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

By:

MOHAMAD DANIAL BIN MOHD SHUKRY

(Matric no.: 138289)

Supervisor:

Associate Professor Dr. Mohd Salman Abu Mansor

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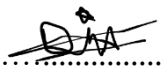
DECLARATION

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

Signed……  .....(MOHAMAD DANIAL BIN MOHD SHUKRY)

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LIST OF ABBREVIATIONS

COVID	Corona Virus Disease
MCO	Movement Control Order
HCW	Health Care Workers
MOH	Ministry Of Health
CAD	Computer-aided Design
CAM	Computer-aided Manufacturing
USM	Universiti Sains Malaysia
RPD	Rapid Product Development
3D	Three Dimensional
SLA	Stereolithography
SLS	Selective Laser Sintering
FDM	Fused Deposition Modelling

ABSTRAK

Pandemik COVID-19 yang berlaku di dunia benar-benar memberi kesan kepada semua orang di dunia ini sama ada di dalam komuniti tetapi juga ekonomi. Kawalan terhad pergerakan yang telah diterapkan oleh sebahagian besar negara telah diperintahkan untuk mengurangkan dan mencegah jangkitan di kalangan masyarakat. Oleh itu, produk baru harus dikembangkan untuk orang awam supaya dapat memberi manfaat dan nilai kepada masyarakat semasa dan selepas Pandemik COVID-19 ini berlaku. Oleh itu, terdapat ruang untuk produk tersebut dikembangkan dan dikomersialkan dengan peluang yang ada ini. Satu tinjauan telah dilakukan kepada pelanggan di mana pelanggan harus memenuhi semua keperluan dan masalah mereka. Hasilnya akan dianalisis dan dengan penghitungan dengan batasan pergerakan telah menciptakan kaedah baru untuk memahami produk yang tersedia dengan menerapkan aplikasi pengimbas 3D di mana kejuteraan balikan akan dilakukan pada model bahagian sasaran. Hasilnya menunjukkan bahawa tinjauan telah memberikan beberapa justifikasi yang memberi peluang untuk pengembangan produk. Mekanisme sistem pintu baru telah dibuat dengan pelaksanaan aplikasi pengimbas 3D. Beberapa kajian telah dibuat mengenai mekanisme sistem pintu yang baru. Projek ini merupakan langkah pertama dalam mengembangkan mekanisme pintu berfungsi sepenuhnya yang sesuai dengan situasi pandemik.

ABSTRACT

The Pandemic COVID-19 that has occurred in the world has affected all the people in the world whereas in the community but also in the economy. The movement limited control that has been applied by most of the country has been instructed to reduce and prevent the infection among the community. Therefore, a new product should be developed for civilians that will give benefit and value to the society during and after the Pandemic of COVID-19. Therefore, there is a space for such a product to be developed and commercialized. A survey has been conducting to the customer where the customer will have to fulfill all their need and problem. The result will be analyzed and the tally with the limitation of movement has created a new method to understanding the available product by implementing the 3D scanner application where the reverse engineering will be conducted on the target part model. Results show that the survey has provided a few justifications which give a chance for the product development. A new mechanism of door system has been created with the implementation of a 3D scanner application. Several studies have been made on the mechanism of the new mechanism of the door system. This project is the first step in developing a fully functional door mechanism that tally with the pandemic situation.

CHAPTER 1

INTRODUCTION

1.1 Project Overview

The Pandemic COVID-19 has affected all the people in the world. The lack of preparation to face this kind of situation has raised many concerns among populations worldwide. This unexpected situation had made most researchers led to finding alternative options to maintain and remain a normal life during and after the pandemic. Many researchers were focusing more on the innovations product that will be helpful to the community to reduce and prevent the problem that is facing most of the population during this Pandemic COVID-19. This is because the pandemic has given a big impact on all sectors. Most of the people in the world are currently limited in their movement to prevent the infection of this Virus. Some of the countries were issue instructions for movement control order (MCO).

Plus, with the all the situation that had to happen to the world has generally changed the way of living. Just contacting fomites and then touching their mouth and nose can infect a close person. Moreover, the virus itself could enter the human body through the eyes [1]. Actions and reactions in the imaging department are similar to those in the community in terms of reducing the danger to personnel and patients while also expanding access to services. Hygiene, social-distance measures, barrier protections, signage, masks, patient triage, patient and staff testing, infection control measures, decluttering, and periodic surface cleaning have all been widely implemented [2]. The global effect of the COVID-19 pandemic has put pressure on the global healthcare system to deliver high-quality care while limiting transmission to non-COVID-19 patients and healthcare employees (HCW) [3].

To face the challenges that are happening in most of the country. All the people must think of a new way of life. In Malaysia, an application called “MySejahtera” has been published and is being used by all the communities in Malaysia. The government developed this application to assist in managing the COVID-19 outbreaks in Malaysia. It enables Malaysian peoples to do a self-health examination, monitor their health state, and communicate that information with the Ministry of Health (MOH), allowing for quick treatment if necessary [4]. The community must be engaged and enabled to play a role in preventing COVID-19 from spreading. People can continue their everyday

routines while reducing COVID-19 transmission thanks to the new normal recommendations [1]. During the Pandemic, many people are currently changing the platform which is more to the online platform. This is because of the limitation of movement by the order from the government which causes the physical platform will not to be the main choice. These changes also have become a new product development in terms of system communication. Product development is very important to maintain the market value, almost every day there will have a new product innovation will be produced.

New product development will be an advantage tool that can help the people in the community to have a better life situation. The pandemic had caused some of the products to are not very effective that potentially reduces the compatibility with the current market. Plus, during the COVID-19 epidemic, many people are currently competed to find a new solution to live in pandemic conditions. One of the competitive tactics is the ability to develop and launch new items. The need and urgency of producing new goods in several areas have also developed because of the COVID-19 outbreak. On the other hand, to adapt swiftly to consumer and market demands, the supply chain must be nimble. So, a new product should be implemented to following the current new normal of living.

1.2 Problem Statement

The Pandemic COVID-19 that has occurred in the world has affected all the people in the world whereas in the community but also in the economy. The movement limited control that has been applied by most of the country has been instructed to reduce and prevent the infection among the community. But because of the implementation, people had to live in new normal to ensure that this Pandemic is under control. Furthermore, the limited movement with a lot of standard operating procedures generally has made a lot of changes in the community's daily lives. To ensure the productivity lives of the community. Therefore, a new product should be developed for civilians that will give benefit and value to the society during and after the Pandemic of COVID-19. Plus, the implementation of the 3D scanner application will generally become an advantage during the limitation of the movement.

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 Pandemic by surveying the target market
2. To find the best product concept of the chosen product for the development of the product
3. To generate a CAD model from scanned data by using Reverse Engineering Technique.
4. To fabricate the new product concept which can be functional to the society in the future.

