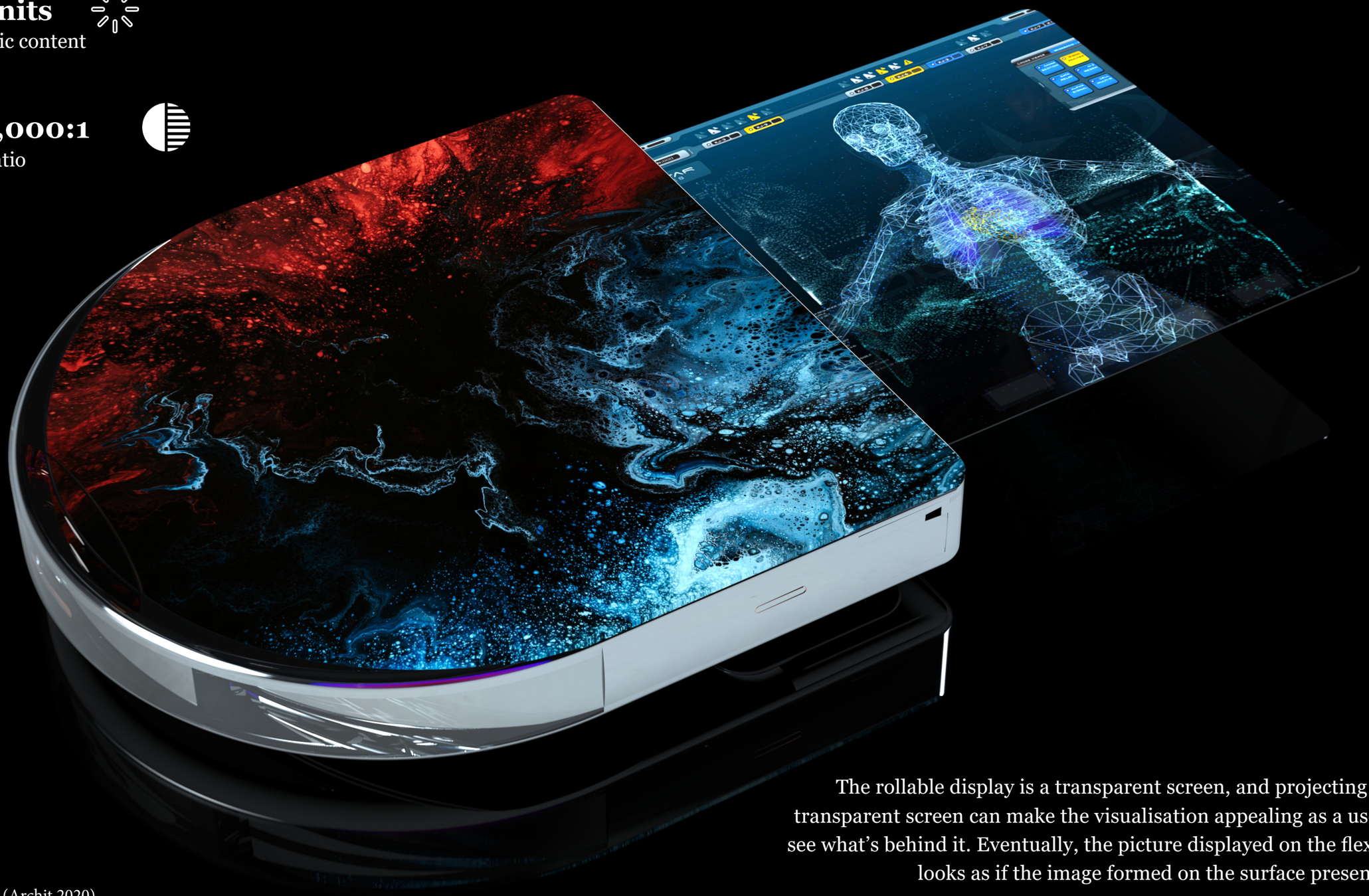
The super AMOLED display has three levels of brightness and knows when to use them. It turns up to 800 nits when in the sun, turns to 1000 nits when using camera and goes to 1300 nits for a full dynamic range content.

Dynamic colours which are consistent through the edges & corners

AI power management for efficient battery life

Up to
**1,300 nits**
for dynamic content

**2,000,000:1**
contrast ratio



The rollable display is a transparent screen, and projecting image on a transparent screen can make the visualisation appealing as a user can even see what's behind it. Eventually, the picture displayed on the flexible screen looks as if the image formed on the surface present behind it.

