3D SCANNER APP FOR NEW PRODUCT DEVELOPMENT DUE TO COVID-19 ENDEMIC

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DECLARATION

This work has not previously been accepted in substance for any degree and is not being concurrentlv submitted in candidature for any degree.

Signed…………………………. (Mohamad Ridzuan bin Habidin)

Date
.... (25/7/2022)

STATEMENT 1

This thesis is the result of my own investigations, except where otherwise stated. Other sources are acknowledged by giving explicit references.
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Firstly, praise and thank Allah for giving me the capability, strength, and motivation to complete this final year project successfully. The golden opportunity given to me to complete this four-year course in Manufacturing Engineering is sincerely appreciated, and I believe all the knowledge and technical skills acquired will be valuable for my future career as an engineer.

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COVID-19	Coronavirus disease
CAD	Computer Aided Design
3D	Three dimensions
stl	Stereolithography
glTF	Graphics Language Transmission Format

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ABSTRAK

Peristwa yang berlaku pada tahun 2020 menjadikan istilah 'pandemic' popular dalam kalangan isi rumah penduduk dunia. Kita telahlah pun hidup dengan virus COVID-19 selama dua tahun, dan virus ini sudahpun berada dalam fasa endemik. Endemik merujuk bahawa virus akan tetap diantara kita dan akan dianggap sebagai penyakit yang biasa. Cabaran yang akan terus dihadapi oleh orang ramai adalah sukar untuk menyesuaikan diri dengan penyebaran virus COVID-19. Justeru itu, sebuah produk baru untuk orang awam yang akan bermanfaat dan tambah nilai kepada masyarakat haruslah dihasilkan. Soal selidik telah dilakukan kepada pengguna untuk mengetahui keperluan sesuatu produk untuk memenuhi kemampuan tuntutan dan kesulitan. Hasil penyelidikan akan dianalisa, dan produk yang sedia ada akan dipilih untuk dilakukan proses imbasan 3 dimensi. Imbasan 3D adalah salah satu proses dalam kejuruteraan balikan untuk menghasilkan sesebuah produk yang baharu. Dengan menggunakan imbasan 3D yang terdapat dalam aplikasi telefon pintar, sebuah pemegang tisu yang baharu sesuai dengan permintaan pengguna dapat dihasilkan. Kajian dilakukan untuk mengenalpasti produk yang dihasilkan adalah berguna kepada pengguna. Projek ini merupakan salah satu langkah dalam menghasilkan lebih banyak produk yang baharu menggunakan imbasan 3D.

3D SCANNER APP FOR NEW PRODUCT DEVELOPMENT DUE TO COVID-19 ENDEMIC

ABSTRACT

The events of 2020 made the term "pandemic" popular in homes around the world. We've been living with COVID-19 for over two years, and the virus is currently in an endemic phase. The endemic indicates that the virus will remain among us and will be treated as a common illness. People are finding it difficult to adjust to the spread of the COVID-19 virus. As a result, a new product for civilians that will benefit and add value to society in the event of the COVID-19 outbreak should be produced. As a result, there is room for such a product to be developed and sold. A survey has been completed for the client, and the consumer will be required to fulfil all their demands and difficulties. The outcome will be analysed, and the tally with the limitation of movement has developed a new approach to understand the available product by implementing the 3D scanner application, where reverse engineering will be performed on the target part model. The results reveal that the survey gave a few arguments, which allow for product development. With the use of a 3D scanner application, a new tissue holder was constructed. Several studies have been undertaken to determine how the tissue holder will benefit the client based on its usefulness. This project is the initial step toward creating a completely functional new design of tissue holder that corresponds to the current scenario using a 3D scanner.

CHAPTER 1

INTRODUCTION

1.1 Project Introduction

The Pandemic Corona Virus Disease (COVID-19), which emerged unexpectedly and affected the world and how people lived their lives. The lack of preparation for such a crisis has caused widespread alarm among populations around the world. The Pandemic Corona Virus Disease (COVID-19), which appeared abruptly and affected the world and how people live their lives. Many researchers were focusing on product innovations that will help the community reduce and prevent the problem that is affecting the majority of the population during this epidemic.

The pandemic has had a big impact on all sectors, and in the endemic phase, all sectors are recovering from the impacts. Most of the people in the world are currently living their life as normal as before the pandemic but with some standard operation procedures are remain depends on the country rules and regulation in order to fight the virus transmission. Therefore, a new product innovation is required to let people to carry on with their daily activities during the endemic stage.

In current technology, new product development can be done on a mobile phone using 3D scanner software. Before being collected by a digital 3D scanner and stored as digital data, the surface image is first converted into billions of coordinate points. In other words, it quickly and accurately translates any real-world 3D object into a digital representation in the form of its XYZ coordinates (Yahya Salloom, 2018). The technology behind CAD models allows us to digitise any physical model for the sake of further modification and reuse. In this study, we investigate how a 3D scanner could be used in the context of the manufacturing process.

The process of creating a CAD model from an already existing CAD model or physical model is referred to as reverse engineering or reverses modelling. By employing the process of reverse engineering, new products can be brought to market more quickly and with a lower overall resource requirement (Kumar, 2018). The engineering phase can be simply translated from the Any physical model of cloud data. Converting digital data into a CAD model that may be utilised to do more accurate software analysis and simulations. Using rapid prototyping tools, it is possible to manufacture a product directly from the data.

1.2 Problem Statement

Life is back to normal but in different ways that affect uncertainties in the trend of product consumption. The lifted movement was limited to most of the country due to the reduced number of cases detected among the community. However, people still had to live in new normal to ensure that this virus infection is under control. Furthermore, the limited movement with standard operation procedure generally has made a lot of changes in the community daily lives even after the change of phase which is endemic. To ensure the productivity lives of the community, a new product should be developed for civilians that will give benefit and value to the society in the COVID-19 endemic phase by implementing the 3D scanner application.