1.4 Project Scope

In this project, a survey will be conducted to identify the current problem and to analyze the market demand among the community. The result of the survey will be investigated and to identify the best potential market of product development due to COVID-19 during and after the Pandemic. The best choice will be studies and the development of the product will be done by designing on the CAD Software. After that, reverse engineering will be applied during the designing of the product where the tool will be used mobile 3D scanner application for the reverse engineering. The compatibility of the implementation of the 3D scanner application will be studied. The end design of the new product development will fabricate by using rapid prototyping and the machining involves in the lab. The end products will be tested the performance. At the end of the process, a new product will be developed with a fully functional. The project implementation methodology, techniques, and tools use, and the flow of the project consists of 6 phases to get the final production model of the project. During the production of a new product, it will undergo all the phases step before a finalized product will be developed.

CHAPTER 2

LITERATURE REVIEW

2.1 Product Development

The constant development of new products is critical for entrepreneurs to stay up with customer requirements and market dynamics in the face of a decreasing product life cycle and varied client expectations for high-quality products [5]. Changes in production technology and service organization are affecting businesses all around the world. Because the product life cycle has never been shorter than it is now, one of the most critical business jobs is new product development. Increasing competitiveness solely through traditional approaches [6].

New product development (NPD) is a critical undertaking for a business to stay competitive [7]. NPD can be defined as a process that starts with the generation of an idea and concludes with the commercialization of new end goods. There is a strong correlation between new product development and a company's performance, whether it is a major or medium-sized business [8].

NPD activities assist a company in developing new processes, tools, and techniques to cut costs, speed up the product development process, and improve the quality of its current products [9]. In today's competitive world, continuous participation in NPD is critical to a company's success [10,11]. As a result, in any successful company, generating new items has become a top priority [12].

Because it has iterative, evolutionary, cooperative, and uncertain qualities, NPD is complicated and unstructured in comparison to the production process [13]. A methodical NPD framework can enable rapid improvements in core inventions, allowing companies to produce new products that perform better. Administrators should think about what they are trying to achieve. The success of the new product's debut, which is also one of the most expensive processes, is a crucial driver of its performance.

The usage of social media tools has the potential to improve new NPD results [14]. Due to its accessibility and ease of use, social media has fast become the most potent and effective platform for product or service consumers to voice and exchange their thoughts [15]. For example, Bashir research has proposed a fresh social media strategy for generating product development leads [16].

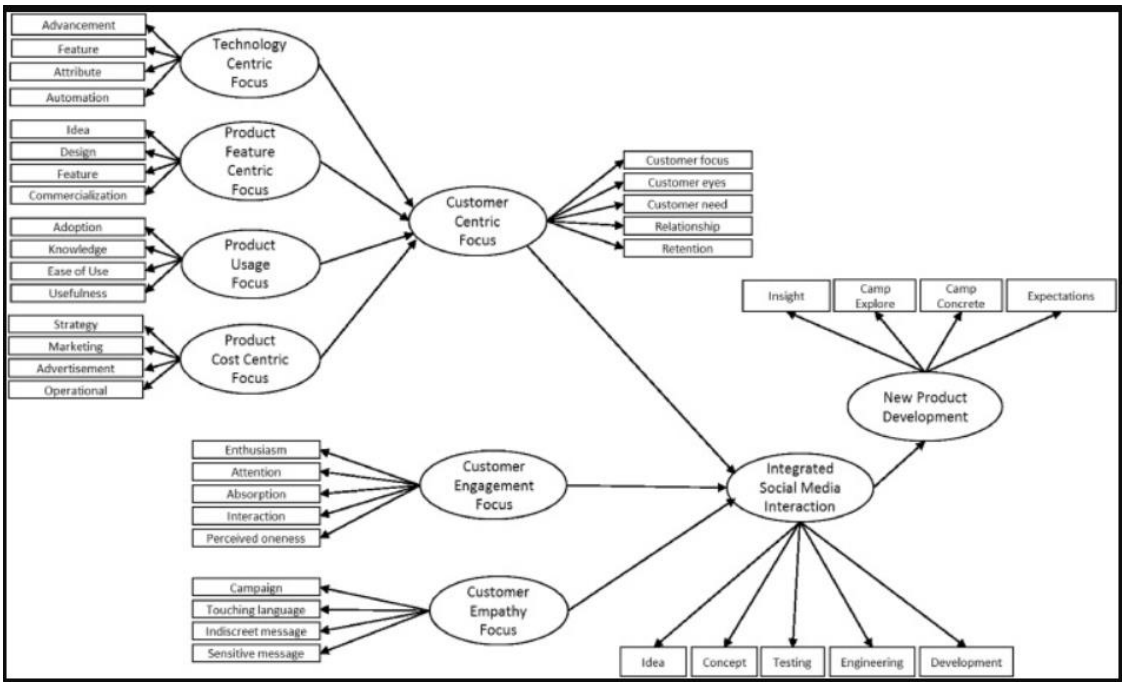


Figure 1: A conceptual framework of social media-driven NPD [5].

Figure 1 presents the conceptual framework of NPD through social media. Where the social media capability to provide a good justification to understand the customer requirement during the product development. By using social media platforms will help to convey the product development concept.

2.2 Reverse Engineering

Reverse engineering, sometimes called back engineering, is the process of generating a CAD model from an existing object. While traditional engineering involves the conversion of technical concepts and models into physical components, while in reverse engineering, real parts are turned into engineering models. The existence of a computer model improves the quality and efficiency of design, manufacture, and analysis enormously.

To take advantage of the benefits of CAD/CAM technologies, reverse engineering usually begins by measuring an existing object to derive a surface or solid model. Another purpose for reverse engineering is to shorten the time it takes to produce a product. In the intensely competitive global market, manufacturers are continuously looking for innovative ways to reduce the time it takes to bring a new product to market. Rapid product development (RPD) is a term that refers to newly created technologies

and procedures that help manufacturers and designers fulfill the needs of shorter product development times. By using reverse engineering, A three-dimensional object or model can be captured in digital form, redesigned, and exported for rapid prototyping/tooling or rapid manufacturing in a matter of minutes.

The goal of reverse engineering systems is to create a 3D scanner that is intelligent. But there is still a long way to go. Even collecting shape and converting it to a CAD model is a challenging and time-consuming task. Despite several promising partial achievements in specific areas, a fully automated approach for creating a complete and consistent CAD model remains a dream. Data gathering, pre-processing, segmentation and surface fitting, and CAD model development are indeed the basic phases of reverse engineering.

Physical constraints force data acquisition systems to collect information from only a small portion of an object's surface. Hence, to fully measure apart, numerous scans are required. Segmentation is the process of conceptually splitting the original point set into subsets, one for each natural surface, so that each subset only contains points sampled from that surface. Each subset of points is classified to determine which type of surface it belongs to. Fitting is used to determining which surface of a particular type has the greatest fit for the points in each subset. Reverse engineering is defined as starting with the product and working backward through the design process to arrive at a product definition statement.

2.2.1 Qlone Mobile Application

Qlone is a 3D tool that is available on mobile applications. It can provide a 3D model by scan on the phone camera. The scanned object should be placed in the center of the mat and guided through the scanning process by the Augmented Reality dome. Scanning the object from two separate angles will result in complete 3D information, which will be auto merged. The 3D model can export models in a variety of formats for use in other 3D tools, especially in the reverse engineering process. The help and guidelines from the app make the process of scanning easier and faster for modeling.

