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Innovated Design of Cheese Tart Press Machine for Small-Medium Enterprise (SME)

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Abstract: Tart is a type of baked open-pastry which consists of a short crust pastry and a filling over it. Short crust pastry often used as the base for the tart. The filling may be usually something sweet and savory poured onto the crust, though modern tarts are usually fruit-based, sometimes with custard. Many machines have been introduced to assist the making of chess tart in the market. However, the existing machine is expensive and it is difficult to be handled. Therefore, this project is intended to overcome the stated problem by designing and developing a cheese tart press machine. The designed machine has following a basic design process started from identification of needs, conceptual design, embodiment design and detail design. Meanwhile, for proof-of-concept testing, the proposed machine concept has been developed to test the functionality and capability. Several activities have been included in discussion. As a summary, the machine has been successfully designed and verified based on the proof-of-concept testing. This machine can be used for pressing tart crust and suitable for homes, industries or individual purpose and also can do bigger task if the size of the machine is scaled up depending on the quantity.

Keywords: Cheese tart, product design, design for functionality

1. Introduction

Tart is a type of baked open-pastry which consists of a short crust pastry and a filling over it (Figure 1). Short crust pastry often used as the base for the tart. The filling may be usually something sweet and savory poured onto the crust, though modern tarts are usually fruit-based, sometimes with custard. In the production of tart, its crust is the main part. In the process of making tart crust, the dough must first be pressed to get the desired shape and size.

Tart crust press machine is a machine used to press the dough for cheese tart crust. This machine is available in the market but limited to a specific size only. Most of the industries need this machine with more than one size of crust to achieve their target for an output.

NK Enterprises is a SME's company which runs the bakery business. One of their main products is the cheese tart. From the gained information, this company used the manual way in pressing the crust for their cheese tart. This resulted in the slow in production process. Additionally, productivity will be not widespread as this is a time-consuming process. The invention of Tart Crust Press Machine is an incoming idea from the problem faced by NK Enterprises. The fabrication of this machine involved the innovation of crust size. Variety of sizes for the crust to be used is introduced.

1.1 Existing Product Identification

Surveyor's mark made on a stationary object of previously determined position and elevation and used as a reference point in tidal observations and surveys. We had observed some types of tart press machine. There are three types of press machine we mark as benchmark of our project:

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Fig 1 -Example of Portable Table

1) Tart stamping machine (double head) SKY-AEG2101 (Figure 2). Specifications:
   - This machine operated by highly efficient pneumatic system
   - It can produce multi size and shape of tart or pie
   - Machine operation is safety and easy
   - It can even be operated with minimal training
   - Compact, low cost and high performance
   - The structure of the machine is made of stainless steel and aluminium.

Fig. 2 -Tart stamping machine (double head) SKY-AEG2101

2) Tart stamping machine (double head) SKY-ETM1101 (Figure 3). Specifications:
   - Handle operation is manual press by hand.
   - It can produce all shape of tart or pie.
   - The structure of the machine is made of mild steel with epoxy.

Fig. 3 -Tart stamping machine (double head) SKY-ETM1101

3) Automatic stamping machine SKY-ASM-2500 (Figure 4) Specifications:
   - This machine can be directly coupled to an automatic encrusting unit.
   - It capable of stamping on various materials like pastry, snow skin,"Ang Ku" dough and other types of dough.
   - Allow the extraction of more consistent pastries through suitable mould, different pattern according to customer need.
   - The structure of the machine is made of stainless steel and aluminium adjustable.
   - Equipped with wheels for convenience moving and rapid cleaning.

Fig. 4 -Automatic stamping machine SKY-ASM-2500

Based on the existing products, most of the inventions are focusing on heavy-duty application and using high tech device which may cause the cost of the product is expensive. Table 1 shows the comparison for the Benchmarking Product.

Table 1 Product Benchmarking.

Description	Product 1	Product 2	Product 3
Product example			
Material	Stainless Steel / Aluminium	Mild Steel with epoxy	Stainless Steel / Aluminium
Handle operation	Auto	Manual	Auto
Power	Electric motor	Handpress	Electric motor

2. Proposed Design of Cheese Tart Press Machine

2.1 Conceptual Design

2.2.1 Component decomposition and function analysis

Component decomposition analysis is a flow chart or process flow that shows a main component and sub component that used in the product. Every part that used will be listed with more specific. Main component is on top of the chart while the sub component placed at the lowest section of the chart. Each component is related with each other. Figure 5 shows the flow chart of component decomposition for tart crust press machine and function analysis in Figure 6.

