UNIVERSITI TEKNIKAL MALAYSIA MELAKA

AN EXPLORATORY DESIGN PROJECT UTILISING THE INFINITIVE QUALITATIVE DESIGN METHOD

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BACHELOR OF MECHANICAL AND MANUFACTURING ENGINEERING TECHNOLOGY (BMMW) WITH HONOURS

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Faculty of Mechanical and Manufacturing Engineering Technology

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MOHD ZAHEDE BIN DANDAI

A thesis submitted
in fulfillment of the requirements for the degree of
Bachelor of Mechanical and Manufacturing Engineering Technology (BMMW) with Honours

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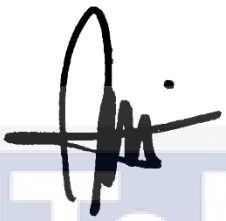
DECLARATION

I declare that this project entitled " An Exploratory Design Project Utilising The Infinitive Qualitative Design Method " is the result of my own research except as cited in the references. The project report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : 

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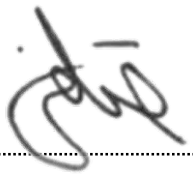
APPROVAL

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the Bachelor of Mechanical and Manufacturing Engineering Technology (BMMW) with Honours.

Signature : 

Supervisor Name : Dr Mohd Qadafie Bin Ibrahim

Date : 20 Jan 2023

DEDICATION

I would like to say a big thanks for my family, friends and supervisor for always encourage me to do my best for this final year project. I have learned from my supervisor alot through out this journey in order to complete my project for final year where he guide me from the very beginning until now.

ABSTRACT

This research aims to explore the use of the Infinitive Qualitative Design Method (IQM) in product design, with a focus on incorporating aesthetic considerations into the design process. Current design procedures often prioritize function over aesthetics, leading to products that are inadequate or unappealing. The study utilizes the IQM to develop a product prototype, in this case a toothbrush holder, that not only addresses practical concerns but also prioritizes aesthetic values. The objectives of the study include designing the prototype using the IQM, verifying its aesthetic appeal, and determining the effectiveness of the IQM as a design process framework. The results of the study show that the IQM was successful in creating a functional and visually pleasing prototype, indicating its potential as a valuable tool in the product design process.

ABSTRAK

Penyelidikan ini bertujuan untuk meneroka penggunaan Kaedah Reka Bentuk Kualitatif Infinitif (IQM) dalam reka bentuk produk, dengan tumpuan untuk memasukkan pertimbangan estetik ke dalam proses reka bentuk. Prosedur reka bentuk semasa sering mengutamakan fungsi daripada estetika, yang membawa kepada produk yang tidak mencukupi atau tidak menarik. Kajian ini menggunakan IQM untuk membangunkan prototaip produk, dalam kes ini pemegang berus gigi, yang bukan sahaja menangani kebimbangan praktikal tetapi juga mengutamakan nilai estetik. Objektif kajian termasuk mereka bentuk prototaip menggunakan IQM, mengesahkan daya tarikan estetiknya, dan menentukan keberkesanan IQM sebagai rangka kerja proses reka bentuk. Hasil kajian menunjukkan bahawa IQM berjaya mencipta prototaip yang berfungsi dan menarik secara visual, menunjukkan potensinya sebagai alat yang berharga dalam proses reka bentuk produk..

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In the Name of Allah, the Most Gracious, the Most Merciful

First and foremost, I would like to thank and praise Allah the Almighty, my Creator, my Sustainer, for everything I received since the beginning of my life.

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Last but not least, thank you to everyone who has been involved in this project on completing this first final year project report.

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IQM - Infinitive Qualitative Method

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CHAPTER 1

INTRODUCTION

1.1 Background

Designing is a comparatively recent field. Professional design development precedes professions. In truth, the process of creating items for a specific purpose, such as tools, precedes the human species. Developing tools is also one of the initial attributes that defined us as humans. Design in its widest sense commenced more than 2.5 million years ago when Homo habilis invented the first tools. Long before we could walk upright, humans started creating. We began manufacturing spears 400 thousand years ago. By forty thousand years ago, we had graduated to sophisticated equipment. Ten thousand years ago, Mesopotamia was indeed the origin of urban planning and design. Enterprise architecture as well as interior decoration are considered to have progressed together. With the invention of cuneiform, it needed about 5,000 years for design work and typography to evolve in Sumeria. After that, everything gained up quickly. Each product or service is created. The impulse to construct derives from our early human ancestors' urge to examine a problem, imagine a different one, and then act to construct that better standard. Creating tools helped us become who we are, and design helped us become humans. First and ultimately, design is the method. The English adjective "design" initially arose in the 1500s, with the oldest recorded reference dated from 1548. Merriam-Collegiate Webster's Dictionary defines "design" as "to envision and organize out throughout the brain; to have as a definite aim; to develop for a certain function or end." The act of sketching is connected to these, with a focus on the structure of the drawings as a pattern or chart, as is "to design plans for creating, fashioning, executing,

or constructing according to plan." There has also been an international design renaissance since the early 1980s. The architecture will continue to soar much further into the twenty-first century, driven to dizzy new heights across the world by the advent of the postmodernist approach beginning at the end of the 1970s, and particularly by the Memphis group of the early 1980s. The design has important ramifications, and corporations and organizations all across the world are striving hard to improve it. Nowadays days, designing is all the rage.

1.2 Problem Statement

Current engineering design procedures often prioritize functional aspects of product design at the expense of aesthetics, resulting in products that are difficult to use, unappealing, and/or inadequate at solving targeted problems. At the same time, designers lack the tools and skills to effectively incorporate aesthetic concerns into their design process, despite the recognized benefits of doing so. This study aims to use the Infinitive Qualitative Design Method (IQM) to develope a product that is not just solve the practical problems but ultimately is to focus on the aesthetics values and to verify if the method can improve the design process.

1.3 Research Objective

The fundamental goal of this research is to investigate design utilizing the Infinitive Qualitative Design technique. The precise goals are as follows:

- To design the product by using Infinitive Qualitative Methods (IQM).
- To make a prototype that is aesthetic pleasing.
- To verify the aesthetic value in the prototype.

1.4 Scope of Research

The scope of this research are as follows:

- Design a new conceptual product
- Infinitive Qualitative Method (IQM) used to build a new conceptual design.
- Varify aesthetic value in the prototrype .

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The literature review is one of the important parts of the research process. This process can help to understand and gain knowledge of selected topics. In this chapter, the review was done by studying the journal articles and papers obtained from random online resources, Google search engine, and Mendeley literature review. These resources were found by searching the online database using some phrases that have relations with the exist product design process. After that, for this project, the toohbrush holder has been selected for the product that need to be developed by using the Infinitive Qualitative Design Method (IQM).

2.2 Design theory

General and specific design knowledge are linked to design methodology and practise through design theory. Its goals are to explain, generalise, and abstract observed design processes, organise engineering design knowledge beyond craftsmanship, develop formal design theories for an algebraic representation of designs and processes, introduce idealised models for the evolutionary design process, and derive theorems, rules, and procedures for solving design problems in synthetic environments. (S Culley, 2001). Also, (Bernhard E Burdek) said that, their efforts are ultimately geared toward optimising the methods, rules, and criteria to be utilised in order to analyse, evaluate, and even enhance design, design theory and methodology like to claim objectivity. Design is the vehicle for

product change, according to (Mike Baxter, 1995), and the more things change, the more design is required.

Through design theory, practical and theoretical design is the process that are linked to conceptual model and implementation. One's purposes are also to discuss, make sweeping statements, as well as conceptual identified design development in order to assemble structural engineering design knowledge much further than artisanship to advance design development concepts for such an algebraic portrayal of design ideas and operations, to implement idealized version features for both the developmental design process and to generate theorems, regulations, and processes for handling the project in composite surroundings.

Additionally, one‘s attempts were indeed subsequently aimed primarily to improving the methodologies, regulations, and characteristics to do so in analysing, review, and perhaps even optimum operation. Design process and methodological approach would like to presume impartiality. Design structure would be the platform for manufacturing concern, so the more things are changing, the design will be needed.

2.3 Product Design

Design does not occur in a vacuum, with unlimited freedom of colour, shape, and material selection. Each product is the outcome of a development process influenced by a variety of factors and judgments, not just creative ones. Ergonomic and ecological demands, economic and political objectives, and artistic-experimental aspirations all play a role here, as do socioeconomic, technological, and cultural advancements, as well as the historical context and conditions of production technology. Dealing with design necessitates always considering the circumstances in which it arose and picturing their impact on the products

(Bernhard E Burdek). However, product design, according to (S Culley, 2001), synthesises fresh information for product realisation, establishes quality by defining usefulness, materialisation, and appearance of artefacts, and influences the technological, economic, and marketing elements of production. Discipline-oriented (scientific) research contributes to the advancement of engineering design by generating information about and for design. Product designers concentrate on a certain application field (for example, architectural, mechanical, or electrical engineering) and confine their scope to issue areas such as conceptualization, detail design, computer support, and product implementation. It's possible that good design is more than an envelopment approach.

Through appropriate fashioning, it must communicate the uniqueness of the product in question. It must make the product's function, as well as its application, readily visible so that the user can understand it. Good design must make the most recent state of technological development visible. Design should not be limited to the product; it should also include aspects such as ecology, energy conservation, recyclability, durability, and ergonomics. The link between humans and objects must be the starting point for the shapes that are used in good design, with issues of occupational medicine and perception taken into account (Bernhard E Burdek).

Configuration design somehow does not occur in isolation, of endless complexion, structure, as well as content options. Also, every design consisted of such a project development which was affected by many factors and verdicts, not even just innovative versions. Intuitive as well as economic and environmental expectations, political and economic priorities, but also artful ambitions contribute a significant role, and so do the socio - economic status, technological, and cultural developments, including the historical background and production engineering terms. Coming to terms of structure design involves

constantly contemplating its factors leading to this and imagining about the effect on production.

Product development, on the other hand, composes additional knowledge for content revelation, develops performance through determining applicability, outward manifestations, as well as visual appeal of exhibits, but rather impacts its rapid technology, economic, and advertising aspects of production. Work ethic study expands systems engineering by obtaining data for the structure design. Design engineers' expertise in a variety application domain including engineering of architecture and design, electrical, or mechanical which limit the scope of issues including concepts, design specification, technical support, as well as establish the effectiveness. That is entirely feasible that great design is like an encirclement strategy. That must interact its distinctiveness of the product concerned through adequate creation. This must create a product's feature but also implementation clear towards the consumer even though that they would comprehend this. One of most describe current of technology progress must be observable in great design. Configuration design should include elements including ecological system, sustainable energy, recycled content, longevity, as well as ergonomically designed through addition to the prototype. The interactions between people but also items could be the beginning for such forms used throughout smart product design, whereas vocational healthcare and perspective concerns considered.

2.4 Design research

Current design methodology research is concerned with the methodological systematisation of design processes, the investigation of design decision-making mechanisms, and the enhancement of design modelling, representation, analysis, simulation, evaluation, or physical testing approaches. Process monitoring and protocol studies are used

to better understand human design methods, design knowledge requests and processing, collaborations, method and tool use, and design communications (S Culley, 2001). However, according to (Paul Rodger & Alex Milton, 2011) said that there are various research methodologies that are routinely employed in modern product design. There is also an explanation of the impact of personal and contextual inspiration on a design project, as well as descriptions of various project triggers such as interviews, literature reviews, questionnaires, and surveys, focus groups, shadowing, and ethnography.

Typically, the goal of product design research is to inquire, watch, think, and learn (objectively) from people who engage with goods, environments, and systems on a daily basis. Previous research has primarily used questionnaires, interviews, or short-term longitudinal studies to investigate product attachment. Product attachment studies that span a product's whole lifespan may lead to a deeper knowledge of the elements that influence product attachment and detachment (Mugge, 2007). Furthermore, more study is needed to test the efficacy of employing these tactics across diverse product categories. Finally, the effect of culture and user values on product attachment is another area that warrants further investigation (Mugge, 2007).

Specific design approach study focused mostly on research methodology implementation of design methods, its research of design stance processes, and thus the improvement of layout modelling techniques, portrayal, interpretation, computation, assessment, and perhaps continuous testing perspectives. Framework findings and quality control have been used to comprehend sentient design techniques, expertise queries as well as handling, partnerships, procedure, or platform utilise, and communications configuration design.

However, there are several methodological approaches which were consistently used in advanced design process. There are even a clarification of how individual and contextual innovation affects a conceptual design, and also explanations of different construction prompts including such interview session, review of literature, online surveys, group discussions, supervising, as well as ethnographic research.

The aim of marketing research design is normally to correspondence, examine, reckon about, but also discover from individuals who interact with commodities, surroundings, and structures on something like a constant basis. To explore content adhesion, prior studies have mainly used survey questions, media appearances, or brief observational research. Content adhesion findings that range a product's entire longevity could provide a more in-depth understanding of the variables which affect market adhesion but also passivity. Further to that, that much research is required to compare the effectiveness of all these strategies throughout a wide range of product classifications. Eventually, the influence of culture and consumer principles on content adhesion is indeed a region that require development much farther.

2.5 Brief

Briefing is the process of reviewing choices and articulating requirements, and a brief is the result of that process. While traditional design practise distinguishes between design stages (briefing, sketch design, detail design, and documentation), these differences are far more fluid in practise. As the design advances and new knowledge is gained, the briefing's worries shift and vice versa. Briefing needs and design decisions are related to the level of detail being addressed as well as who the intended resolution of those requirements may be (David Marchant, 2016). Furthermore, (David Marchant) said that the activities of briefing, which states problems to be solved, and creating instantiating solutions are inextricably

intertwined, as they are both components of the same process to develop and procure a product that meets one or more needs. The satisfaction of many types of criteria is an essential component of the design process for a product and its continued use. Requirements may be imposed by the client who commissions the product, the designers, or one or more regulatory authorities.

An outline is indeed the outcome of analysing options and clarifying specifications. Whilst also conventional construction technique differs among designing phase which are briefing, schematic design, design specification, and record keeping, throughout procedure, such distinctions are much more flexible. The briefing's concerns transition as that the layout progresses and new information is obtained, and conversely. Briefing prerequisites and design considerations were indeed linked to the extent of specifics getting constantly discussed including who will then be committed to resolving some these prerequisites.

Besides that, statement, that also indicates the issues to be addressed, and establishing basis solutions are intrinsically linked, because they're both elements of the very same process and developing and obtain a design that satisfies one or perhaps more needs. A fulfilment of several different classifications is an important part of the development process for such a commodity and its ongoing utilise. The consumer who bribes the product, the developers, one or more regulatory agencies could impose obligations.

2.6 Design Process

The Product Design process is a critical framework in which designers solve problems. Product design requires concepts and skills that vary and change depending on the stage of the process. Many attempts have been made to create maps or models of the design process. Some of these models simply describe the sequences of activities that occur

during the design process; others attempt to prescribe a better or more appropriate pattern of activities. Descriptive models of the design process frequently emphasise the importance of developing a solution concept early in the process. Figure 2.1 is show a straightforward four-stage design process model that includes exploration, generation, evaluation, and communication (Nigel Cross, 2001).

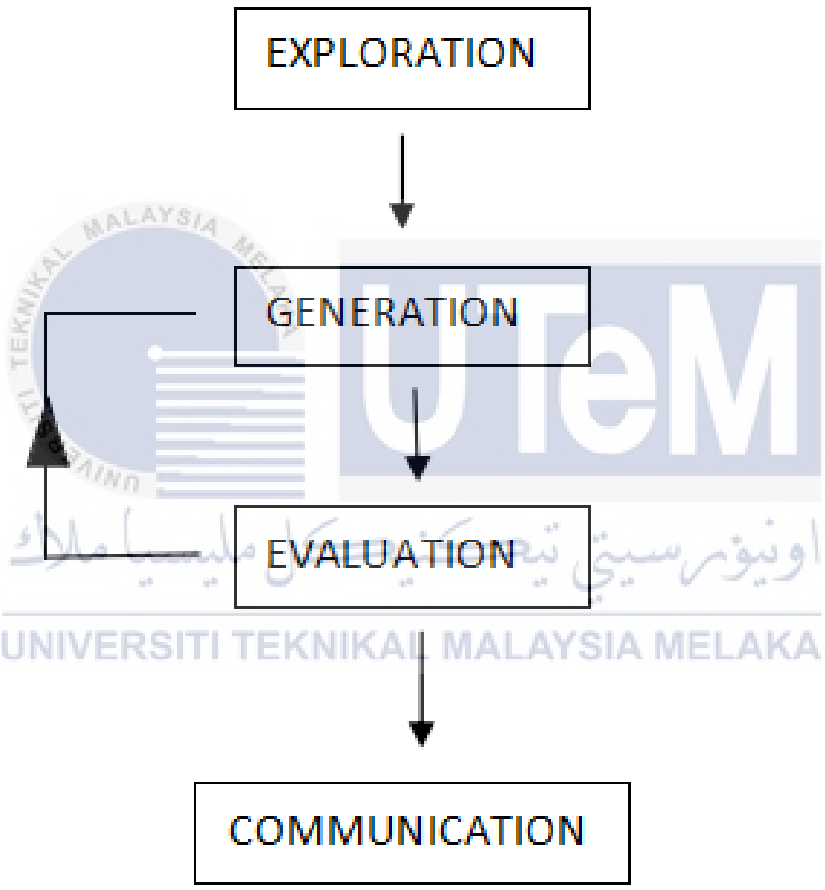


Figure 2.1 : A simple four-stage model of the design (Nigel Cross,2001)

Figure 2.1 diagrammatically depicts this simple four-stage approach. Assuming that the evaluation step does not always lead to the communication of a final design, but that a new and more satisfying concept must be chosen at times, an iterative feedback loop from the evaluation stage to the creation stage is demonstrated. Models of the design process are

typically depicted in this flow diagram format, with the design progressing from one stage to the next but with feedback loops indicating repetitive returns to earlier phases that are frequently required (Nigel Cross, 2001). In comparison to what (French, 1985) had produced, its more detailed model of the design process, as shown in Figure 2.2 below, was based on the following activities: problem analysis, conceptual design, scheme embodiment, and detailing. The circles in the diagram represent completed stages or outputs, whereas the rectangles represent activities or ongoing work.

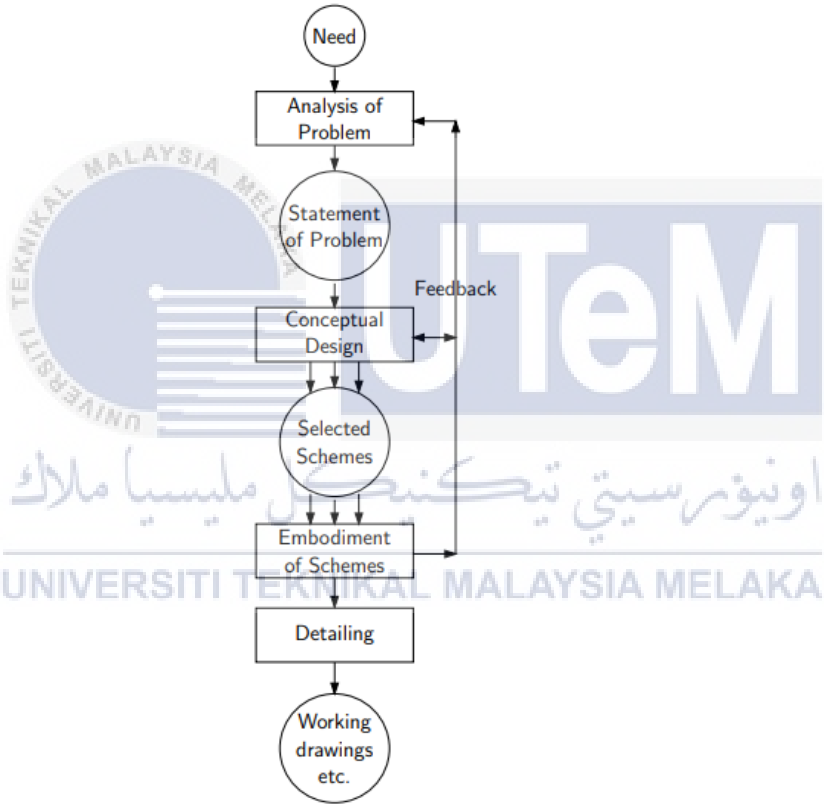


Figure 2.2 : Model of the design process (French, 1985).

The process starts with a need statement, and the analysis of the problem is the first design activity. The examination of the problem, according to (French, 1985), is an important aspect of the whole process. The problem is stated in the output.

Based on the design process, in order to generate the product, analyzing the problems should be done and there must be problems occurs through basic demands to ensure the problem statement is being stated. After observing the problem statement, conceptual design will be generated according to the concept design stages. Proceed to the selected schemes and embodiment of schemes in terms of the evaluation process. Next, detailing the process in order to deliver the core benefit proposition, within the targets set in the design specifications. After the detailing process, it will move towards the last process which is working drawings which will be the last operations in the system design process.

2.7 Concept Generation

Concept generation is described as a process of creating a favourable concept for the future. The description tries to create a platform for structuring thought generation in a segmented based. A revolutionary idea of the new concept does not appear out of nowhere which the statement makes two principles, that a new development is formed by referencing to certain conceptual frameworks and there is a framework for producing a new idea (Toshiharu Taura Yukari Nagai, 2011). To determine if a new idea or concept is economically viable, Product Concept Generation must begin with product design and development. Analyzing client demands entails conducting thorough market research, exploring new technologies, and mapping prospective developing markets to determine customer wants. The notion of an early depiction of a product, as well as adding only the necessary features, are the key qualities of the product. In the concept development, the embodiment of numerous traits into some form of technology technique arose. If more than one concept is produced, the concept that best satisfies the most requirements should be chosen. The concept is faster to build and modifying the final generated product are two truths that mostly reside. Returning to the idea stage after the detail design stage has been finished is not desirable for bigger projects (Heman M. Patil, Saurabh S. Sirsikar & Nitin N.

Gholap, 2017). The purpose of Concept Generation is to identify theories that can satisfy the necessary functions. These ideas can be further developed to meet the Design Standards. Various technologies can be used to generate ideas as feasible. Brainstorming, analogies, and morphology are the examples among those methods.

i) Brainstorming.

The purpose of brainstorming is to generate ideas as conceivable regarding ways to solve problems. Every one of the created ideas must be documented in the form of sketches or phrases. Think as broadly as possible in terms of possibilities, since outrageous ideas provide a larger variety of ideas from which to pick. During brainstorming, alternative topics to investigate include the topic's many requirements, purposes, or capabilities. Additionally, it is critical not to assess the ideas at this stage since this will restrict the brainstorming process. Ullman (2010), p. 190.

ii) Analogies.

The analogy tool's objective is to discover another product that performs a comparable functionality to the one being produced and evaluate how well the product handled the prospect. Analogies can also be drawn from environment, such as where the contemporary Velcro concept got inspired according to how burrs attached to clothing. Ullman (2010), p. 192.

iii) Morphology.

The morphological technique focuses upon those distinct functions. Concepts for every specific function are developed, and afterwards concepts from different divisions of operations are blended until an excellent overall concept is determined. (Steinberg, 2007, p. 56) Figure 2.3 show the Morphology Matrix on how well this technique may be used professionally. The Concept Generation process will be carried out in two stages. The

brainstorming technique will be utilized extensively throughout the first phase to produce 10 broad solutions to the issues. As in the second approach, these concepts will be reduced to three and formed further towards increasingly full frameworks. This stage will make use of the analogies and morphology tool. After the three concepts were further refined, it would be practically and technologically constructed. Particular demands could be better understood by 3D modelling each notion. This contains details like physical measurements, weight, price, and general perspective. Sterlin (2007).

Figure 2.3 : Pugh Morphology Matrix

2.8 Concept Evaluation and Selection

The three concepts that emerge will be assessed based upon how they meet the needed parameters. The design that adequately satisfies the criteria will indeed be selected for further improvement in order to analyse the notions.

The Pugh technique will be used as an example for the concept evaluation. Pugh's technique is used in analysing and evaluates ideas based on related qualities. Figure 2.4 below shows the Pugh's Technique Matrix represents how such a technique can really be implemented. Thus, the individual requirements chosen from the design requirements are presented and ranked in order of priority. The 'preferred' notion is then designated as that of the Baseline, and the remaining ideas are evaluated by comparing to it. The ideas are graded on a scale of -1 (worse than the baseline), 0 (equal performance), and +1 (best performance) (the idea is better than the baseline for that characteristic). The results are then multiplied by the original ratings and summed. The obtained ratings indicate which idea best satisfies the criteria and should thus be explored subsequently. (Ullman,2010, pp. 222-224).

	Baseline	Alternative Solution		
Criteria	Current Solution	Alternative 1	Alternative 2	Alternative 3
Feasibility	5	1	1	1
Cost	4	-1	-1	0
Long Term Benefit	1	0	-1	1
Maintainability	3	0	0	-1
Availability of Resources	2	1	0	-1
Sum of all Positives		7	5	6
Sum of all Negatives		4	5	5
Sum of all Neutrals		0	0	0
Total		**3**	**0**	**1**

Figure 2.4 : Pugh's Method Matrix

Since unrestricted innovation and thinking skills are beneficial across many phases of the design phase, concept idea selection would be the act of reducing a collection of concept possibilities for evaluation. Whilst idea inclusion is a converged operation, it is often repetitive and does not always result in a dominating notion. Choice and assessment are incremental procedures that must be incorporated into product innovation. Thus, Processing elements by analysing the course to go and developing several options from which to pick should be temporarily expand so that the collection of thoughts under discussion may need to be blended and refined in these notions. Instead of aiming to determine the "greatest" concept, choices should be a limiting process that eliminates out inappropriate ideas. (Paul Rodger & Alex Milton, 2011). The design phase during the idea selection phase is typically imprecise and imprecise, necessitating the use of a concept process of selection to guarantee that the ideal or most relevant concept is obtained. The idea selection approach provides a systematic mechanism for obtaining and organizing subjective opinion by formulating and making evident the choice process. There are numerous techniques that are used in concept selection. As a result, concept selection is among the most crucial and consequential considerations developed during the planning process (Stoll Henry W, 1999).

2.9 IQM Design Framework

The suggested framework has been developed and proven using a methodical technique. A methodical procedure designed to guarantee the finding is credible and helpful, from the formulation of prerequisites for such research problem through the building of the proposition. A study approach is a published study that employs two or three separate methodologies (for example, a questionnaire and a case analysis as the elements from the same entire research) (Andreasen, 2011).

There are four stages of NPD progress in this research. When the concept is formed, it is evaluated by a research study. If the outcome is verified, a prototype or draught design is now being built. The design is then adjusted based on the results of the controlled study, and more improvements are introduced.

Figure 2.5 : The major phases as used by more established framework adapted as initial foundation framework.

This framework has four primary stages: recognizing the requirements and limitations, visualizing how this would be utilized, choosing an appropriate concept and motivation, and producing the actual physiological result (Figure 2.5). Given the difficulty of implementing this structure, it is far more certain in proposing the structure if the data demonstrated that information from questionnaires, experiments, and research reports were converged to about the same outcome.

The fundamental project's purpose, as shown in (Figure 2.6), is to optimize industrial design inside a design process context. This structure proposes a mechanism of achieving

overall possible benefits of aesthetic throughout the design and implementation for consumer goods, with only an emphasis mostly on aesthetically uniqueness of manufacturing. Next even as systematic approach to industrial design. As a consequence, via defined organizational systems and practices for such implementation of product development and also the enhancement of industrial design results, this framework provides integration confluence of such industrial design phase further into contemporary organized product development cycle.

Another aim is to remove as well as disseminate information about industrial design. The conceptual framework encourages the comprehensive incorporation of industrial design specifications further into product development system and gives for the coordinated dissemination of information in something like a system that creates the effect of innovative product features.

Next, to reinforce the implementation of change technique. Through combining a very well infrastructure with innovative design & analysis characteristics, the platform includes the integration of a modernized product development cycle. In this regard, the structure is flexible and responsive at every stage of the customizable conceptual design.

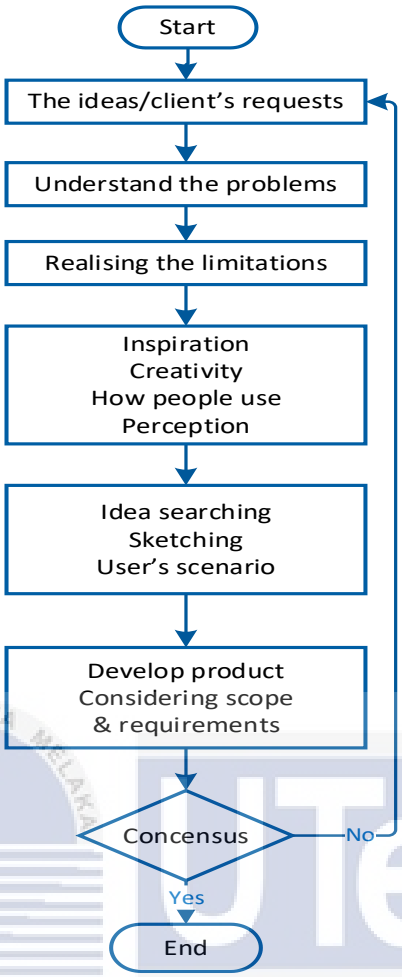


Figure 2.6 : Flowchart for detail design activities in the framework.

2.10 Infinitive Qualitative Method (IQM)

The Infinitive Qualitative Method (IQM) is an innovative product design process with aesthetic enhancement. The IQM is a conceptual design process framework. This method is under study and not a framework yet. This method is discussed below by (M. Qadafie, 2021). In the IQM, the infinitive shape concept which is the iteration approach has been used. This conceptual design process is proposed for new products or revisions from market feedback and also actively involves the marketing team. There are two main

components in the IQM as well as the separation for design and development process. The figure 2.7 below shows the Infinitive Qualitative Method (IQM).

Figure 2.7 : Infinitive Qualitative Method (IQM)

At the beginning of this conceptual design process, the red dot needs to be identified. The red dot is a starting point which is connecting the interests of the client or customer, marketing, and engineering with design. Before going through to the product design milestone, several keys need to consider including understanding the problems and identifying the customer requirements. Next is the product selected for this study.