1.3 Objectives

There are four main objectives of this study:

1. To identify the problem and the potential market of the product due to COVID-19 endemic by conducting survey on the target market.
2. To find the best product concept of the chosen product for the developing of the product.
3. To generate CAD model from scanned data by using reverse engineering technique.
4. To fabricate the new product that can be functional to the society in COVID-19 endemic phase.

1.4 Project scope

In this project, the first step is to find out what the current demand for a product. The current market demand of a product can be done by do some research through websites, data statistics and market survey. The result will be investigated and to identify the best potential market of product development for COVID-19 endemic phase. Selection and characterisation of products become critical concerns. Then, a 3D scanner application is used to scan the existing product that being selected to be develop in three dimensions using reverse engineering technique. The product development design will do by using CAD software which is SOLIDWORKS. The end design of new product will fabricate by using rapid prototyping and the machining involves in the lab. The project implementation, methodology, and the flow of the project consist of several phases to get the final decision of the product development. The product must undergo all the steps before it is fully capable and finalised to be developed.

CHAPTER 2

LITERATURE REVIEW

2.1 Product development

The term "new product development" refers to all stages of the process of bringing a product or service to market from scratch. The new product development stages are determined as follows, according to the classification, which is still relevant today with minor additions. The first stage is to come up with ideas. This is the stage in which new product concepts are thoroughly researched. Businesses create hundreds, if not thousands, of ideas to generate a few of good ideas (Othman & Bamasood, 2021). Screen concepts. This level scans product ideas that satisfy organizational goals. Every idea is assessed to decide which are powerful and which should be rejected.

Following that is the process of concept creation and testing. This stage involves preliminary investigation to determine which ideas merit further inquiry. To generate new products, product concepts must be interesting. The next step is to create a marketing strategy. The initial marketing plan for a promising idea is formed after the development and testing stages.

Next is marketing strategy creation. After creation and testing, the initial product marketing strategy is created. Selections are evaluated at this stage based on quantitative factors such as profit, return on investment, and sales capacity. Product development starts with an idea on paper and advances to a product that is demonstrable and repeatable. Commercial experiments verify operating decisions. Test marketing helps management launch a new product. Finally, commercialization, this stage sees product release. The corporation may need to build or lease a production facility, which can be expensive. First-year advertising, sales promotion, and marketing costs may be considerable.

2.2 Reverse Engineering

The technique of creating a CAD model from an existing object is known as reverse engineering. While traditional engineering entails the conversion of technical concepts and models into physical components, reverse engineering involves the transformation of genuine parts into engineering models. The presence of a computer model vastly increases the quality and efficiency of design, manufacturing, and analysis. The reverse engineering technique will employ a 3D scanner found in a mobile phone.

This project and study will make use of a non-contact 3D scanner and an optical scanner. Optical three-dimensional digital scanning can also be divided into other categories, including laser scanners, white light scanners, computed tomography scans, time of flight scans, and many others. According to the data gathering process, we may categorise non-contact type active laser scanners into three major types: laser triangulation scanners, time of flight laser scanners, and phase shift scanners (Kumar, 2018). This project will make use of a time of flight laser scanner. After scanning the designed specimen, the resulting point clouds are generated by combining self-rotated/shifted images (Straub and Kerlin, 2014). Figure 1 depicts this process.

The lighting arrangement in the scanning location influences both the calibration of the scanner and the scanning process (Wang, 2021). Data processing challenges include regulating the unaligned measurement from a collection of photographs to reduce errors and exporting the file to any other software and handling the data, which may necessitate the use of a third-party app to convert the file. The inaccuracies in the recorded data from the scanner fluctuate as the working environment changes.

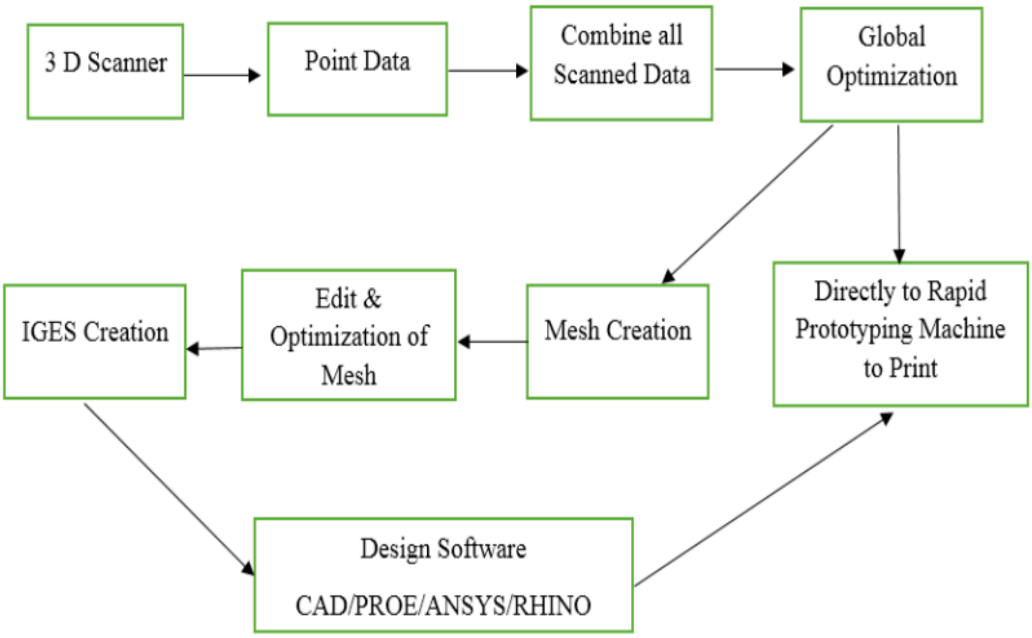

Figure 1: 3D scanner process

Nowadays, Smartphones have become an essential part of daily life, and in addition to high-performance cameras, some smartphones also incorporate a depth camera that allows for the assessment of 3D distances. Furthermore, devices equipped with a motion tracking camera can autonomously estimate their own position in order to obtain a comprehensive 3D point cloud in real time. For example, the time-of-flight (ToF) sensor in the Samsung Note 10+ enables 3D scan function in the phone function, and the LiDAR sensor in the iPhone has a similar purpose to the ToF sensor.