2.2.2 3D Scanning 3DF Zephyr Photogrammetry Software

3DF Zephyr, can automatically reconstruct 3D models from pictures and handle any 3D reconstruction or scanning difficulty. Regardless of the camera sensor, drone, or laser scanner gadget the user will employ. 3DF Zephyr is free to use open-source

software. However, there are certain restrictions, such as the ability to upload just 50 photographs and the ability to post only one image at a time.

2.3 Rapid Prototyping

Rapid prototyping was generally the new technology that currently becomes the main fabrication of the product development. Rapid prototyping systems are fully automated systems that simply require a 3D CAD model. With the use of software linked with printers, 3D CAD models are sliced into several layers. These processes are sometimes referred to as layered manufacturing or solid freeform fabrication [17]. Additive manufacturing, often known as three-dimensional (3D) printing, is a ground-breaking and rapidly expanding technology that has revolutionized the workflow of numerous professions and fields of research, including surgery, diagnostics, healthcare, dentistry, aerospace, and education [18]. This technology is increasingly being used to create prototypes in a variety of industries, including automotive, healthcare, aerospace, sports, textile, apparel, and the fashion industry [19]. A three-dimensional transformation approach for digital models. Plastics, concrete, and ceramics are often utilized materials. Efforts to develop additive manufacturing processes began in the 1980s [20].

It's also known as additive manufacturing, which offers cost-effectiveness, sustainability, waste remediation, and product design advantages such as material options and the incorporation of novelty [19]. To build personalized entities on demand, structures can be created from a digital 3D file utilizing computer-aided design (CAD) software or imaging techniques [21]. This technology can evaluate the quality and performance of a part or product before entering into large-scale manufacturing, saving money, labor, and resources, which has helped it acquire a lot of attention in numerous industries [19].

This technology has various types of 3D printing technology which use a different mechanism of production. Some of the 3D printing technologies are Fused Deposition Modelling (FDM), Vat polymerization (Stereolithography (SLA), selective laser sintering (SLS), and many others. In product design, mating parts and components testing is crucial for product functionality, performance, and service life span. Rapid prototyping is also used for ‘form and fit testing of mating components. In addition to

analysis in CAD software, rapid prototyping provides realistic ‘real life’ and ‘life size’ verification tools before the actual manufacturing of a product.

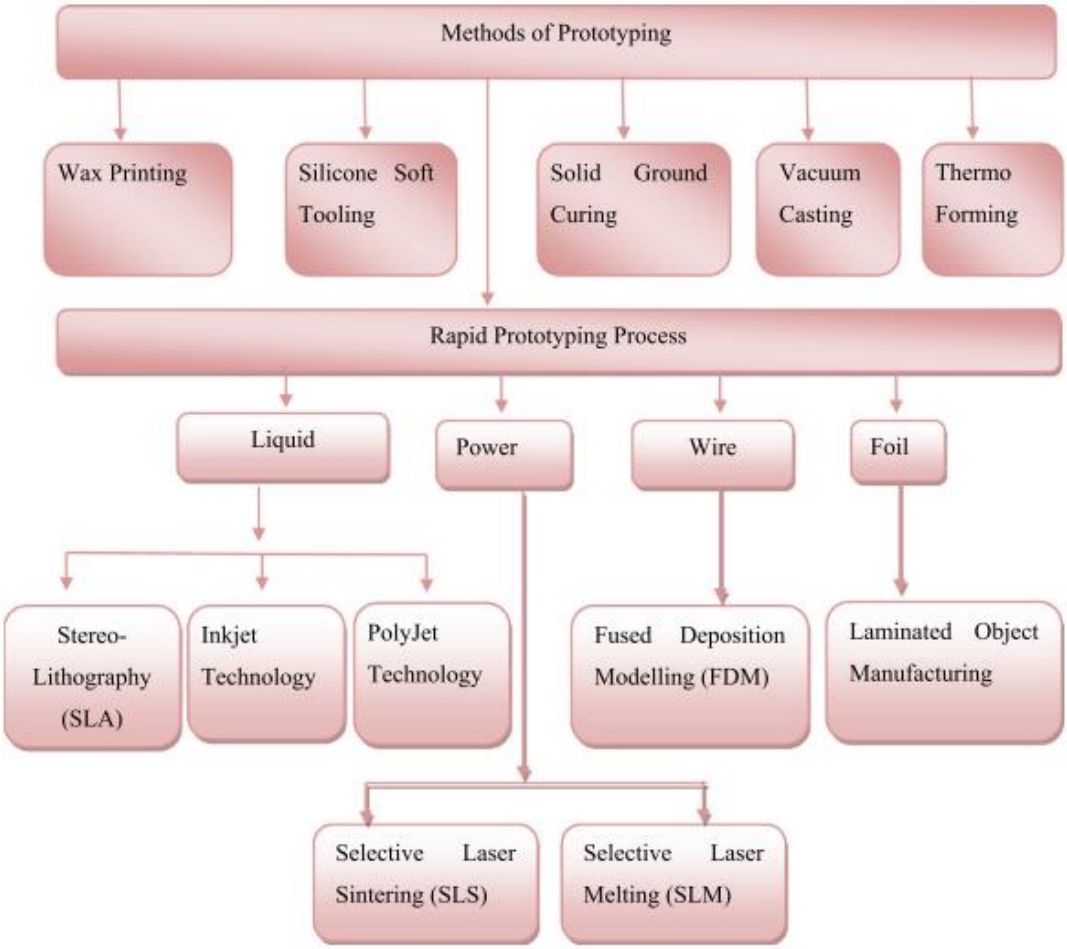


Figure 2: Classification of prototyping methods [17].

Figure 2 shows the method and the process of the available rapid prototyping process. There are several methods of rapid prototyping, and all the methods and processes are producing different textures and mechanical features. Different method but the same function which creates a layer of material into a desire shape and design. In general, Powder-based or extrusion-based 3D printers are the most common in the public domain. The powder-based 3D printer works in a similar way to an ink-on-paper printer, A roller spreads and compacts a layer of powder particles, and then binder droplets are selectively deposited onto the powder surface. The 3D printer provides a benefit and an advanced technology in terms of fabrication.

2.3.1 Fused Deposition Modelling (FDM)

Nozzle-based deposition systems, such as FDM, are a form of nozzle-based system. This method uses the extrusion of molten material through a nozzle with a specified diameter to construct three-dimensional objects by depositing successive layers of material on a heating plate, all according to a computer-generated design [22]. It can create pieces with exquisite features and complex structures. However, residual tensions can cause dimensional inaccuracies and a loss of mechanical qualities throughout the printing process. Because thermal residual stresses are affected by temperature fluctuations, changes in printing conditions can have a considerable impact on the printer quality and dimensions [23].

2.3.2 Stereolithography (SLA)

SLA is a type of 3D printing that uses light irradiation (such as a laser beam, UV, or visible light) to manufacture solid things from a photoreactive liquid resin [24]. Lithographic 3D printing can create stiff prototypes with great resolution and no gaps between print layers. Parts printed with SLA technology can be totally solid and water-resistant [25]. The body of a three-dimensional solid is made up of these polymers. Stereolithography is a technique that can be used to make prototypes for new items, medical models, and computer hardware, among other things. The stereolithography method is quick and capable of producing practically any design, but this method can be costly for the fabrication process.

