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Development of Pressure Fryer for Fried Chicken

Sia Chee Kiong[1,a], Mohd Fahrul Hassan[1,b*], Mohd Hafiz Ali[2,c], John Mbogo Kafuku[3,d]

[1]Faculty of Mechanical and Manufacturing Engineering,
Universiti Tun Hussein Onn Malaysia, Parit Raja, 86400 Batu Pahat, Johor, MALAYSIA

[2]Department of Mechanical Engineering,
Politeknik Kota Kinabalu, 88460 Sepanggar, Kota Kinabalu, Sabah, MALAYSIA

[3]Department of Mechanical and Industrial Engineering,
College of Engineering and Technology, University of Dar es Salaam, P.O. Box 35131, Dar es Salaam, TANZANIA

*Corresponding Author

Email: [a]sia@uthm.edu.my, [b]fahrul@uthm.edu.my, [b]mohdhafiz@polikk.edu.my, [c]jkafuku@gmail.com

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Abstract: Fried chicken is one of the Malaysian favorite food especially for students who are most of them having a lunch or dinner with a cup of rise. Buying the fried chicken is quite expensive if they buy most every day. The way how to cut the cost is fry the chicken by themselves. However, many of them are not trained how to fry a chicken with a good condition. Therefore, this project is intended to overcome the stated problem by designing and developing a pressure fryer. 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 pressure fryer has been successfully designed and verified based on the proof-of-concept testing. This machine can be used for frying a chicken with a good condition and suitable for home or individual purpose and also can do bigger task if the size of the machine is scaling up depend on the required chicken's quantity.

Keywords: Fried chicken, product design, design for functionality

1. Introduction

In cooking, pressure frying is a variation on pressure cooking where meat and cooking oil are brought to high temperature while pressure is held high enough to cook the food quickly. This leaves the meat very hot and juicy (Figure 1). A receptacle used in pressure frying is known as a pressure fryer. Pressure fryer is widely used in fast food industry. It is exclusively used by big corporations to fry their chicken fast. Instead of traditional frying, pressure fryer keeps the juice in the meat rather than traditional frying. The technique that is used with pressure fryer is called broasting [1-3]. Example of Company that uses Pressure Fryer is KFC and Wendy's. All the negative press surrounding trans-fats has rekindled a public-sector panic about the problem of obesity in this country, which in turn is increasingly being blamed on the purveyors of fried foods. Good frying habits include using healthier high quality oils, filtering frequently, discarding degraded oil, and using fryers that recover temperature quickly.

Fig. 1 – Fried Chicken

Pressure fryer is not easily accessible in Malaysia culture because the price of the pressure fryer mostly is not affordable for Malaysian. But with the engineering technique we believe that we could produce cheaper pressure fryer that affordable to

**Corresponding author: fahrul@uthm.edu.my*

everyone especially for those that involve in a small business [3-4].

1.1 Existing Product Identification

Benchmarking can be simply defined as a continuous process to find and implement best practices that will lead to superior performance. There are many products available in the market, but, in this project, three existing products have been reviewed to be benchmark for the future solution [3-6].

1) PFE 500 (HennyPenny)

The most versatile pressure fryer that is available in the market is PFE 500. Even though it is bit expensive but the advantage of this model is automatic oil filtration. The design of this model is very sleek and easy to use. Figure 2 shows PFE model of pressure fryer.

Fig. 2 – PFE model by HennyPenny

2) FKM-FC (BKI)

The Experience of 60 years in food industry has made the BKI Company to come up with a reliable model in pressure frying. The Figure 3 shows model has completed the standard features for a pressure fryer to operate flawlessly.

Fig. 3 – FKM-FC model by BKI

3) High Efficiency Fryer LP56 (Winston)

The Figure 4 shows the collectramatic High Efficiency Fryer LP56 operates at a fraction of the high pressure fryer. This means longer shortening life, less wear on the equipment, and a better kitchen environment. The LP56 is an open high efficiency with 18.lb. (8.2kg) capacity and an 8 channel programmable control.

Fig. 4 – Model High Efficiency Fryer LP56 by Winston

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.

2. Proposed Design of Pressure Fryer

2.1 Conceptual Design

2.2.1 Component decomposition and function analysis

Component decomposition is a diagram which includes the block diagram of each part of the real product and its subassemblies that will make up the full product in the form of a hierarchical structure, as shown in following Figure 5 and 6.