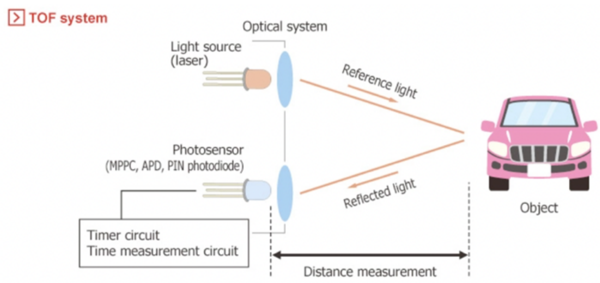

Figure 2: LiDAR system use the time of flight a reflection of a light beam
(Hamamatsu Photonic K.K, 2016)

Lidar, or light detection and ranging, has existed for quite some time. It returns to the laser's source after bouncing off objects and calculating distance by timing the light pulse's passage, or flight. A time-of-flight camera is a form of lidar. This type of lidar technology emits waves of light pulses and can measure each one with its sensor, creating a field of points that map out distances and can "mesh" the dimensions of a location and the things within it. The light pulses are imperceptible to the naked eye but can be detected by a night vision camera.

A ToF camera offers several advantages over other 3D scanning technologies. ToF can measure three-dimensional depth maps at video speeds, making it perfect for use in rapid object scanners. Actively measuring the transit duration of infrared light, this sensor does not interfere with the visible spectrum picture. Its key components are a CMOS chip and an infrared light source, and it offers mass manufacturing capability at an affordable price. ToF operation is comparable to that of a video camera and may therefore be conducted by regular individuals. This research will utilize the Samsung Note 10+ as the scanning device due of the smartphone's built-in ToF sensor, which delivers superior scanning results than the iPhone's LiDAR sensor.

2.2.1 Samsung 3D Scanner

Samsung 3D Scanner is an application that is available on mobile phones. It can provide a 3D model by scanning it with the phone camera. The scanning object must be place in the center of the scanning are during the scanning process. Scanning the object from two different angles generates complete 3D data that is auto-merged. The 3D model can export models in a variety of formats for use in other 3D tools, particularly those used in reverse engineering. The app's assistance and guidelines make scanning easier and faster for modelling.

2.2.2 Scandy Pro

Scandy Pro is a 3D scanning app that exploits the true depth active 3D sensors in Apple’s iPhone brands to enable accurate 3D capture. The method of the scanning is that the scanning object must be placed in the centre of the scanning area during the scanning process. Scanning the object takes some time since the sensor measures the true depth of the area to complete 3D data that is auto merged. The 3D model can export models in a variety of formats for use in other 3D tools.

2.2.3 Capture 3D

Capture 3D is a 3D scanning app that uses the true depth active 3D sensors in Apple's iPhone brands to make accurate 3D capture possible. During the scanning process, the object being scanned must be in the middle of the scanning area. Scanning the object takes some time because the sensor measures the true depth of the area to create 3D data that is automatically merged. The 3D model can send models to other 3D tools in a number of different formats similar with the Scandy Pro application.

2.2.4 Additional software

Based on three propose 3D scanner application that available in mobile phone, Samsung 3D scanner was selected. In order to import the scanned product for this project, need two more additional of software to convert ad edit the scanned product. The additional software that will be use which is Meshmixer and Wings 3D.

2.2.4(a) Meshmixer

Meshmixer is cutting-edge software for working with triangle meshes, reading and modifying 3D printing files. It will be beneficial for cleaning up 3D scans, 3D printing, and designing objects. Meshmixer's functions include model transform scanning, model scaling, file size reduction, plate cut, and mesh repair.

2.2.4(b) Wings 3D

Wings 3D provides a variety of modelling tools, an adaptable interface, support for lights and materials, and an AutoUV mapping feature. Wings 3D is a piece of software capable of converting.obj scan files to .stl files. The Samsung 3D scanner application can only generate.obj files, which cannot be read by CAD. Therefore, .stl files must be converted.

2.3 Product Design

The process of producing maps or models of the design process has been attempted countless times. Some of these models describe the action sequences that occur frequently in design. Some models, on the other hand, attempt to recommend an improved or more suitable sequence of actions. Reflecting the solution-oriented nature of design thinking, descriptive models of the design process frequently emphasize the importance of establishing a solution concept early in the process.

In order to arrive at a solution, it is required to perform processes such as analyzing, assessing, refining, and developing this initial solution assumption. Of course, there are occasions when the analysis and evaluation uncover fundamental issues in the initial concept, and the project needs to be scrapped, a new concept needs to be established, and the cycle needs to begin again from the beginning (Othman and Bamasood, 2021). The process is histological in nature, and it makes use of previously acquired information in addition to general guidelines and rules of thumb in order to direct the designer in the direction that he or she hopes will lead to success. However, there is no guarantee that the chosen path will be the right one.

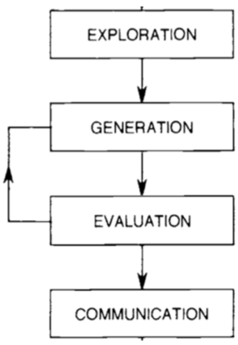

Figure 3: Simple design process (Othman and Bamasood, 2021)

In most cases, some preliminary investigation into the space occupied by the ill-defined challenge comes before the designer even begins to formulate a concept from which the proposal itself would eventually emerge. The graphic on the right illustrates a straightforward model of the design process that consists of four stages: exploration, generation, assessment, and communication. These four activity categories are arranged in the order in which they naturally occur.

2.4 Rapid prototyping

Rapid prototyping comprises a series of processes that transform a CAD model's virtual representation into a physical part (Gibson, 2019). Additive manufacturing will be utilised in a variety of ways and to differing degrees for various products. Small, relatively simple goods may only need rapid prototyping for visualisation models (Wang, 2021), whereas larger, more complex products with substantial technical content may need additive manufacturing at various stages and iterations of the development cycle.