Rendered Image (Archit,2020)

# Beauty with Brains

### Ergonomically Designed

Thinking about the user's hand, the form of the device has elevation and depressions, which fits perfectly. It has a rubber grip which enhances a user's grip on the device.

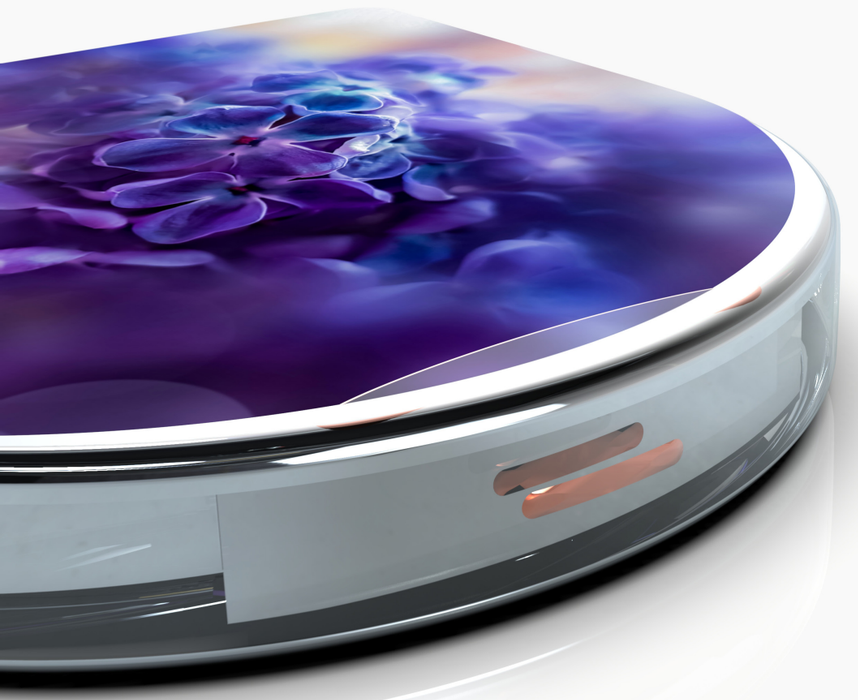
### Colour and Texture Changing material

Never the same when you see and feel it

Rendered Image (Archit,2020)

Tactile Button for Rollable Display

The smooth sound of the click for the massive rollable display



# A massive leap with the pro camera system!!


Rendered Image (Archit,2020)


(Rendered Image (Archit,2020)
(adopted)Blum, 2017)

# Detecting the issue by just pointing the camera


Rendered Image (Archit,2020) edited(Kreuter, 2016)

# Mixed Reality : Seeing a Dinosaur

Rendered Image (Archit,2020)
edited(Kondratiev, 2019)

Selfie??
Ahh!! yes ofcourse

## Under Display Camera

The new front-facing under the display camera helps to take amazing selfie and portraits


Rendered Image (Archit,2020)
(adopted)(Du Preez, 2018)

# Battery!! Goes on and on...

### Super Fast Charging

Plug in for super fast charging in just minutes

### AI Intelligence Battery

Ai monitored battery which adapts according to the usage

Rendered Image (Archit,2020)

# Water!!! Not afraid of it

Water Resistant

## Goes up to 1.5 metres of water for about 30 minutes

IP68 Rated Protection

Rendered Image (Archit,2020)

Rendered Image (Archit,2020)