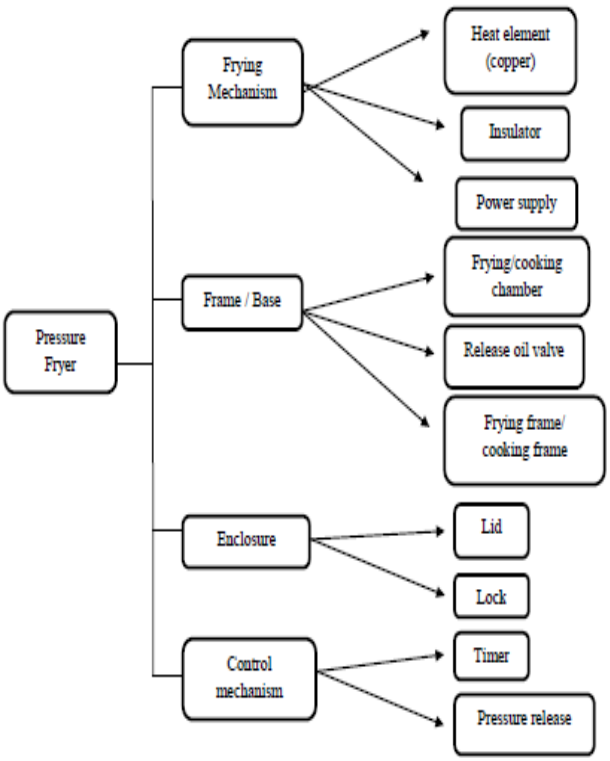

Fig. 5 – Component Decomposition of Pressure Fryer

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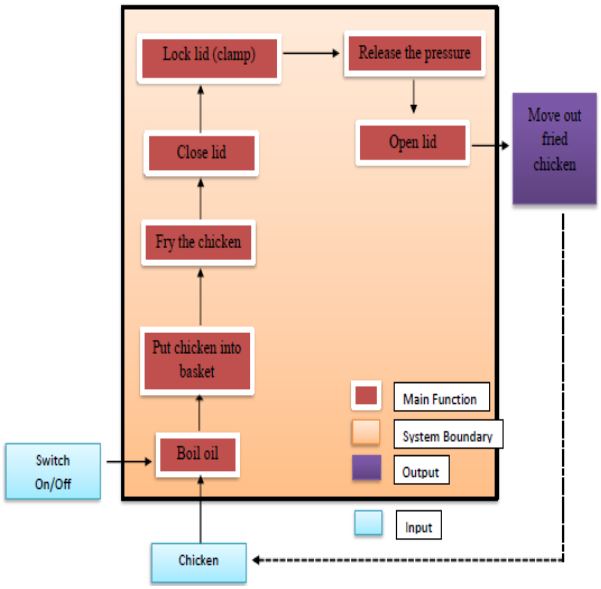

Fig. 6 – Function Analysis of Pressure Fryer

2.2.2 Concept Selection

The Table 1 below show that the final concept selection for our product. Combination 1 has been selected from several alternatives based on morphological chart.

Table 1 – Concept selection

Features	Specification
Power supply	Gas
Frame material	Mild steel
Lock mechanism	Clamp lock
Lid material	Stainless steel
Clambell basket	Solid cylinder metal
Insulator	Convention plate to plate

2.2.3 Concept Sketching

Product sketching is the field of initial product design and the ability to represent your ideas by using effective visual method such as sketching opens doors for better communication between designers and clients. Designers find that using products sketching is an efficient way to speed up the process of developing ideas in the real life. The Figure 7 shows the product sketching for the pressure fryer.

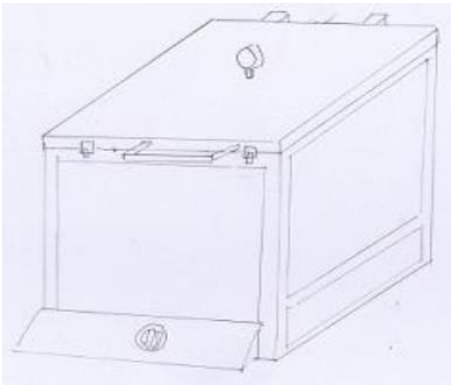

Fig. 7 – Sketching of the Pressure Fryer

2.2 Embodiment Design

2.2.1 Product Architecture

The embodiment process is the bridge between the conceptual stage of the design process and the detail design stage. A more detailed analysis of the selected concepts is undertaken in the embodiment stage of the design process. It is the stage in where the design process where the design concept is invested into physical unit and the stage where most analysis takes place to determine the physical shape and configuration of the components that makes up the system (Figure 8). Subjects covered include a definitive layout, preliminary form design (component shapes and materials), preliminary production information (design for manufacture and assembly), materials and process selection and process selection and industrial design.