Following this basic objective of simple model manufacturing, rapid prototyping technology advanced as materials, precision, and output quality all increased over time. Immediately, models were recruited to provide information regarding the "3 Fs" of Form, Fit, and Function, sometimes known as the "3 Fs." (Gibson, 2010) The early models were used to help fully appreciate the shape and essential function of a design, allowing for a deeper comprehension (Form). Due to the improved precision of the process, components were able to be fabricated to the requisite assembly tolerances (Fit). As a result of enhanced material characteristics, components could be appropriately treated and evaluated based on how they would ultimately perform.

Moreover, in the early phases of the product development process, it may be necessary to make just rough prototypes, for which rapid prototyping is utilised due to the speed with which they may be generated (Wang, 2021). Before parts can be used, they may require rigorous cleaning and postprocessing, such as sanding, surface preparation, and painting, during the final phases of production. In this circumstance, additive manufacturing is particularly advantageous since it enables the fabrication of complex shapes without the need for special tools.

CHAPTER 3

METHODOLOGY

3.1 Introduction

This chapter provides a summary of the research methodologies that were utilized throughout the course of this project. It provides information on the participants, including the criteria for inclusion in the study, who the participants were, and how they were sampled. In other words, it explains the criteria for inclusion in the study.

The product that was selected for the purpose of this investigation, as well as the factors that led to that decision. The application for the 3D scanner that was utilized for the purpose of data collection in preparation for the 3D scanning of the product. The next step in the development of the new product is the design stage, and the final step is the fabrication process.

This chapter also includes a presentation of the flow chart for the project. The process began with the initial working step and continued until the final decision was made regarding product development. Type of survey analysis is also included in this chapter, which contains the synopsis of all the responses. By gathering information and considering all responses, one can gain a better understanding of how customers feel about potential new products that could be developed.

3.2 Process Flow Chart

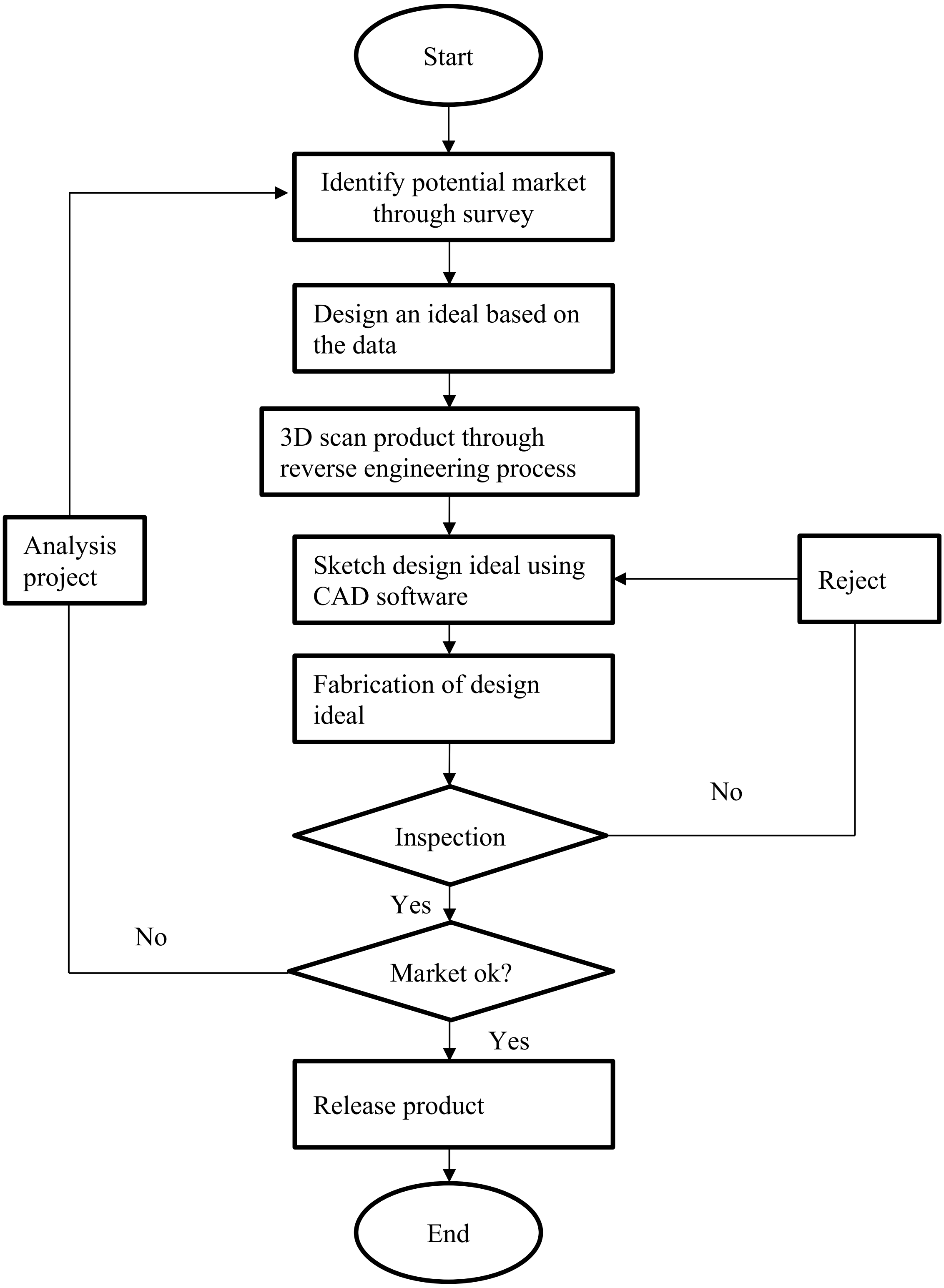

Figure 4: The flow chart of the project

3.3 Survey Analysis

As part of the survey research and competitive analysis that goes into developing a new product, customer preferences are examined. An analysis of a number of the client's capabilities, such as their purchasing and investing options. Market surveys are instruments for gathering direct input from the target audience to better understand their characteristics, expectations, and requirements. To have a good product market, customers are an important tool before identified the potential market.