CHAPTER 3

METHODOLOGY

3.1 Process Flow Chart

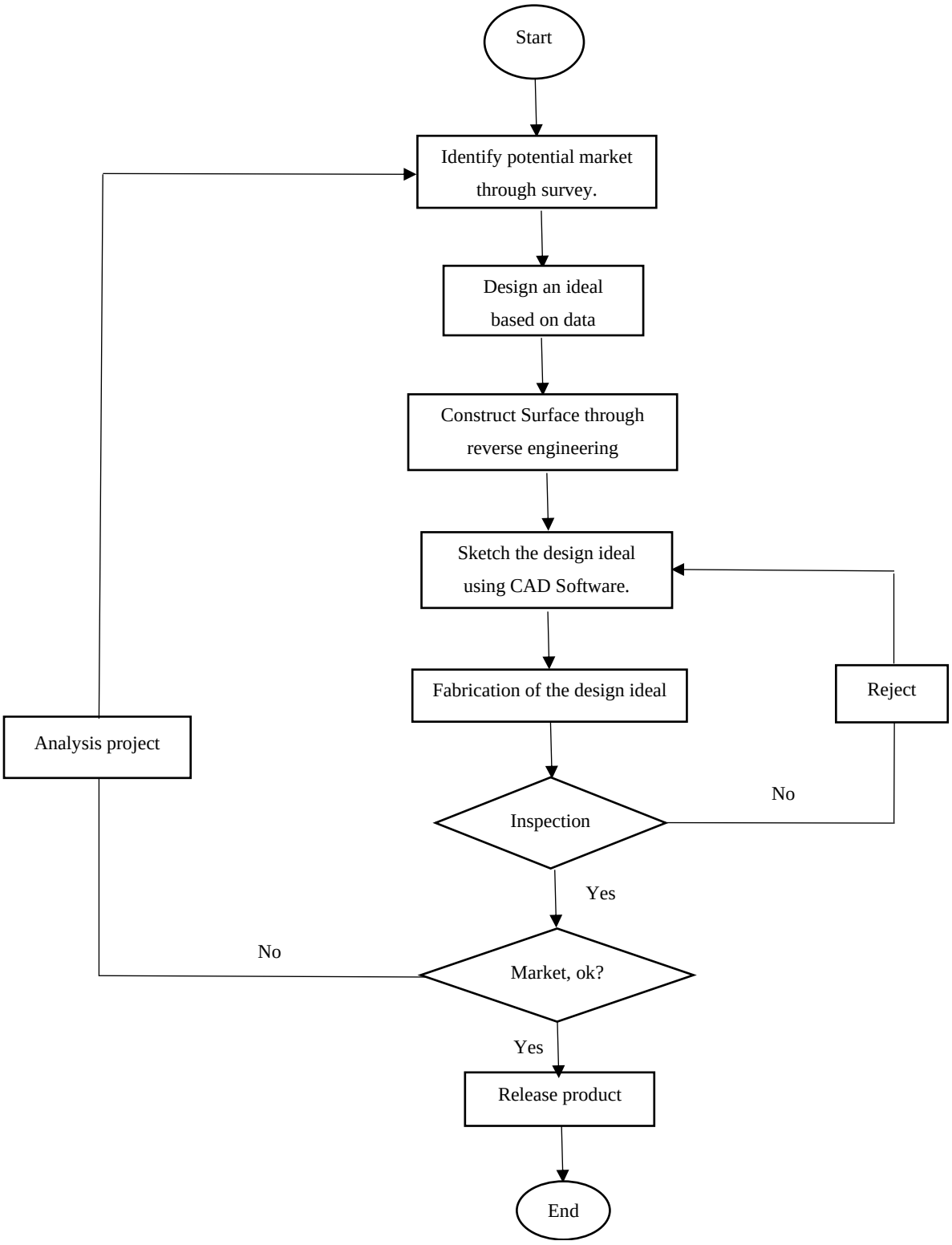


Figure 3: The Flow Chart of the project

3.2 Survey analysis

Customer inclinations are investigated as part of survey research and market analysis for a new product. An evaluation of a variety of client capacities, including investing features and purchase 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.

1. Primary market research

The process of collecting new data that has not been obtained previously. A market research survey, an interview, or a questionnaire are all examples of primary market research.

2. Secondary market research

The procedure for collecting data that has already been generated. Using pre-existing data to support the content is an example of secondary market research.

3.2.1 Conducting a survey

A survey is a way of gathering data from a small group of people to extrapolate the results to a broader population. Surveys are used by almost everyone in the information economy, from corporations and the media to government and academics, for data and insights. Every product is made for its customer. It is created whether to solve their problem or fulfill all their need. In product development, customers' opinions and feedback are one of the most essential components for sustainability and success for the lifecycle of a product. So, it is important to clarify 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.

3.3 Design ideal based on data survey.

As the data have shown that the majority of the respondents are currently teenagers where the average age of respondents is 29 years old. what it can conclude that most of the communities in Malaysia are having problems handling the new normal

of the pandemic effect. Plus, the limitation to going outside with a lot of procedures that need to follow had made the people in Malaysia were having an issue with this situation. As most of the customer feedback is sure that available product is sufficient to cope with the new lifestyle, but they suggested that most of the product be many tallies with the pandemic situation.

Since most of the issues that have been mentioned in the survey are involve safety health where most of the respondents are afraid and worried about the virus issue and because of the pandemic that caused most of the community in Malaysia that are using the virtual platform as the new place for communication or meeting were one of the problems that been mentioned in the survey. As the analysis data have shown that there some potential market that would be a benefit to the customers.

3.3.1(a) Touchless product

The COVID-19 situation gave a big impact on the community. The people are afraid to touch in the public place. So, most of them will be trying to avoid touch in the public place but their limitation with this issue where some places need touch to control the mechanism. For example, in the public lift. So, instead of avoiding the problem, it would be better to face and reduce the problem that involves in this situation.

3.3.1(b) Ergonomic with the user

Ergonomics is one of the important tools in designing the product. Where it helps to reduce human error and limitation. The pandemic situation also had made most of the community in Malaysia have a virtual meeting instead of a physical meeting. That situation had caused a lot of sitting on the chair and watching the screen on the laptop, tablet, or handphone. So, this issue also has made some of the customers are not uncomfortable with this situation where it can cause injury to them because of unergonomic product.

3.3.1(c) Good in terms of health safety

Health is one of the main issues that caused all pandemic situations. The COVID-19 situation has aware the community about the health. So, this situation had made the respondent worried about living outside the house since the spread of the virus in the community has become increase from time to time. So, it is important to have a product that guaranteed the health safety of customers.