### Dolby Atmos

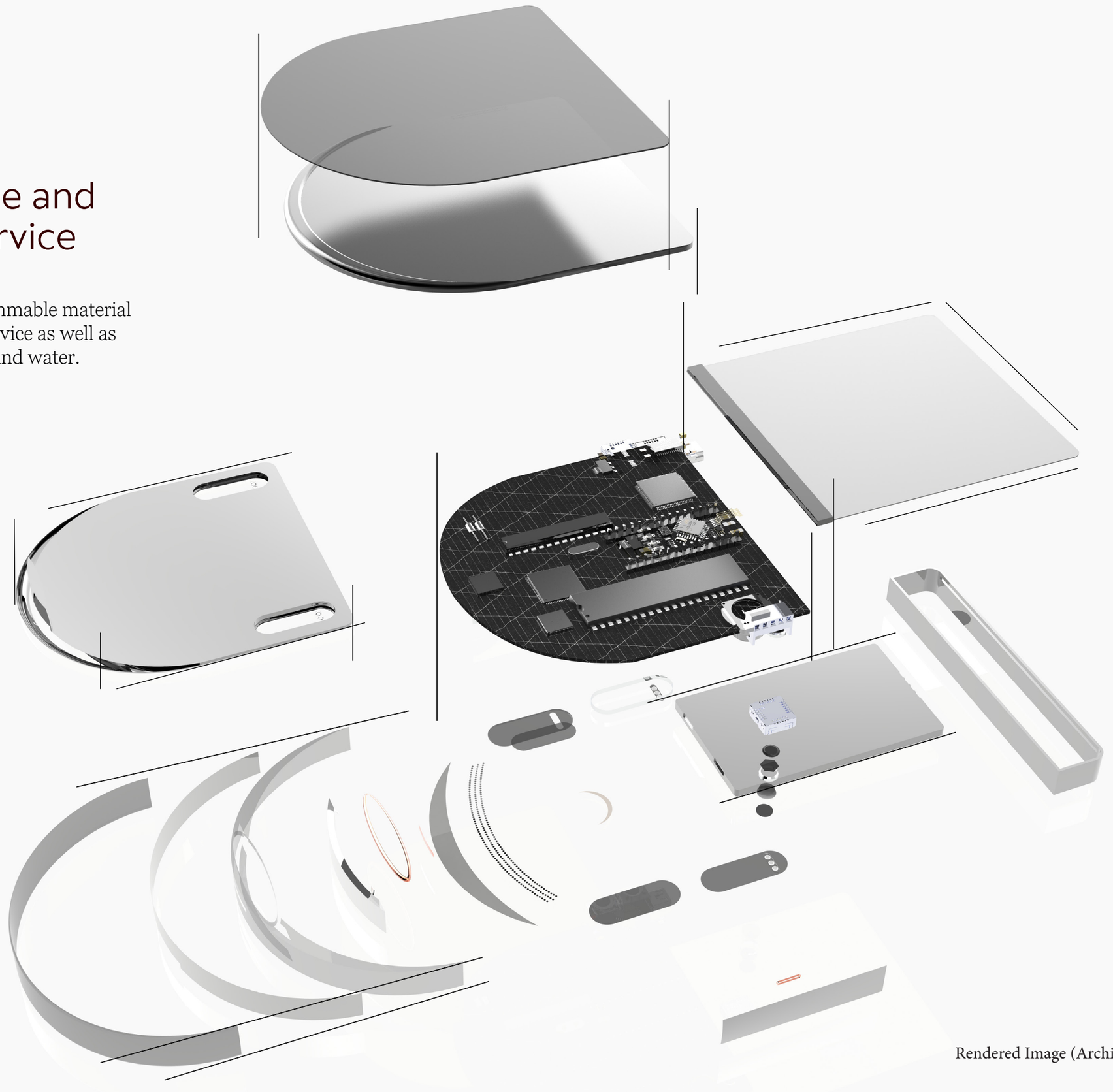
3 Dimensional sound which gives an overall 3D experience