2.11 Product Selected for Study

In this project, the toothbrush holder has been choose as a product to develop by using the IQM. A toothbrushes holder is a basket or rack in a bathroom that stores toothbrushes when they are not in use, protecting it from germs and bacteria. Since a

toothbrush is a tool used in oral care to clean the teeth, gums, and tongue. It consists of a highly clustered bristle head with a top for applying toothpaste, attached on a handle for cleaning hard-to-reach areas of the mouth. Brushing teeth is typically done at a sink in the kitchen or bathroom, where the brush is rinsed to eliminate any remaining dirt and then dried to reduce circumstances conducive to germ growth. The toothbrush is the most often used oral hygiene aid, however incorrect toothbrush storage leads to contamination. If a toothbrush is not correctly handled and maintained, it can cause a variety of dental and systemic disorders such as septicaemia, pulmonary, cardiovascular, gastrointestinal, and renal issues. Bacteria love moisture and will thrive in this environment, therefore, never store the toothbrush in a closed or airtight container. Instead of putting it in a drawer or cupboard, the toothbrush should be placed in a cup or holder in an upright posture to ensure that it dries thoroughly. Next is to analyse the toothbrush.

2.12 Type of Toothbrush

Toothbrushes are an essential tool for maintaining good oral hygiene and preventing dental problems such as tooth decay and gum disease. There are many different types of toothbrushes on the market, ranging from manual to electric, and choosing the right one for the needs can be a bit overwhelming. Here is an analysis of the various types of toothbrushes and some of their key features:

- Manual toothbrushes: These are the most traditional type of toothbrush and are often the least expensive option. They come in a variety of shapes and sizes and are usually made of nylon bristles attached to a plastic handle. The bristles can be soft, medium, or hard, and the size of the brush head can vary depending on the manufacturer. Some manual toothbrushes also have a rubber gum massager or a tongue cleaner on the back of the brush head.

- Electric toothbrushes: Electric toothbrushes use a motor to vibrate the bristles, which can make brushing teeth easier and more effective. They often come with different brush head options, such as a deep clean brush or a sensitive brush, and some models have a timer to help brush for the recommended two minutes. Electric toothbrushes tend to be more expensive than manual toothbrushes.

2.13 Size of Toothbrush

Thus, for this project, we are focusing on the manual toothbrush, since this kind of toothbrush is commonly use, the size of toothbrush is need for the process in this project. Next is the analysis of the size of the toothbrush. Toothbrush come in various sizes, including standard size for adults and smaller size for children and babies. Figure 2.8 show the sizes of the toothbrush.

Toothbrush Age Group	Babies	Children	Adults
Length	12.2	16.6	19.1
Head Length	2.1	2.3	3
Head Width	0.9	1.3	1.4
Neck Length	2.6	3.8	4.2
Neck Width	0.8	1.4	0.5
Handle Length	8.6	10.5	11.5
Handle Width	1.4	1.3	1.1

Figure 2.8 : Sizes of toothbrush.

Standard size toothbrushes are usually about 7 to 8 inches in length and have a brush head that is about 1 inch wide and 1 inch tall. These are designed to fit the average adult mouth and are suitable for most people. Children's toothbrushes are typically smaller than standard size toothbrushes, with a brush head that is about half the size of an adult brush. These are designed to fit the smaller mouths of children and are easier for them to use.

2.14 Type of Toothbrush handle

Toothbrush handles come in a variety of designs, including straight handles, contoured handles, and angled handles. There is 2 types of toothbrush handle. Figure 2.9 show the type of toothbrush handle.

Figure 2.9 : Straight Handle Toothbrush.

The first one is Straight handles, this are the most common and are simply a straight rod with a brush head at one end. These are easy to hold and use, but they may not be as comfortable for people with limited dexterity or arthritis.

Figure 2.10 : Countour handle Toothbrush.

Next is Contoured handles, they are designed to fit the shape of the hand and may be more comfortable to hold than straight handles. They can also be easier to grip, especially if they have a non-slip coating. Figure 2.10 show the contour handle. Next process is to analyses about the toothbrush holder.

2.15 Toothbrush holder

A toothbrush holder is a small container or device that is used to hold toothbrushes. It can be made of a variety of materials, such as plastic, ceramic, or metal, and is designed to keep toothbrushes organized and easily accessible. Some toothbrush holders are designed to hold a single toothbrush, while others can hold multiple toothbrushes. They are often used in bathrooms to keep toothbrushes organized and to help prevent the spread of germs. Next is to analyse the toothbrush holder.

2.16 Type of Toothbrush holder

There are many different designs, styles, and materials used in the manufacture of toothbrush holders. They can be made of materials such as plastic, ceramic, glass, metal, or silicone, and can be found in a wide range of colors, sizes, and shapes. Some toothbrush holders are simple and functional, while others are more decorative and can be used to add a touch of style to a bathroom. Some toothbrush holders are designed to hold a single toothbrush, while others can hold multiple toothbrushes at once. There are also toothbrush holders that are specifically designed for use with electric toothbrushes, and others that are intended for use when traveling. Overall, there is a wide variety of toothbrush holders available to suit different needs and preferences. Table 2.1 below show the common types of Toothbrush holder.

Wall-mounted Toothbrush holder	    These holders are designed to be mounted on a wall in a bathroom or other convenient location, providing a convenient and hygienic way to keep toothbrushes organized and easily accessible. This type of holder is mounted on the wall and can hold multiple toothbrushes at once.
Countertop Toothbrush holder	   

	These holders are designed to be placed on a bathroom counter or other flat surface, providing a convenient and hygienic way to store and organize toothbrushes
Travel Toothbrush holder	 These holders are designed to be portable and easy to carry, making them an ideal choice for people who are constantly on the go and need to keep their toothbrushes with them when traveling.

Toothbrush holder with cover	    These holders are designed to keep toothbrushes clean and organized, and feature a cover or lid to protect them from dust and other contaminants.
Toothbrush and toothpaste holder	    This type of holder is designed to hold both a toothbrush and toothpaste.

Suction cup toothbrush holder	 Suction cup toothbrush holders are a convenient and hygienic storage solution for toothbrushes, as they can be easily attached to flat surfaces such as walls or mirrors.

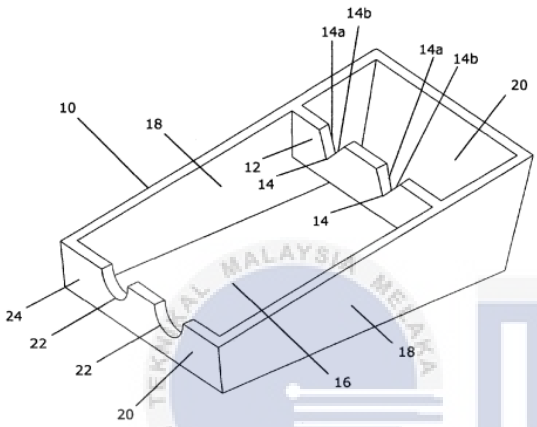
Table 2.1 : Type of Toothbrush holder.

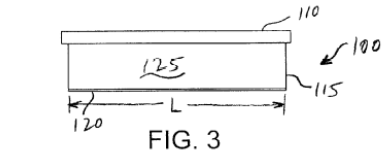
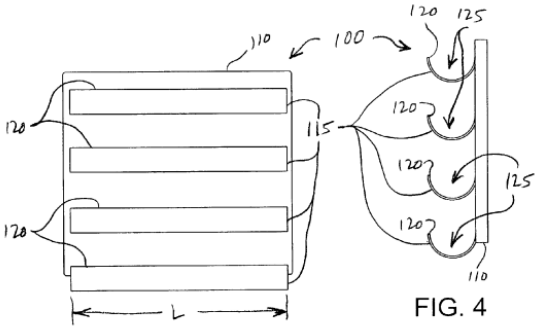
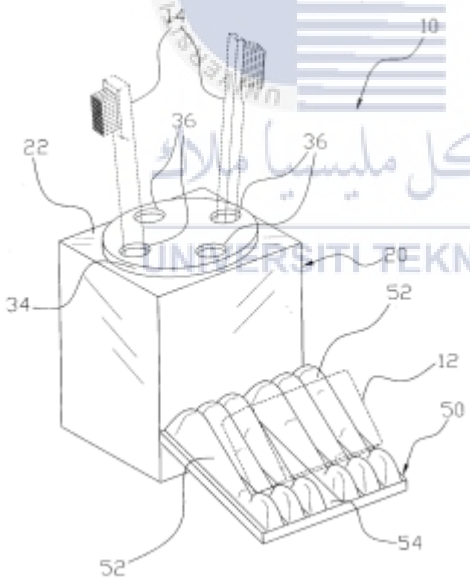
Table 2.1 has show type of toothbrush holder. Thus, these toothbrush holders all serve the same purpose of holding and storing a toothbrush, but they differ in their features and design

2.17 Patent

We conducted a search for toothbrush holder patents and analyzed the specifications of various brands to gain a deeper understanding of the design concepts and features of these products. Through this research, we identified weaknesses in the existing designs and generated new ideas for improving upon them. Our goal is to create toothbrush holders that are more functional and appealing to consumers by adding new features or developing

entirely new conceptual designs. The Table 2.2 shows four examples of toothbrush holders, one for each type.

Patents			Descriptions
 US8464868 Kruger et al.	Toothbrush holder	Strenghts	• It have a flat surface, so it will stable. • Serves for toothbrushes only. • Light weight. • Durability
		Weakness	• Doesn't have a hole that allow the water to flow out. • Low capacity to put toothbrushes. • Aesthetic unpleasing. • Difficult to clean up.

 FIG. 3  FIG. 4 FIG. 2 US20040055977A1 Wendy M.Ryan	Toothbrush holder	Strenghts	• Has more capacity. • Can place toothbrush and toothpaste. • Easy to dry the toothbrush.
		Weakness	• Take space on the wall. • Aesthetic unpleasing.
 US20040060829A1 Bernard R. Oldenkamp	Toothbrush holder	Strenghts	• Have extra capacity for toothbrushes. • Toothbrushes place can be change. • Durability.
		Weakness	• Aesthetic unpleasing. • Unattractive design.

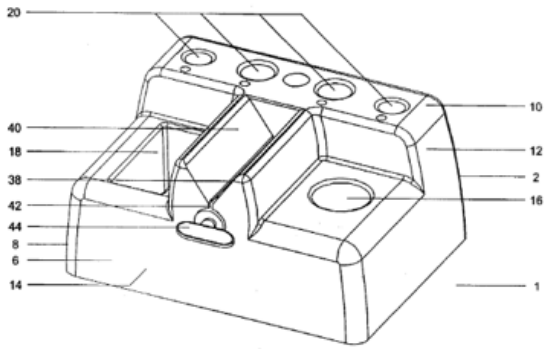
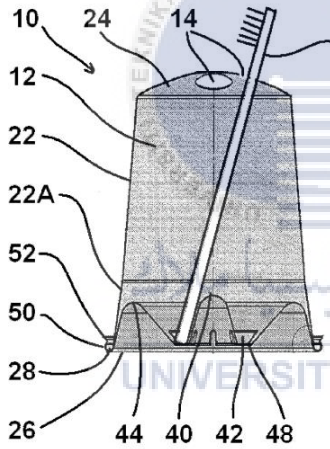
 US20040050733A1 Bilss Essence Page	Toothbrush holder	Strenghts	• Durability. • Attaractive design. • Have extra features which is toothpaste squeezer.
		Weakness	• Not hold the toothbrush securely. • Difficult to clean up.
 US20110198454A1 Donald J. Volk	Toothbrush holder	Strenghts	• Attractive design • Minimalist. • Durability.
		Weakness	• Difficult to clean up. • Low storage for toothbrushes.

Table 2.2 : Analysis of patent.

CHAPTER 3

METHODOLOGY

3.1 Introduction

This chapter is all about methods or approaches used to solve the problem of the project. The methodology is also needed to implement the project systematically to achieve a more satisfactory result. The results have been described in this section.

3.2 Design Methodology

The goal of this project is to create a conceptual design for a toothbrush holder using the Infinitive Qualitative Method (IQM). To do this, the project will begin by conducting research to gather information about the design of toothbrush holders. This research may include reviewing library resources, internet sources, journals, and other relevant materials. Thus, compile all of the important information that have gathered into a report. The ultimate goal of the project is to develop a toothbrush holder that is functional and aesthetically pleasing

In the next stage, several conceptual designs are developed by sketching. The best design composition will be determined by using some of the methods based on several criteria. The design that has been selected will be developed by drawing it in the Solidworks software. The final design will be manufactured as a prototype at the end of this project. Figure 3.1 show the Flow chart of the study

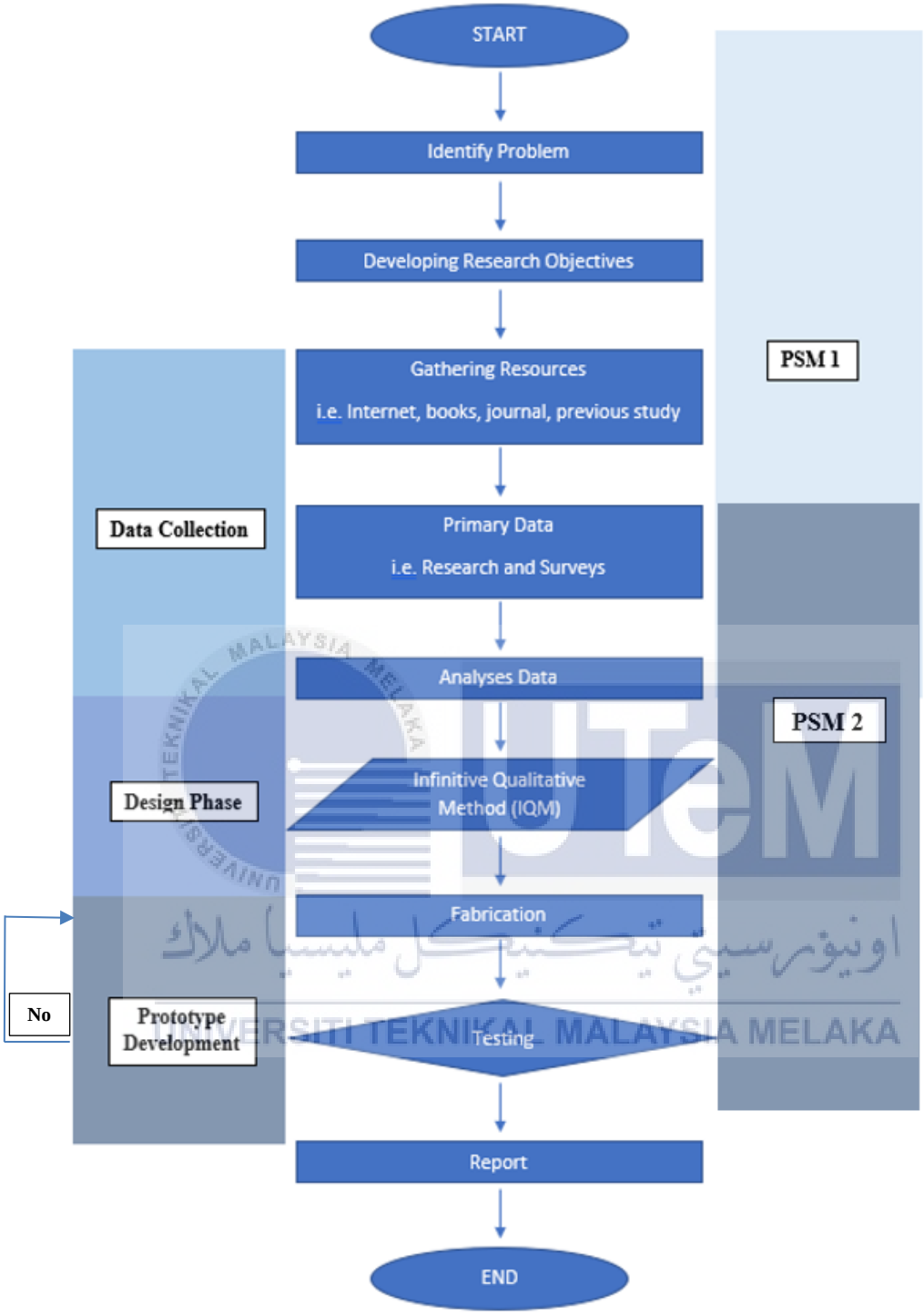


Figure 3.1 : Flow chart of the study.

3.3 Data Collection

Data collection is a process of gathering information from all the relevant sources. Data collection methods can be divided into two categories which are secondary data collection methods and primary data collection methods. The secondary data was collected through several sources including the internet, journal, previous study, books, and several patents. Other than that, it is the primary data. Primary data is the source of data that others have yet to interpret. Primary data can be divided into two parts, including quantitative and qualitative data.

For this project, the primary data was collected through research and surveys. The research was conducted by examining various sources such as websites, pictures, blogs, and patents on the internet. A questionnaire was also administered using the Google Form platform to a community of people living in large cities around Melaka in order to obtain the results and data analysis. This allowed the researchers to gain a deeper understanding of the attitudes and opinions of the community regarding toothbrush holders and to identify any trends or patterns in their responses.

3.4 Primary Data

To gather primary data for this project, variety of research and survey methods to collect quantitative data about the needs and preferences of the community with regards to the design of a toothbrush holder. This data was obtained by conducting online research, including looking at websites and videos, and by surveying members of the community.

The research was conducted in order to gather the information needed to complete the project and develop a design that meets the needs of the target market. As a result of this research, multiple concept designs for the toothbrush holder were developed, each with its own unique characteristics.

3.5 Distribute Questionnaire

To ensure that the decision made based on the survey results is the most accurate and optimal choice, it is important that the survey questions be distributed randomly and that all respondents answer honestly. A total of 30 respondents will be required to participate in the survey. An example of one of the survey questions can be seen in the Figure 3.2. The results of this survey will be analyzed and used to inform the next steps in the project, including the design process.

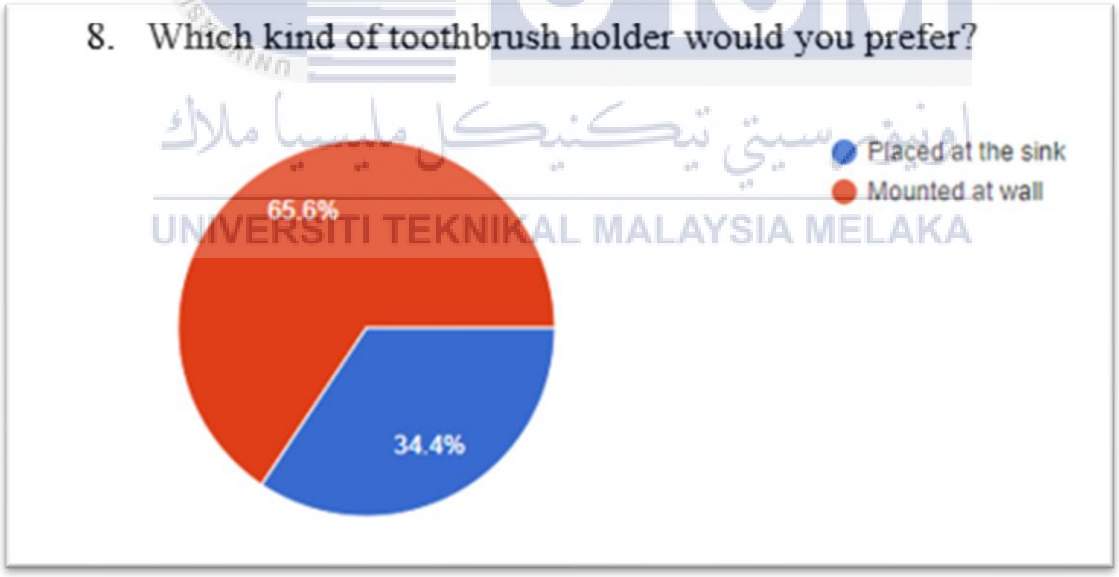


Figure 3.2 : Example of survey question .

3.6 Design Phase

At this stage, the design phase is the process of developing as many design ideas as possible through the data collected. The conceptual design will be focused on. Then a selection is made to determine or choose the best design using several methods. The concept that has been selected will draw using SolidWorks software to provide a 3D CAD model and technical drawing. To complete the design process in this phase, the Infinitive Qualitative Method (IQM) approach has been used. The design process and prototype development are included.

3.7 Product Design in IQM

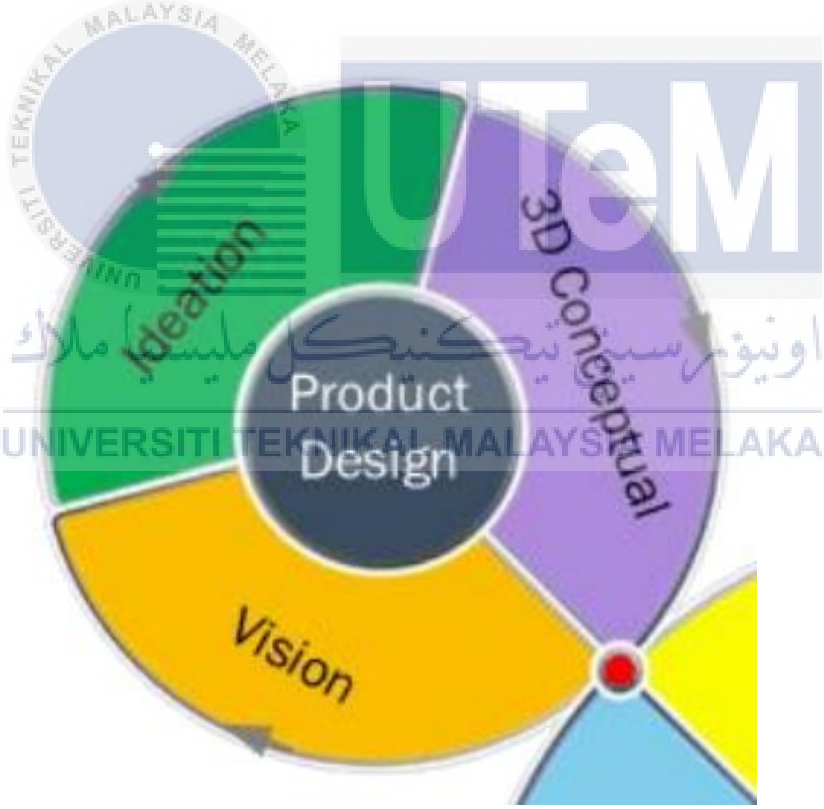


Figure 3.3 : Product design component in IQM

After the red dot has been defined, there is 3 phase in this product design component in IQM which is Vision, Ideation, and 3D conceptual. Each phase will be described in this section.

3.8 Design Brief

Before moving to this 3 phase, the design brief is need to developed in word cloud style to emphasize the important keywords, to set the basis of the design, and to accumulate the requests, requirements, and limitations. To fulfill the word cloud development, several tools have been proposed including the bipolar semantic differential method and physical aesthetic table to define the criteria or aesthetic keyword or pre-select words to characterize a product related to this project. Figure 3.4 below shows an example of the bipolar semantic differential method.

Social values and position (SVP) (n = 5)		*Usability and interaction (UI) (n = 8)*		*Qualities of form (QF) (n = 6)*		*Personality characteristics (PC) (n = 10)*	
SVP-1	Contemporary Traditional	UI-1	Clear Confusing	QF-1	Elegant Inelegant	PC-1	Attractive Repulsive
SVP-2	High Class Low Class	UI-2	Easy To Use Difficult To Use	QF-2	Organic Geometric	PC-2	Aggressive Submissive
SVP-3	High Technology Low Technology	UI-3	Safe Dangerous	QF-3	Ornate Plain	PC-3	Futuristic Nostalgic
SVP-4	Expensive Cheap	UI-4	Comfortable Uncomfortable	QF-4	Innovative Imitative	PC-4	Quiet Noisy
SVP-5	Global Local	UI-5	Reliable Unreliable	QF-5	Compact Large	PC-5	Mature Immature
		UI-6	Robust Delicate	QF-6	Symmetrical Asymmetrical	PC-6	Exciting Calm
		UI-7	Easy To Clean Difficult To Clean			PC-7	Feminine Masculine
		UI-8	Practical Impractical			PC-8	Friendly Unfriendly
						PC-9	Extraordinary Ordinary
						PC-10	Interesting Boring

Figure 3.4 : Bipolar Semantic Differential Method.

3.9 Vision

At the product design, several milestones need to be followed, and proposed tools and activities to complete the design process. The figure 3.5 below shows the product design component in the IQM.

Figure 3.5 : IQM Product Design Component.

Once the design brief was identified, the process will continue to the next milestone which is the vision. The characteristics and ideas generation need to be set to create a clear vision. After a clear vision has been identified, the design mood board must be developed to complete the activity.

3.10 Ideation

The next milestone is the ideation phase. This phase is the process of developing as many sketches as possible to generate the conceptual design. It might be no colour and oblique or isometric hand sketches. The sketches must be strictly based on the word cloud and mood board to align with the design brief for this project. After finishing with the sketches, some of the best design features will be selected to generate several conceptual designs of the product. The finalized design sketches are the next milestone in this conceptual design process. At this phase, each conceptual design has transformed into the spider chart. In the IQM, the spider chart or web chart is proposed to use to select the final design. The spider chart is used to clearly compare based on design criteria and overall understanding of the pros and cons of all conceptual design. This process is used to select the best design for the Toothbrush holder in this project.

3.11 3D Development

Once the conceptual design has been selected, the process will move to the next milestone in the product design which is developing the 3D part. The 3D part was developed using the Solidworks software to produce a full rendering product. This 3D part also has used to evaluate the colour and shape, suggest the changes, and get feedback from engineering perspectives. In this project, the process only will be cover for the product design. For the next component of the conceptual design process which is product development, the engineering, and manufacturing of the product will develop as a functional prototype.

3.12 Colour scheme

A color scheme plays a crucial role in the overall design and branding of a product. It helps to create a cohesive and cohesive look and feel for the product, which is important for building a strong and consistent brand image. The color scheme is used to determine the colors that will be used in the product's packaging, branding, and marketing materials, as well as in the product itself. The colors chosen for the color scheme should be carefully selected for the visual appeal, symbolism, and the emotions that are intended to evoke in the viewer. The color scheme can be designed to complement the product, creating a harmonious and cohesive look, or it can be used to contrast with the product, creating a bold and eye-catching look. It is important to choose a color scheme that is appropriate for the product and its intended audience, as the wrong colors can create the wrong impression and impact the product's success.

3.13 Prototype Development

After the final 3D part was finalized, the detail design was developed using SolidWorks software. Every part or component, drawing, and assembly was produced. The drawing also includes the dimensions and Bill of Materials. The CAD data is created for components and assemblies to check for interferences before any physical part is manufactured. Selective laser sintering (SLS) is an additive manufacturing technique that uses a laser as the power source to sinter powdered material is one of the manufacturing processes that can be applied to fabricate the prototype for this project. The SLS machine will produce a functional prototype that can be used for the testing process at the next stage of this project.

3.14 Validation

The validation of aesthetic criteria is a crucial step in the design process that involves evaluating and verifying the visual and sensory qualities of a product. This includes aspects such as color, shape, texture, and overall appearance. By verifying aesthetic criteria, we can ensure that the product is aesthetically pleasing and meets the needs and preferences. This helps to ensure that the final product will be successful.

3.15 Testing

For the testing, the first step that needs to consider is to analyze the product whether can be used. The testing process will also focus on the functionality of the prototype including mounted at wall. If the prototype has a problem, all processes will be repeated.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Introduction

This chapter presents the findings and analysis of data obtained from making a design by using the Infinitive Qualitative Design Method. The result which has been analyzed must achieve the objective that has been set for this project. The analyzed data has been used to develop a product as a prototype which is the output of using the IQM design. The process of fabricating the prototype will be described in this section.

4.2 Primary Data

For primary data and results, quantitative data had been obtained by using research and survey methods to get the result and analysis of the community need to develop a design. The research had been done by looking at some internet pages and websites. This is done to get the data needed to complete the project. The figure 4.1 show the type of toothbrush holder research that had been done. Therefore, multiple concept designs has been developed, and all of it does have their own characteristics.