3.3.1 Primary market research

The action of obtaining new information that has not been gathered in the past is referred to as data collection. Primary market research can take the form of a number of different activities, such as a survey, an interview, or a questionnaire.

3.3.2 Secondary market research

The method that is used to collect data that has already been produced. A good example of secondary market research is when you use data that has already been collected to support the content.

3.4 Conducting a survey

Survey is to find and identify the opinion of the customers. Based on the feedback from the respondent in the survey, the feedback from the respondent will be analysis and it will consider all the problems and suggestions. The survey is conducted through a google form survey and pass down through the social media application.

3.5 Design ideal based on data survey

Based on the result of the survey feedback, As the data shown that majority of the respondents are currently in teenagers where the average age of respondents are 20-25 years old. What it can conclude that most of the community in Malaysia are having problem to handling with the new normal of the pandemic affect. With the moving phase to the endemic and some of regulation need to follow had made the people in Malaysia were having issue with this situation. As most of the customer feedback which is sure that available product is sufficient to cope with the lifestyle, but they suggested that most of the product to be much tally with the endemic situation. Respondent hope that in the endemic phase the existing product will came with good features to ease the problem when using the product.

3.5.1 Sustainable

Sustainable is also one of the important issues for the new product development for endemic phase. In the pandemic phase we can obviously see the waste created from the people to prevent the virus infection. The hope for the Endemic phase is to reduce the number of waste and use sustainable product that can be reuse and recycle.

3.5.2 Ergonomics

Ergonomics is one of the important tools in designing a product. Where it helps to reduce human error and limitations. In the end, we will see the regulations that people need to follow although life is back to normal as before. As an example, people in certain areas share items such as those in public toilets. So, this issue also makes some of the customers uncomfortable with this situation, which can cause a lot of problems for them because of the ergonomic product.

3.5.3 Health Safety

Good in term of health safety. Health is one of the main issues that caused all endemic situation. The COVID-19 situation has aware the community about the health. So, this situation had made the respondent worried to living outside the house since the spread of virus in the community has become increase from time to time. However, life goes on and people need to accept that the need to live with the virus. So, it is important to have a product that guaranteed the health safety of customers.

3.6 Final Product Selection

Toilet paper is used by billions of people around the world. Modern commercialization began in the 1800s, and minor changes have taken place since. Currently, toilet paper is sold as long sheets of tissue paper, most often about 4 inches (approximately 10 cm) in width, usually wound around a hollow cardboard or compressed-paper cylindrical core into toilet paper rolls for convenience. People are living their lives as normal as before the virus hit the world. Tissue is one of the things that most people use for daily hygiene purposes. Based on the survey, having a lot of people in public areas has a bad influence on hygiene, especially for the use of roll tissue in public toilets. The authorities need some solution so that the tissue can be used for all consumers.

3.7 Construct reverse engineering surface model

As the Figure 5 has shown the design of the tissue holder that currently in the market. Where it starts with the scanned body of the tissue holder, and it depends on the type of tissue holder in each customer. The model used for reverse engineering for Samsung 3D Scanner was used. In this model, there will have two-part that will be scanned as the first one is the main body of the tissue holder and the tissue holder cover.

This project aims to maintain the current function used by the customers and provided a new simple way of operation on the tissue holder in public area. Reverse engineering use to make this product applied to all tissue size to create a new type of tissue holder. So, by applying reverse engineering on this project, it will be used on all types of the tissue size without the need to change the holder type used by customers.

3.7.1 Samsung 3D scanner procedure

For this project Samsung 3D scanner is selected due this application allows customers to 3D scan on the go. The whole idea is to make three-dimensional scanning as simple as taking selfies with a mobile phone. Samsung 3D scanner have better in terms of scanning results due compared to Capture 3D and Scandy Pro application.

3.7.1(a) Scanning

The collection of information from the component already in use is the initial stage of the reverse engineering process. The process of scanning an object with a Samsung 3D scanner begins with taking an image of the target object and then rotating it through a full 360 degrees while following dotted yellow reference points. The method that we use to scan the object is to walk all the way around it and record video from each of the four possible perspectives. In addition, if you place the item in the turning table, you can rotate it so that it does not move while it is being scanned if you keep it still. Bright, diffuse lighting is required in order to achieve the best possible results. The quality of the scans will suffer if there is insufficient wind or if there is no direct sunlight. In order for the scanner app to accurately capture the product's contours and dimensions, the surface type of the item being scanned needs to have a matte finish.