### Spatial Audio

Immersive and interactive sound experience

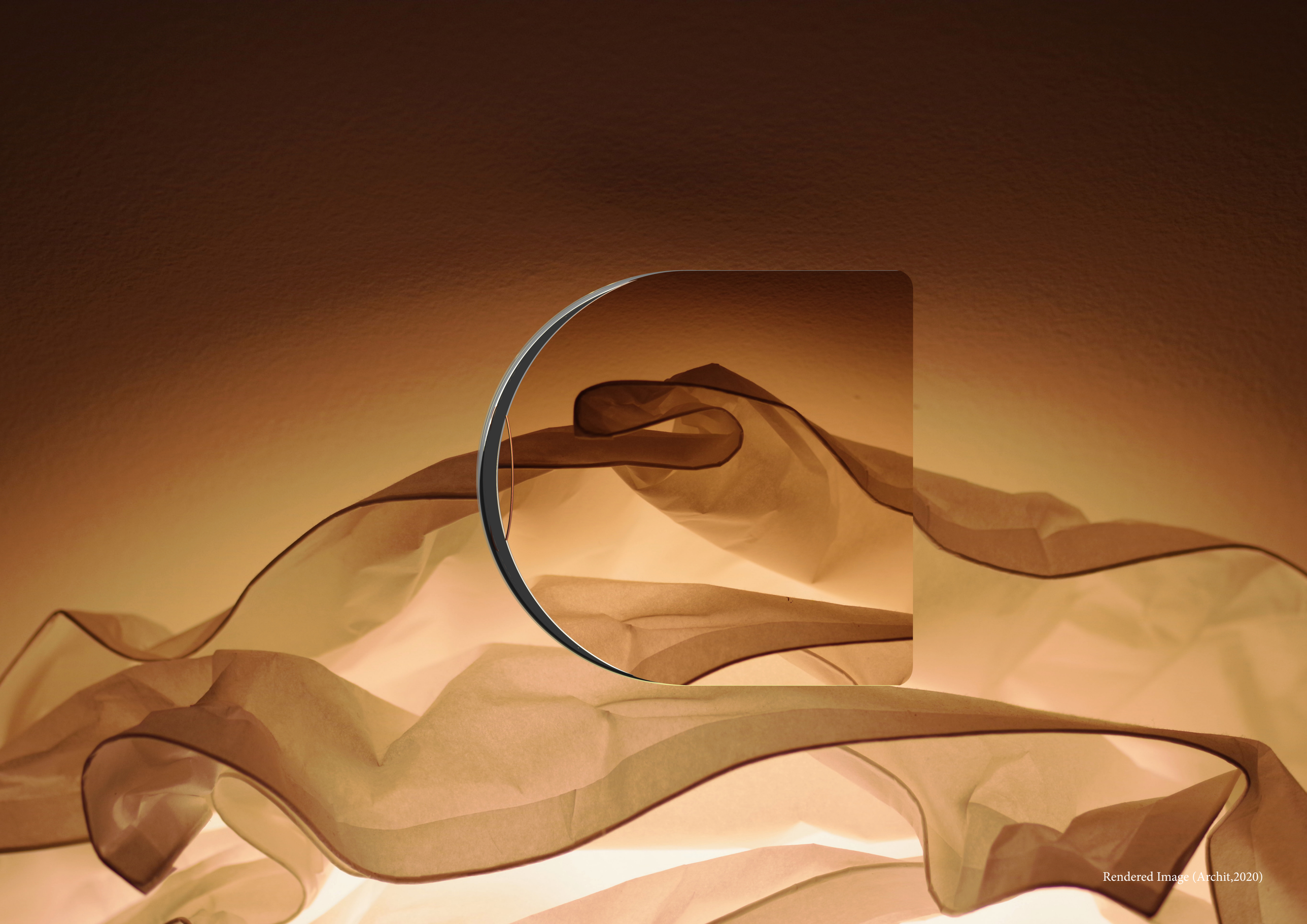
# Hmmm!!
# It’s easily recyclable and even easier to service

The magnetic-activated shape programmable material helps in easy disassembling of the device as well as reliable protection against dust and water.

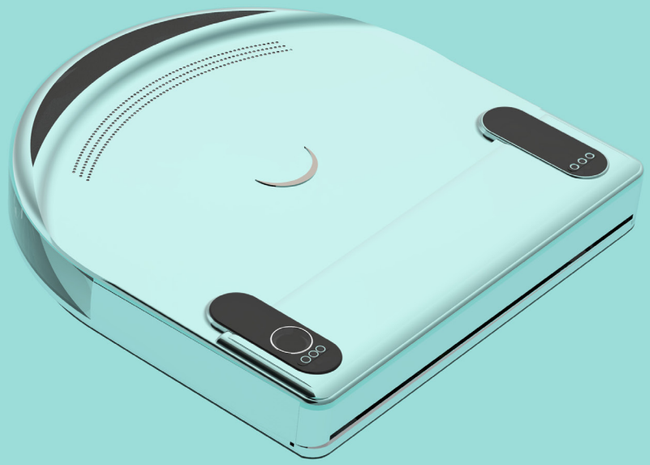


Rendered Image (Archit,2020)

Rendered Image (Archit,2020)



Rendered Image (Archit,2020)



Rendered Image (Archit,2020)

# | 5.0 RESEARCH REFLECTIONS

The design research project has challenged the design skills as well as design thinking of finding a problem and then finding the appropriate solution to it. As the consumer electronics industry is quite vast and the technology is rapidly changing, designing a product which can elevate the user experience as well as make a connection with the user was a challenge. As users are from various geographies and demographics, it was challenging to identify the problem faced by multiple users.