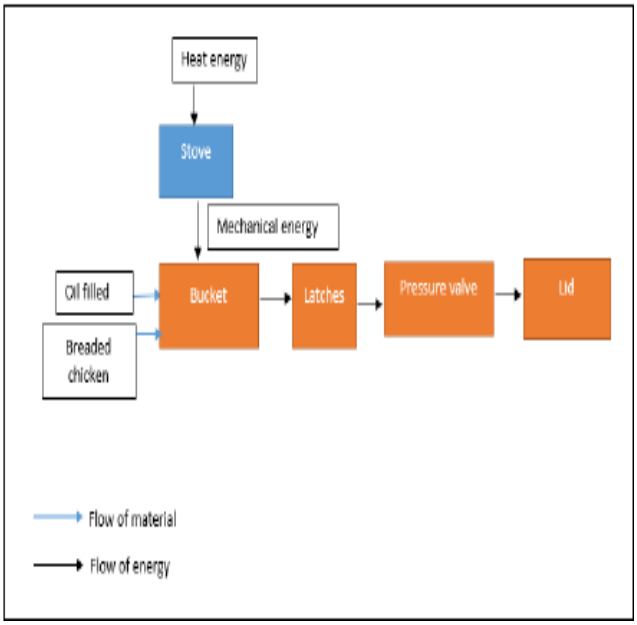

Fig. 8 – Schematic diagram of Pressure Fryer

2.2.2 Product Configuration

In configuration design we establish the shape and general dimensions of components while exact dimensions and tolerances are established in parametric design. In this section, each and every chosen concept was developed further details so that in the end, the result can be obtain regarding the product 's function needs. Each component may be added with some special features so that it can deliver better function. Pressure Fryer has 3 main bodies, frame, pressure control and timer control. In this section, we will explain on each of these components configuration.

A standard component is usually an individual part, manufactured in thousands or millions, to the same specification such as size, weight, material, and others. Table 2 shows the list of standard components for the Pressure fryer. Standard module is a standardized, often interchangeable component of a system or construction that is designed for easy assembly or flexible use. Table 2 shows the list of standard module for the pressure fryer. Special purpose components 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 special purpose components for the Pressure Fryer.

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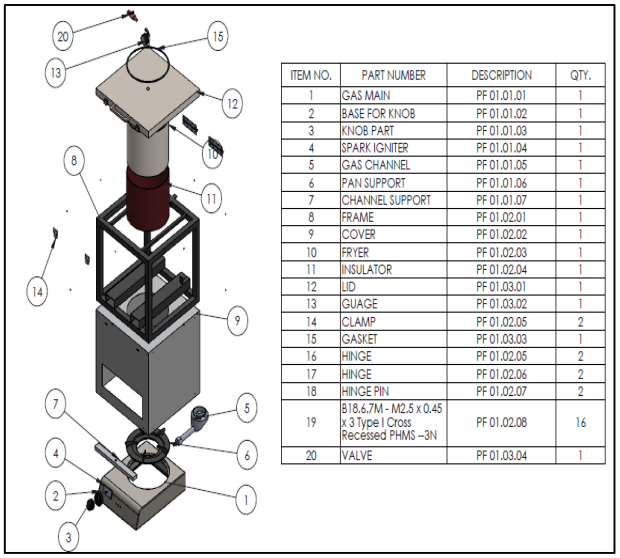
Table 2 – List of standard and special parts

Standard Components	**Quantity**
Stove	1
Hollow screw	1
Screw	16
Pipe	1
Pot	1
Standard Modules	**Quantity**
Pressure gauge	1
Hollow screw	1
Special purpose part	**Quantity**
Body frame	1
Handle	1
Frying cage	1

2.3 Detail Design

2.2.1 Detail Drawing

In this chapter, early drawing is produced to explain the product. Detail drawing is a drawing of a part giving an exact description, construction and dimensions. Part drawing will show a dimension, scale, quantity and material of part design. The mainly part of product is lid, frame, cover, fryer, insulator and gauge. The main support of this product is frame, cover and lid. The whole part of pressure fryer has approximately 20 piece of part as shown in Figure 9.



ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	GAS MAIN	PF 01.01.01	1
2	BASE FOR KNOB	PF 01.01.02	1
3	KNOB PART	PF 01.01.03	1
4	SPARK IGNITER	PF 01.01.04	1
5	GAS CHANNEL	PF 01.01.05	1
6	PAN SUPPORT	PF 01.01.06	1
7	CHANNEL SUPPORT	PF 01.01.07	1
8	FRAME	PF 01.02.01	1
9	COVER	PF 01.02.02	1
10	FRYER	PF 01.02.03	1
11	INSULATOR	PF 01.02.04	1
12	LID	PF 01.03.01	1
13	GUAGE	PF 01.03.02	1
14	CLAMP	PF 01.02.05	2
15	GASKET	PF 01.03.03	1
16	HINGE	PF 01.02.05	2
17	HINGE	PF 01.02.06	2
18	HINGE PIN	PF 01.02.07	2
19	B18.6.7M - M2.5 x 0.45 x 3 Type I Cross Recessed PHMS --3N	PF 01.02.08	16
20	VALVE	PF 01.03.04	1

Fig. 9 – Exploded view of Pressure Fryer

Assembly drawings can be used to represent items that consist of more than one component. Assembly drawing that is used to give to give information for the manufacture or construction of a product. They show how the components fit together and may include sections, or 3 dimensional views, showing the assembled components, or an exploded view showing the relationship between the components and how they fit together. These drawings list all parts and sub-assemblies that make the final product. Figure 10 below shows the pressure fryer had been assembled using SolidWorks software.

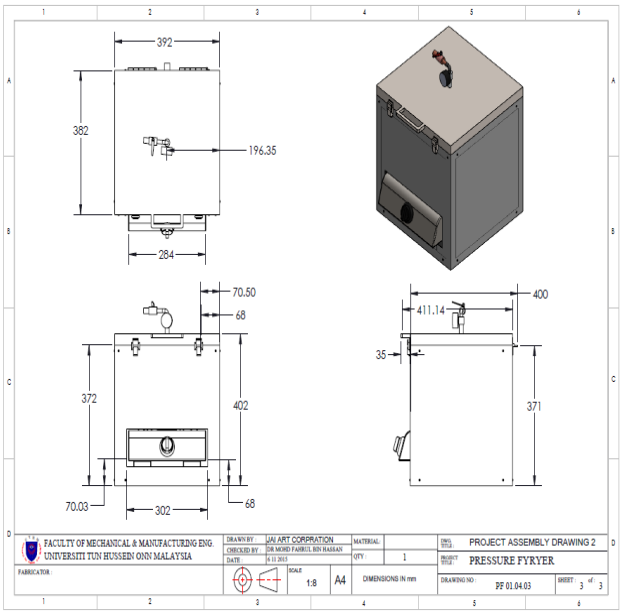


Fig. 10 – Assembling of Pressure Fryer

2.2.2 Final Product Design Specification

The Final Product Design Specification for the pressure fryer is listed in Table 3.

3. Prototype Development

Prototyping is the process of building a model of a system. In terms of an information system, prototypes are employed to help us build an information system that easy to explain for end users. Prototyping is a process that is part of the analysis phase of the systems development life cycle. During the requirements determination portion of the systems analysis phase, system analysts to gather the information about the organization's current procedure and business processes related the proposed information system.

Table 3 – Final product design specification

Criteria	**Specification**
Performance	Capable of cooking a piece of chicken in short time
Operating temperature	100°C to 200°C
Weight	50 kg
Material	Stainless steel, mild steel and copper
Estimated lifetime	5 years
Number of part	20 parts
Maintenance	Clean fryer pot
Safety	Design with protective cover
Ergonomics	Easy to setup

In this project also, we had studied the current information system, and conduct customers survey by collecting useful documentation. This helps the analysts develop an initial set of

system requirements. Prototyping can improve this process because it converts the basic. The user gained feedback from the developing a physical system that the users can touch and see facilitates an evaluative response that the analyst can employ to modify existing requirements as well as developing new ones.