3.3.2 Final product selection

Door control mechanisms are used to open or close a door. Door handles can be found on a variety of doors, including residential and commercial building outside doors, internal doors, closet doors, and vehicle doors. Depending on the intended usage, door handles come in a variety of styles. A considerable number of handles, particularly for residential doors, have latching or locking mechanisms built-in or are made to suit standardized door locking or latching devices. The lever handle and the doorknob are the two most prevalent forms of door handles. Based on the criteria of the survey analysis which are three main issues from the customer demand. By applying the demand from the customer on the door mechanism will help to provide a good product based on justification from the customer feedback. The design ideas for the door mechanism are currently focused on the touchless product, ergonomic and good in terms of health. With the new implementation a new mechanism which will be a benefit for the society especially during and after the pandemic

3.4 Construct reverse engineering surface model.

As the Figure has shown the design of the body of the latch lock. Where it starts with the scanned body of the current latch lock, and it depends on the type of door used in each customer. As in this situation where the latch lock is available from the knob door mechanism. The model used for reverse engineering for 3D Scanner Qlone was used. In this model, there will have two-part that will be scanned as the first one is the body of the latch lock and the inner parts of the latch lock. This project aims to maintain the current door used by the customers and provided a new mechanism on the door mechanism. As there are many types of doors used by customers. This may be a problem for this product to apply to all types of door mechanisms. So, reverse engineering use to make this product applied to all types of door mechanisms. So, by applying reverse engineering on this project, it will be used on all types of the door without the need to change the current door used by customers. Plus, this may open the market value as all types of doors can be used with this leg door product.

3.4.1 Qlone Application procedure

3.4.1(a) Scanning

The first step in reverse engineering apart is to capture the data from the existing part. Before doing anything with Qlone, need to print the paper that called AR Mat as the Figure 4 show. The software uses this black and white checkerboard pattern as a tracking marker. It can be printed on any printer, although thick paper is strongly suggested to prevent the pattern from deforming. Objects must fit into the pattern's central square as Figure 4 shows. Effectively limiting their maximum footprint to 15 × 15 cm. The height of things, however, is the most significant constraint. This has to do with the AR-dome the software will project. The way to use to scan the object is by a walk around the object to capture the video from four different angles. Besides, also can rotate the object at the mat by not moving around. For optimal results, bright, diffuse lighting is required. If there is no direct sunshine or wind, the paper will not move if it is not attached to a firm surface outside.

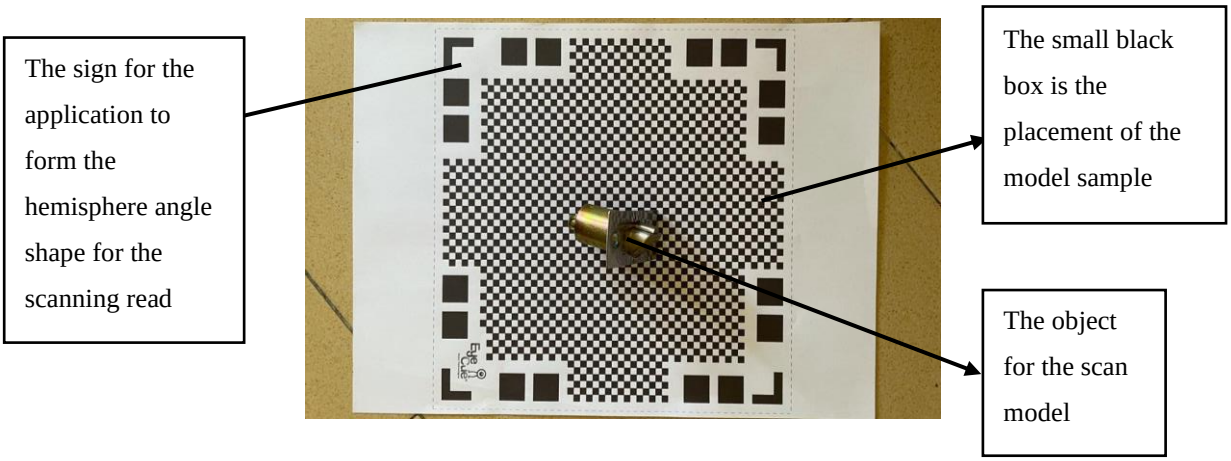


Figure 4: The object for the reverse engineering

3.4.1(b) Editing the 3D model

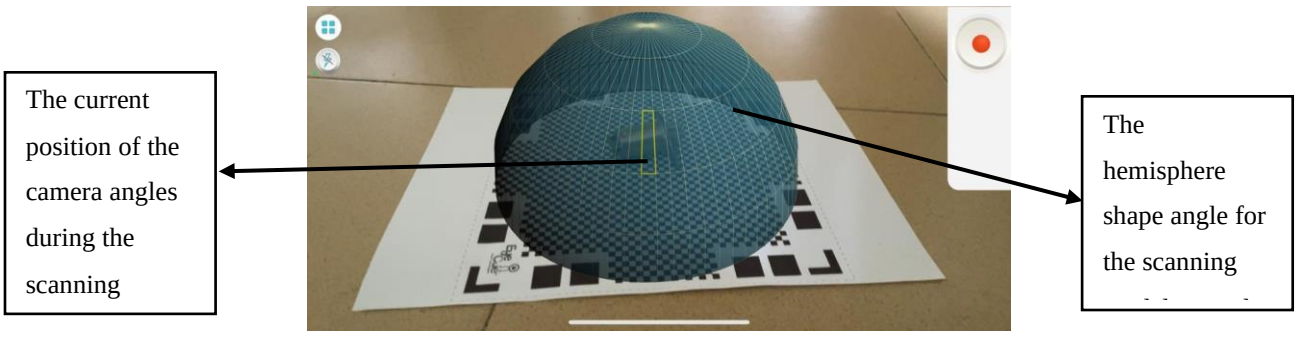


Figure 5: The angles provided by the application system

Figure 5 shows the angles provided by the Qlone application during the scanning process. The model will be scanned with a 360-degree angle surround the sample model until a full mesh model forms in the application. Qlone has a large selection of editing and retouching tools. Precision editing is simply impossible on such a little screen. For editing, one-finger touch input is required, and two-finger input is required for navigating. It may use a color picker to paint directly on the model in that color, blur particular texture elements, and resize or decimate the model all within the program. Figure 6 shows the result of the scanning of the latch door using Qlone application.

Figure 6: The result of the scanning object

3.4.1(c) Exporting

Purchasing credits is required for exporting to 3D file formats that can be imported into external software. The part model will be export into an STL file as it is compatible with the CAD software for the construct surface model analysis with the dimension of the part model. The are several files can be saved as the Figure 7 show. But for the transfer to CAD software, the STL file will be used as the scanner file.