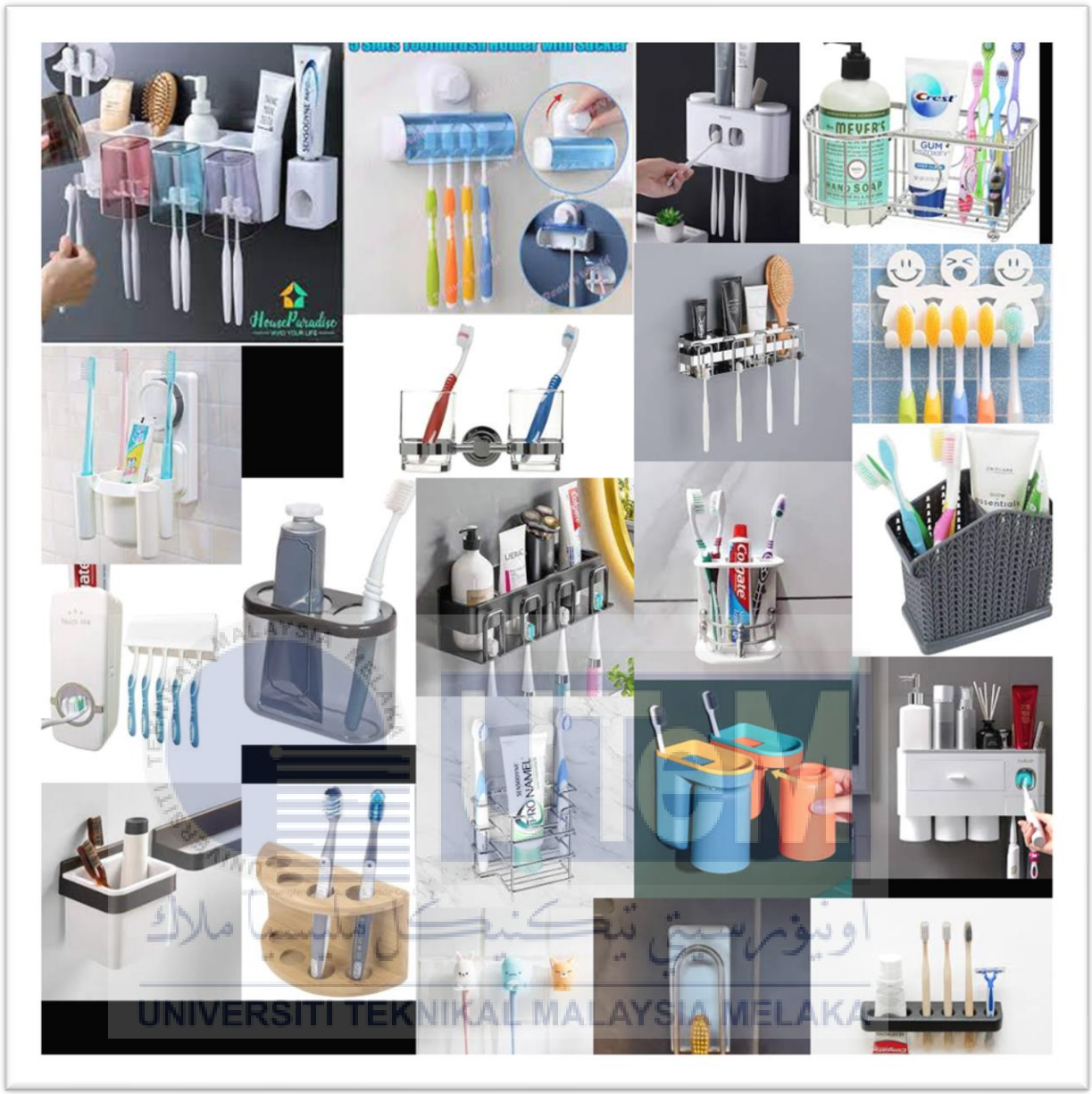
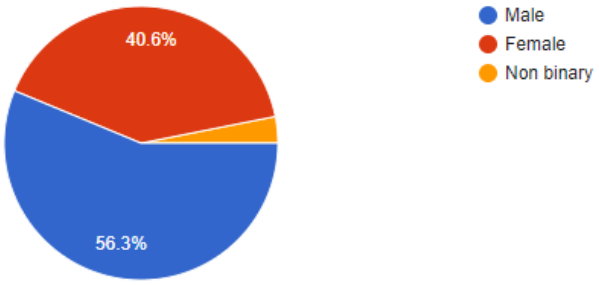
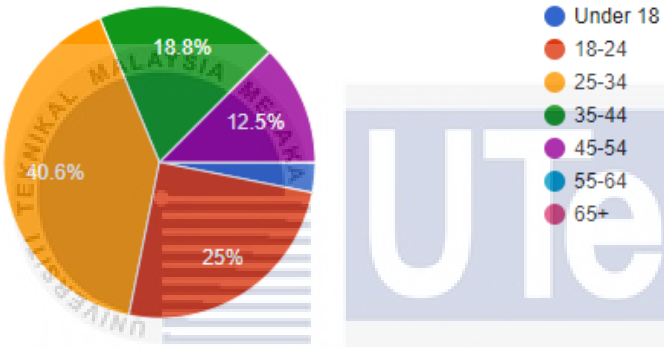
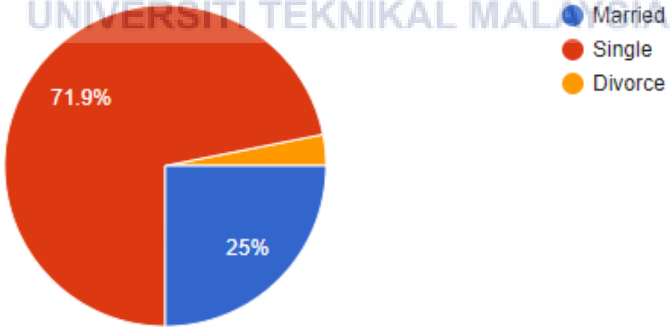
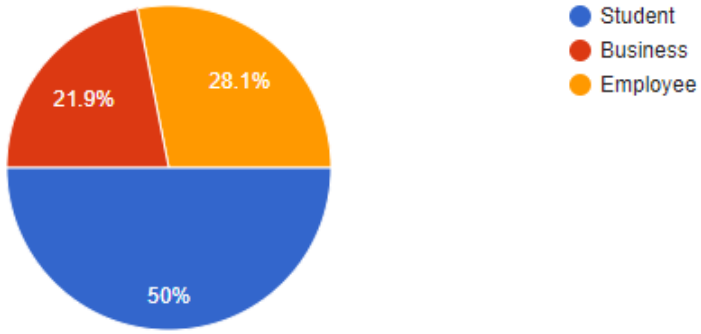
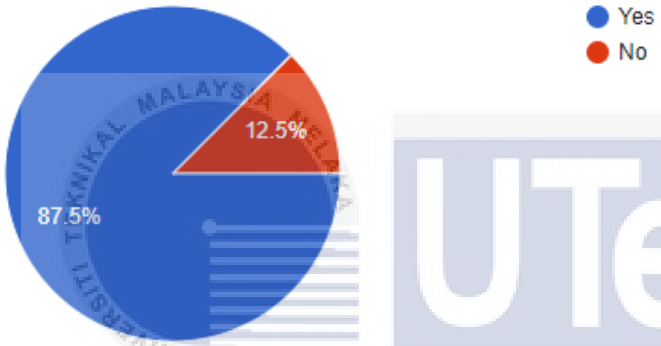
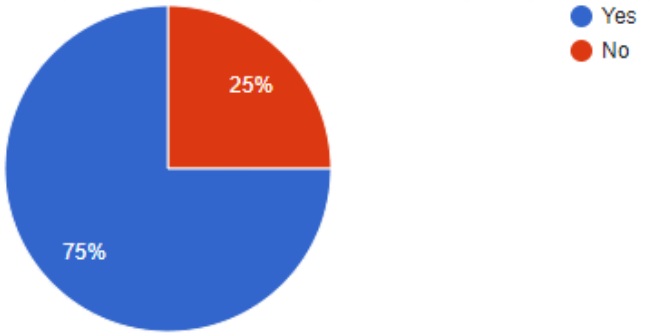
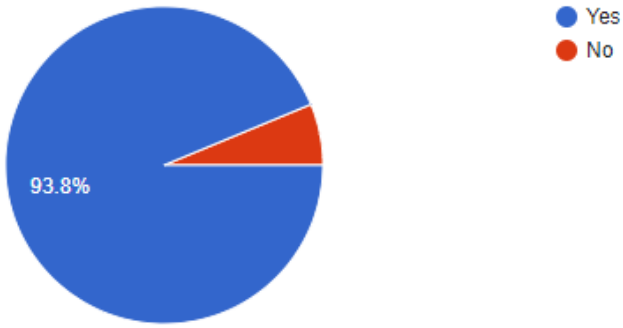
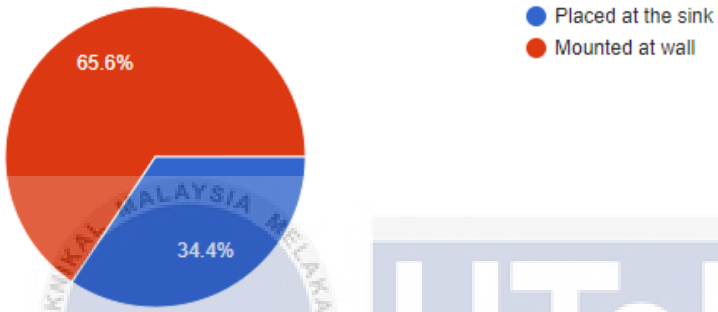
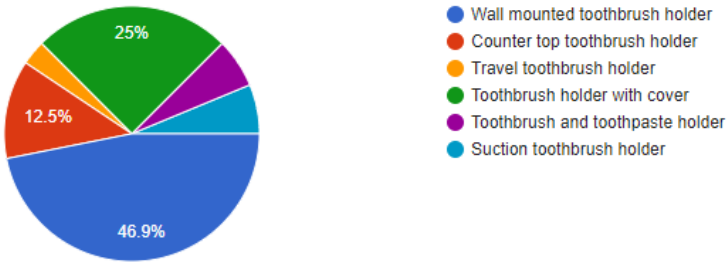


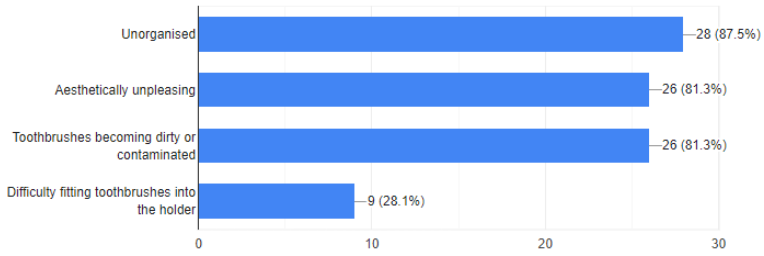
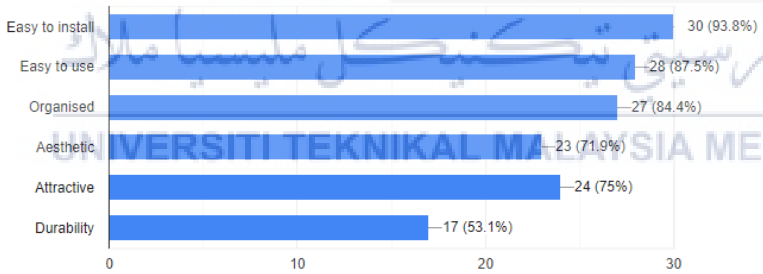
Table 4.1 : Type of toothbrush holder.

The next data was gathered from questionnaires. The questionnaires had been obtained by using the Google Form platform. There are more than 30 respondents that took part in these online surveys that were distributed to contacts living in cities around Melaka. All data from these surveys will analyze to figure out what criteria needs for this product design and development phase. Every single data analysis for this survey had been described in this section. Table 4.1 shows the questionaire result.

1. What is your gender? 	- Total up to 32 respondents that respond. - More than half are male.
2. How old are you? 	- More than 40% from 25 to 34 years old. - Around 25% is 18 to 24 years old.
3. What is your marital status? 	- 71.9% of the respondents are single which is not married yet. - 25% of the respondents are married and have a family.
4. What is your occupation?	

	- Most of the respondent are student . - Another 21.9% and 28.1% have business and an employee.
5. Do you have a toothbrush holder in your bathroom? 	- Majority of the respondents do have a toothbrush holder in their bathroom.
6. Do you think your bathroom sink has any space to place a toothbrush holder? 	- Majority of the respondents have problem with a space in their sink when placed the toothbrush holder.
7. Would you prefer to stay organised in your bathroom?	- Majority of the respondents prefer to stay

	organised in their bathroom.
8. Which kind of toothbrush holder would you prefer? 	- More than half of the respondents are more prefer for mounted at wall. - there are slight differences between toothbrush holder type, which is 65.6% is mounted at wall and another 34.4% is preferring to place at the sink.
9. What type of toothbrush holder would you prefer? 	- Most of the respondents are more prefer the wall mounted toothbrush holder.

10. Which problem that you faced while using the current toothbrush holder?  	- Most of the respondents have problem with un organised toothbrush holder. - Other respondents also have faced a problem such like aesthetically unpleasing and toothbrushes becoming dirty.
11. Which criteria do you think that need in this new toothbrush holder?  	- Having a toothbrush holder that are easy to install is the highest consideration for all respondents and followed by easy to use, organised and attractive.
12. Do you have any design ideas that can be used in the new toothbrush holder development?	- Most of respondent ideas would like to

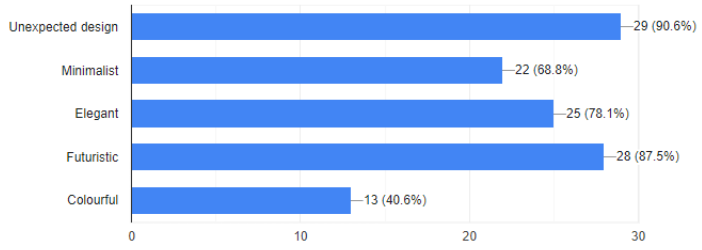
	have a Unexpected design and followed by Futuristic looks, Elegant, Minimalist, and Colourful.

Table 4.2 : Questionaire result.

This questionnaire is to gather feedback on the current toothbrush holder product from respondents. Results show that the majority have difficulty finding sufficient space in their sink and prioritize organization in their bathroom. They prefer wall-mounted holders and have expressed concerns with dirty toothbrushes. Respondents prioritize easy-to-use and visually pleasing solutions, as well as designs that are unexpected and futuristic, elegant, minimalist, and colorful. This data will inform the conceptual design for the toothbrush holder.

4.3 Process Flow

The design process for this project begins with the creation of a design brief, which outlines the project goals and objectives, target audience, and any specific requirements or constraints. Once the design brief is complete, a word cloud is created to visually represent key words and themes that will inform the design. From there, a mood board is assembled to provide visual inspiration and set the overall tone for the design. Finally, sketches are

created to explore different design options and refine the chosen direction before moving on to the final design. Figure 4.1 show the porcess flow.

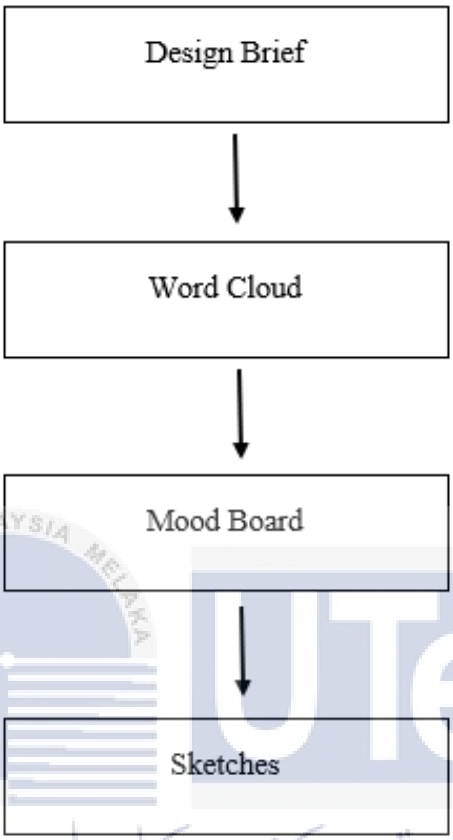
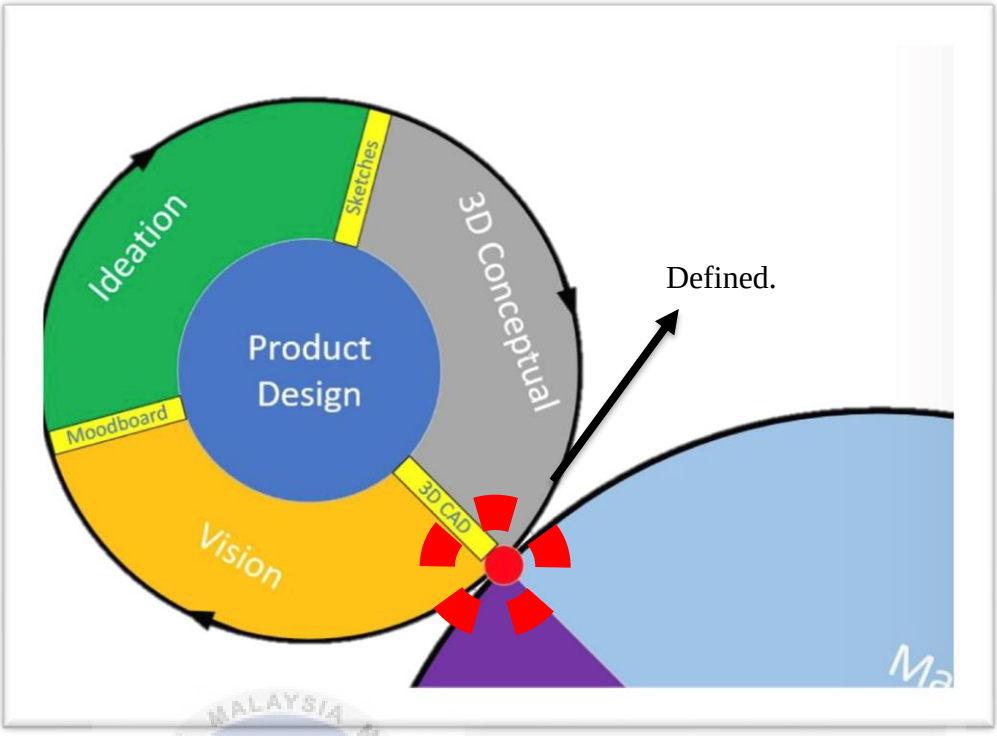


Figure 4.1 : Process flow.

Based on the understanding of the problems and the data that has gathered from the primary data, the data has been used as a red dot to start the IQM approach. After the red dot was defined, the design brief for this project will be created. The design brief is described in this section.



4.4 Design Brief

The product will be developed in mounted wall based on the selected respondent's perspectives which are most of them prefer the toothbrush holder to be wall mounted. From the primary data, this product needs to be designed for ease of installation, susceptibility to use, and contented organization. Respondents also want the product to have an aesthetic value which is an attractive design, futuristic, elegant, and minimalist. Therefore, the product shall be created by using the IQM approach which boosts the values of aesthetics by choosing some criteria or aesthetic keyword or pre-select words in the bipolar semantic differential method.

Figure 4.2 : Word cloud

The criteria design also needs to consider the part to overcome the problem, which is staying organized, and not being unattractive design. In the IQM approach, the design brief is developed in the word cloud style. The figure 4.2 shows the word cloud.

4.5 Mood Board

After the word cloud has been developed, the characteristics and ideas generation needs to be done to create a clear vision. The vision for this design phase is to design the mounted wall based on respondents' perspective. No matter what form and shape it will take as long as it is based on the mounted wall.

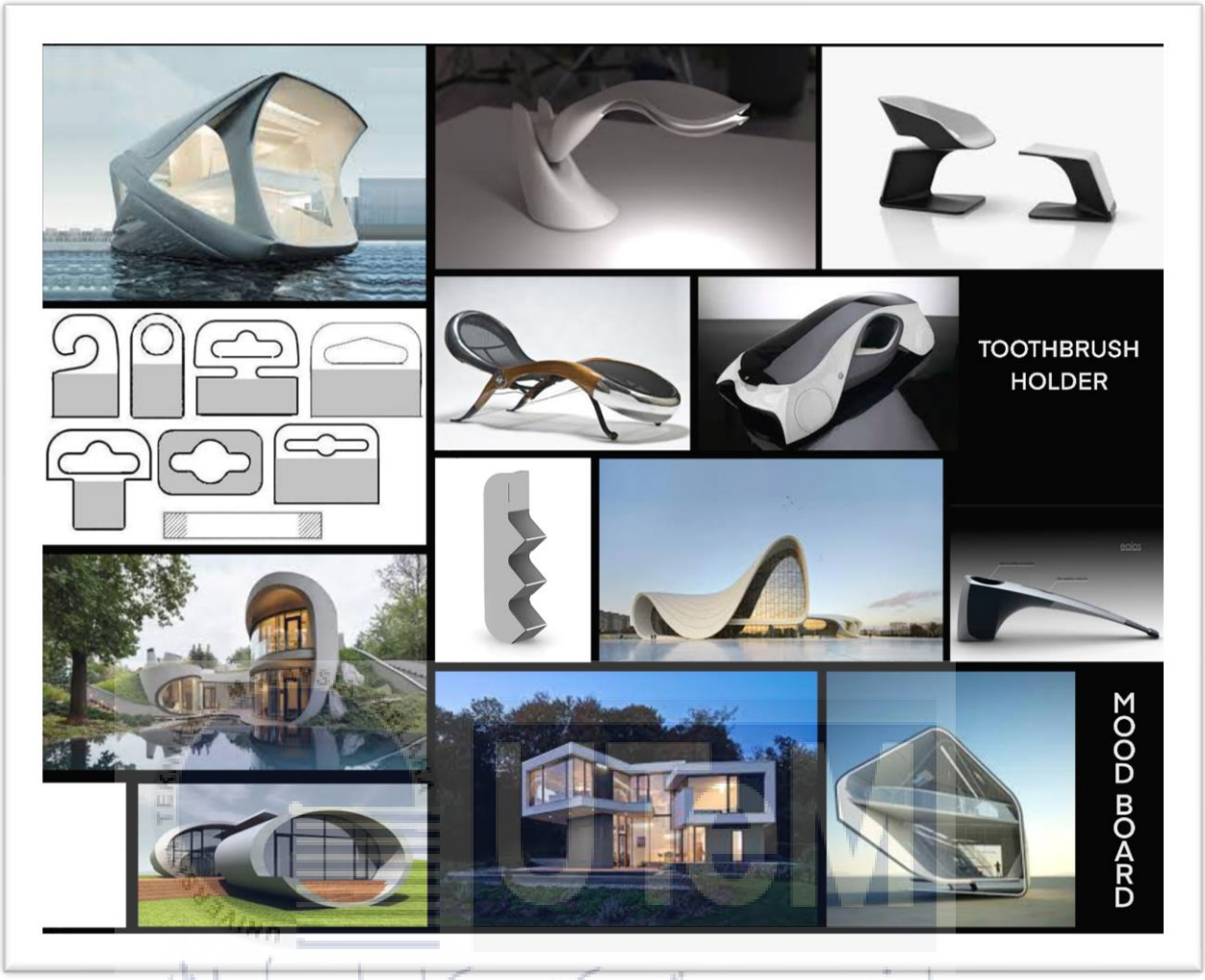


Figure 4.3 : Mood Board

After a clear vision has been identified, the design mood board will be developed. In this project, the mood board is used as an inspiration and ideas generations which is based on the aesthetic criteria in the word cloud that has been created. Figure 4.3 show the mood board for this project.

4.6 Sketches

Next, the ideation phase, in this phase, the sketch was randomly developed as many as possible, and generating the idea of the sketch based on the word cloud and the mood board. The word cloud and mood board are used as guidelines to produce the sketches until

the end of the project, to make sure it aligns with the design brief for this project. There have been 9 sketches created randomly. The figures 4.4 show some of the sketches that had been produced.

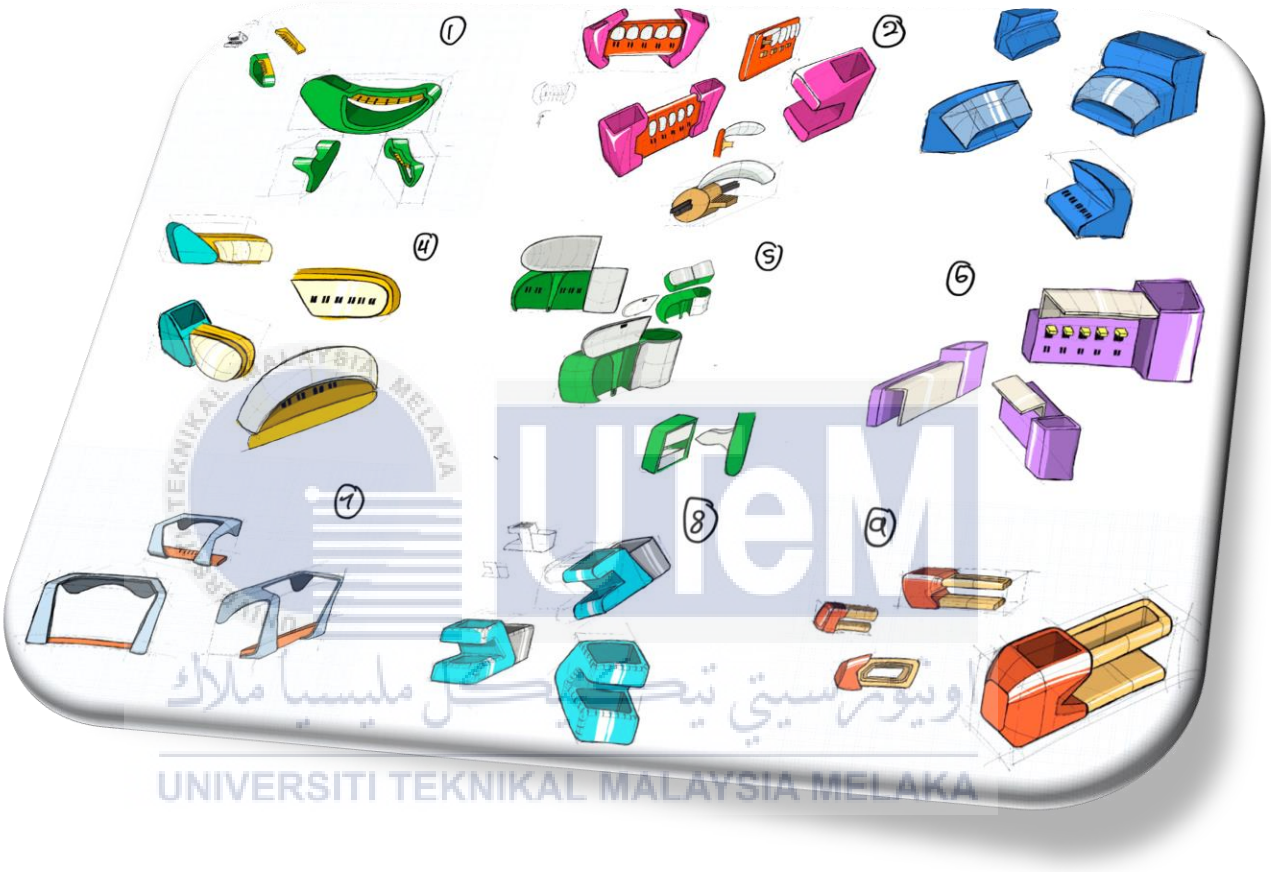
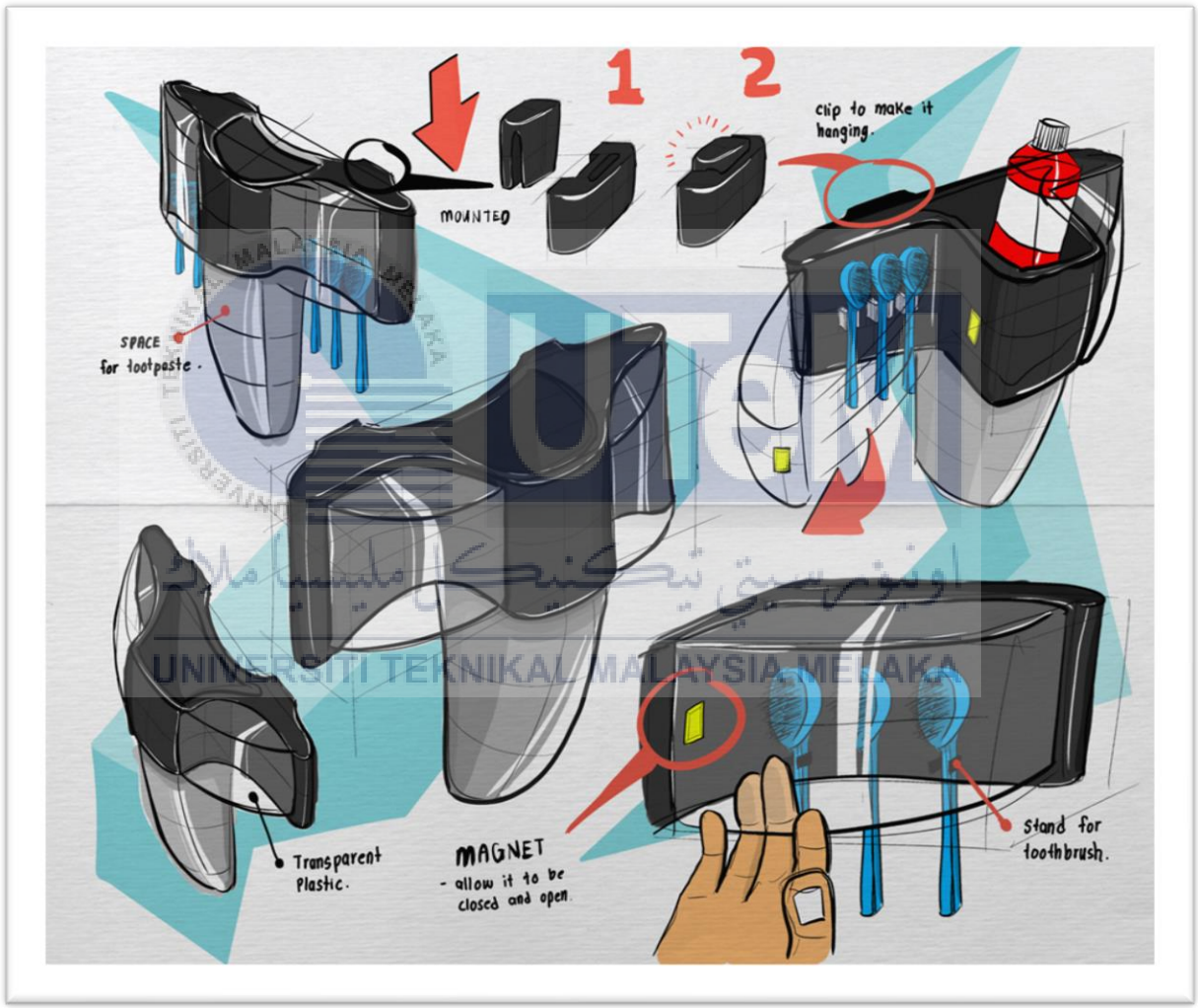


Figure 4.4 : Sketches

4.7 Concept Selection

Once the initial sketches are completed, to finalize the design, we will develop 3 selected sketches from the 9 initial sketches, taking into consideration the characteristics outlined in the design brief and the inspiration from the mood board. These final sketches will be chosen based on how well they meet the goals and objectives outlined in the design

brief and align with the overall aesthetic established by the mood board. To generate new ideas and improve upon the design, we will using the SCAMPER method to the 9 initial sketches, considering how they can be modified or combined to enhance the 3 selected design. The resulting design, as shown in Figure 4.5, will be a combination of these selected and improved sketches, adhering to the design brief and mood board..