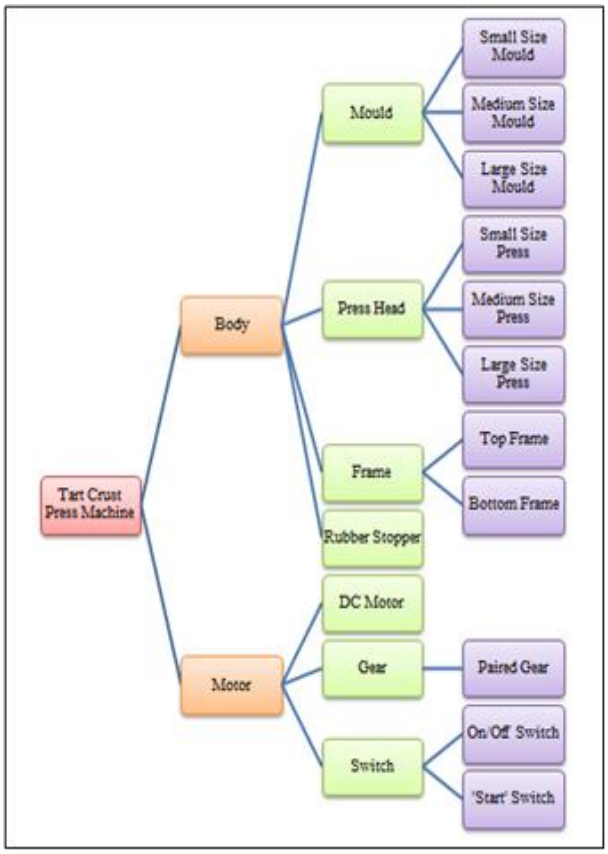

Fig. 5 – Component Decomposition

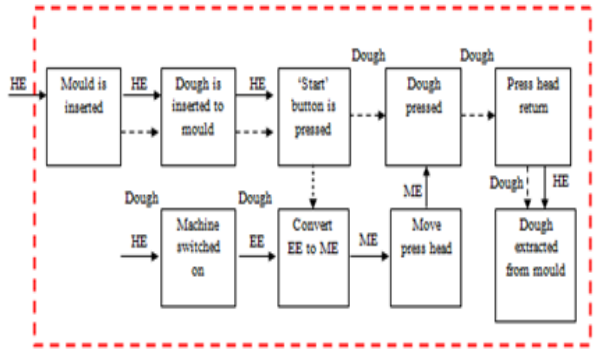

Fig. 6 – Function Analysis of Portable Marketing Set

2.2.2 **Concept Selection**

These are two concept of tart crust press machines selected. Figure below shows all the two types of concepts. We choose the type 2 tart crust press machine because it is more modern and safe to use as shown in Figure 7.

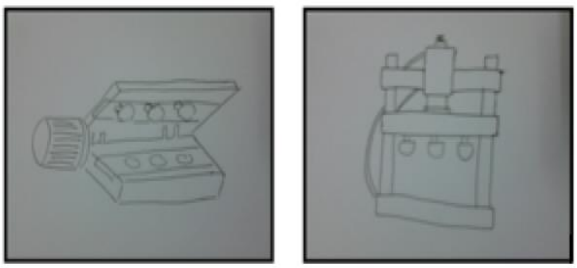

Fig. 7 –Concept selection

2.2.3 **Product sketching**

2.2 **Embodiment Design**

2.2.1 **Product Architecture**

Figure 8 shows the selected product that have been sketched to be our product development.

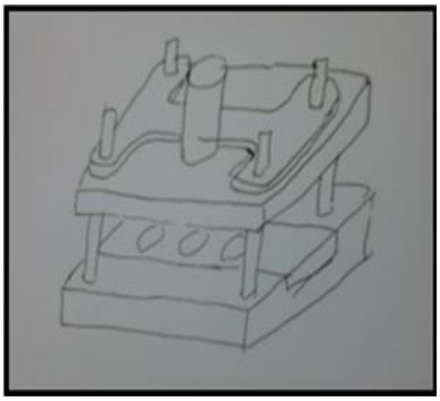

Fig. 8 – Schematic diagram of the proposed concept.