Time management was another critical issue faced during the research work. In addition to these issues, polygon modelling and sculpting the device was a significant challenge faced by the author. The primary benefit with the research report was enjoying the process of design with the research work that was carried out on various subjects and then the successful outcome of it which links to the benefits of the users.

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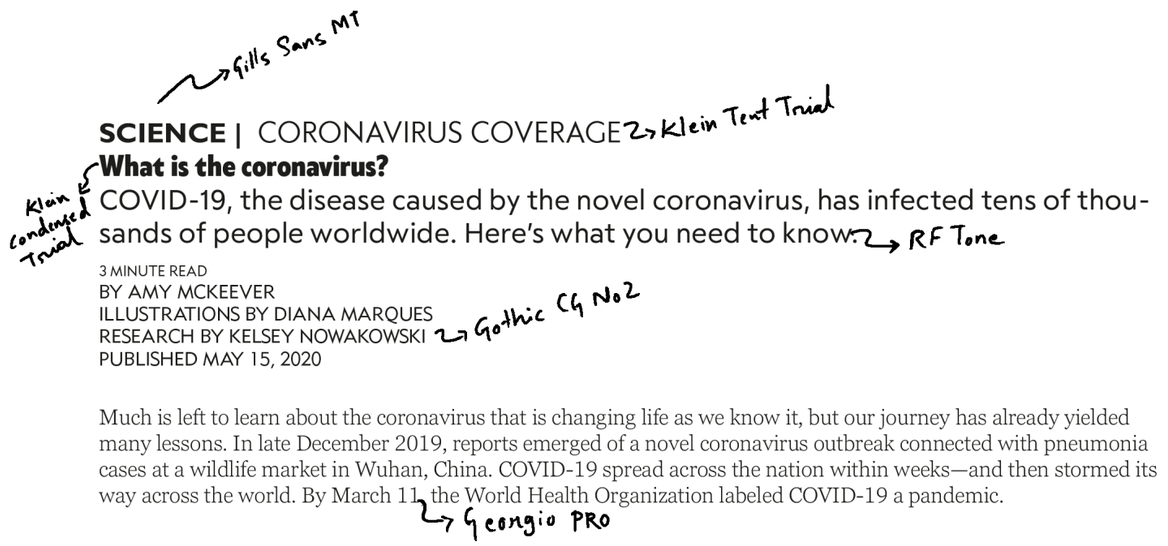
ISBN: 978-3-319-67002-7




# | APPENDIX

## Typefaces

A particular font and text size research was carried out. It was done to find the appropriate layout and text to be used in the research process.




## Recycling & E-waste

**Table I** Summary of barriers to adoption of modular upgradability

| *Demand-side* | *Technological* | *Competition* |
|---|---|---|
| Emotional appeal | Uncertainty in platform investments | With own products |
| Variety seeking | Performance loss owing to modularization | With suppliers |
| Replacement effort | Technological change | With other OEMs |
| Decision biases | Performance in saturation | With secondary markets |
| Keeping up with new specs | | |

*Note*: OEMs = original equipment manufacturers.

The reason for not adopting a modular design approach for electronic products.

## Emotional Design

A simple event during a usage episode

**Encountering events:** Someone may uncover secret features or properties of the commodity through the direct experience of commodity use. A participant reported an event that explored a shortcut in an mp3 player's navigation system. Such types of activities may cause feelings such as shock, excitement, or contentment or frustration in general.

**Malfunction, brake-down, improper reaction incidents:** Such cases are characterised by the product's incorrect response to the user's
Credits. Reported instances of this sort of incidents include a coffee seller that only poured half full of coffee, a device that crashes, or a laundry machine taking too long to have the tap off.