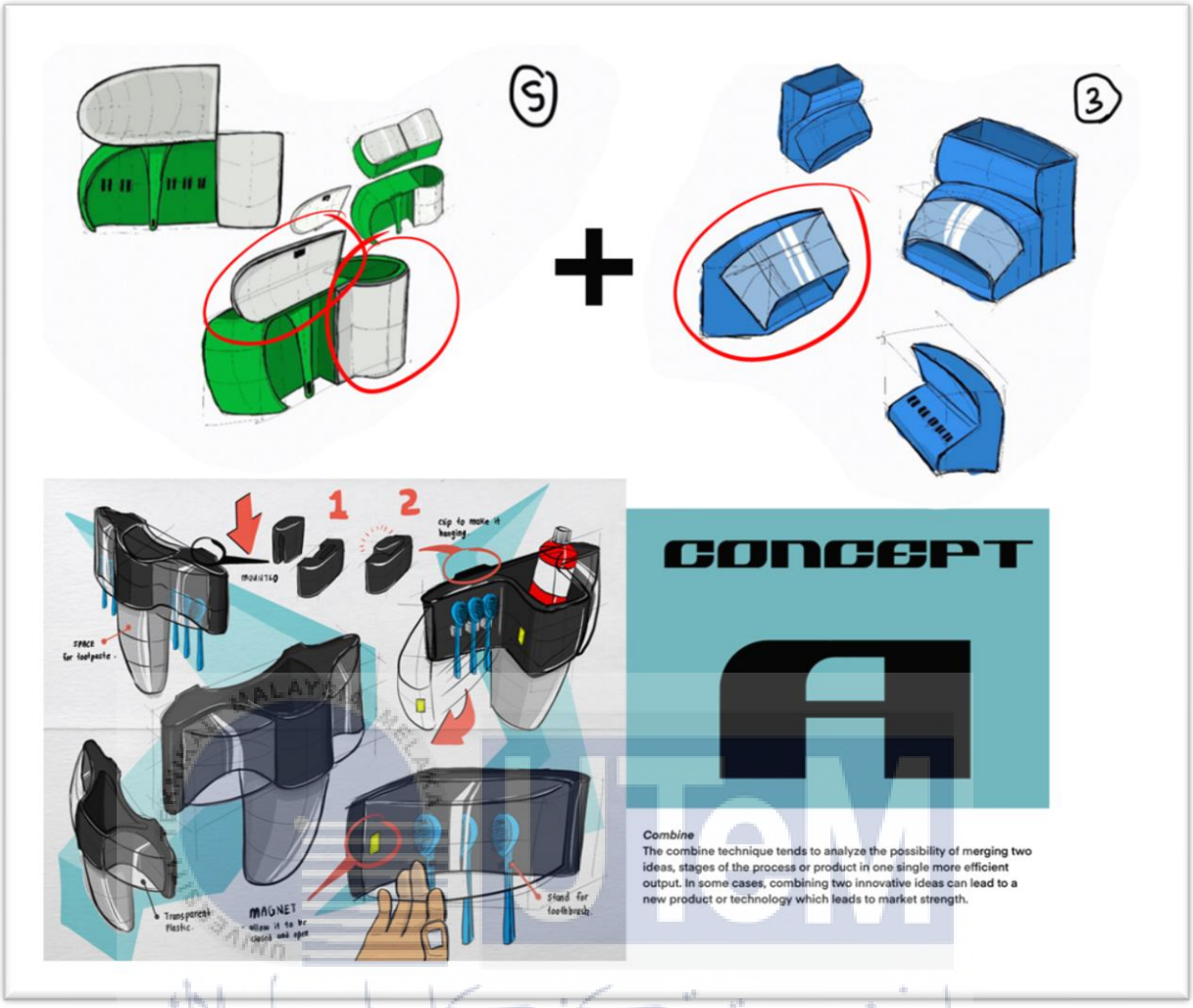
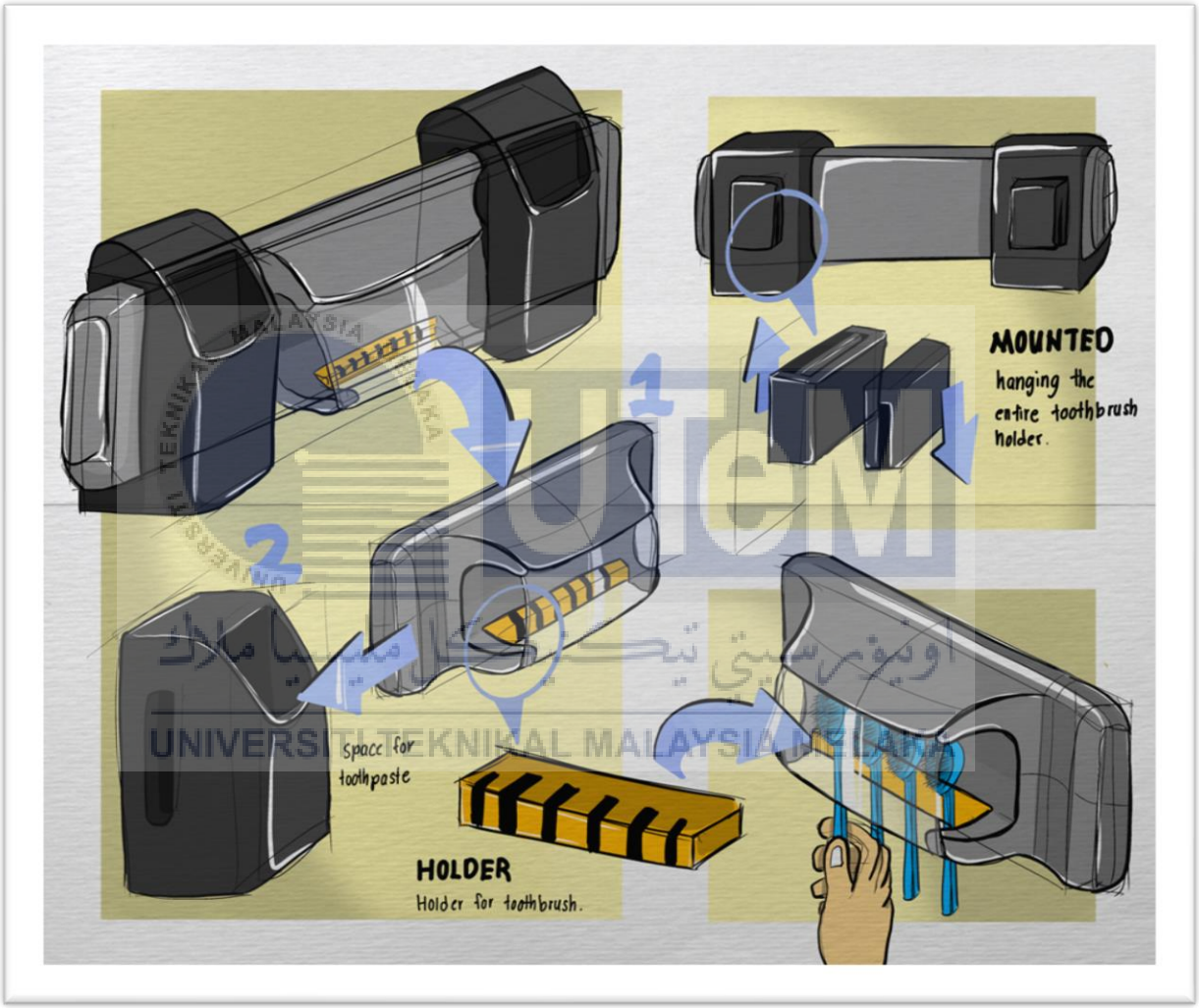


Figure 4.5 : Concept A.

The first conceptual design is concept A. This concept is the combination of the sketches 5 and sketches 3, from the sketches 5, mechanism of the cover for the open-closes toothbrush and the cup for the toothpaste concept has been taken. For sketches 3, the curved cover for the toothbrush were taken. Thus, the outcomes from this 2 sketches were developed to create 1 new sketches idea for concept A, this sketches also stick with the design brief and the mood board that has been created. The mid of the sketches is a place to put the toothpaste, and the left and right is a place to hang the toothbrush. To make it mounted at the wall, a mounted part has been created right behind the left and the right of the part. Moreover, the

toothbrush has covers where it can be open and close. This concept is a colour based concepts based on the design brief and the mood board, which is black, white and silver. Thus, the next conceptual is Concept B. Figures 4.6 shows the Concept B.



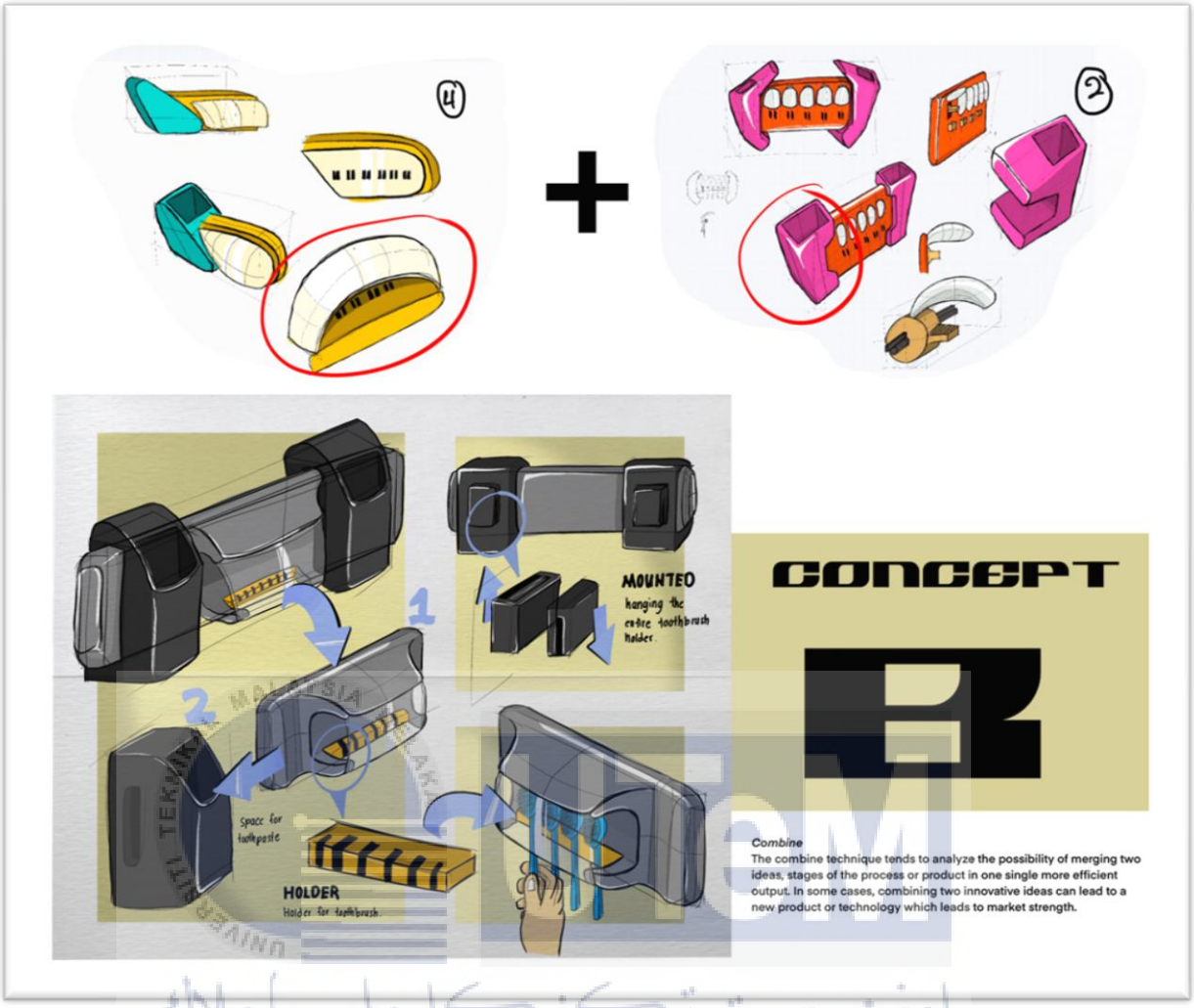
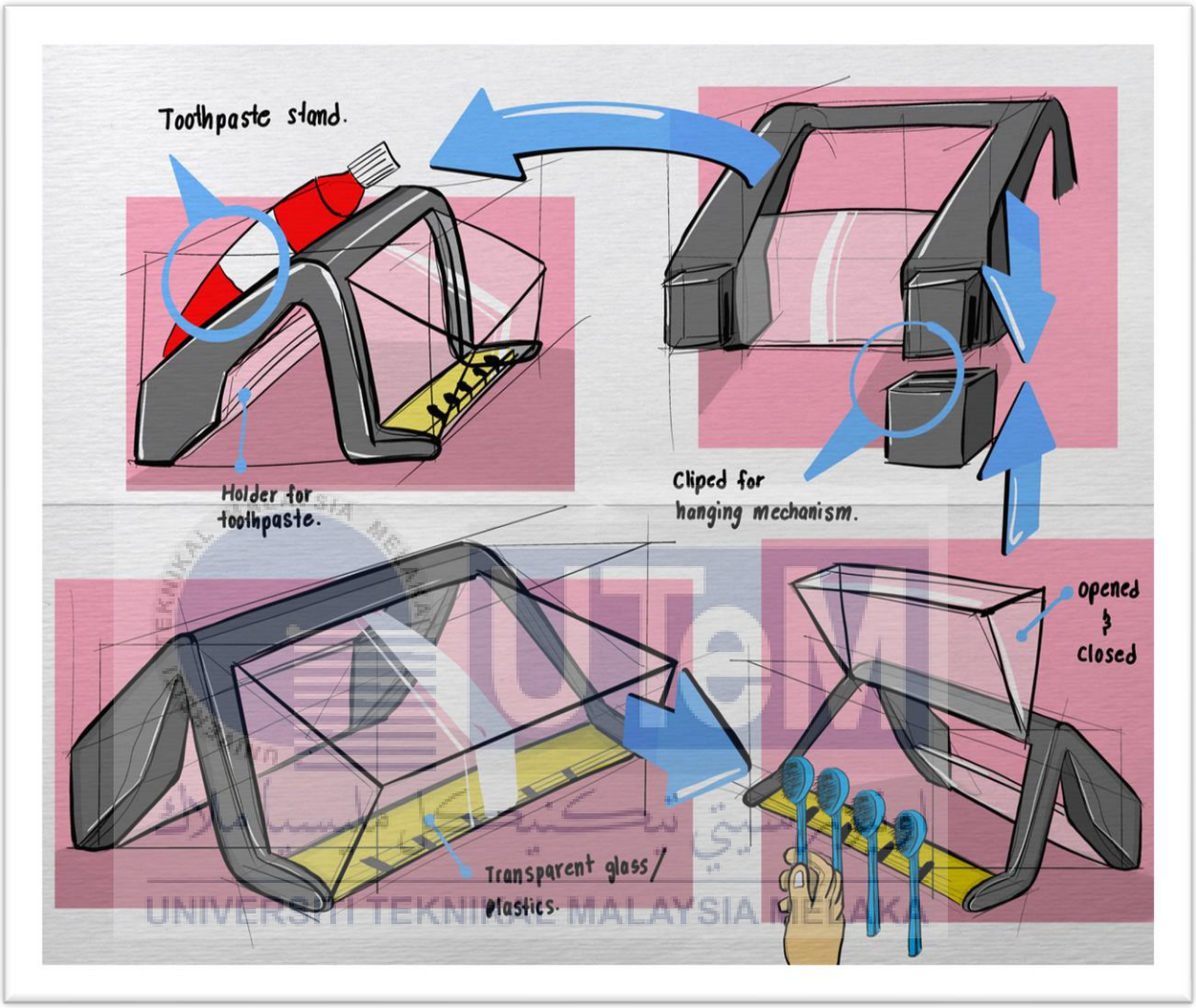


Figure 4.6 : Concept B.

The next design sketches are concept B. The concept is a combination of sketches 4 and sketches 2. From sketches 4, the shape of the toothbrush was taken because the shape is more related to the mood board, and for sketches 2, the left and the right part is a place for putting the toothpaste. So, the result of combining the 2 sketches is there, where the middle part is a place to put the toothbrush there, it is not like concept A where it has an open-closes cover, this one stays still there but has a space that allows putting the toothbrush, hanging it there. The left and the right part are places to put the toothpaste, there are a-holes behind them that allow inserting the mid part, this makes the end of the left and right parts have the

shape of a square and also strengthening the part. Lastly is Concept C, figures below show the Concept C.



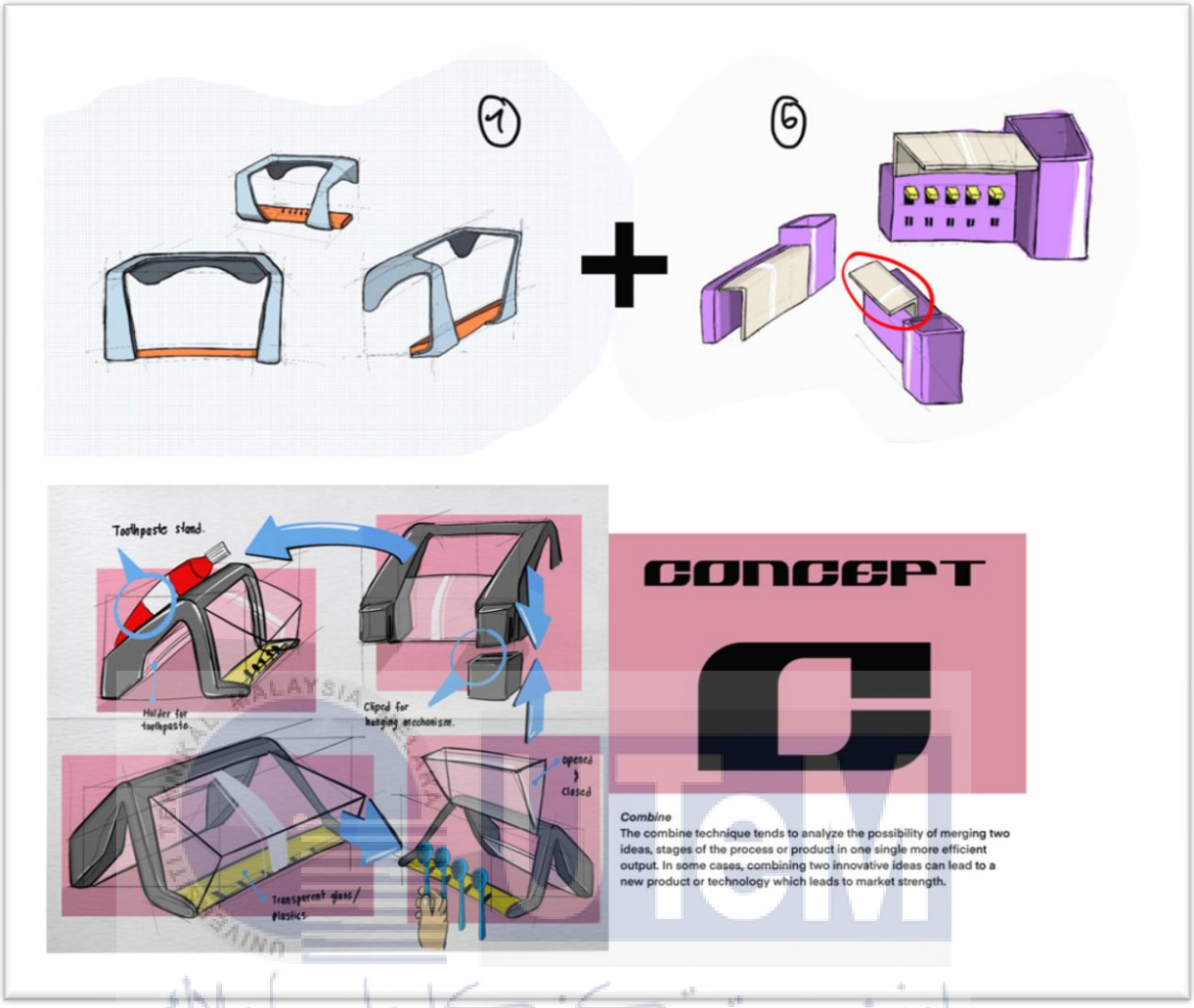


Figure 4.7 : Concept C

Figure 4.7 above shows the conceptual design C. This concept is designed with a combination of sketches 7 and sketches 6. From the sketches 7, the whole concept had been takes since the shape are considered to follow the design brief and the moodboard, with the organic shape allow it to be seen as a minimalist style. The concept sketches from the sketches 6 is for the cover style which is the mechanism that allow it to open-close, make it to cover the toothbrush place.

4.8 Final Concept Design Selection

After several conceptual designs had been developed, the next process is to select the best final design for the mounted wall toothbrush holder. In this IQM approach, we use the spider chart to compare based on design features, criteria, or factors and an overall understanding of the pros and cons of all the conceptual designs. The scores assigned to each metric are relatively scaled- for instance, from 0 – 100 where higher scores indicated better performances under the metrics.

The design features and criteria has been set into two main components to meet the customer's requirements and the product characteristics. Two main components consist of the functionality of the product and the product aesthetics. Since the design is based on the mounted wall concept, reliability is also considered the functionality of the product. It includes easy to install and easy to use. Next, organised also considers as functional of the product. The product that has an organise for toothbrush place is better. For the aesthetic components, the attractive form and shape complexity considers as a new design or fresh idea. Other than that, the colour effect on form, and innovative and attractive colour use. All those criteria and characteristics in both functionality and aesthetics will be transformed and represented as a keyword in the spider chart. Next, the conceptual design will be analysed based on those keywords in which the scores were assigned to make the comparison between three conceptual designs which one has better results to select the best design for this project. The Tables 4.3 and 4.4 below show the analysed scores and spider chart.

Criteria	Concept A	Concept B	Concept C
Reliability	65	70	55
Fresh idea	70	55	65
Attractive	70	60	35
Futuristic	70	50	35
Mechanisr	75	55	75
Design fre	75	60	35

Table 4.3 : Scores.

After evaluating each concept based on a range of different criteria, it was determined that Concept A had the highest overall scores. Specifically, Concept A had a score of 65 for reliability, 70 for fresh ideas, 70 for attractiveness, 70 for futuristic design elements, 75 for mechanisms and 75 for design freshness. Concept B, on the other hand, had a score of 70 for reliability, 55 for fresh ideas, 60 for attractiveness, 50 for futuristic design elements, 55 for mechanisms and 60 for design freshness. Concept C received lower scores overall with 55 for reliability, 65 for fresh ideas, 35 for attractiveness, 35 for futuristic design elements, 75 for mechanisms and 35 for design freshness.

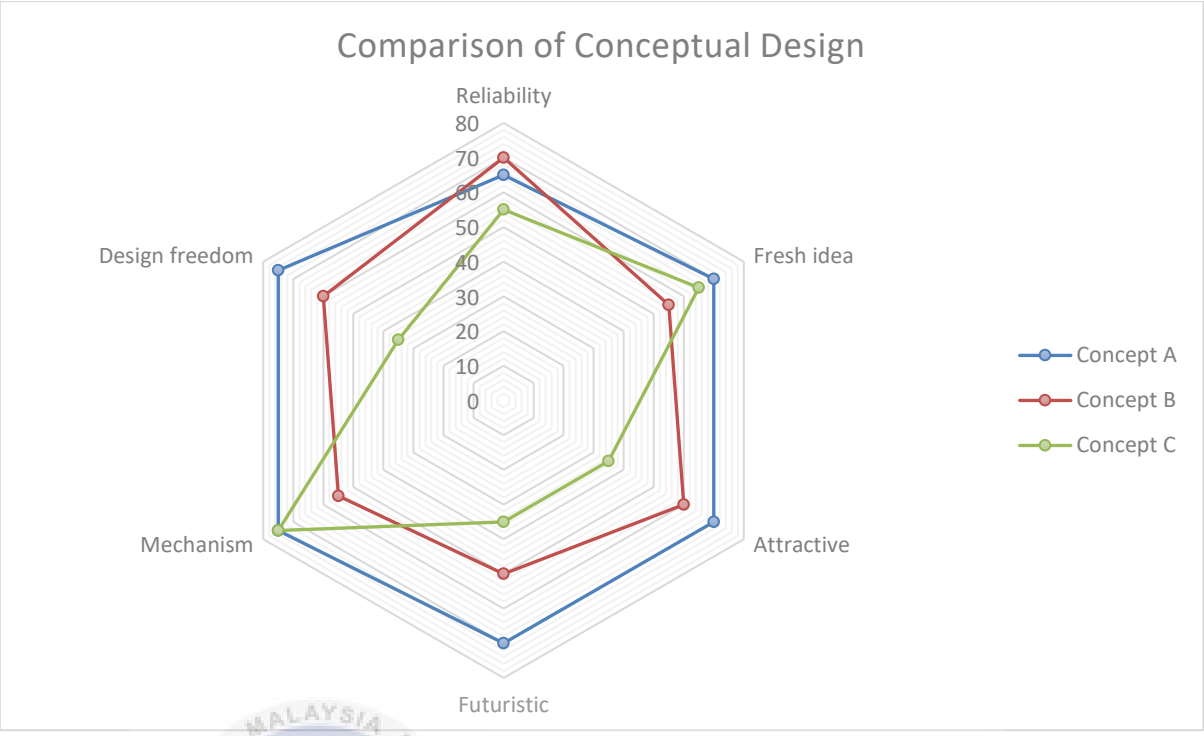


Table 4.4 : Spider chart.

After thoroughly comparing each conceptual design against a variety of criteria, such as reliability, freshness of ideas, attractiveness, futuristic design elements, and overall mechanisms, Concept A emerged as the clear winner. Consideration was given not only to the customer's needs and the design brief, but also reference materials such as mood boards, to ensure that Concept A met or exceeded expectations in every area.

Furthermore, Concept A showed a consistently good performance across all criteria, displaying an average value that was deemed suitable for the project. This made it the obvious choice for proceeding with the project. Concept A had the best balance of design aesthetics and functional reliability, which made it the ideal choice for meeting the needs of the customer and fulfilling the project's objectives.

Overall, the decision to select Concept A was based on a thorough and rigorous evaluation process that considered all relevant factors, and it is confidently expected that Concept A will prove to be a successful and satisfying solution for the customer.

4.9 Conceptual Design

At this stage, once the conceptual design had been selected, the details design was developed using Solidworks software. The overall dimension of the product had been set through an embodiment by using a paper box model. Every part or component, drawing, and assembly was produced. The drawing also includes the dimensions. The design detail drawing was attached in the appendix. The figure 4.8 below show the embodiment and figure 4.9 show the conceptual design that had been created in the solidworks.

Figure 4.8 : Embodiment.

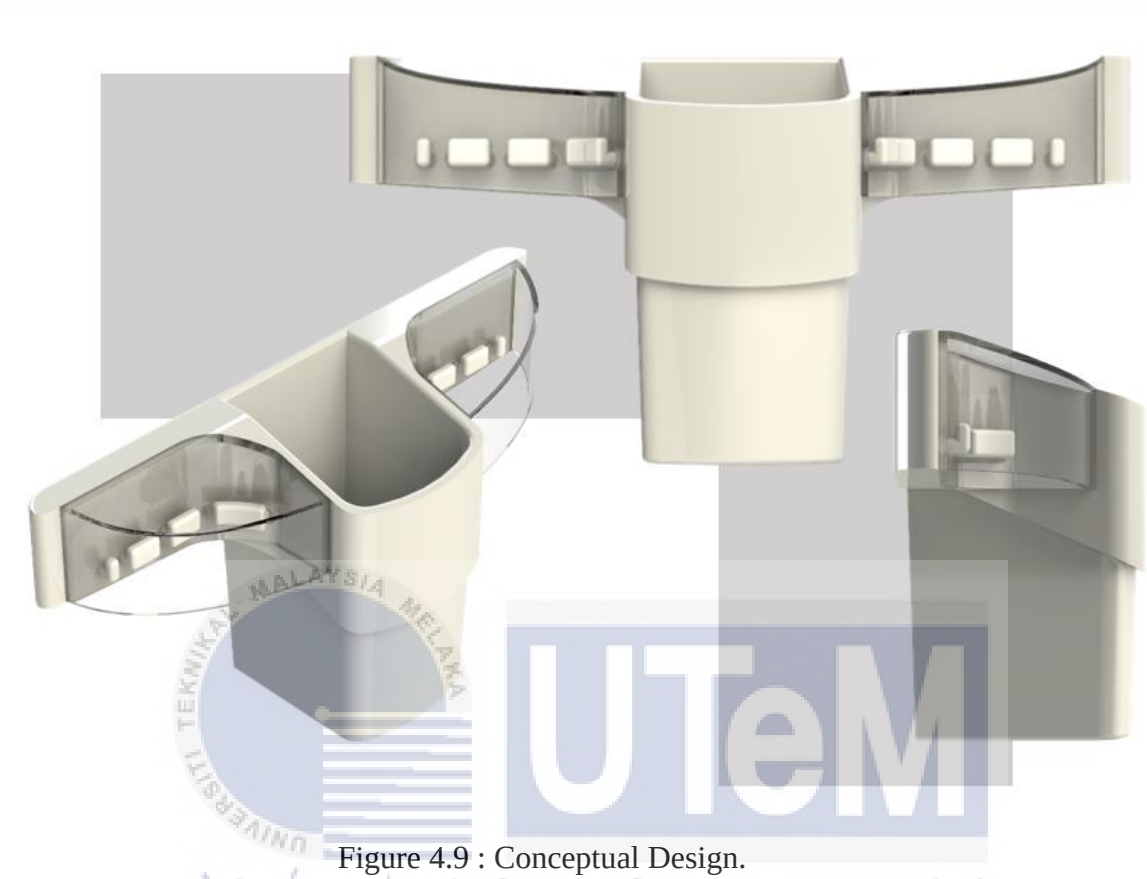


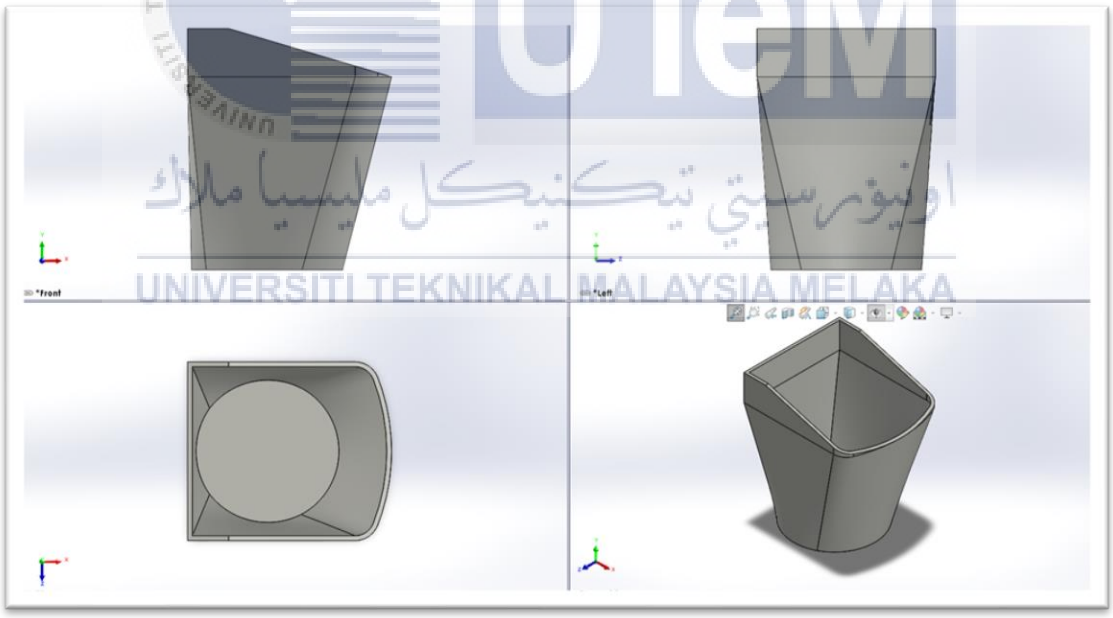
Figure 4.9 : Conceptual Design.