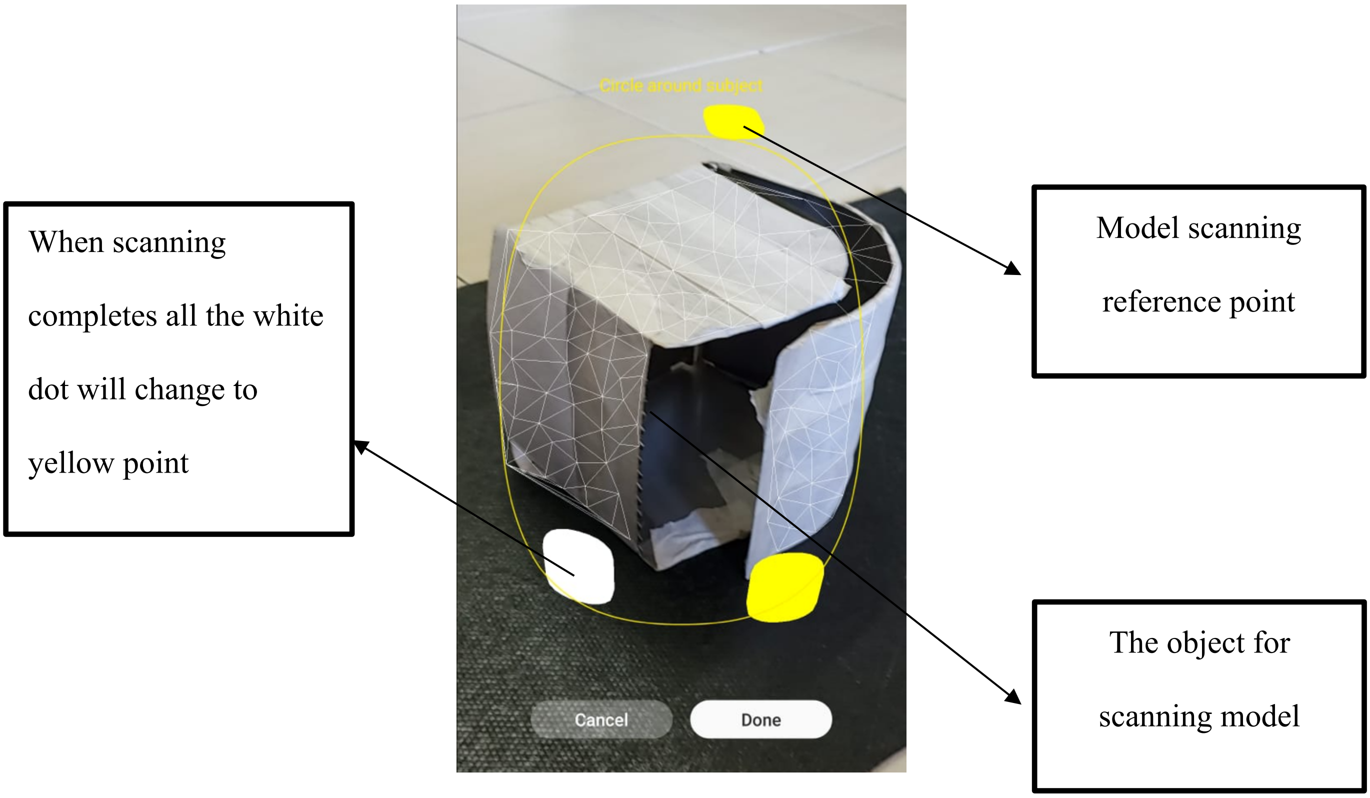

Figure 5: The object for reverse engineering

The Samsung 3D scanning application includes features such as a model scanning reference point that, when activated, will cause a change in colour to indicate the portion of the object that has already been scanned. As soon as the scanning process is finished, the white dot will transform into a yellow one. When the object surface is shiny, the scanning process cannot be used because of this limitation. The application of masking tape to the surface of the object in order to hide imperfections in order to achieve better results. When the scanning is finished, you will need to press the "done" button so that the application can begin to process the scanned object. This will allow the application to save the scanned data.

3.7.1(b) 3D scan object processing.

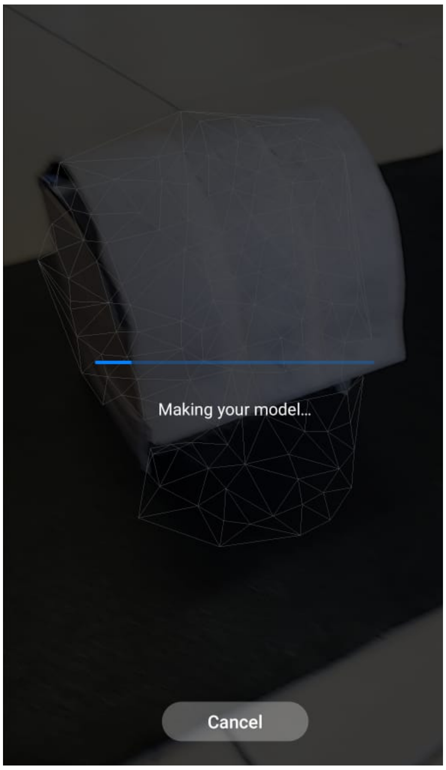

Figure 6: scanning processing

Figure 7: Result of scanning object

The object's scanning process is represented in Figure 6, which can be found here. It takes about a minute and a half for the scanning process to complete before it displays the results of the scanned object. The results of scanning the object will strip away all of the superfluous background, leaving only the object itself to be shown to rotate around itself in a full circle.

Transfer process of all of the scanned data that was obtained by the Samsung 3D application by using the share button. PNG, bin, and glTF files are the formats of the zipped documents that are contained in the folder. The data from the scanned object's mesh can be found in the glTF file.