Before prototype of the project was constructed, selection of materials and parts has conducted by selecting the most suitable materials and parts for the prototype.

3.1 **Process Involved**

The process involved in our product prototyping such as the follow. Several manufacturing process has been involved in this project such as measurement, cutting process, welding process, grinding process and etc. All of the process is using by the mechanical engineering knowledge. During the process, all of the safety factor important thing to make sure there are no error and injuries happen during the process.

3.2.1 **Measurement Process**

Measure the item and material such as length and diameter before cutting process. Figure 11 shows measurement processes.

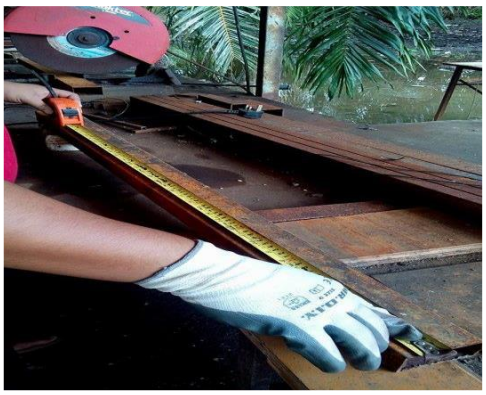


Fig. 11 – Measurement Process

3.2.2 **Cutting Process**

This process includes cutting the metal material such as rectangular hollow mild steel, stainless steel plate and etc by using cutting machine to make the body frame, cover body, and lid. Figure 12 shows the cutting process.

Fig. 12 – Cutting process

3.2.3 **Welding Process**

This process is to make body frame, lid frame and to fasten the stainless steel plate. Figure 13 shows the welding process.

Fig. 13 – Welding process

3.2.4 **Drilling Process**

This process is to make hole for screw and hole for regulator. Figure 14 shows the drilling process.

Fig. 14 – Welding process

3.2.5 **Grinding Process**

This process is to remove the slag from the body after welding process and to clean the metal surface. Figure 15 shows the grinding process.

Fig. 15 – Grinding process

3.2.6 **Painting Process**

Painting process is also part of this process to make neatness to the product. Painting process were including body

frame, lid frame and cover body. Figure 16 shows the painting process.

Fig. 16 – Painting process

3.2 Prototyping (Assemble) Process Time

To complete this prototype of "Pressure Fryer", it had involved two major process of manufacturing processes which is fabrication process and assembly process. The prototype fabricating process takes around three weeks to complete. Effective time management is importance in these stages to make sure that prototype of the project can be done in time. At this stages, all the materials are combined together to form the prototype of the pressure fryer.

3.2.1 Fabrication Process

Fabrication process was conducted by manufacture on three main parts of this prototype; body frame, cover body and lid. This process involved in fabrication is measurement process, cutting process, grinding process, welding process, drilling process and painting process.

3.2.2 Assembly Process

Assembly process is the final stage of the manufacturing process by combining all manufactured part together as one final product. Manufactured parts of the project such as main body frame and lid were attached together. Next, installation of cover body and cover lid and additional equipment such as gas cooker, locking clamp, pressure gauge, pot and insulator were preceded by producing the complete pressure fryer. Table 4 presents the process duration.

Table 4 – Process duration

Process	Duration (Hour)
Measurement, cutting, drilling and grinding process	11
Welding process	8
Painting process	5
Main part assemble process	5
Final assemble process	4

3.3 Final Prototype

Final prototype product is designed to be tested to enhance precision by the system analysis. Figure 17 below shows the complete prototype of pressure fryer.

Fig. 17 – Prototype of Pressure Fryer

4. Conclusion

The overall performance of the designed product is mainly relying on the conceptual idea as long as materials involved. Understanding on the behavior of the selected materials is very important in order to make sure that designed parts could meet the standard qualification. For further development, investigation on the product materials will be considered by improving life time and the overall performance of our designed product.

In conclusion, our group has successfully managed to complete the given task in total duration of 14 weeks' time by pressure fryer as our project for the integrated design subject. High degree of cooperation among group members plays a significant role in this stage in order to make sure given tasks could be achieved on given period of time. Throughout this project, we had gained much of knowledge related with the engineering design by understanding the whole design process in order to convert conceptual idea into real manufactured product.

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