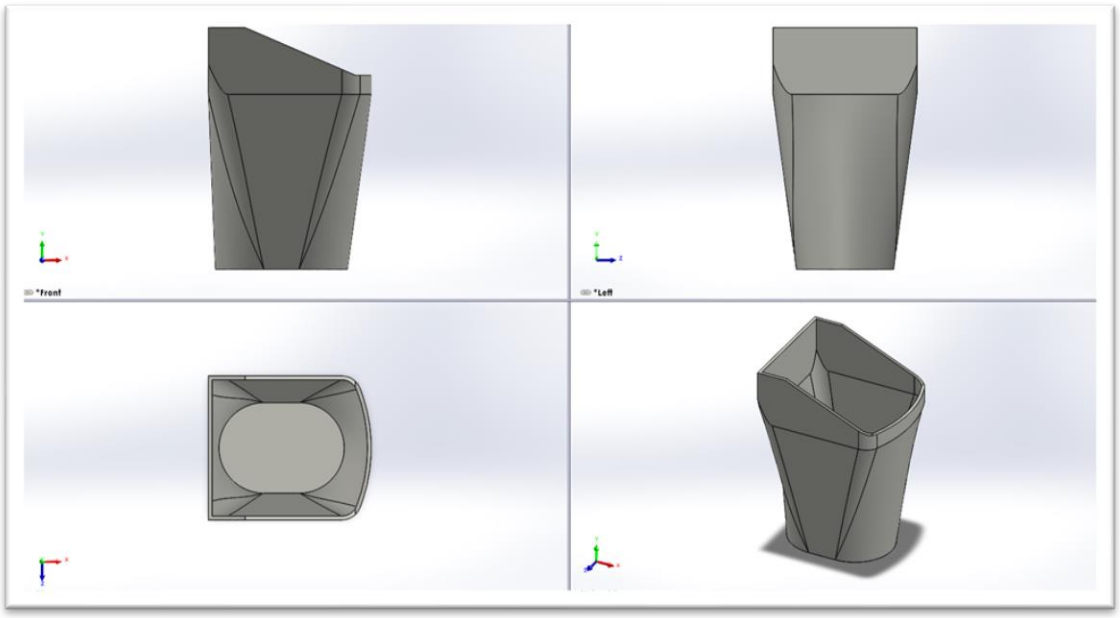
The design proposal is not fully aligned with the selected mood boards, as it is still lacking elements that reflect the desired aesthetic direction. The mood boards chosen for this project are heavily focused on curvy, oval, and organic shapes. To ensure that the final design aligns with these desired aesthetics, the design will be refined to incorporate more elements that reflect the mood boards. This will result in a design that is more closely aligned with the desired aesthetic direction and is more cohesive with the overall project vision.

4.10 Refining

During the design phase, it was determined that the design of the cup portion of the product did not align with the mood board. As a result, a decision was made to modify the

design of the cup and three different design concepts were developed. These concepts are described in Table 4.5 and show the various design options that were considered. These options were likely evaluated based on how well they fit the mood board and other design criteria, such as aesthetics. After reviewing the different design concepts, one of them was likely chosen to move forward with, or elements from multiple concepts may have been incorporated into a final design. The purpose of this process is to create a cup design that is cohesive with the overall concept and meets the desired aesthetic and functional requirements.

Cup 1

Cup 2



Cup 3

Table 4.5 : The 3 design fo cup.

Cup 2 has been selected as the final design after a thorough evaluation process that considered how well it aligned with the concept design of the mood boards. Recognizing

that in order to take the design to the next level, it was necessary to refer back to the mood boards and to incorporate additional aesthetic elements. By doing so, the aim was to create a design that not only fit well with the concept design, but also had a higher level of aesthetic value.

As a final step, the design of Cup 2 was refined, incorporating feedback from the evaluation process, to create the final version of the design. The final design can be viewed in Table 4.6 and Figure 4.10, where the design of Cup 2 has been enhanced and refined with references to the mood board, to increase the aesthetic value and make it more coherent with the concept design. As a result, Cup 2 was selected as the best-fit product based on how well it fit the concept design of the mood boards and how it was refined to provide added value in terms of aesthetics.

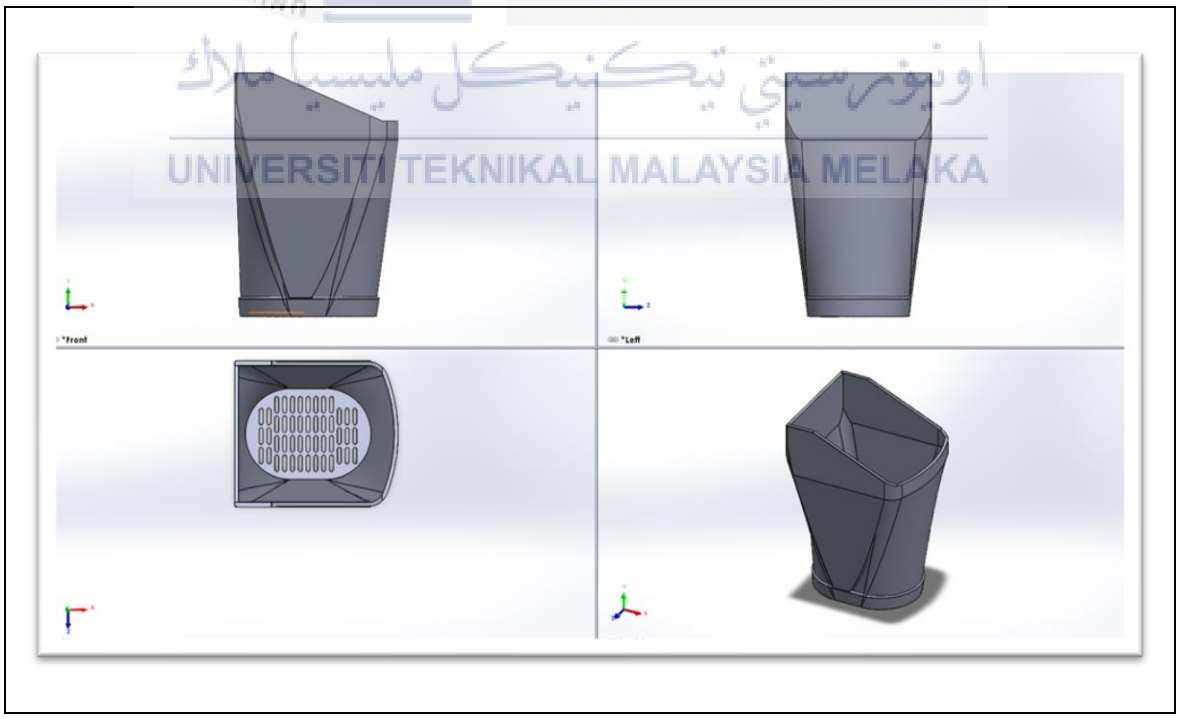


Table 4.6 : 3D part of the cup in solidworks.

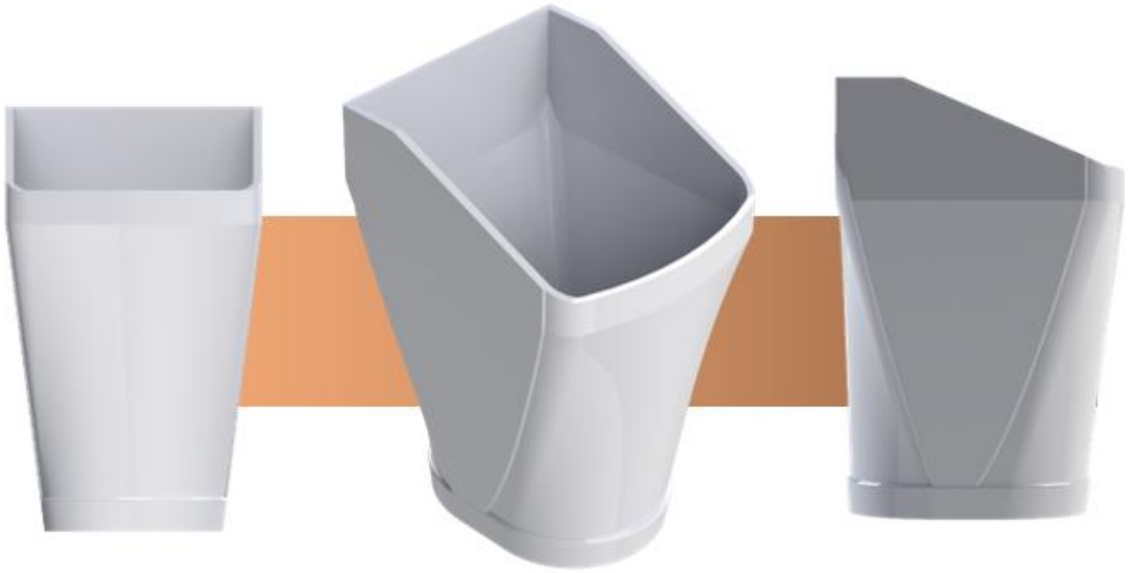


Figure 4.10 : 3D Solidwork rendered the cup 2.

In addition to modifying the design of the cup, the body of the product also underwent refining in order to enhance its aesthetic value and better align it with the concept design outlined in the mood board. The refinements made to the body of the product are shown in Table 4.6 and Figure 4.11. These changes likely aimed to improve the overall appearance of the product and make it more visually appealing, while also ensuring that it remained consistent with the desired concept design. The refining process may have involved making adjustments to the shape, size, or other features of the body to achieve the desired aesthetic and functional goals. The resulting design, as shown in Table 4.7 and Figure 4.11, represents the product after undergoing the refining phases.

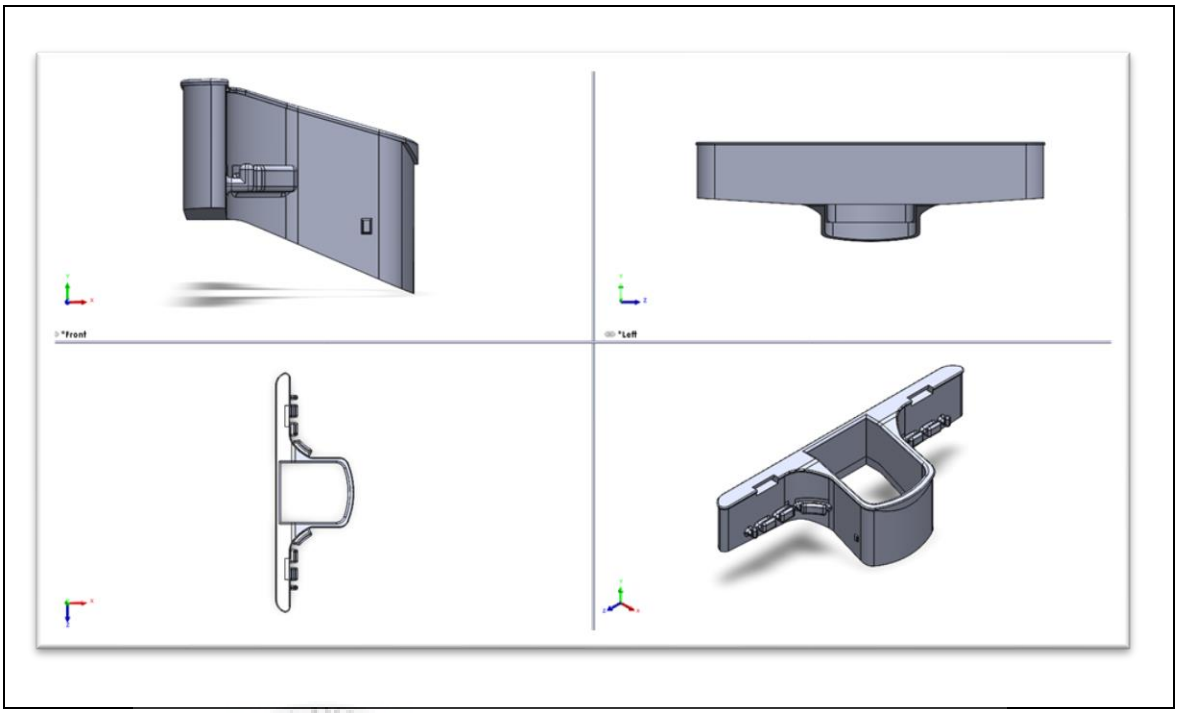


Table 4.7 : 3D part of the body in solidworks.

Figure 4.11 : 3D Solidwork rendered part body.

Once all of the individual parts of the product have been designed and produced, they will be assembled to create the final product. The process of assembly involves putting the

various parts together in a way that allows them to function properly and meet the desired performance and aesthetic goals. Figure 4.12 shows the assembled product, which is the final result of the design and production process. The finished product should be a cohesive and functional whole that meets the requirements outlined in the design brief and mood board.

Figure 4.12 : 3D Concept of Toohbrush holder.

4.11 Colour Scheme

After the conceptual design, it is crucial to apply the selected color scheme to the final product design in order to create a cohesive and consistent visual appearance that aligns with the design brief and mood board. It is essential to consider how the colors will affect

the overall aesthetic of the product. Figure 4.13 below show the scheme colour for the toothbrush holder.

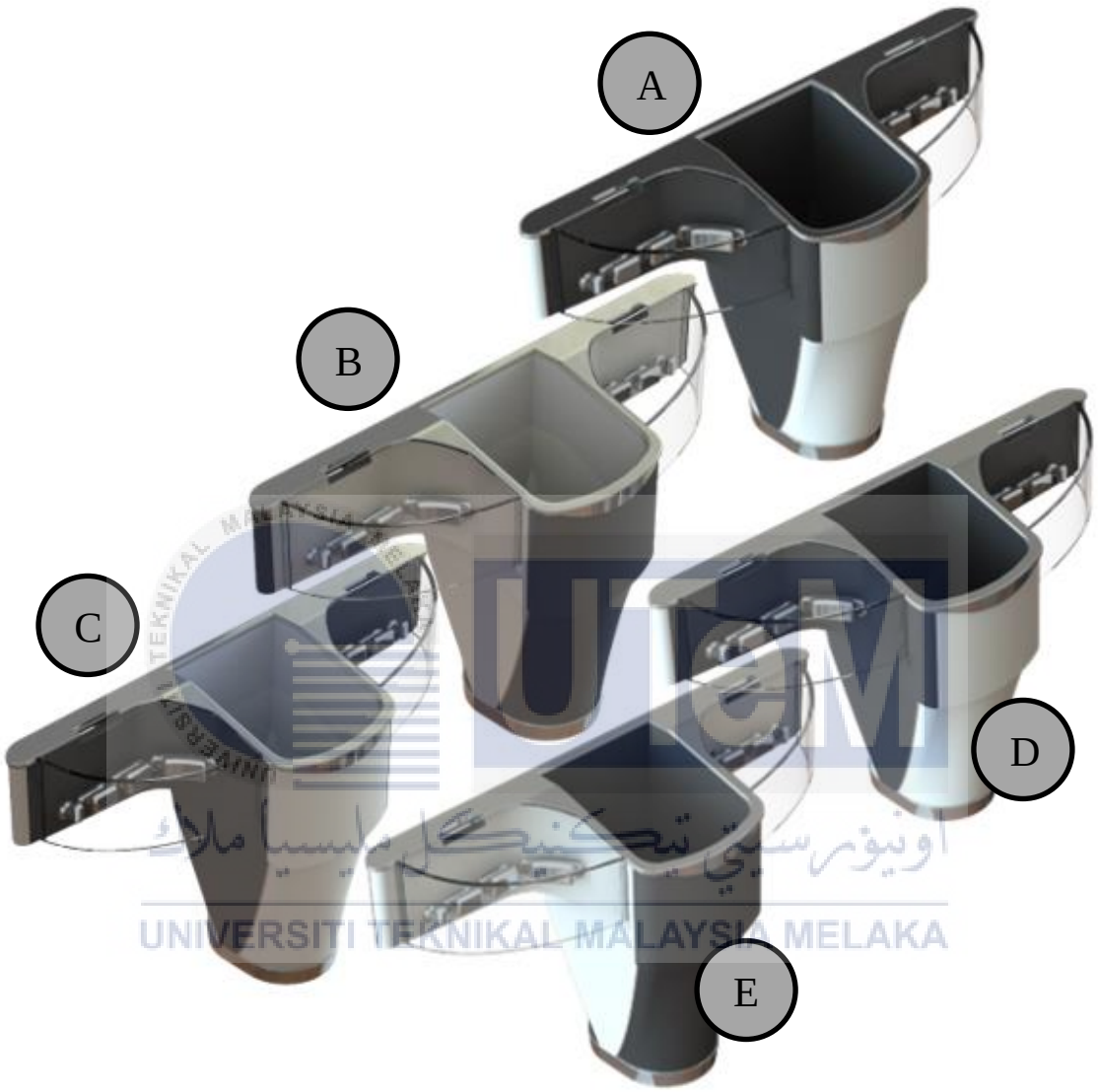


Figure 4.13 : Colour Scheme.

It is important to carefully consider which color scheme is the most suitable for a design project. In this case, the color scheme labeled "B" was selected because it is the most closely related to the design brief and the mood board that were created previously. This color scheme has a futuristic look and is more appealing because of its curvy shades of color.

The color scheme will fit with the overall aesthetic and theme of the project in order to create a cohesive and effective design.

4.12 Final Concept

After the 3D parts of the toothbrush holder, including the body and cup, were developed, they were assembled to create a final conceptual design after the refining phase. This allowed to working on the project to see how the various parts fit together and to evaluate the overall appearance and functionality of the product. Figure 4.14 shows the last rendered image in Solidworks for the toothbrush holder, which represents the final conceptual design after the refining phase. This image likely includes visual details such as textures, colors, and reflections to help convey the appearance of the product. The image may have been used to present the product to others or to make final adjustments to the design before proceeding to the production phase.

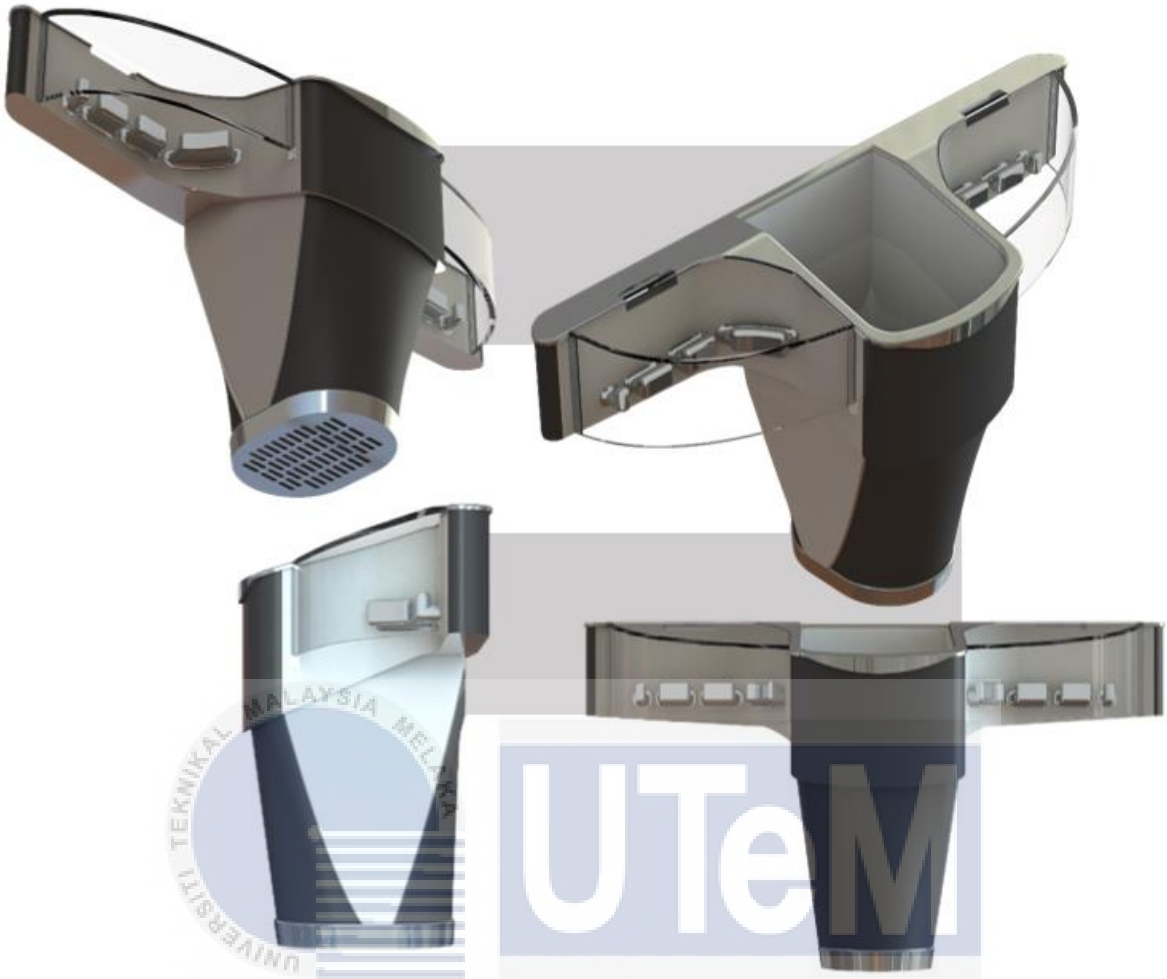
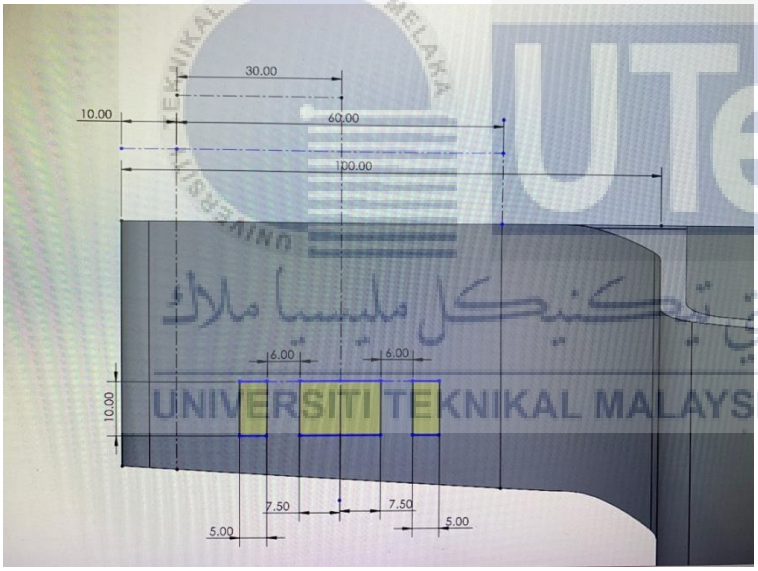
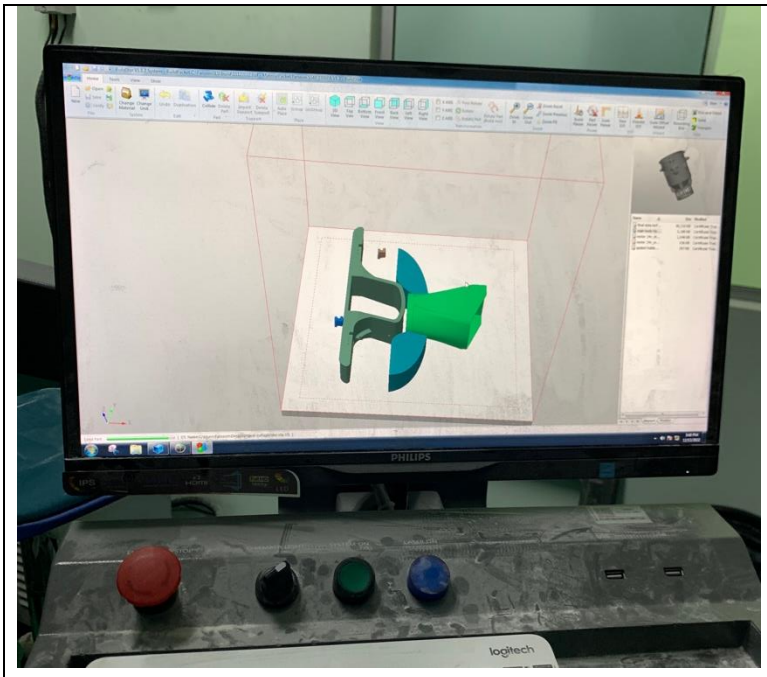


Figure 4.14 : Assembled final concept part in solidwork.

4.13 Prototype Development

After the detail finished and finalized, the prototype will be developed using the selective laser sintering (SLS) 3D printing machine. SLS is a technique of additive production that uses a laser to sinter powdered material which typically contains nylon or polyamide and automatically aims at space points identified by a 3D model, binding the material to form a solid structure. For this project, the material used is nylon and before the SLS machine is run, several processes need to be done to ensure the printed product will not suffer any damage. All the processes were described in the table 4.8 below.

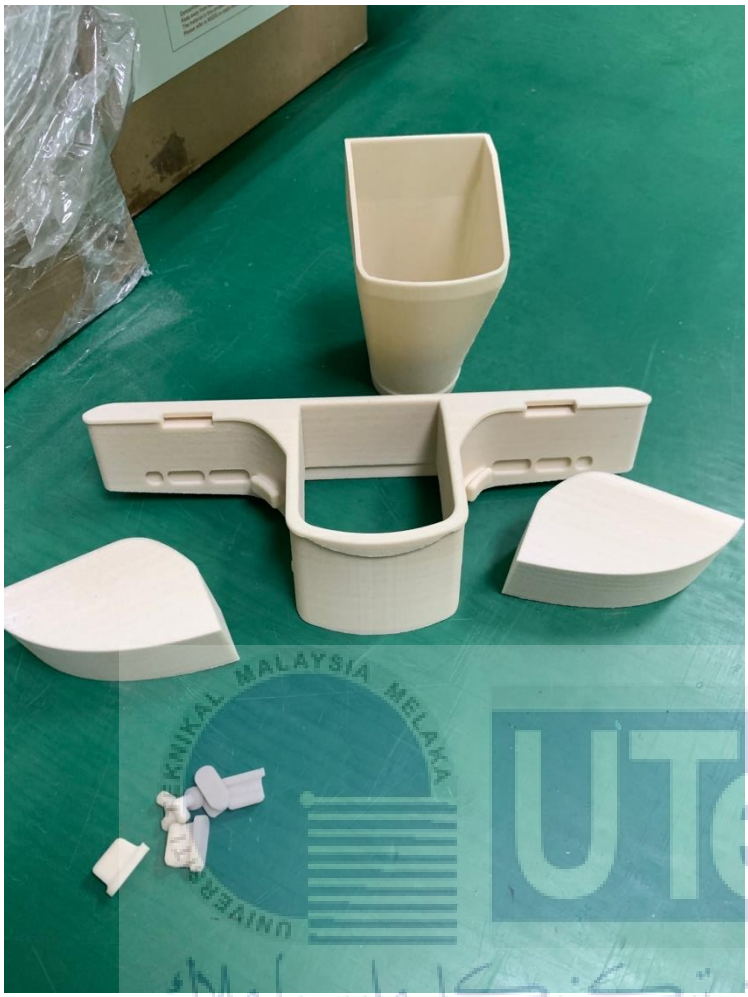
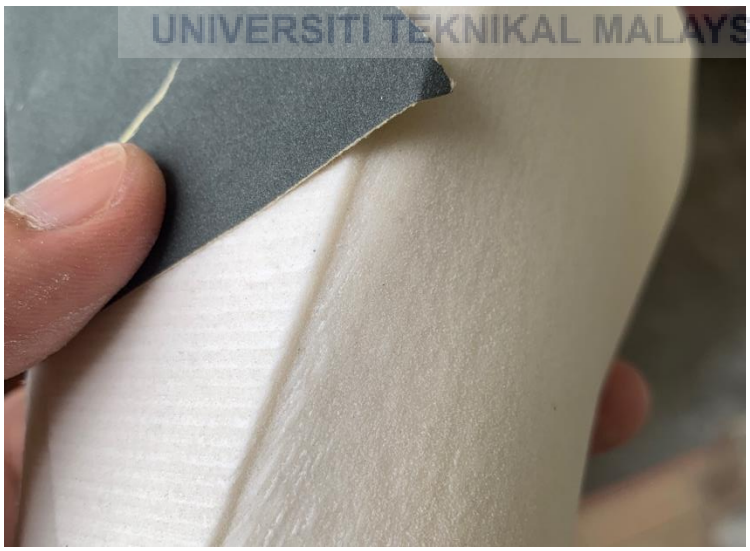
PROCESS	DESCRIPTIONS
Produce a CAD and STL file.   	- The first step before going through with the SLS 3D printing process, the final product must be developed as a CAD file. Every dimension and tolerance for assembly must be clearly set to avoid the failure of the final product. After finished the CAD file, the file must be converted into an STL file.