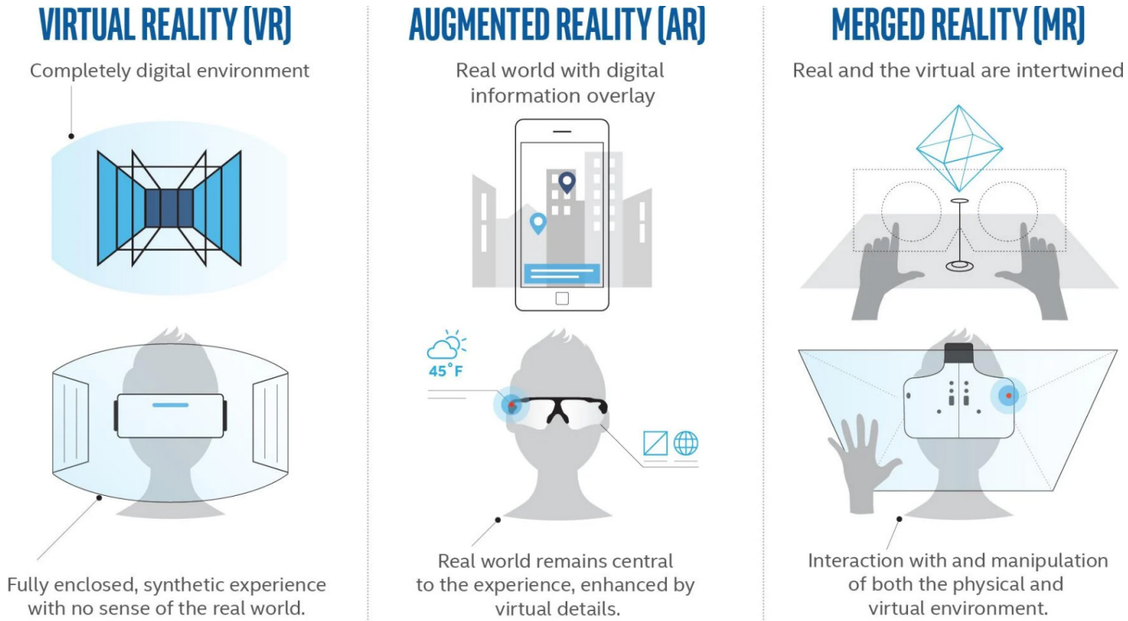
**Errors and accidents:** These incidents include acts missed by consumers. Examples involve clicking the incorrect button when attempting to read an SMS, dumping coffee on a table when drinking out from a flask with an open cap, not being able to insert a rusty wooden fork through a slice of mushroom, hitting the heated handles of a saucepot.

**Completion of usage episodes:** The outcomes may be emotionally evocative as one finishes a consumption, repair, or maintenance session for the drug. One participant recorded a case where she felt satisfied when she finished
Installing a tent as a sign for starting enjoyable times.

**Communication events:** It may also be emotionally evocative to receive an SMS or an e-mail via communication devices. Those times may be fun or negative based on the quality of the post.



## Mixed Reality




Mixed reality concept and is a mix of the virtual world , i.e., mixed reality and augmented reality.

Augmented reality ( AR) is a real-world virtual phenomenon environment in which real world resident objects are enhanced computer-generated perceptual information, often via multiple sensory modalities, including visual , auditory, haptic, somatosensory and olfactory. AR, can be described as a device that fulfils three basic features: real and virtual combinations.

Virtual Reality ( VR) is a virtual reality that can be similar to, or entirely separate from, the physical world. Applications for virtual reality that involve all Educational use (i.e. medical or military training) and entertainment (i.e. video games).

Mixed Reality (MR) is the combination between natural and simulated realities to create creative environments and visualisations through which real-time physical and digital artefacts coexist and communicate. Mixed reality does not occur in the actual or virtual universe alone, it is a mixture of realism and virtual reality, integrating both mixed reality and improved virtuality through digital technologies.

# Ethics and Forms

Coventry University ETHICS

Your Ethics Application P105788 has been approved by your Supervisor Clive Hilton. The request has now been passed to the Module Leader, School Ethics Leader or Faculty Leader for approval.

| | |
|---|---|
| Ref: | P105788 |
| Project Title: | Can the emotional bonding of Consumer electronics help the Millenials to reduce technological waste? |
| Applicant: | Archit Parhi |
| Submitted: | 19/04/2020 19:16 |
| Supervisor: | Clive Hilton |
| Module Code: | 7030AAD |
| Module Leader: | Clive Hilton |

Go to ethics.coventry.ac.uk to view this request in more detail.