2.2.2 **Product Configuration**

The shape and general dimensions of components were established in configuration design. Exact dimensions and tolerances are established in parametric design. Component can be classified into special-purpose parts, standard parts, and standard assemblies. A part is characterized by its geometric features such as holes, slots, walls, ribs, projections, fillets, and chamfers.

A standard component is usually an individual part, manufactured in thousands or millions, to the same specification such as size, weight, material, and others. Meanwhile, special purpose parts are components that its operations are limited to the acquisition of specific function. The special purpose components are usually subsidiary components. Table 2 shows the list of standard. Table 3 shows the list of standard modules. Table 4 shows the list of special purpose part.

Table 2 – Standard Components

Part	Quantity
5/2 Way Solenoid Valve	1
Regulator	1
Tube	5
Pneumatic piston	1
Socket head cap screw	12
Heavy hex screw	12
Push button	1

Table 3 – Standard modules

Part	Quantity
Start/Stop switch	1

Table 4 – Special Purpose Parts

Part	Quantity
Piston	1
Rod	4
Support rod	2
Press head	1
Dough mould	1
Shell set	1
Body plate	1

2.2.3 **Product Architecture**

Product architecture is the scheme by which the functional elements of the product are arranged into physical element of a product to carry out its required functions. Architecture also has profound implications for how our product are designed, made, sold, used, and repaired. A product's architecture is selected to establish the best system for functional success once a design concept has been chosen for our product. The design process of our product is carried out based on the predefined architecture as shown in Figure 9.

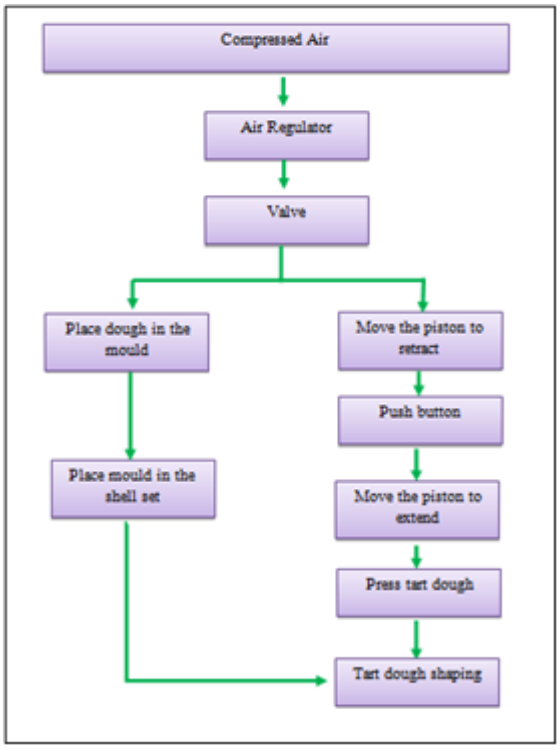

Fig. 9 - Schematic diagram of Cheese Tart Press Machine

2.3 **Detail Design**

2.2.1 **Detail Drawing**

A detail drawing is the most important drawing for fabrication work. A detail drawing is a drawing of a part giving a complete and exact description of its form, dimensions, and construction. Detail drawing must be concise, in that they convey only the information needed to create the part, such as the size, type of material, finish, tolerance and any special instruction. In other word, all information needed to produce the part should be on the detail drawing. In our project, the detail drawing as follows.

Part drawing shows the detail of part design in term of its dimension and material. Overall, the Cheese Tart Press Machine has 9 parts as shown in Figure 10.

Assembly drawing is a detail drawing that shows how all of the parts interact in mating to each other to form a useful machine. It will allow us to identify the exact connection between each part. A complete assembly drawing is presentation of the product or structure put together, showing all parts in their operational positions. An assembly drawing is needed for all products or inventions that have more than one part. Assembly drawing for Cheese Tart Press Machine is illustrated in Figure 11.