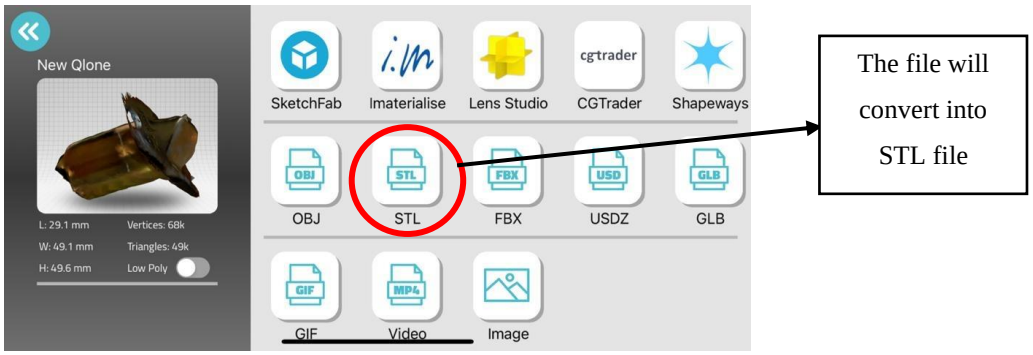
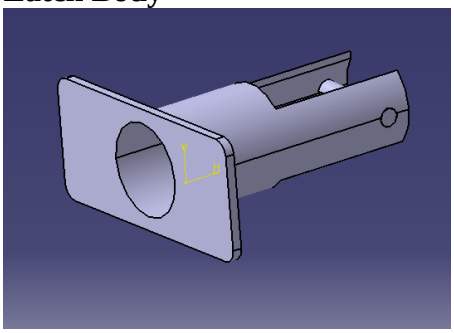
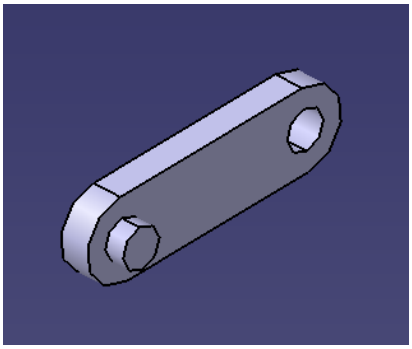
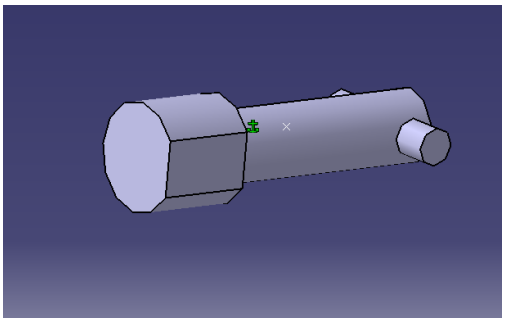
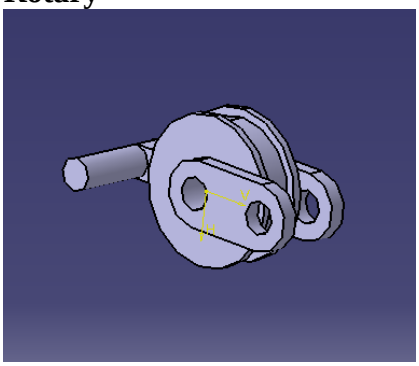
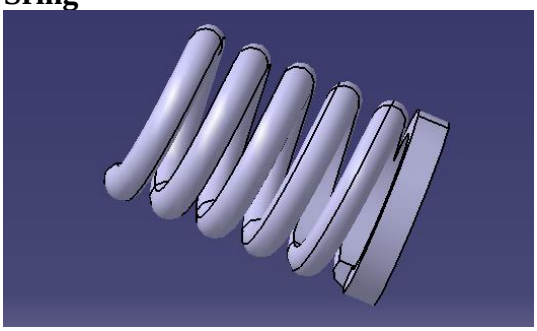
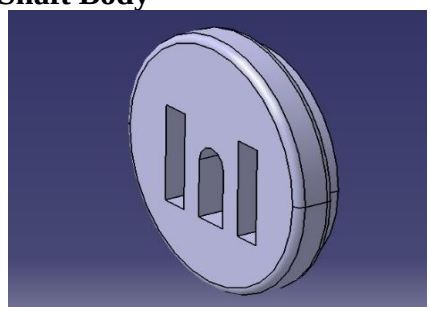


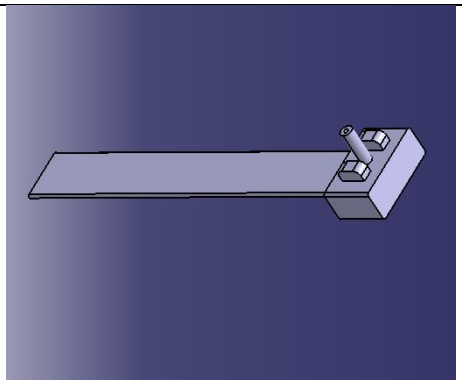
Figure 7: 3D file formats available in the Qlone application

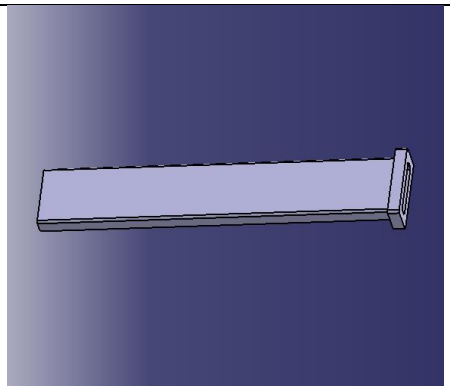
3.5 Modeling and design the ideal

Product design and modeling are important tools for producing a product. As table 1 show the list part of the touchless door mechanism. It shows the total of 9 parts that are used for this product.

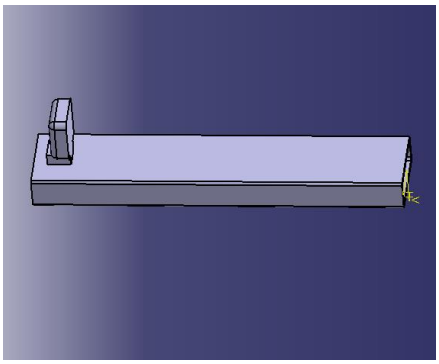
Table 1: List parts of the products

List of Parts	
1. Latch Body 	**2. Crank** 
3. Latch 	**4. Rotary** 
5. Sring 	**6. Shaft Body** 
7. Shaft 1	**8. Shaft 2**





9. Shaft 4



3.5.1 Simulation model

The process of constructing a mathematical representation of an actual or prospective product in a computer model is known as simulation analysis in CAD. Engineers frequently simulate product design modal and structural qualities. Simulation is the process of simulating the operation of a real-world process or system through time. CAD Software is used to execute the simulation. Simulation is utilized in a variety of scenarios, including technology simulation for performance optimization and product design testing. In this week, a simulation that involves the performance model of the leg door control model is proposed. The simulation showed how the function of each of the parts involves the leg control product.