3.7.1(c) Exporting to Wings3D

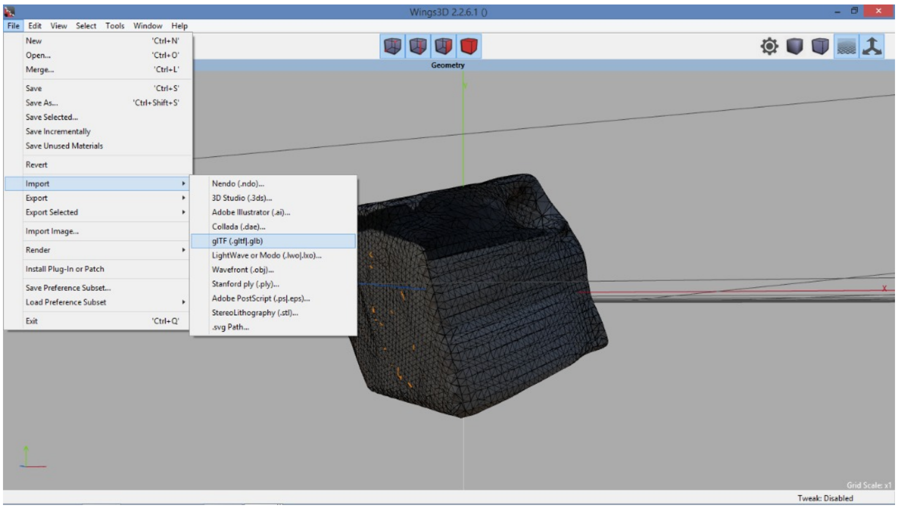

Figure 8: Import file

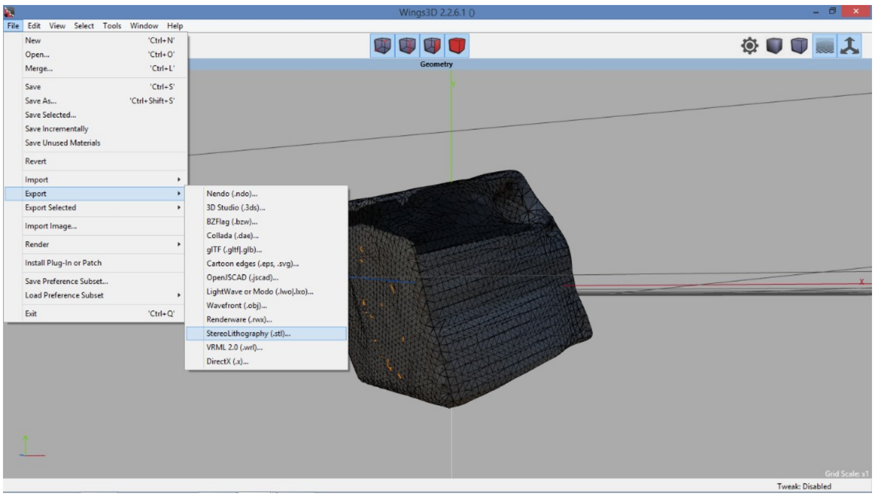

Figure 9: Export file to stl file

The software known as Wings3D is installed on the computer, and it is this program that is used to import the scan data. In order to import the software, a glTF file will be utilized. After importing the data, the file needs to be exported in order to be converted into a stl file type. A .stl file can be used to import it into SOLIDWORKS so editing of the object can be done.

3.7.1(d) Exporting to Meshmixer software

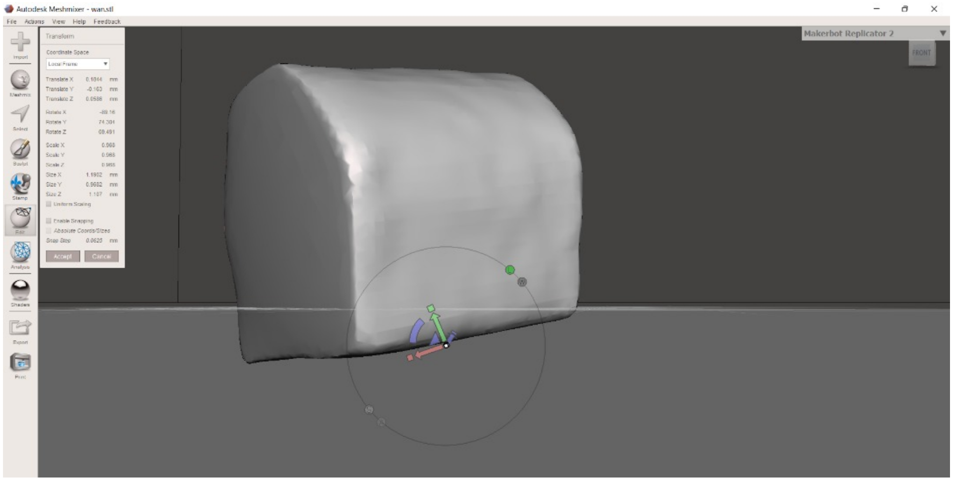

Figure 10: Edit feature

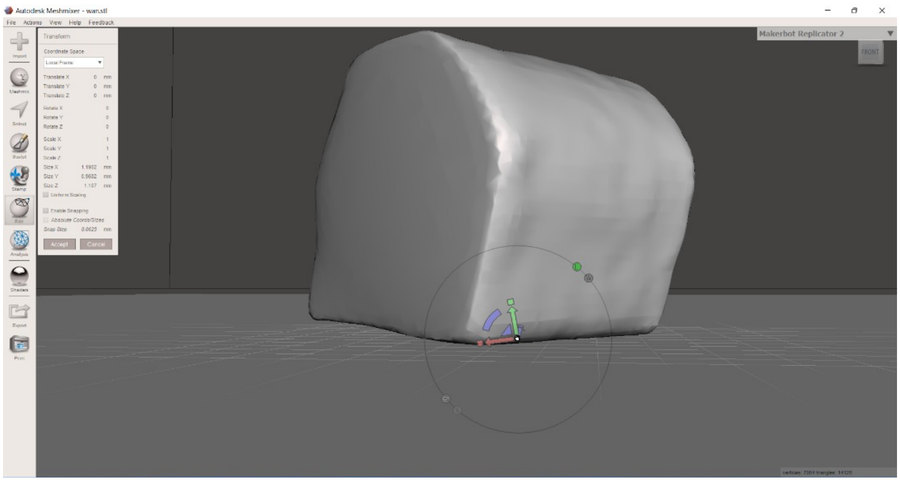

Figure 11: Data scan axis edit and fix

In addition to this, the scanned object in the Samsung 3D scanner is not positioned in the appropriate axis for X, Y, or Z. It is possible to edit the object axis by using the Meshmixer software, which also enables the origin to be corrected in the same normal manner as the XYZ axis.

3.8 CAD modelling and design

Product design and modeling are important tools for producing a product. Figures below shows the total of 9 parts that are used for this easy hold tissue holder.