 	- Next, the STL file needs to be imported into the SLS 3D printing post-processing software. The BuildStar software had been used. Buildstar is a versatile build preparation software package that allows the user to prepare to build files for production in the Farsoon SLS 3D printing machine. Once imported the files can be moved, rotated, and scaled as necessary to create a compact build file that fits the build platform. After the files are ready to be run into the SLS 3D printing machine, the process will go through to the material raw material preparation.
Filtering Process.	- Next is filtering process. This process is performed to reclaim or filter out the used material. This machine is working on vibration to separate the excess material from the finished product after

	using the SLS 3D printer machine. In this machine, there is a filter at the center of the machine. After excess material has filtered out, the material dropped down to the container in the machine.
Mixing Process. 	- After that, the mixing process. This process is to mix to excess material and raw material to another use. For this process, the plastic colour mixer machine is used. The material is mixed into a good compound to ensure the material can produce a good condition of the product surface and does not suffer any damage.

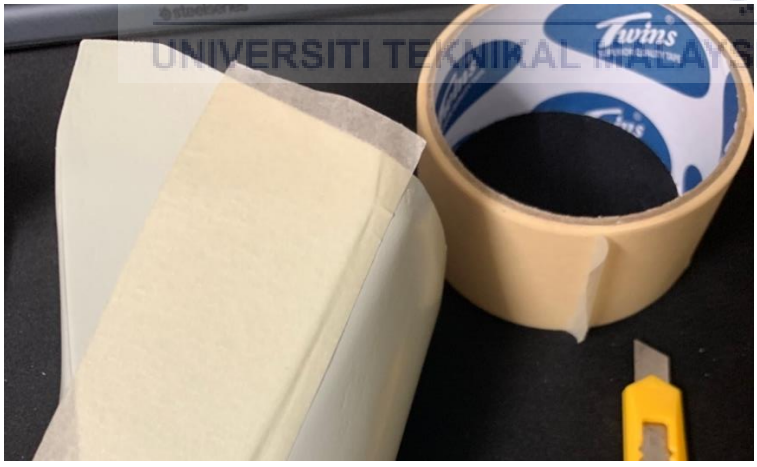
Filling the Power. 	- Then, filling the powder. After the mixing process is finished, the compound mix material will be reused. The material will be gradually removed and poured into the powder bin SLS machine and will be inserted into the machine for the next process.
Printing Process.	- Next, the printing process. The powder bin and the build area are first heated just below the melting temperature of the polymer and a recoating blade spreads a thin layer of powder over the build platform. A CO2 laser then scans the contour of the next layer and selectively sinters (fuses

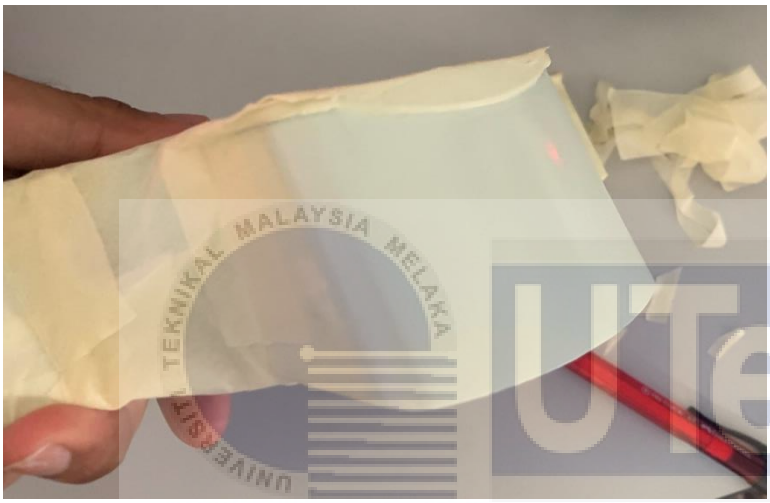
	together) the particles of the polymer powder. The entire cross-section of the component is scanned, so the part is built solid. When the layer is complete, the build platform moves downwards and the blade re-coats the surface. The process then repeats until the whole part is complete.
Cleaning Process. 	- After printing, the parts are fully encapsulated in the unsintered powder and the powder bin has to cool down before the parts can be unpacked. This can take a considerable amount of time (up to 12 hours). The parts are then cleaned with compressed air or other blasting media and are ready to use or further post process.

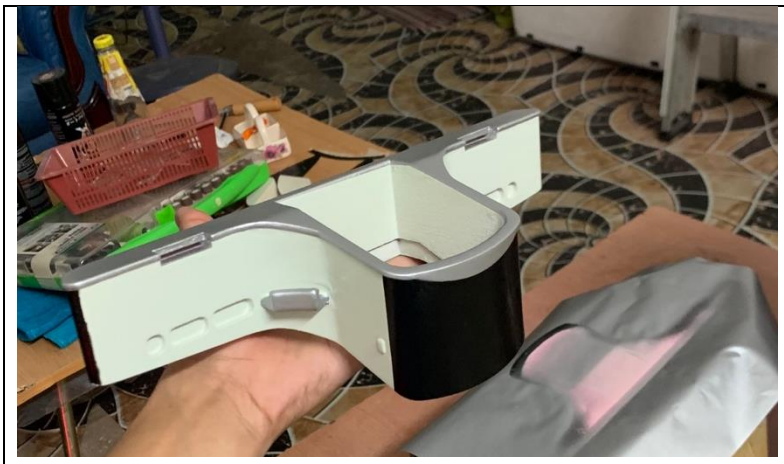
Finish Product. 	- After finishing the cleaning process, the finished product is ready for the next process which is the finishing process. There are many ways to do the finishing process depending on the surface condition product. Finishing method that can be applied include sanding, painting, and others.
Smoothing surface. 	- The smoothing surface. For the prototype, After the finished product has been removed from the cleaning process, the product has been touched up using putty filler to repair some damaged surfaces. Then the product is polished with sandpaper to get a better surface.

Coating spray.

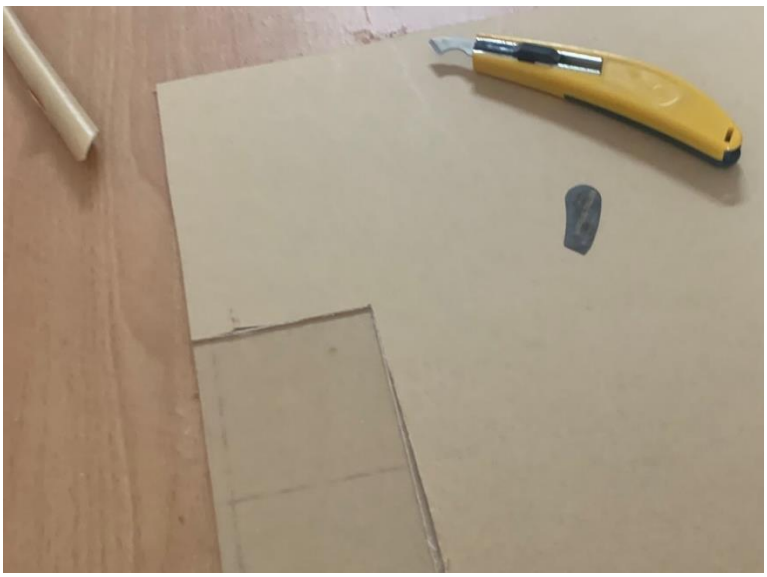
- Before getting to the actual colour, the part needs to be coated first to get a better surface and nice colour. The coat has a total of 2 layers of coating to have a glossy looks surface.

 	
Spraying colour. 	- For the colouring phase, the tape is used for separating the colour section, because each part has 3 colour which is white colour (artic white), black, and silver. Thus, the colour goes through 3 step process for each colour. Each colour is layered with 3 layers to get a better and glossy look surface.

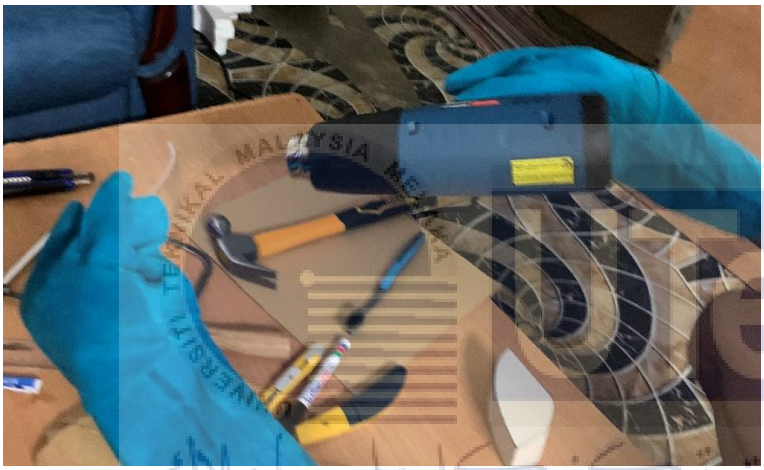




Bending acrylic.



- Bending acrylic, this phase is to create the cover for the product. To create that, acrylic has been catted based on the dimension that has been get in Solidworks. Then, to get the curve,

  	the tool used is a steel file. After getting the shape, the acrylic goes to the bending phase, here where the dummy is used to get the curve as needed, while the hot gun makes the acrylic slowly can be shaped to follow the dummy shape. Lastly, both parts are combined by using acrylic glue, acrylic glue gives a better finishing which is a transparent finish.

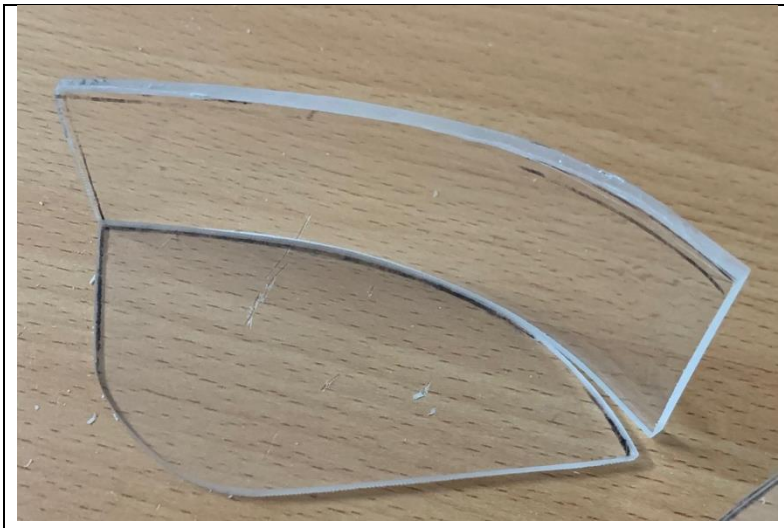
 	
Finished product	- Lastly, there is a 10 part, and all of them has been assembled to get the final looks of the product.

Table 4.8 : Process of making the prototype.

4.14 Final Product

After the making process was completed, it comes up with the final product of prototype. The figure above shows the final product. The final product had been designed with a hanging style that can be mounted to the wall. The final product is developed with the additional parts which are the hanging hook and hinge for the cover that allows it to open - close. For the use of the product, as mentioned in the design brief, it is easy to install by just taping the hook to the wall, then the product also has to hook behind it, thus connecting the product should be done to make it mounted to the wall.

4.15 Verifying Aesthetic

Next, we will verify the aesthetic of the product to ensure it is successful in this project. We will do this by conducting an aesthetic verifying to determine if it meets the necessary criteria for a well-designed product.

- Is the aesthetic functional?

Yes, the aesthetic of the product is functional. the design elements of the product serve a purpose and enhance its usability or functionality in some way. The product has a certain shape, these design elements help to make it easier to use. The product has visual elements, such as the chrome hook, these help to clearly communicate its functions or features to the user..

- Is the aesthetic timeless?

Yes, the aesthetic of the product is timeless. This design elements of the product are not likely to quickly become dated or go out of style. A timeless aesthetic is one that is classic

and enduring, rather than being tied to a specific trend or moment in time. Designing the colour and shape as futuristic and organic shape, it is more likely to remain relevant and appealing over the long term.

- Is the aesthetic unique?

Yes, the aesthetic of the product is unique. This design elements of the product are distinct and set it apart from similar products on the market.This unique aesthetic help this product stand out and catch the attention of potential customers, which can be an important factor in its success. This unique aesthetic achieved through the use of unconventional color combinations, unusual materials, or unexpected design, this is more likely to be memorable and distinctive in the minds of consumers.

4.16 Testing

The testing of the product focused solely on its functionality. The product was installed on the wall in the vertical position and was tested by hanging the toothbrush and placing toothpaste in the cup. The testing was conducted on a daily basis to ensure that the product would perform consistently over time. The test procedure was simple: the toothbrush was hung on the designated hooks and the toothpaste was placed in the cup compartment. The product was then left to function for a period of 24 hours. After the testing period was over, the product was evaluated for its performance.

As a result of the testing, it was determined that the product was functioning properly. The toothbrush were held securely in place and remained organized throughout the testing period. The toothpaste was also held in place and remained easy to access. Overall, the product performed as expected and met the functional requirements.

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This is the last chapter that concludes the successful and unsuccessful findings that had been achieved throughout this project. All of the researches and results depends on the objectives that had been set in the first place.

5.2 Conclusion

In conclusion, this project was successfully completed and achieved all of its objectives. The primary objective was to design a product using the Infinitive Qualitative Method (IQM), and a toothbrush holder was chosen as the product for this project. The secondary objectives included the making of a prototype based on the analyzed data gathered from research and surveys, as well as the verifying of the prototype for it aesthetic criteria. Through the use of the IQM and various design methods, a new conceptual design for the wall-mounted toothbrush holder was developed and successfully fabricated as a prototype. Simple testing was conducted on the prototype, and it was found to be functional and well-organized. Overall, the project was successful in meeting its objectives and producing a high-quality product that met both functional and aesthetic requirements.

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5.3 Recommendations

There are several suggestions for future improvements to the product that could result in a better design and outcome. Some potential areas for improvement include the size of the design, the angle at which the toothpaste is placed, and the design structure. Additionally, incorporating electrical and lighting elements could differentiate the product from others on the market and enhance its functionality. It may also be possible to improve the product by including a mechanism for auto-squeezing toothpaste or adding lighting to enhance its aesthetic value. The concept design can be further developed by referring to the mood board and adhering to the design brief. The mood board can provide a wealth of ideas and inspiration, and by focusing on it, designers can generate numerous concepts and ideas. While this project has successfully solved a functional problem, there is still potential for improvement and enhancement of aesthetic value.

5.4 Project Potential

The study found that the Infinitive Qualitative Method (IQM) is an effective framework for designing conceptual products. It helps designers stay focused and stay true to their initial ideas, as outlined in the mood board and design brief. The mood board provides a wealth of inspiration and ideas, and the designer can use it as a reference to extract their own ideas and ensure that their design aligns with the desired concept. The step-by-step process of the IQM is beneficial in guiding the design process and helping the designer stay on track. After completing the 3D model in Solidworks, the designer can refer back to the mood board to check that the product meets the desired aesthetic goals. As long as the designer stays true to the mood board and design brief, the final product should closely resemble the concept that was initially envisioned. The IQM is a simple but effective approach that can enhance the aesthetic value of the product.

REFERENCES

K. Scott Swan and Michael Luchs, 2011. Journal of Product Innovation. From the Special Issue Editors: Product Design Research and Practice: Past, Present and Future.

S Culley, A Duffy, C McMahon, K Wallace, 2001. Design Research - Theories, Methodologies, and Product Modelling.

Peter Downton, 2013. Design Research – Reviseed Kindle Edition.

Peter L. Phillips, 2004. Creating The Perfect Design Brief – How to Manage Design for Strategic Advantage.

Toshiharu Taura • Yukari Nagai, 2013. Concept Generation for Design Creativity – A Systematized Theory and Methodology.

Bernhard E Burdek, 2005. Design History, Theory and Practice of Product Design.

Paul Rodger and Alex Milton, 2011. Product Design.

Mike Baxter, 1995. Product Design – A Practical Guide to Systematic Product Development.

FabrizioCeschin, 2016. Evolution of design for sustainability: From product design to design for system innovations and transitions. Pages 118 – 163. https://www.sciencedirect.com/science/article/pii/S0142694X16300631

MinuKumar Charles H. Noble, 2015. Beyond form and function: Why do consumers value product design. Pages 613 – 620.

Ken Friedman and Erik Stolterman, 2011. Design Thinking, Design Theory.

BRYAN LAWSON, 1980. HOW DESIGNER THINK – THE DESIGN PROCESS DEMYSTIFIED.

NIGEL CROSS, 2002. ENGINEERING DESIGN METHODS STRATEGIES FOR PRODUCT DESIGN.

FRENCH, 1985. DESIGN PROCESS.

DAVID MARCHANT, 2016. THE DESIGN BRIEF : REQUIREMENT AND COMPLIANCE.

KEN FRIEDMAN AND ERIK STOLTERMAN, 2011. DESIGN THINGS.

HEMNANT M. PATIL & SAURABH S. SIRSIKAR & NITIN N. GHOLAP, 2017. IN JOURNAL OF PRODUCT DESIGN AND DEVELOPMENT: PHASES AND APPROACH.

STOLL, HENRY W, 1999. PRODUCT DESIGN METHODS AND PRACTICES.

NIGEL CROSS, 2021. FIFTH EDITION. ENGINEERING DESIGN METHODS.

G. M. BONNEMA, 2008. ARTICLE IN JOURNAL OF PHYSICS CONFERENCE. FUNKEY ARCHITECTING: AN INTEGRATED APPROACH TO SYSTEM ARCHITECTING USING FUNCTION, KEY DRIVERS AND SYSTEM BUDGETS.

ABDULLAH, R., AND RODZI, A.M., 2011. LABOR UTILIZATION AND MAN TO MACHINE RATIO STUDY AT A SEMICONDUCTOR FACILITY. JOURNAL OF ENGINEERING AND TECHNOLOGY (JET), 2, PP. 75-84.

RAHMAN, M.N., ABDULLAH, R., AND KAMARUDIN, N., 2012. WORK STUDY TECHNIQUES EVALUATION AT BACK-END SEMICONDUCTOR MANUFACTURING. PROCEEDINGS OF THE 2012 INTERNATIONAL CONFERENCE ON DESIGN AND CONCURRENT ENGINEERING, MELAKA, MALAYSIA, 2, PP. 24-27.

APPENDICES

APPENDIX A Gantt Chart

AN EXPLORATORY DESIGN PROJECT UTILISING THE INFINITIVE QUALITATIVE DESIGN METHOD

MOHD ZAHEDE BIN DANDAI
GANTT CHART

Project Start: Mon, 10/10/2022
Display Week: 1

TASK	PROGRESS	START	END
PRIMARY DATA			
Research	100%	10/10/22	10/19/22
Survey	100%	10/17/22	10/23/22
DESIGN PROCESS			
Mood board	100%	10/24/22	10/26/22
Sketches	100%	10/26/22	10/31/22
Selection of concept design	100%	10/31/22	11/4/22
GENERATE 3D MODEL			
Solidwork model	100%	11/5/22	11/8/22
DEVELOPMENT PROTOTYPE			
Preparing file	100%	11/9/22	11/13/22
3D printing process	100%	11/14/22	11/27/22
Prototyping	100%	11/28/22	12/23/22
Report	100%	12/24/22	1/8/23
Insert new rows ABOVE this one			

APPENDIX B Questionaire

DATA ANALYSE FOR TOOTHBRUSH HOLDER DEVELOPMENT

Assalamualaikum w.b.t and greeting. My name is Mohd Zahede Bin Dandai, a final year student from Bachelor of Engineering Mechanical and Manufacturing Technology. I am conducting a survey
in completing my final year project, "AN EXPLORATORY DESIGN PROJECT UTILISING THE INFINITIVE QUALITATIVE DESIGN METHOD". This survey is conducted to get pieces of information that
could help me in product design and development in this project. Your individual responses and
identify are confidential and the questionnaire will only take about 10 minutes. Thank you for your
time and cooperation!

1. What is your gender?

Mark only one oval.

- Male
- Female

2. Hold old are you?

Mark only one oval.

- Under 18
- 18-24
- 25-34
- 35-44
- 45-54
- 55-64
- 65+

3. What is your marital status?

Mark only one oval.

- Married
- Single
- Divorce

4. What is your occupation?

Mark only one oval.

- Student
- Business
- Employee
- Other: _____

5. Do you have a toothbrush holder in your bathroom?

Mark only one oval.

- Yes
- No

6. Do you think your bathroom sink has any space to place a toothbrush holder?

Mark only one oval.

- Yes
- No

7. Would you prefer to stay organised in your bathroom?

Mark only one oval.

- ◯ Yes
- ◯ No

8. Which kind of toothbrush holder would you prefer?

Mark only one oval.

- ◯ Placed at the sink
- ◯ Mounted at wall
- ◯ Other: _____

9. What type of toothbrush holder would you prefer?

Mark only one oval.

Wall mounted toothbrush holder

Counter top toothbrush holder

Travel toothbrush holder

Toothbrush holder with cover

Toothbrush and toothpaste holder

Suction toothbrush holder

10. Which problems that you faced while using your current toothbrush holder?

Check all that apply.

- [ ] Unorganised
- [ ] Aesthetically unpleasing
- [ ] Toothbrushes becoming dirty or contaminated
- [ ] Difficulty fitting toothbrushes into the holder

11. Which criteria do you think that needed in this new toothbrush holder?

Check all that apply.

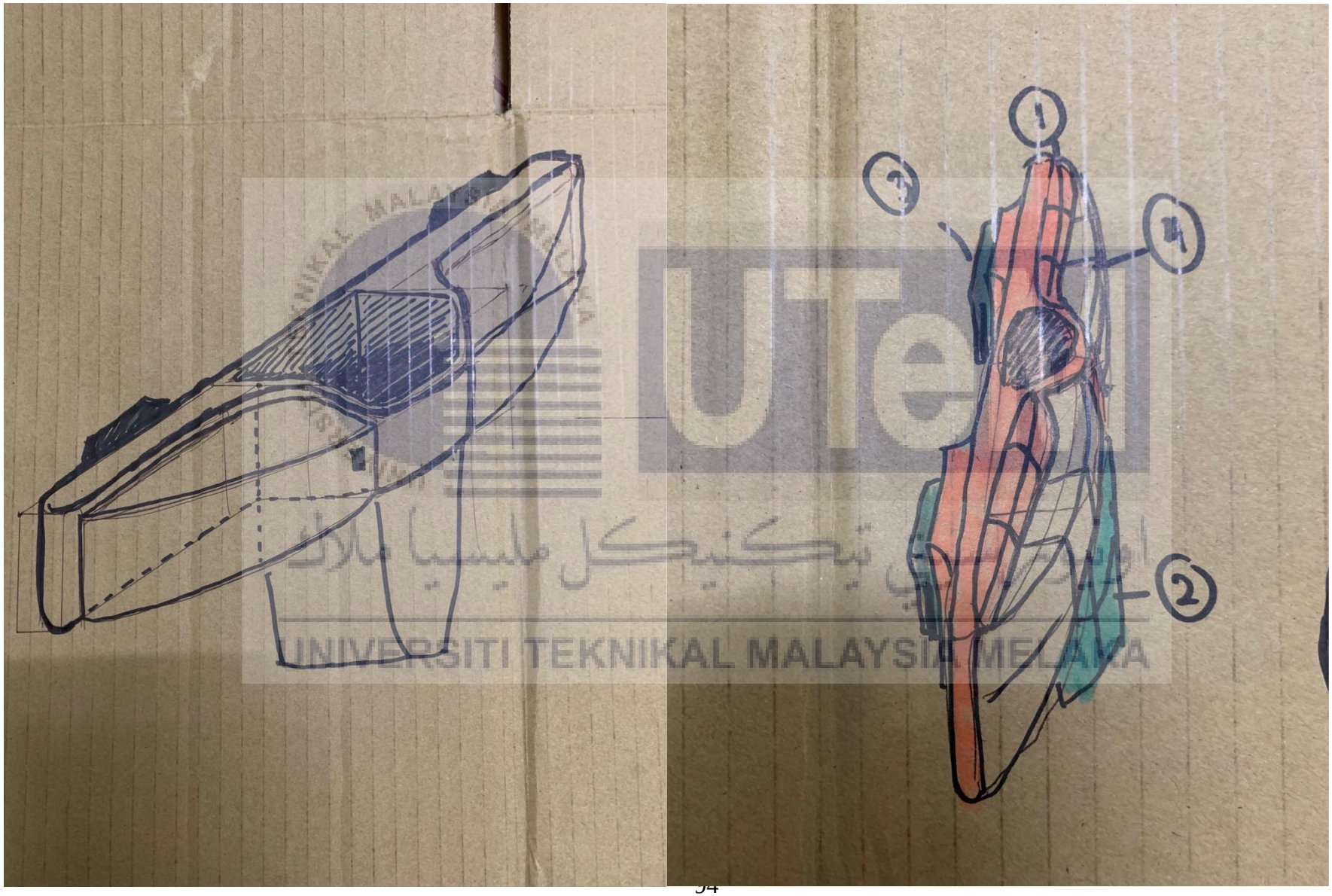
- [ ] Easy to install
- [ ] Easy to use
- [ ] Organised
- [ ] Aesthetic
- [ ] Attractive
- [ ] Durability

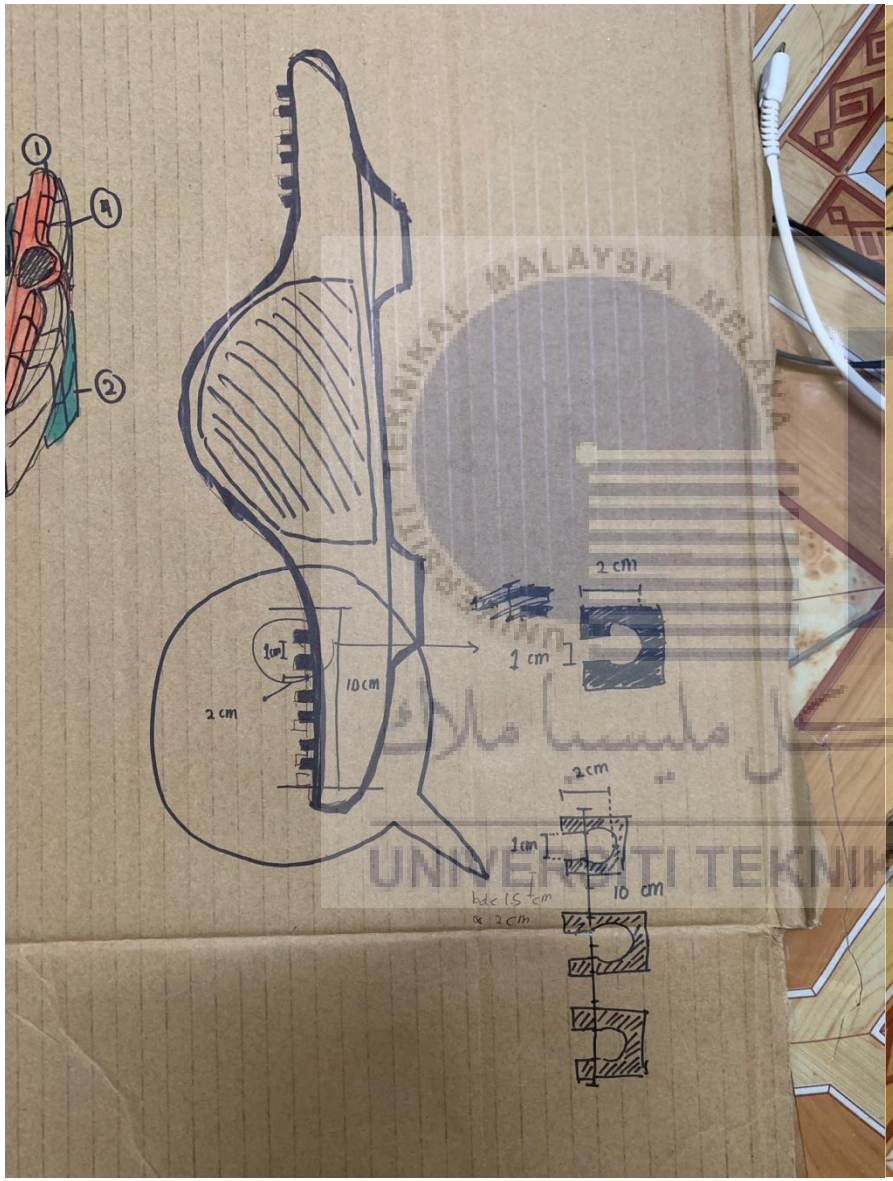
12. Do you have any design ideas that can be used in the new toothbrush holder development?

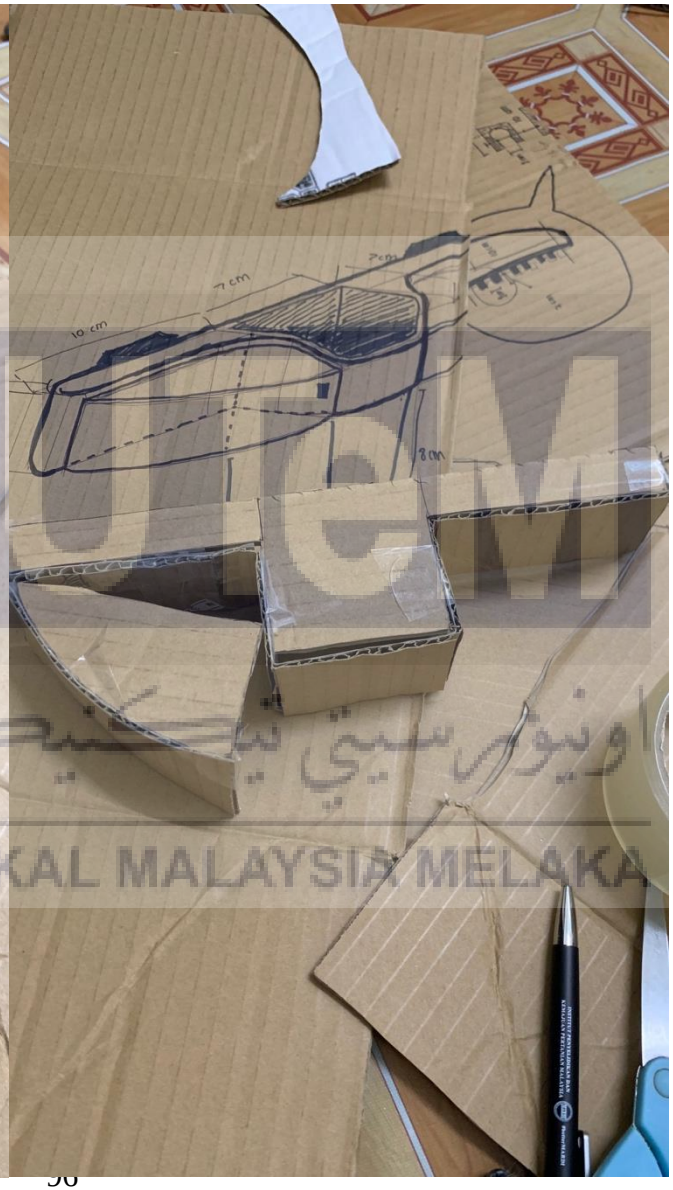
Check all that apply.