3.5.1(a) Simulation of Inner Part of the latch body

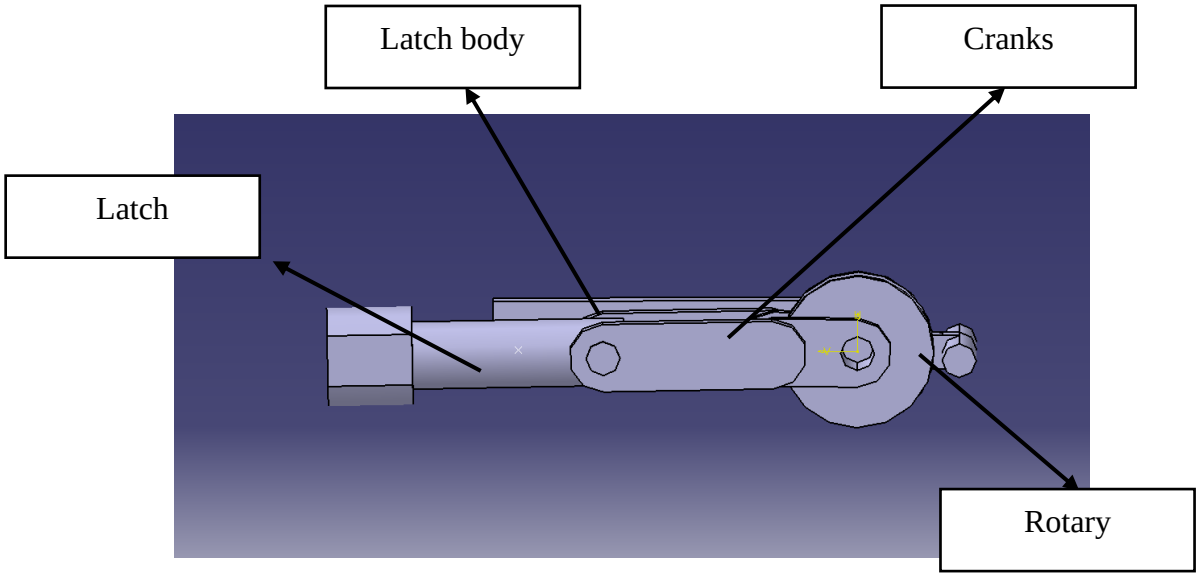


Figure 8: The label part for the inner mechanism of the latch

Figure 8 shows the overview part involves in the inner mechanism of the latch body. Based on the simulation that has been made in the Figure below, there are four revolve joints that have been made on the inner mechanism as Figure 9 shown. Where the maximum angular set for the joint is a limit of 90 degrees. As the rotary part connected with the shaft 1. The shaft will act as the control for the door mechanism. When the shaft pushes downward the rotary part will move 90 degrees downward followed by the crank part. The crank part which relates to the latch part also will move along with the crank and it will pull the latch into the latch body cylinder part. There is the total of 4 joint show in Figure 9 that has been command on the simulation of the latch mechanism.

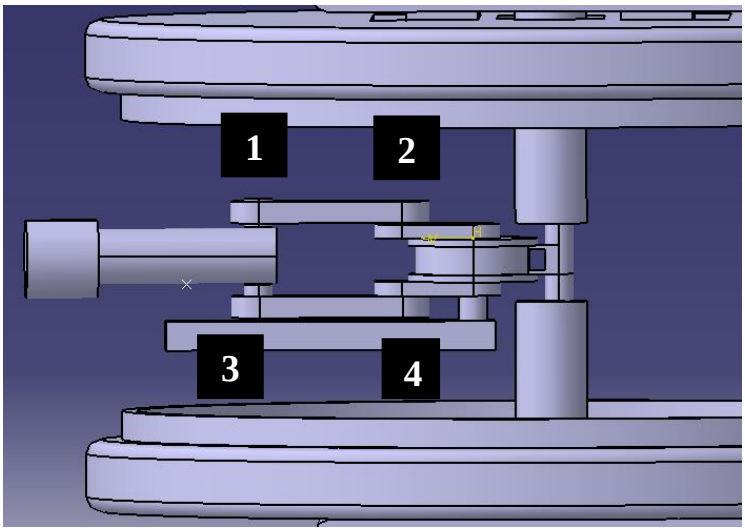


Figure 9:The part command for the latch mechanism

As Figure 10 shows, there is a total of three commands for this inner mechanism which is used in the simulation.

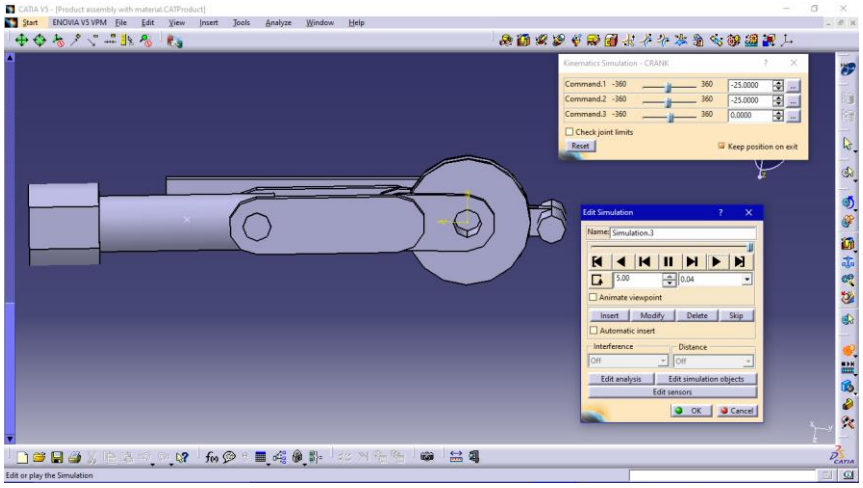


Figure 10: The simulation of the latch mechanism

The spring is placed in the latch as a extend and compress of the latch. The use of spring will ensure the latch can be formed back into its original place after it has been compressed. Figure 11 shows the spring located on the latch inner part to have the elastic force when the force is applied to the latch mechanism. The spring will help to move the rotary part to its actual position after it has been pulled out. Figure 12 shows the overall simulation of the product.