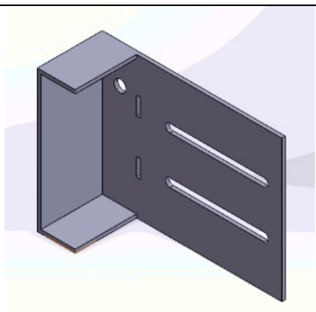

Figure 12: Holder bracket (right)

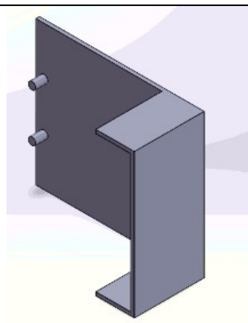

Figure 13: Holder bracket (left)

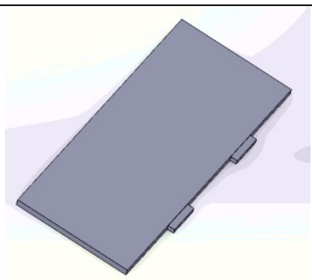

Figure 14: Holder enclosed (right)

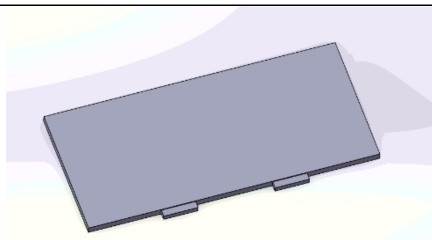

Figure 15: Holder Enclosed (left)

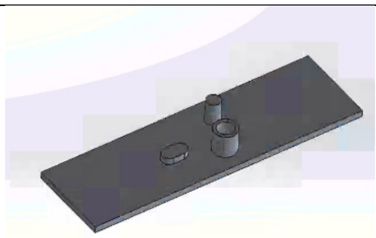

Figure 16: Top holder cover (right)

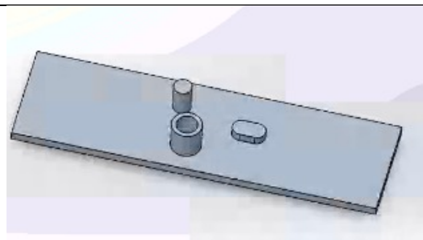

Figure 17: Top holder cover (left)

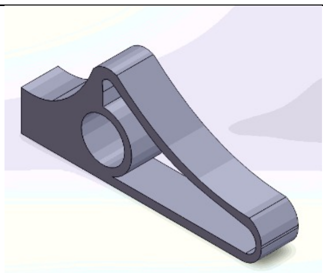

Figure 18: Tissue holder gripper

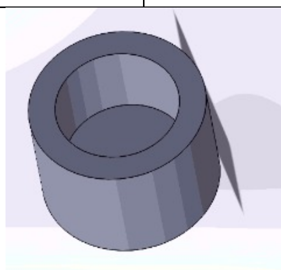

Figure 19: Pin cover

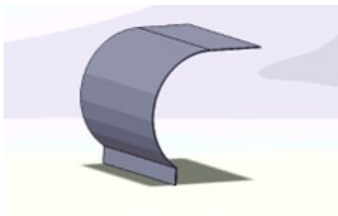

Figure 20: Cover

3.8.1 Complete Assembly

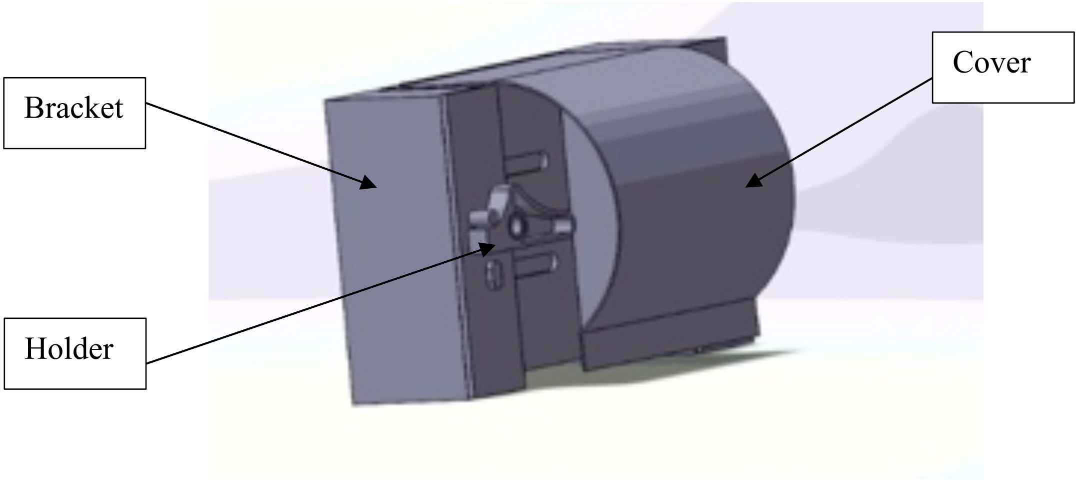

Figure 21: Origin shape and size assembly

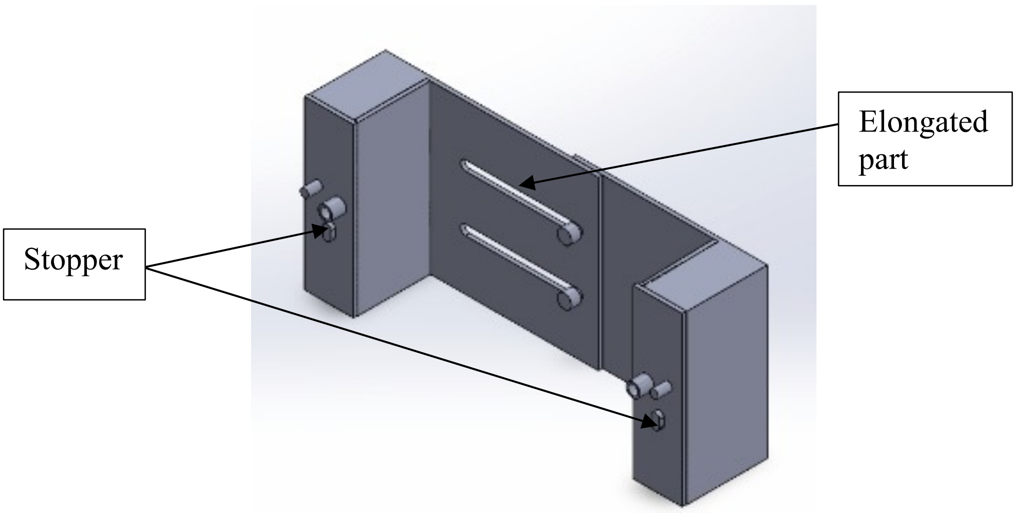

Figure 22: Elongated size of holder assembly without cover