## Research Method Record Sheet (F1)

Please complete one of these record sheets for **each** significant piece of empirical or ethnographic research task you are planning e.g. interviews, observation, survey/questionnaire/focus group. Once you have completed this form please show it to your design tutor and when they are confident that you have a safe and sensitive structure for your research task then go to the Ethics portal and complete the submission process and await approval.
Note that **grey areas on the form suggest more information or discussion with tutor** will be required.

| | | | | | |
|---|---|---|---|---|---|
| **Student name** | Archit Parhi | | | | |
| **Project title** | Can the emotional bonding of Consumer electronics help the Millennials to reduce technologically waste? | | | | |
| **Task description** | There are objects and products in our lives, which we use daily and interact with but still, take them for granted. We don't understand the value of these objects until and unless we lose their presence.<br>There is a special bonding between certain products in our life which we genuinely care about. This special bonding is due to emotional attachment, colour, sense of touch and the user experience we get from the product.<br>Having a good relation and bonding with products can increase the life cycle of it and thus help in low wastage. Bonding with a product can even help increase the longevity of the product. By researching the human product relationship, I am planning to improve the product life cycle which leads to a positive impact on the environment and even affect the mood of human beings. | | | | |
| **Date you intend to conduct the research** | 01/06/2020 | | **Final major project tutors name** | Clive Hilton | |
| Research Method | | | | | |
| **General research approach**<br>(Tick appropriate box – circle around sub-choices) | Interview<br>•Structured *(circle)*<br>•Semi-structured<br>•unstructured | Focus group | Observation | Questionnaire or survey | Other *(please specify)* |
| **How many people and events will be involved**<br>*(Circle appropriate and indicate where process will be repeated.)* | 1 person<br>2 two people<br>*(will it be repeated –how often?)* | 2 - 3 people<br>4 – 6<br>*other please state*<br>*(how many will be held?)* | 1 person<br>small group 1 to 5<br>variable number<br>*(how many will be conducted?)* | 20<br>50<br>100+<br>*(how many do you aim to complete?)* | ? |
| **Will you know the participants?** | Yes *(circle)*<br>I am familiar with them | | No<br>I have not had prior contact with those involved. | | |
| Participant Info | | | | | |
| **What is the characteristic of the group?**<br>(please circle) | • Students<br>• Friends or family | Professional groups or individual | Under 18 | Vulnerable adult or group | Other (please specify) |
| **Where will the research take place?** | Within the University | Within a known and regularly visited space e.g. home, café, official community space | In a professional environment | • In a school<br>• In a medical practice or hospital<br>• A sensitive environment | Non-specific or variable location *(please explain)* |
| **How far will you have to travel to conduct the research and** | Local | Within the region | To another city | Abroad | |

| | | | | | | |
|---|---|---|---|---|---|---|
| **how will you get there?** | What mode of travel will you use?<br>Using public transport. | | | | | |
| **What time of day will you conduct the research** | Daytime 9-5 | Early morning | Evening | At night | | |
| Data collection | | | | | | |
| **What type of information do you need to collect?** | Statistics<br>e.g,<br>Numbers or patterns for comparing) | Words<br>e.g. Opinion, attitudes feelings or ideas, | Measurements of people<br>e.g. measuring anthropometric data | Collections<br><br>e.g. materials, pictures, artefacts | | Observations of situations, tasks, behaviour |
| **Data will be captured in the form of....** | Words | Numerical | Audio | Photos | Video | Samples |
| **Please provide a list of the questions you intend to ask** (*interview, questionnaire or focus group) or the foci you wish to observe e.g. utilisation of public seating from the perspective of comfort, use and misuse)* | List questions below – A concise number of simple, clear and focused questions.<br><br>1.What type of consumer electronics do you use?<br>2.What feature do you like about it?<br>3.What is the speciality of your product?<br>4.How are you attached with it?<br>5.Is it a service-based product?<br>6.What colour do you prefer for your product?<br>7.Does its full fill your requirements?<br>8.What features do you want in the future?<br>9.Is it reliable and secure?<br>10.Do you want to use it forever?<br>11.What are the drawbacks?<br>12.If product with same functionality is given will you discard your current product?<br>13.How often do you buy consumer electronics?<br>14.How is the service given for your electronic device?<br>15.How often you upgrade your products?<br>16.Do you recycle your products?<br>17.Are you aware of the waste that is produced by electronic products? | | | | | |



| | | |
|---|---|---|
| | | |
| **Resources**<br>Will any specialist equipment or facilities be required to complete this task? | (please list) | (highlight any resources requiring special booking or access) |
| **Tutors comments**<br>*(Please add any useful information that will help the reviewer)* | | |
| **Tutors signature** | I have discussed the research method with the student and feel that this can be considered for review on the Ethics Portal [https://ethics.coventry.ac.uk]<br><br>Signed: | Date |

Now your tutor has reviewed this research task you can complete the online Ethics Portal process (upload this form along with your PIS and Consent Form Blanks. You will find the link on Moodle and a profile will need to be set up. The reviewing tutor will be Karen Bull and the project supervisor will be your Final Major Project tutor.