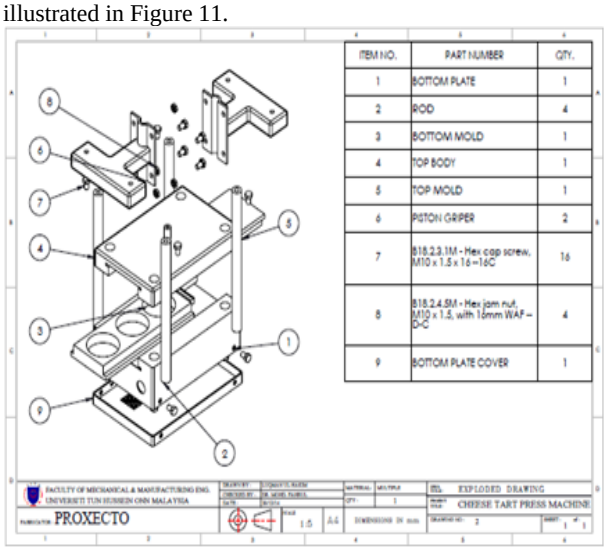

Fig. 10 – Exploded view of Cheese Tart Press Machine

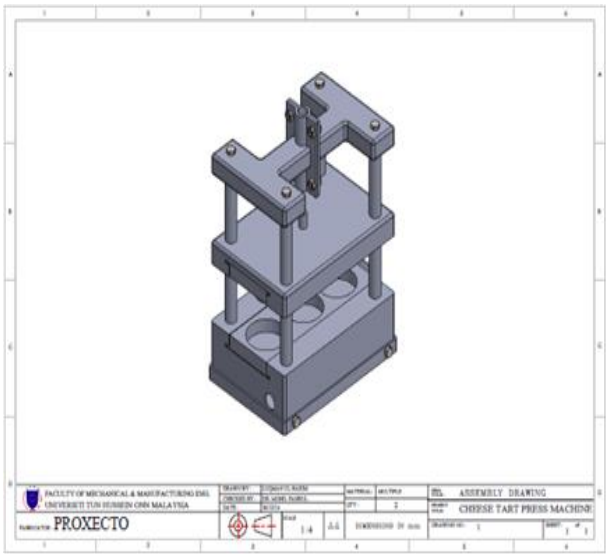

Fig. 11 – Assembly drawing of Cheese Tart Press Machine

2.2.2 **Final Product Design Specification**

The main purpose of this product design is to make a modification and an innovation for a Cheese Tart Press Machine. This purpose of this product is to press three cheese tarts dough into shape in a single press with exchangeable size.

Client requirements:

- Low power consumption
- Less pollution especially on noise
- Hygiene
- Portable
- Safety
- Switch (downward and upward)
- For indoor and outdoor usage

3. Prototype Development

Prototype testing consist of six of different types which are product concept test, proof-of-concept test, virtual prototype test, alpha prototype, beta prototype and pre-production prototype test.

A prototype or developed design is a very important part of the design and manufacturing process. Testing and evaluation, simply confirms that the product will work as it is supposed to, or if it needs refinement. A prototype is an early sample, model, or release of a product built to test a concept or process or to act as a thing to be replicated or learned from. Evaluating a prototype allows the production costs to be assessed and finalized. Every stage of manufacturing can be scrutinized for potential costs. This may lead to alternative and cheaper manufacturing processes being selected, for future production

3.1 Process Involved

These machines are built to be easy to handle and safe in every part on this machine. The function prototype is similar to the actual machine that can press the tart crust with three sizes. However, the shape, dimensions, and the material used is slightly different as to build the actual machine involves high costs. Then, after make sure the motor and all the components function the process started. Early involvement allows procurement (e.g. customers) to suggest new technologies, manufacturing methods and processes that's add value and competitive advantage joint before product design is locked down (Figure 12).

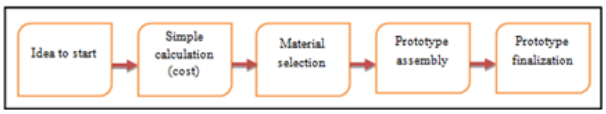

Fig. 12 - The Processes Involved for the Prototyping Processes

❖ Idea to start

Idea originally came from SMEs Company, NK Enterprise which run bakery business and cheese tart is one of their main product. Since they have problem related to the making process of the crust for their tart, this project is aim to help solve the problem faced by them. A machine is designed to ease the operation of shaping the tart crust processing industry.