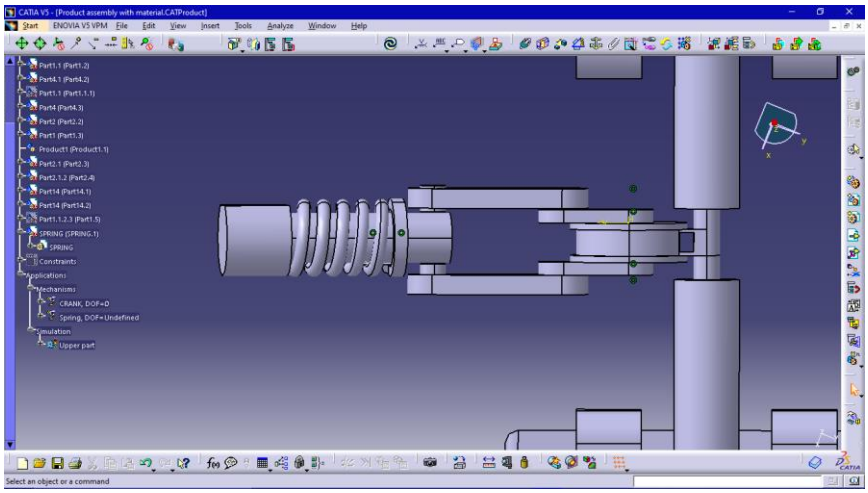


Figure 11: The view of the latch mechanism

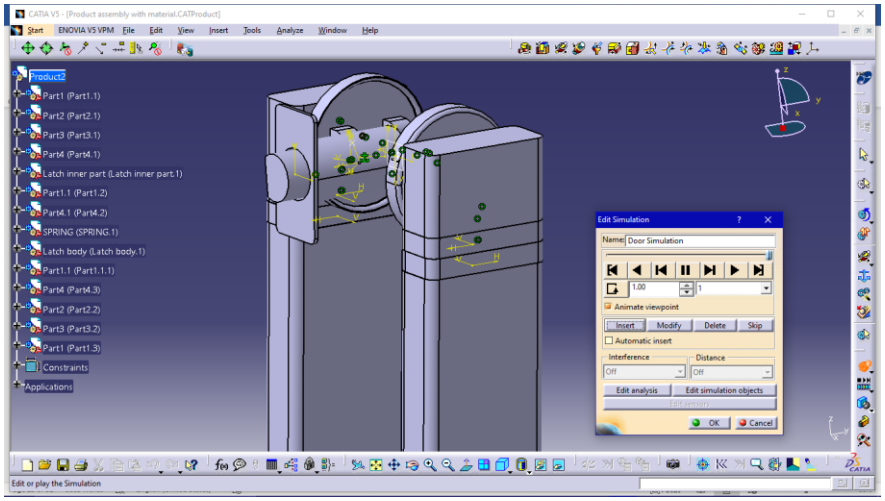


Figure 12: The simulation for the product model

3.5.2 Applying material

All engineering applications and designs start with material selection. Application requirements, potential materials, physical principles, and selection can all be used to define this selection process. The application's requirements are the part's design or function. The only materials that can be utilized in the application are those that are listed as possible. The application requirements determine the materials that can be used. Plus, the available material in the school also would be the main reason for the selective material of the product. Figure 13 shown the material selection of the door control product. The material was selected based on few criteria which are cost

reduction, Improved product performance, and reliability, and Improve manufacturing. Table 2 shows the list of materials applied on the part of the touchless door mechanism.

Table 2: List of material pf the product

No.	Parts	Material
1.	Shaft control	Plastic
3.	Rotary mechanism	Plastic
4.	Latch Body	Aluminium
5.	Latch	Stainless steel
6.	Door Houses	Plastic

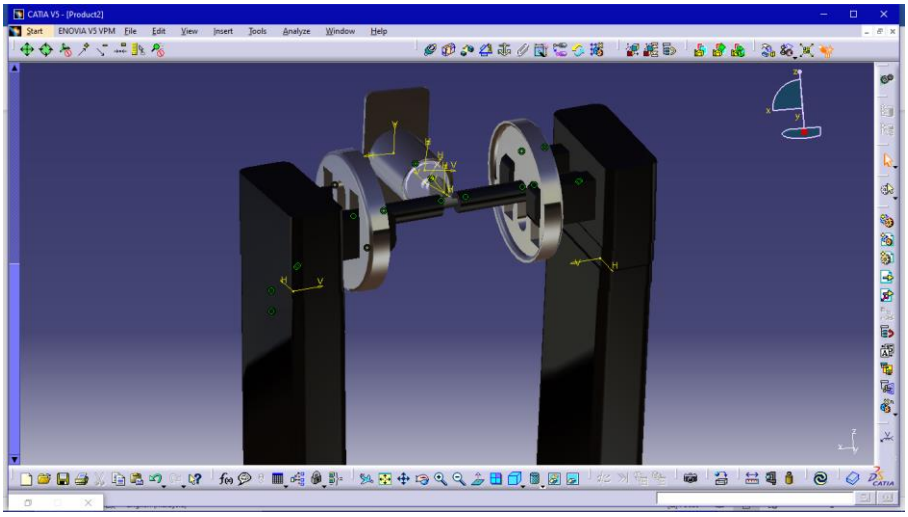


Figure 13: The result of applying the material to the design model.

3.6 Fabrication of product design

3.6.1 3D Printing

Figure 14 shows the fabrication of the shaft part, the fabrication is going through the rapid prototyping method. In this fabrication process, the FDM machine method is

used for fabricated all four parts of the shafts. Computer-aided design (CAD) files are used to create objects with an FDM printer. Before an object can be printed, Its CAD file must be translated to a 3D printer-friendly format, which is typically an STL file. During printing, these materials are unwound from a coil and fed through an extrusion nozzle in the form of plastic threads, or filaments. The filaments are melted and extruded onto a base, also known as a build platform or table, by the nozzle. A computer controls both the nozzle and the base, converting the dimensions of an object into X, Y, and Z coordinates for the nozzle and base to follow during printing. The extrusion nozzle moves horizontally and vertically over the build platform in a conventional FDM machine, "drawing" a cross-section of an object onto the platform. This tiny layer of plastic cools and solidifies, adhering to the layer beneath it almost instantly.

Figure 14: The FDM rapid prototyping process

CHAPTER 4
RESULT AND DISCUSSION

4.1 Results

A result of the development of the product. Three things are focused on in this study. The result is focused on the product identification result, 3D scanner result, and final product fabrication. All these things will be analyzed and interpret as the result data.

4.1.1 Product identification result

A small survey of the customers was carried out and the result of the survey is analyzing as the Appendix A has shown. The target respondent for the product identification is people that live in Malaysia which currently having Pandemic COVID-19. The result will divide into subcategorized which more specifically list out all the problem outcomes of the people who are currently affected by the Pandemic situation. Total 53 of the respondents that responds to the survey. All the data are analyzed, and most of the answer will be focusing on in table 3 list of the need that is required from the customers. The Figure 15 show that 87.5% of the respondent are affected by the pandemic COVID-19 while only 12.5% that are not sure and 0% that not affected by the pandemic. It shows that majority of the people are having a small impact changing their lifestyles.

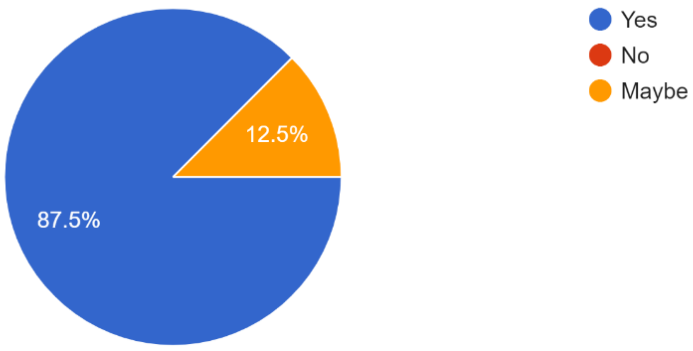


Figure 15: Percentage of affected of the pandemic to respondent lifestyle.

Table 3: Interpreted need table of customers

Question/Prompt	Customer Statements	Interpreted Need
What is the recommendation that you need during the Pandemic COVID-19?	Easily to handle it	The product is user friendly where it can be adjustable depending on the customer demand and it takes a few steps to use the product
	Saving time when using it	The products tool can operate within a few steps
	The cost must be reasonable, and the material used must have quality and lightweight	The product tool is durable with an affordable price
	Good in terms of health safety	The product is currently limiting the using a touch where it uses the leg to use it
	Touchless product	

4.1.1(a) Reflect On the Results and The Process

The suggestion of the respondent will organize these needs into a hierarchical list. The list will usually consist of some major needs, each of which will be followed by some secondary needs. This will provide an answer for all the list of problems. It will help to find several solutions for all the problems.

1. The product is multifunctional.
   * Can use for several purposes.

2. The product is user-friendly, and everyone can use this.
   * User-friendly.
   * Safe to everyone even children and senior citizens.