**PLEASE REMEMBER THAT ANY PARTICIPANT IN YOUR RESEARCH PROCESS MUST HAVE SIGNED A PARTICIPANT CONSENT FORM AS PROVIDED ON THE ETHICS PORTAL.**

## Participant Information Sheet (PIS) (F2)

You are being invited to take part in research that will inform a student coursework submission. The student concerned preparing research to support a major industrial design project that will be assessed at Coventry University.

Your participation in this research is entirely voluntary.

**What is the purpose of the research?**

The main objective is to explore new technologies and physical form for the consumer electronics which will help to build a relationship of the product with the consumer(millennials) and thus reduce electronic waste.

**Why have I been chosen?**

You have been selected on the basis that you are a product designer who can implement a sustainable change in the existing market

**Do I have to take part?**

It is up to you to decide whether to take part, and you are free to withdraw at any time without giving a reason. If, after completing the research you wish to withdraw your data from the study you may do so for a period of two weeks after participation. After this point your data will have been added to that of other participants for the purposes of analysis. If you wish to have your data removed please contact Archit Parhi at the earliest opportunity.

If you agree to take part please sign the attached Consent Form.

**What will this involve?**

Please describe the research organisation and especially

1) You will be asked to engage in the project in the following way:

During the research, you will be asked series of questions. You may be asked to talk about the electronic gadget that you carry and the photograph of it.

2) Data/answers or observations will be used in the following way:

The data will be used n the report and will be safe within the university.



You do not have to complete any of the specified tasks, answer any of the questions nor have photo/audio/video or measurements recorded unless you wish to do so. You can decide to finish at any time and no other involvement would be required from you.

If you would like any more details about the nature of this work or how the information will be used please contact Karen Bull or the student's Course Director (see contact details below).

**What are the possible disadvantages and risks of taking part?**

The staff and students are not aware of any risks or disadvantages to you of taking part in this study.

**What are the possible benefits of taking part?**

It is hoped that the information the student gains from this research can be used to provide the students with a valuable learning experience.

**What if something goes wrong?**

If you have a complaint regarding how the research has been carried out or how the student has behaved, you are requested to inform Karen Bull who will try to resolve the matter (see contact details below).

**What will happen to the results of the research?**

The research will be used to inform the student's coursework submission and may in the future form part of their professional design portfolio. Please let the student concerned know if you are interested in seeing a summary of their research findings.

**Student contact details:**

Name- Archit Parhi
Student ID- 9604687
Contact Number- 07500799210
Email ID- parhia@uni.coventry.ac.uk

**Staff contact details:**

If you would like to discuss this further, or have any questions, please contact

- Clive Hilton [MSc] c.hilton@coventry.ac.uk

**CONSENT FORM (For all participants) (F3)**

**Title of Project: Design for Relationship**

**Student researcher**: Archit Parhi

**Supervising tutor:**
**Mr Clive Hilton**

| | Please tick |
|---|---|
| 1. I confirm that I have read and understood the participant information sheet for the above study and have had the opportunity to ask questions. | ☐ |
| 2. I understand that my participation is voluntary and that I am free to withdraw at anytime without giving a reason. | ☐ |
| 3. I understand that all the information I provide will be treated in confidence | ☐ |
| 4. I understand that I also have the right to change my mind about participating in the study for a short period after the study has concluded (*insert deadline here*). | ☐ |
| 5. I agree to be filmed/recorded *(delete as appropriate)* as part of the research project | ☐ |
| 6. I agree to take part in the research project | ☐ |

Name of participant: .....

Signature of participant: .....
Date: .....

Name of Researcher: .....

Signature of researcher: .....
Date: .....





# Questions

A concise number of simple, clear and focused questions.

1.What type of consumer electronics do you use?
2.What feature do you like about it?
3.What is the speciality of your product?
4.How are you attached with it?
5.Is it a service-based product?
6.What colour do you prefer for your product?
7.Does its full fill your requirements?
8.What features do you want in the future?
9.Is it reliable and secure?
10.Do you want to use it forever?
11.What are the drawbacks?
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16.Do you recycle your products?
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