❖ Simple calculation (cost)

This calculation based on a budget that can be provided by each member of the group and also budget raised by the industry or the university. This calculation also includes the cost of materials used and the fabrication cost of the machine. This is important to ensure that the fabrication process be implemented as planned.

❖ Material selection

In planning for the actual machine, the main material used is stainless steel for frames, rod, top body, bottom plate, and piston griper. Stainless steel has been selected for this material corresponds to the manufacturing process based foods.

3.2 Prototyping (Assemble) Process Time

Manufacturing process is one of the process including in established the prototype. Effective time management is highly demand in this stages by make sure that prototype of the project can be done in time. Table 5 shows the process duration in the making of this prototype.

3.3 Final prototype

A final prototype of Cheese Tart Press Machine is designed to test and trial a new design to enhance precision by system analyst and users. Prototyping serves to provide specifications for a real, working system rather than a theoretical one. Figure 13 shows the final prototype product of Cheese Tart Press Machine.

Table 5 – Process duration

Component	Process Involved	Time (minutes)
Bottom mould	Measuring and marking	13 minutes
	Cutting	20 minutes
	Milling	30 minutes
	Assemble to the bottom plate	10 minutes
	Measuring and marking	
	Milling	
	Drilling	
	Miling	20 minutes
	Driling	30 minutes
	Assemble cover to the bottom plate	15 minutes
		30 minutes
Bottom plate	Cutting	30 minutes
Bottom plate	Milling	10 minutes
cover	Grip the pneumatic piston	40 minutes
Piston Griper	Measuring diameter of the	35 minutes
Press head	head	10 minutes
Rod	Assemble to top body and	10 minutes
Top body	body plate	10 minutes
Pneumatic	Measuring inner and outer	10 minutes
piston	diameter	10 minutes
	Assemble to top body and	23 minutes
	body plate	33 minutes
	Measuring	20 minutes
	Milling	10 minutes
	Drilling	
	Install pnuematic piston to the top body	
	Total	430 minutes

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Fig. 13 – Final prototype of the product

4. Conclusion

Our product, Tart Crust Press Machine was created based on the problem that has been collected from the Small and Medium Enterprise (SME), NK Enterprise. From the problems, we have decided to solve one of the problems. One of the problems that occur in the company is the making of the crust of the cheese tart. Based on the problems given, the customer requirements have to be defined so that the several concepts of machines can be generated. Every each of the group members will be given task to find the patents of the machines that already available. Questionnaire has to be generated as one of the medium of survey to collect the customer requirement and make comparison of the available product, produce the objective tree of the product, define the weight age importance of the features in the products according to priority, produce the House of Quality, define the functions and features in the product and produce a rough sketching on the product.

Tart Crust Press Machine is a semi-automatic machine. It uses electro-pneumatic as it operating system because it is easy to operate and install than ordinary pneumatic system. It also makes the machine run smoothly and efficiently. This machine offers in three size of tart crust, small, medium and large. This is due to the requirement of the company itself that want a machine that can produce tart crust in many sizes. The rate of production is higher than by handmade. The rate is 3pcs/1s. The problem for having more sizes and also time for production rate is solved.

This machine is potential to be sale due to the demand of the entrepreneur especially local entrepreneur. This machine can help the existing entrepreneur boost their sale on the tart based product. Tart Crust Press Machine can be used to make more than 3 types of tart that also can give the entrepreneur to add some new menu on their list. It will bring increasing of profit to the company. So, the company can save labor cost because this machine only required one operator to run the machine. This machine is suitable for the SME only because the production rate is not suitable for the big scale company. The main objective of our project has been achieved, to design a tart crust machine that come in various in sizes.

In conclusion, Tart Crust Press Machine already fabricated and functioned as the other machine that already in the market but with our own design. This machine is one of the new inventions that bring much benefit to the people especially the entrepreneurs. This product is easy to handle or use it and also can reduce the work and also time for pressing the crust compared to the manual way.

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