- [ ] Unexpected design
- [ ] Minimalist
- [ ] Elegant
- [ ] Futurastic
- [ ] Colourful

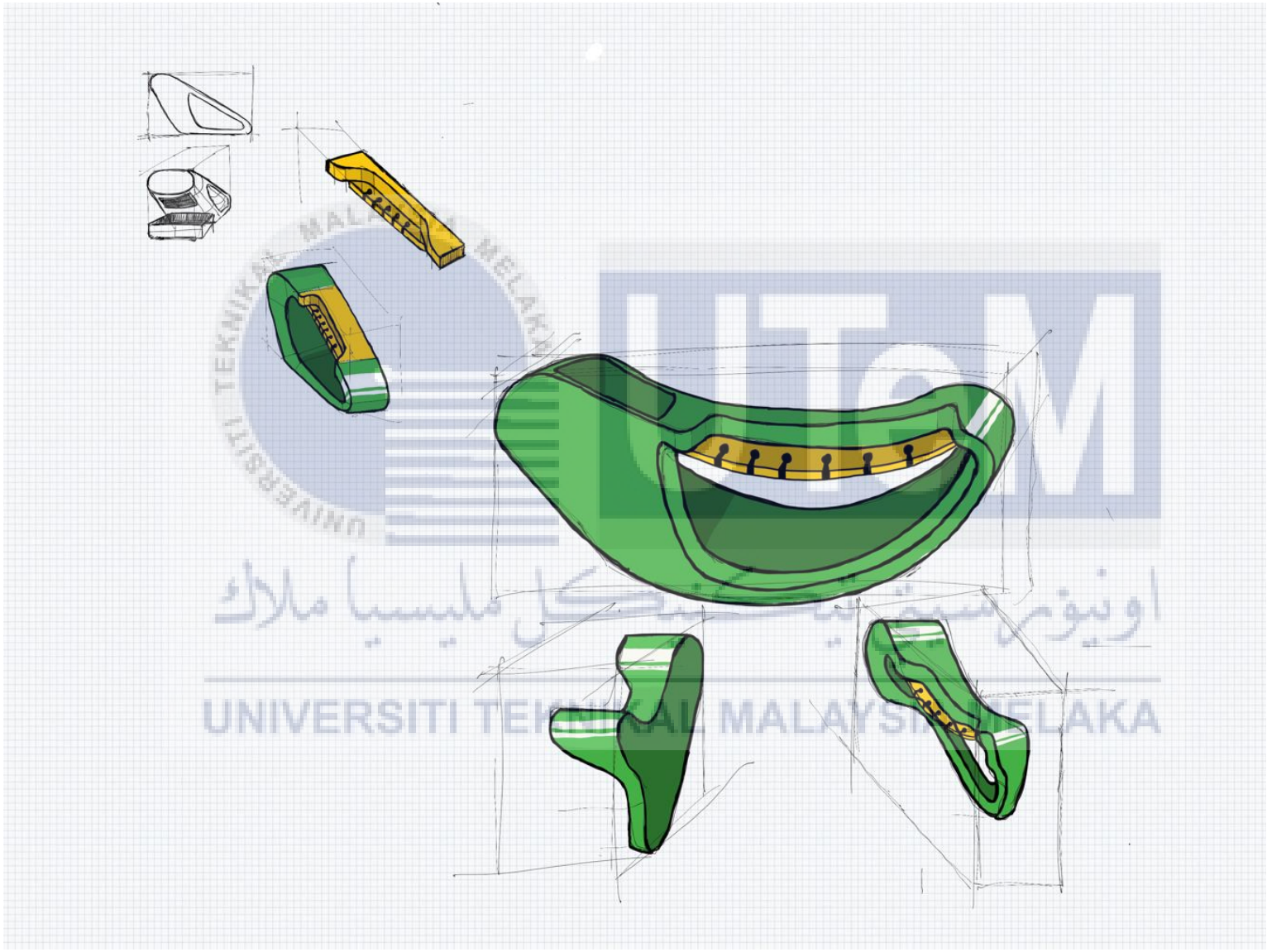
APPENDIX C Embodiment

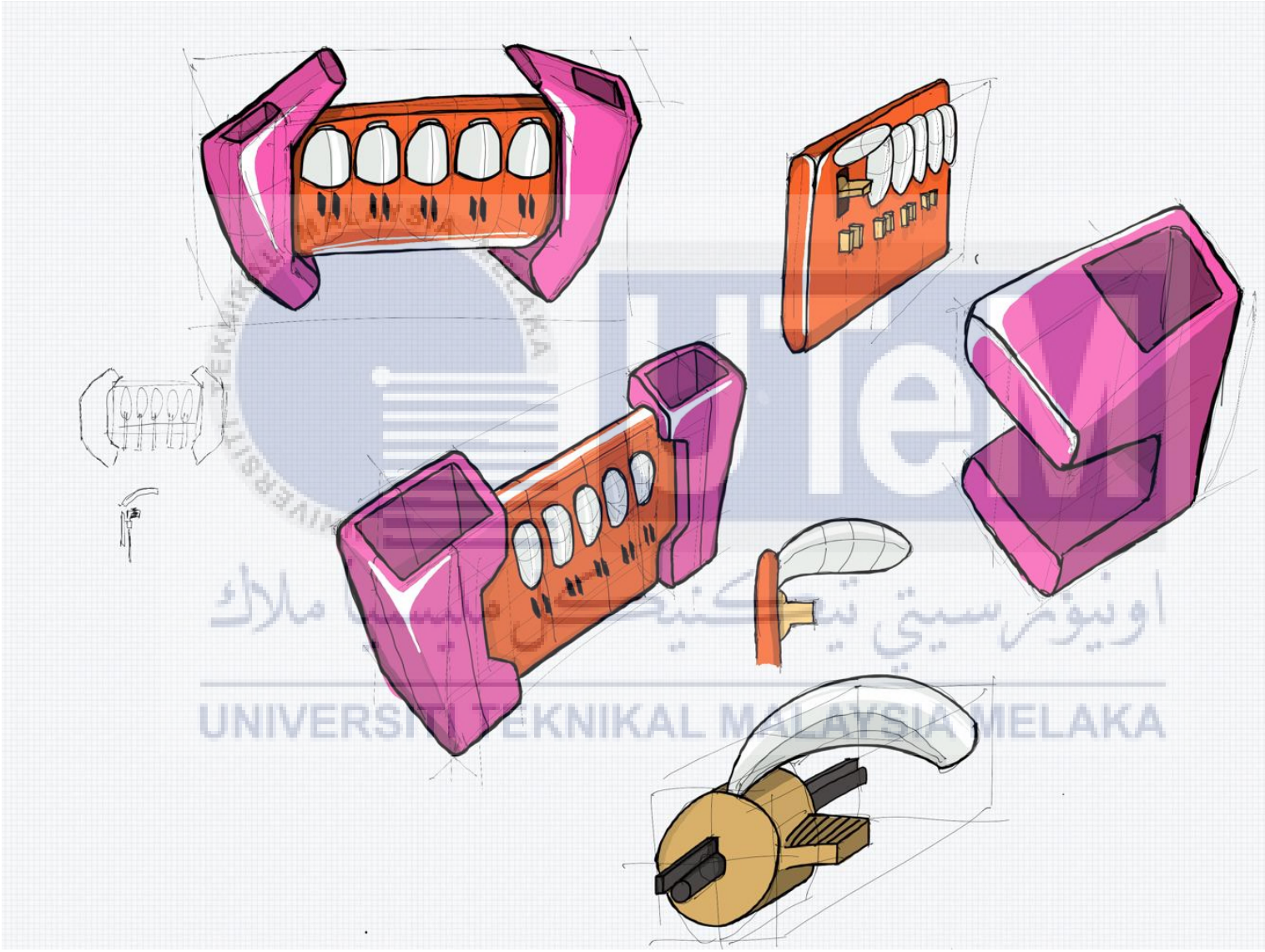


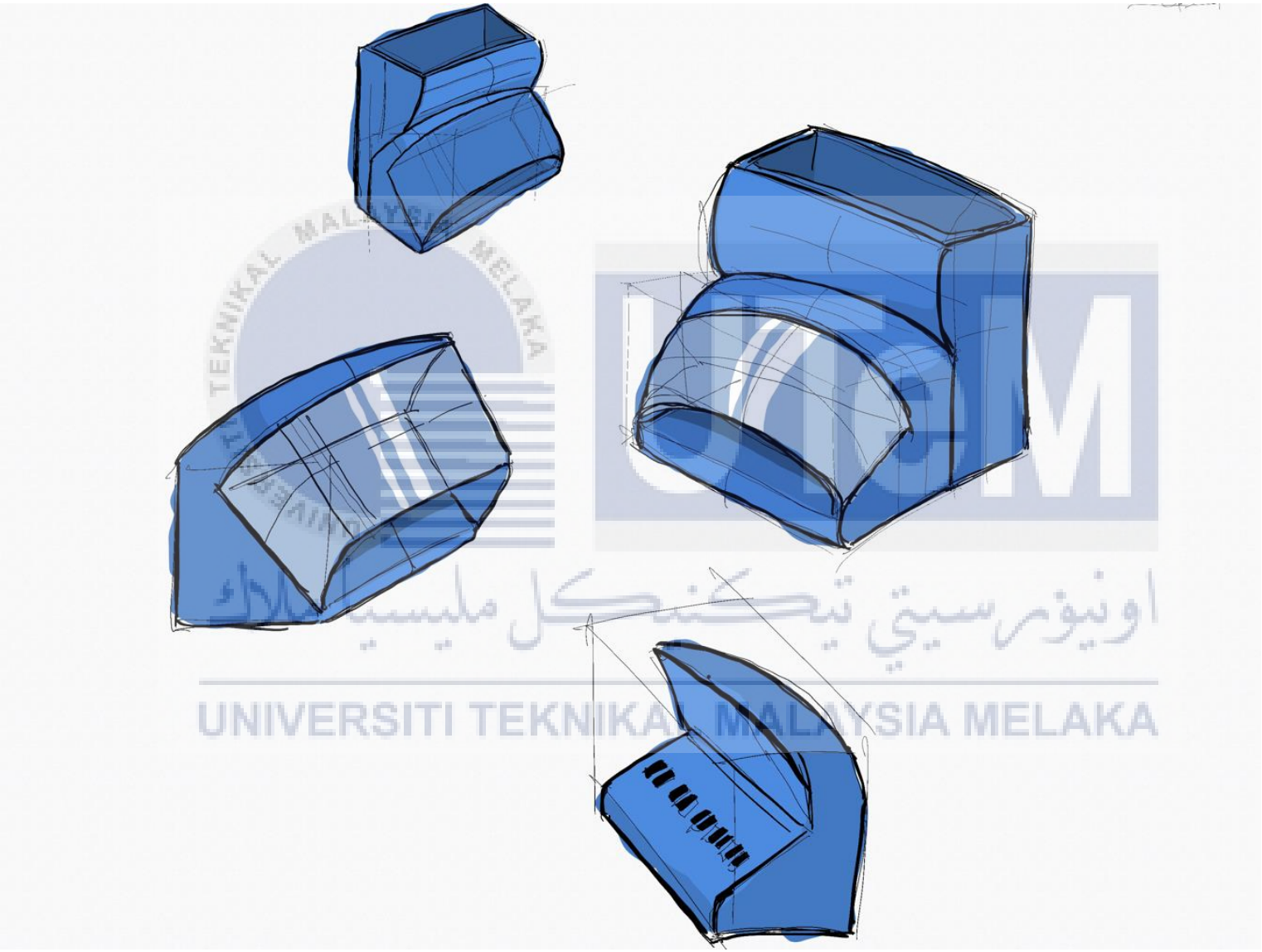


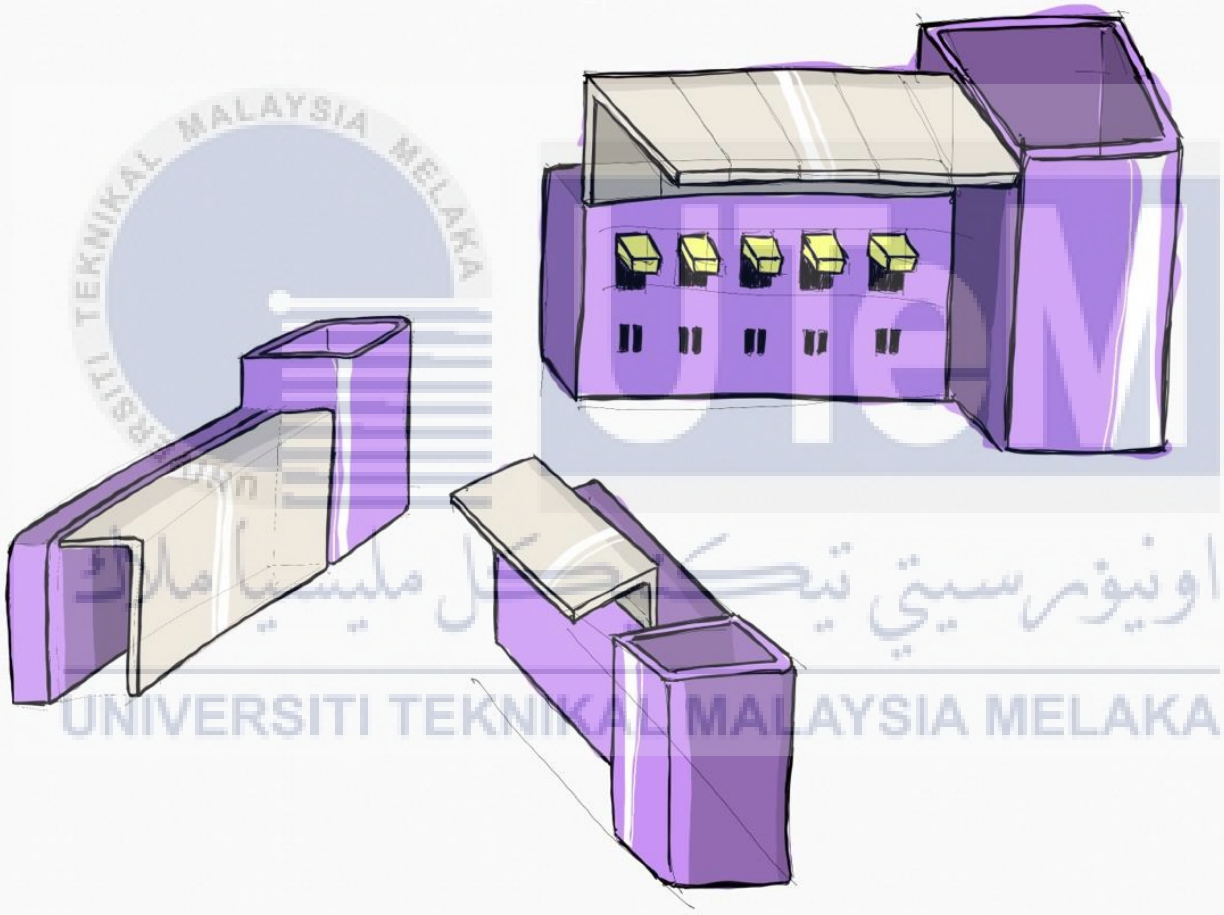


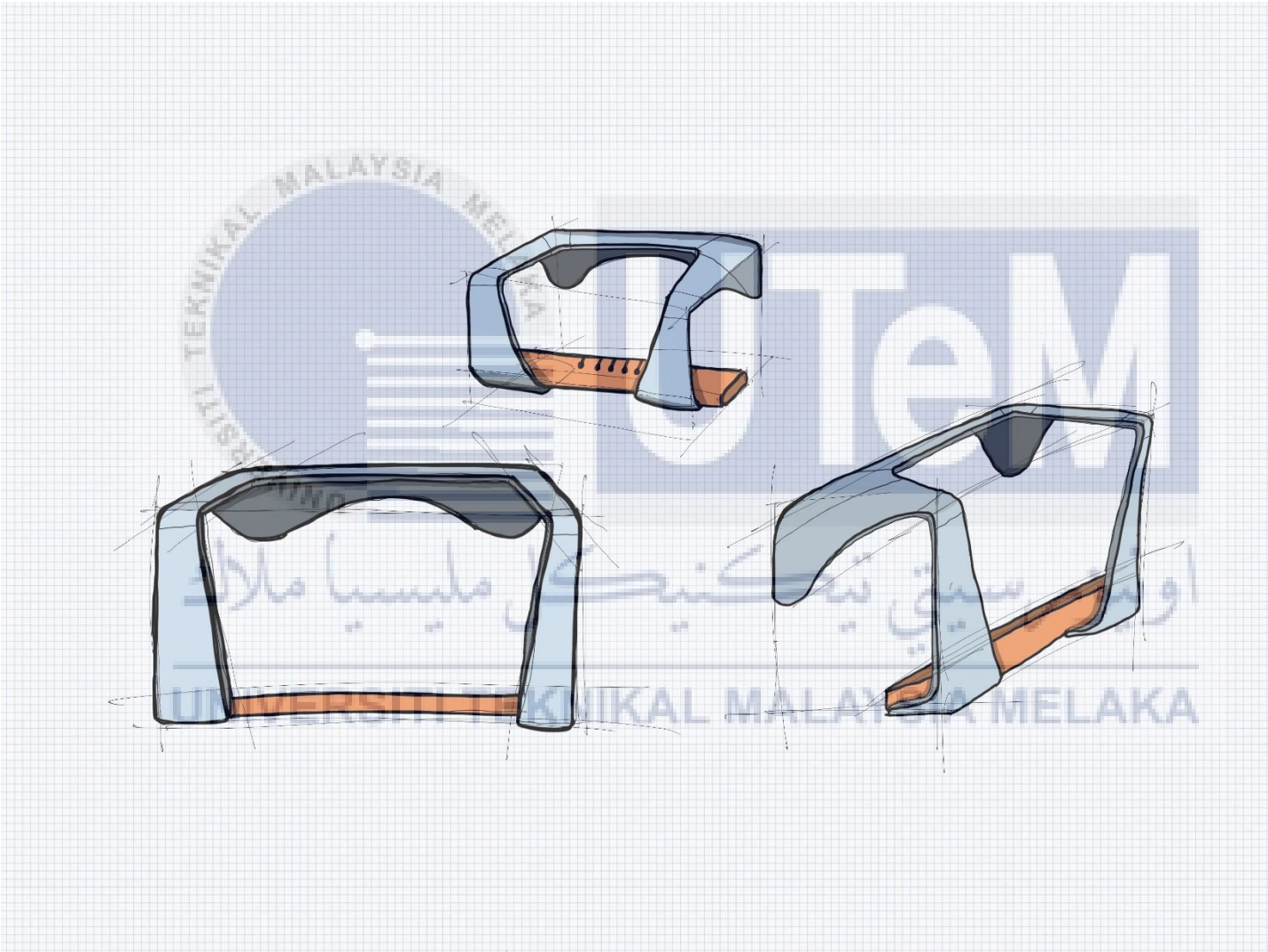
APPENDIX D Sketches

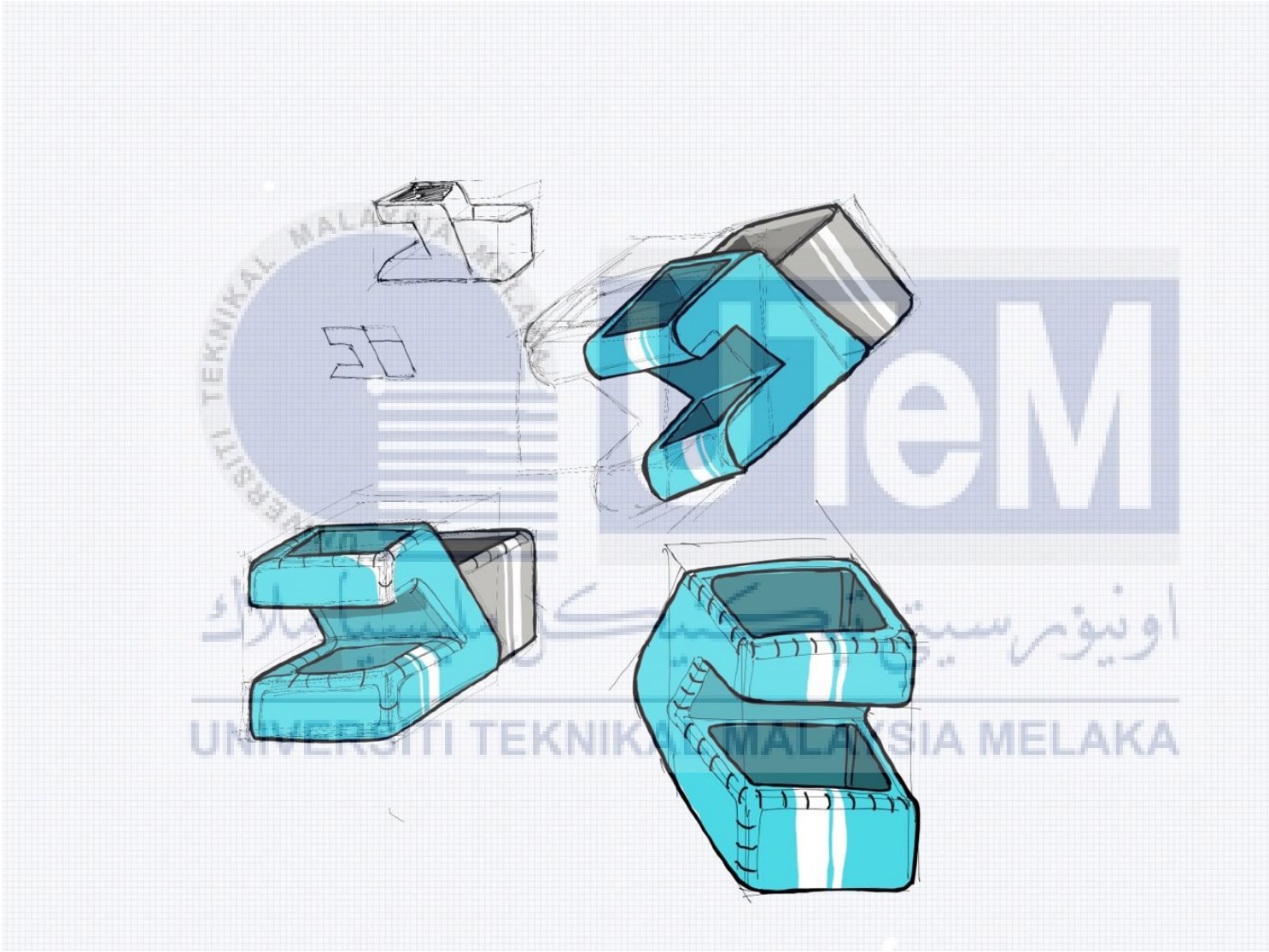


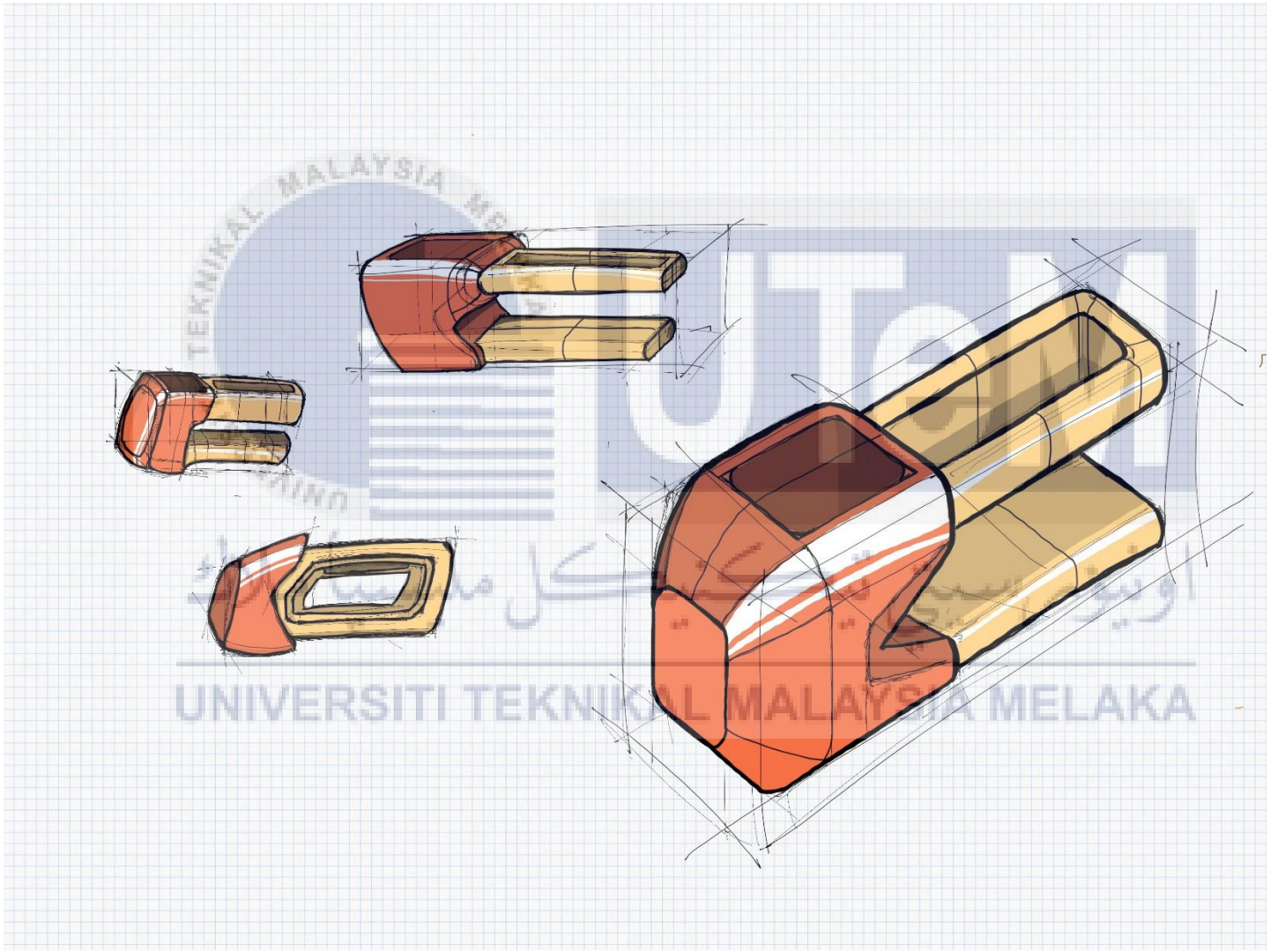


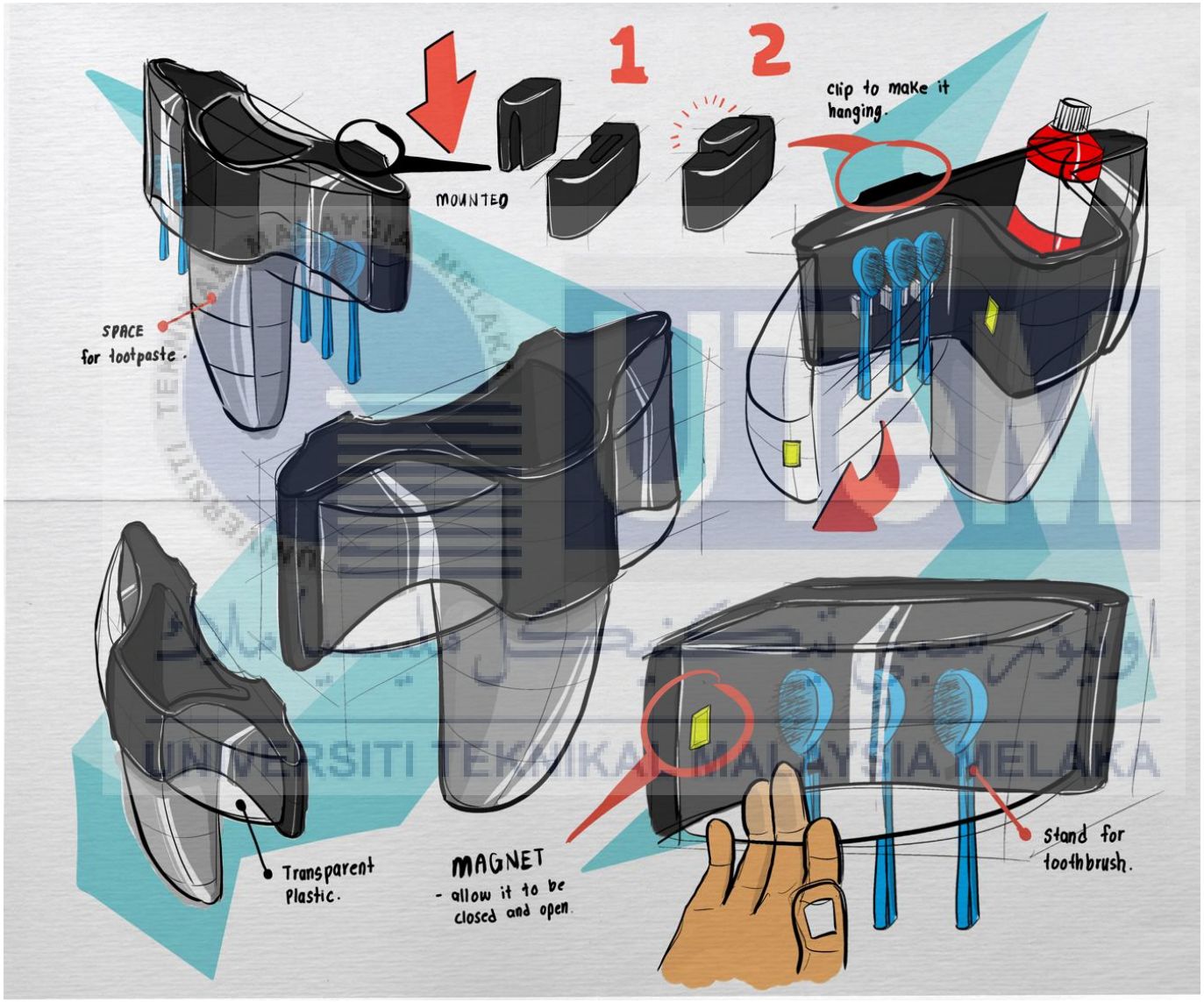


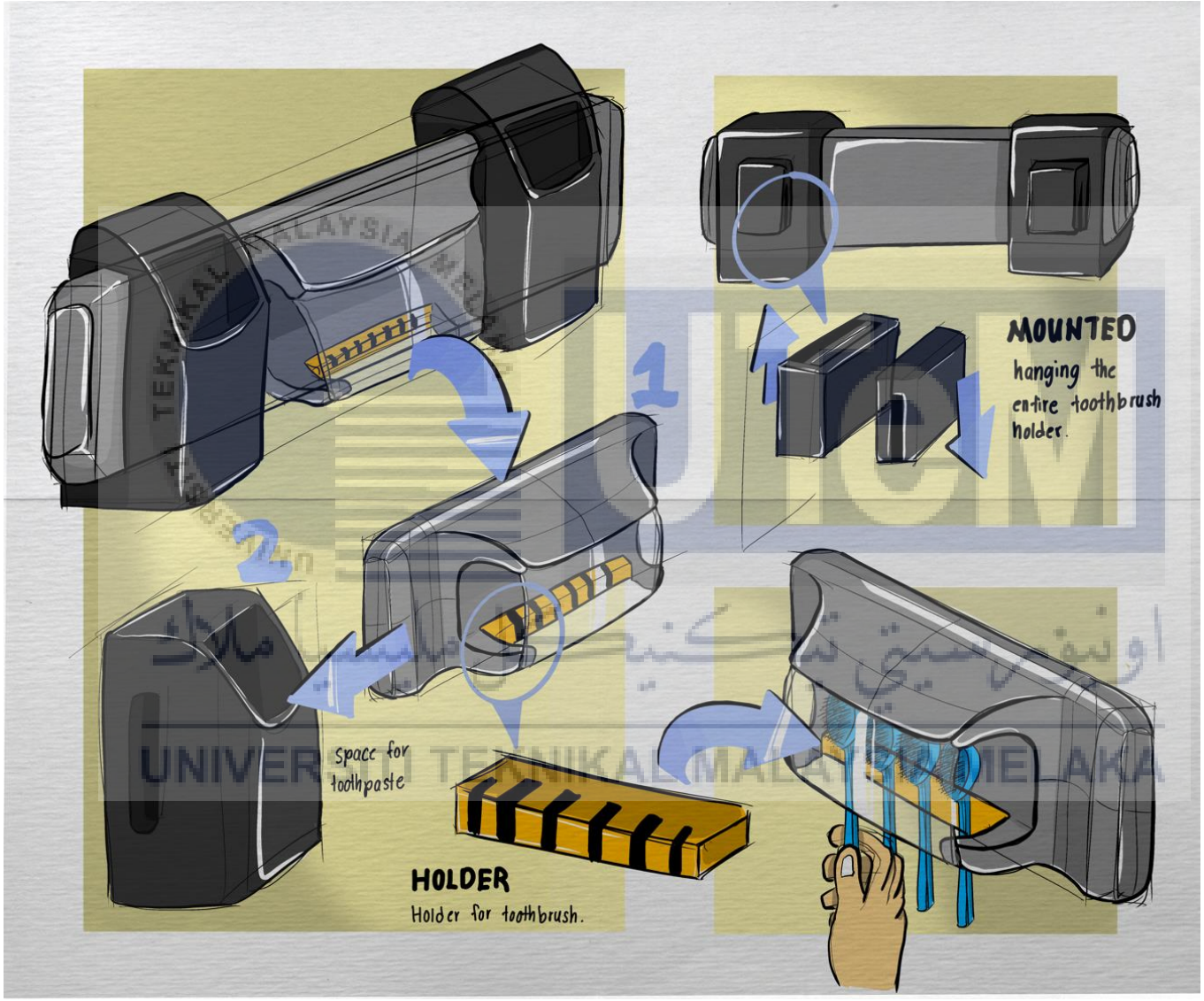


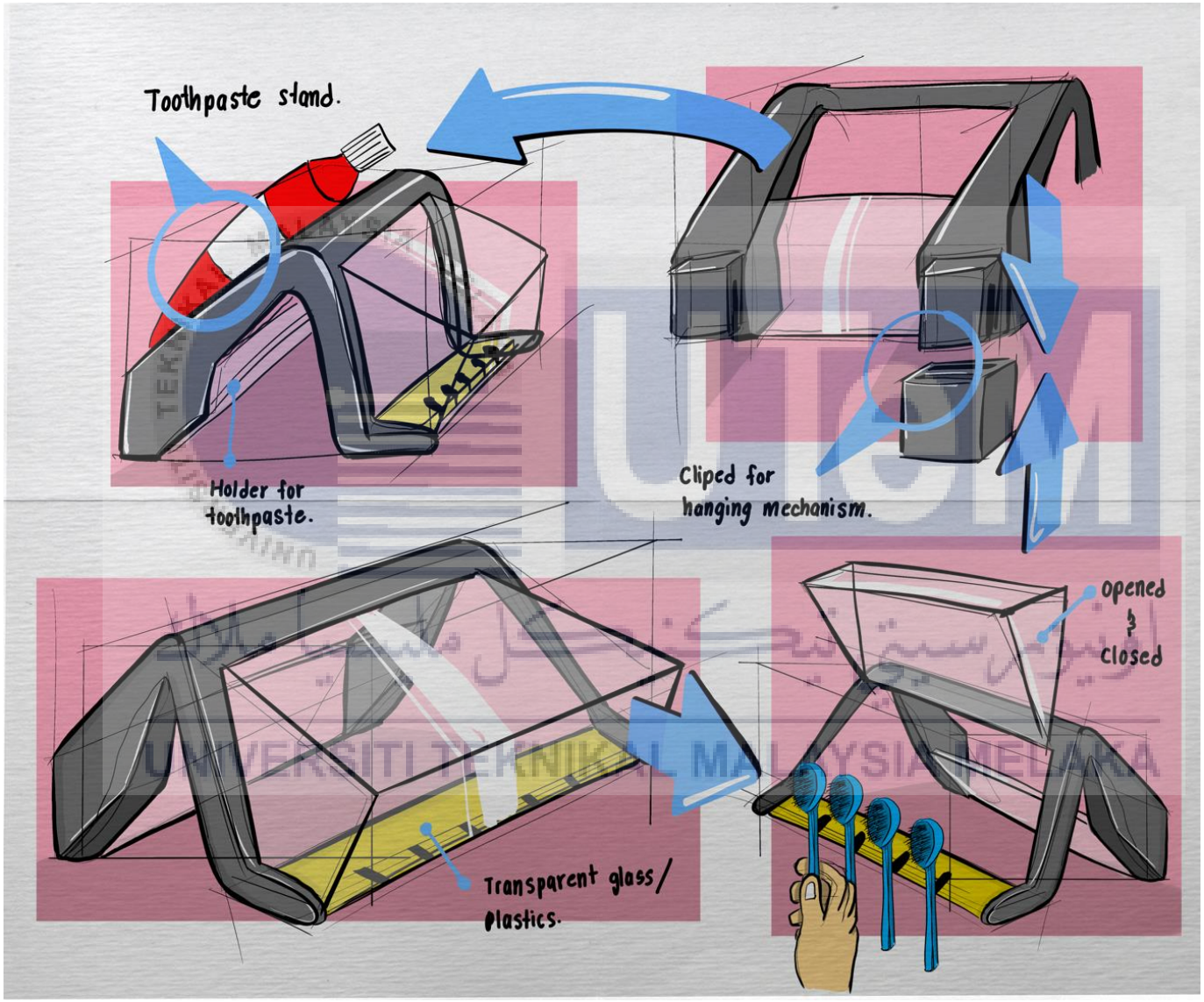




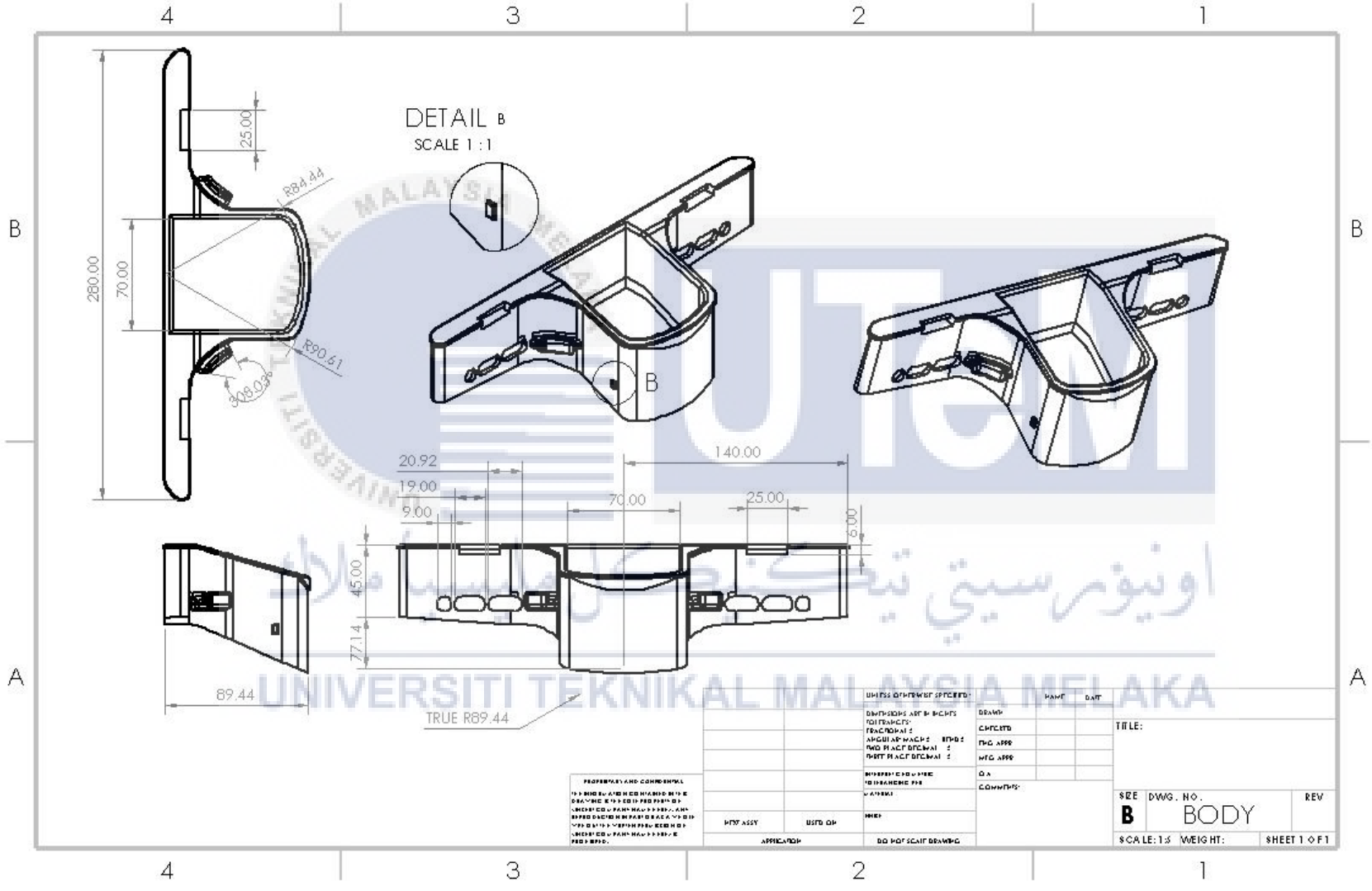


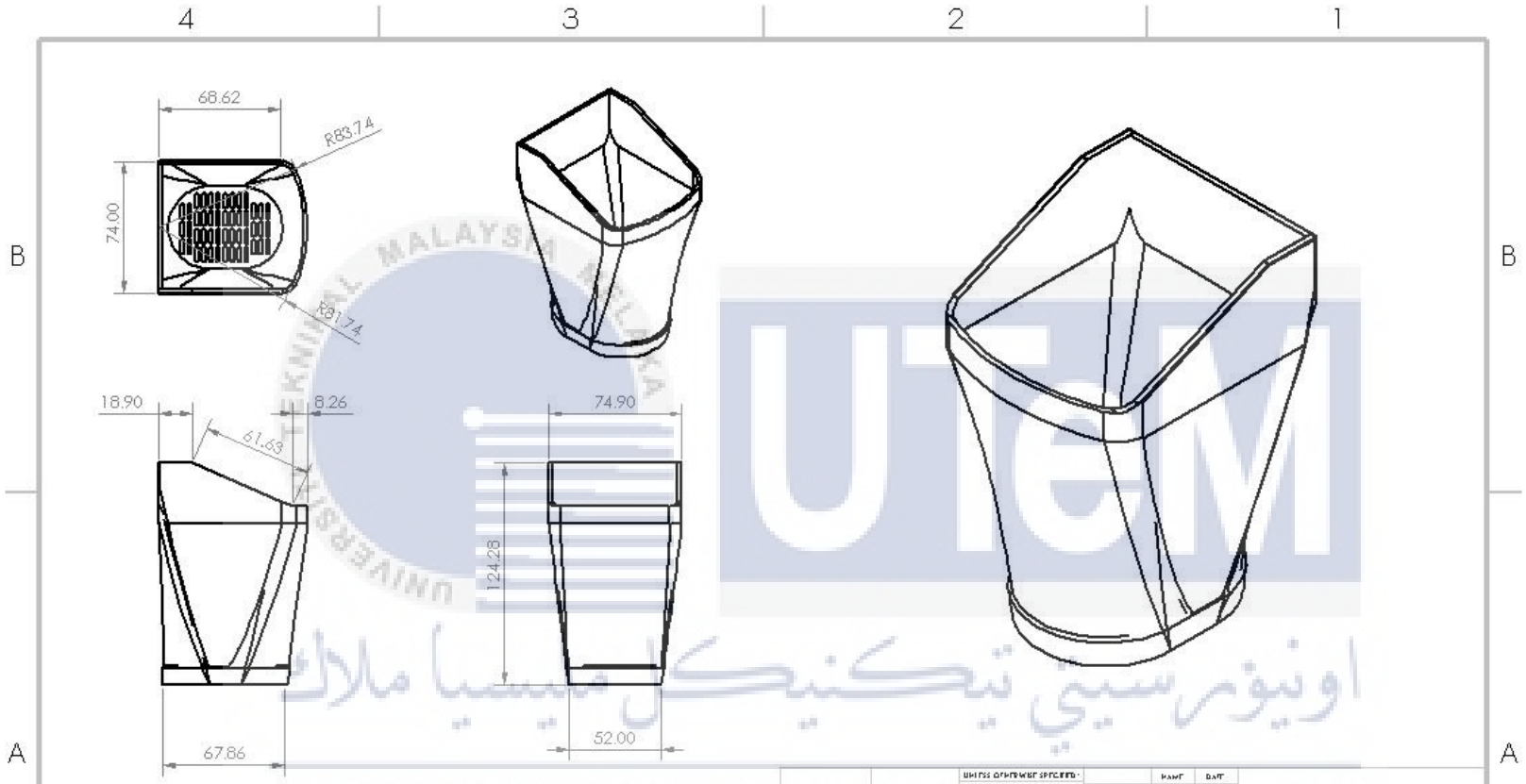

1
2
MOUNTED
clip to make it hanging.
SPACE for tootpaste.
Transparent Plastic.
MAGNET
- allow it to be closed and open.
stand for toothbrush.

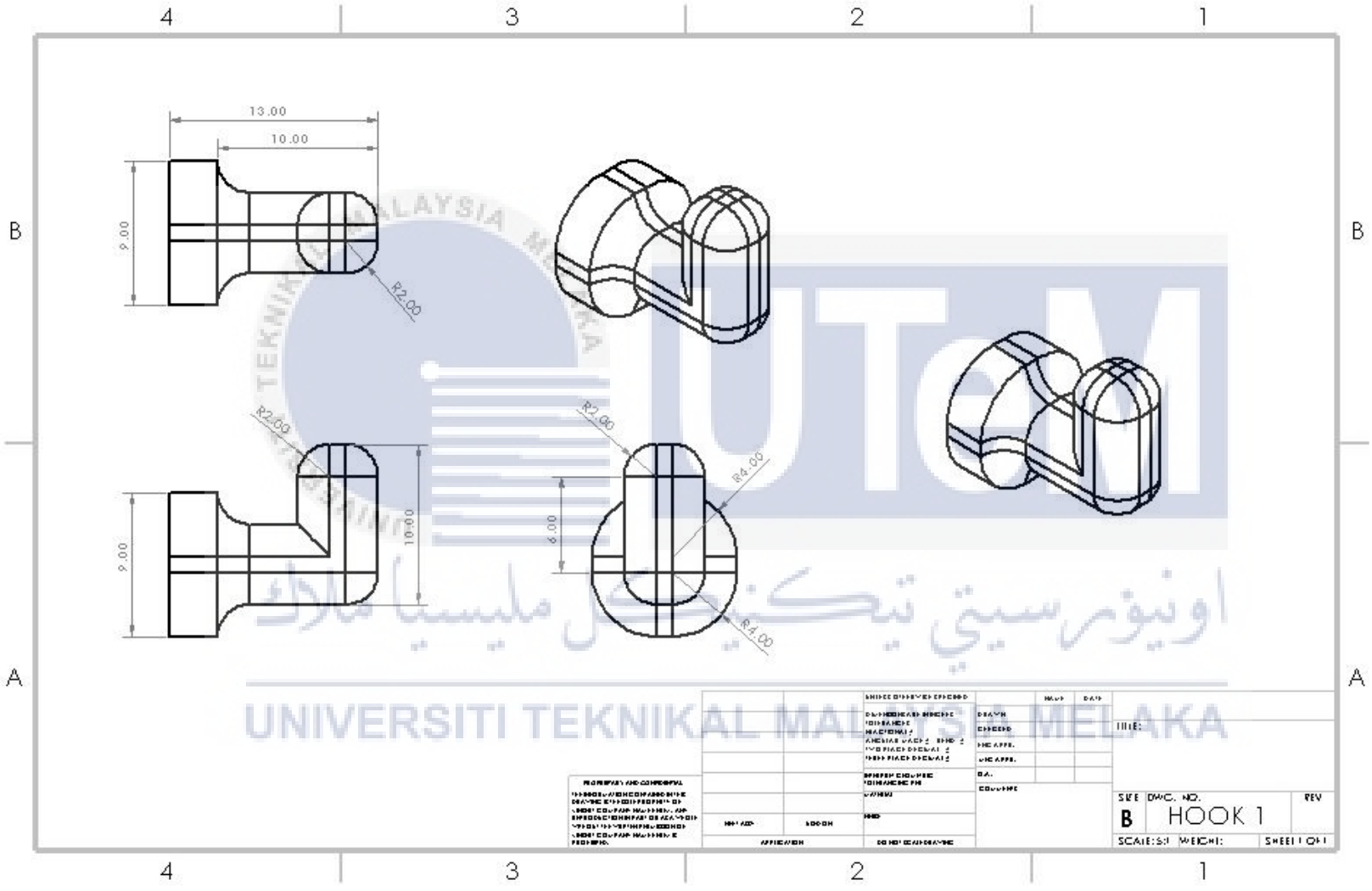

1
MOUNTED
hanging the entire toothbrush holder.
2
space for toothpaste
HOLDER
Holder for toothbrush.

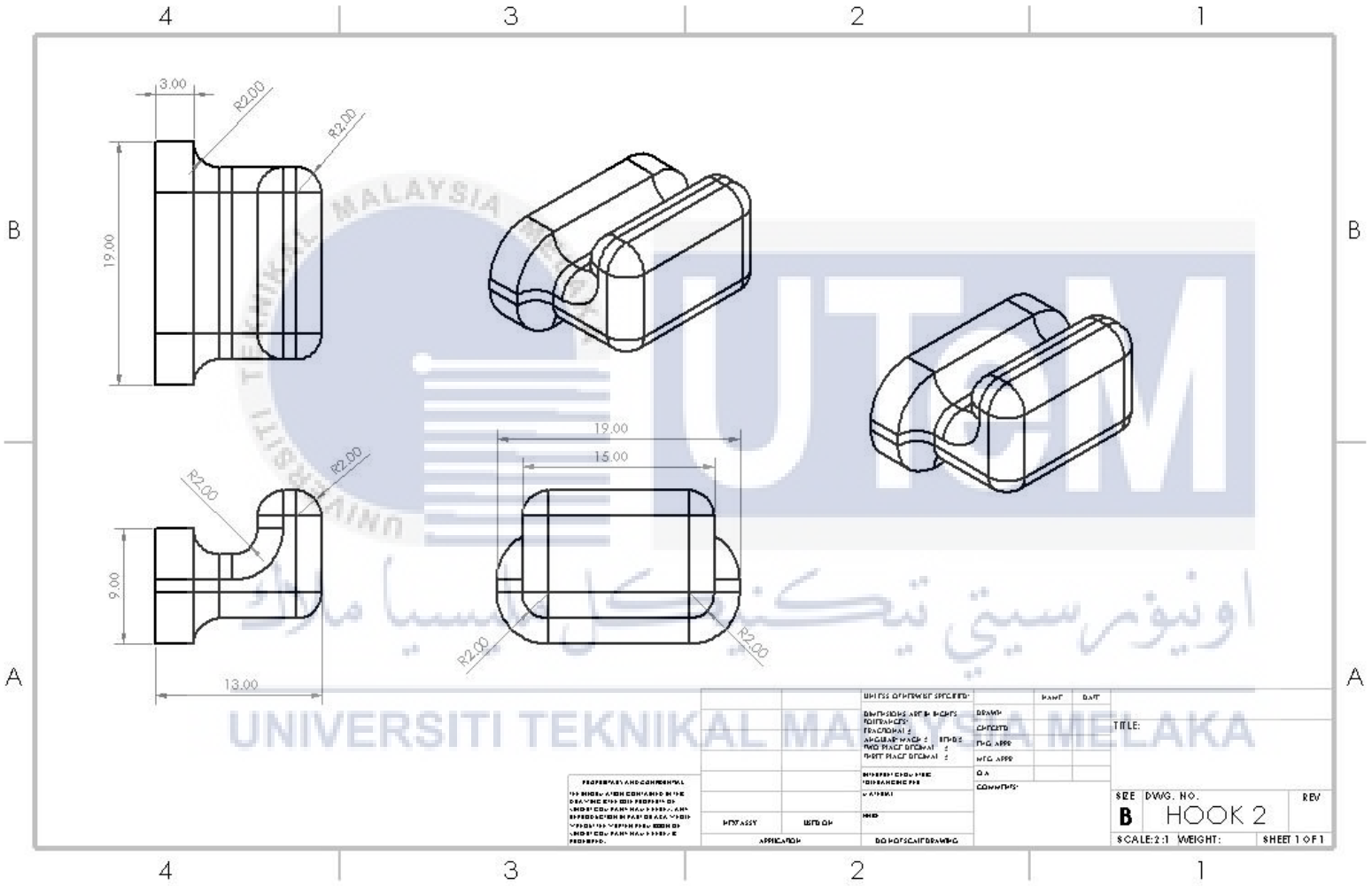

Toothpaste stand.
Holder for toothpaste.
Cliped for hanging mechanism.
opened
closed
Transparent glass/ plastics.

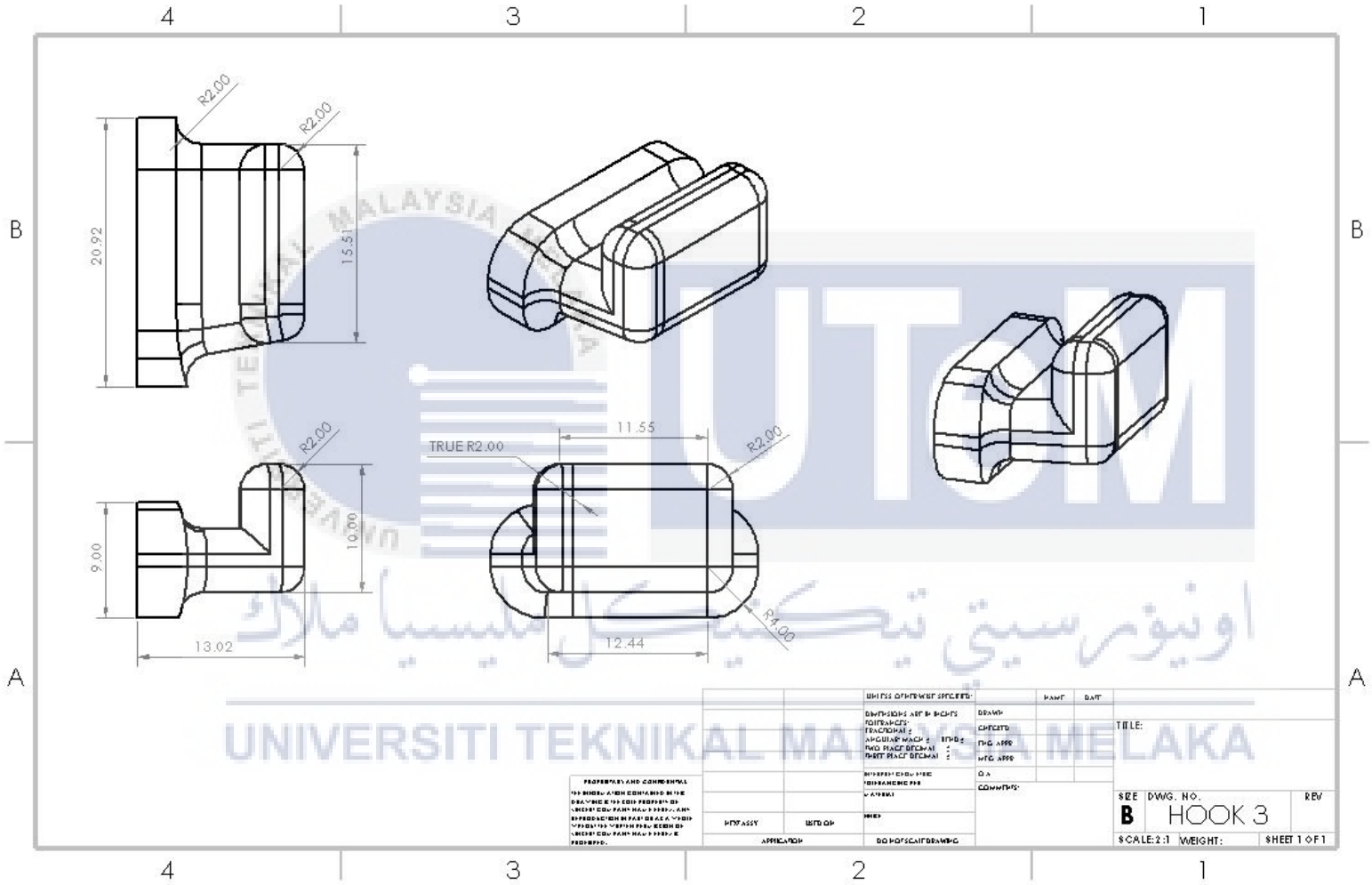
APPENDIX E Drawings

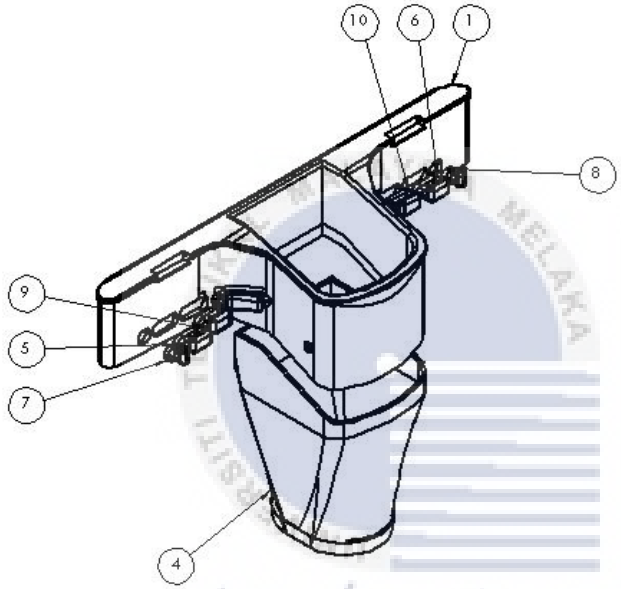


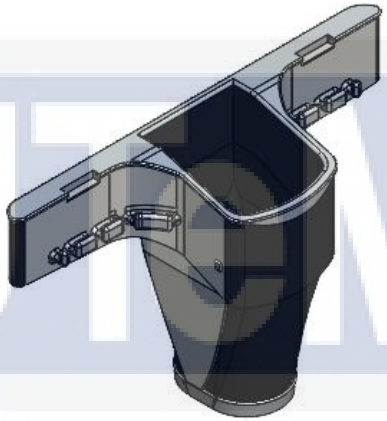





4
3
2
1
B
A
3.00
R2.00
R2.00
19.00
19.00
15.00
R2.00
R2.00
9.00
R2.00
R2.00
13.00
UNIVERSITI TEKNIKAL MALAYSIA MELAKA
TITLE:
SIZE
B
DWG. NO.
HOOK 2
REV
SCALE:2:1 WEIGHT:
SHEET 1 OF 1







ITEM NO.	PART NUMBER	QTY.
1	body	1
2	left	1
3	right	1
4	cup	1
5	15mm	1
6	15mm left	1
7	5mm	1
8	5mm left	1
9	Random 1mm	1
10	Random 1mm left	1

ASSEMBLED

D