

Design and Development of Dried Chili Seeds Separator Machine

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Abstract: Chili is a fruit of Capsicum plants which is known as a vegetable and cultivated as food. In this project, dried chili has been used as this chili is one of the main ingredients for most of the food in Malaysia. However, the dried chili contents of many seeds which is may provide dangers on human health. Seeds of dried chili can cause cancer of the stomach, intestinal infections, weak syndrome intestine, appendix and other health problems. Therefore, this project is intended to overcome the stated problem by designing and developing a dried chili seeds separator 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 dried chili seeds separator machine has been successfully designed and verified based on the proof-of-concept testing. This machine can be used for separating the dried chili seeds and suitable for home or individual purpose and also can do bigger task if the size of the machine is scaled up depending on the chili's quantity.

Keywords: Dried chili seeds, product design, design for functionality

1. Introduction

Chili is a fruit of Capsicum plants [1]. The fruit is known as a vegetable and cultivated as food. It is also known as 'Lada' (East Coast) or chili. It produces small flowers that turn into fruit in every branch of leaves. Chili is rich in vitamin C, vitamin A and minerals such as iron, calcium, phosphorus, sodium and potassium. This vegetable is said to be worth in terms of health to relieve pain associated with obesity. It is also good for blood circulation and can solve the problem of sore throat. Cayenne pepper contains a substance that prevents cells from clotted blood, thus preventing a disease of the blood clot known as thrombosis [2]. Figure 1 shows a basket of dried chili.

In this project, we focus on dried chili where this chili is one of main ingredients most of the food in Malaysia. This product is created because there is awareness in the hearts of our group about the dangers of seed of dried chilies on human health. This is because the disease. A dangerous disease caused by eating our own way, especially Malaysians. Seed of dried

chilies can cause cancer of the stomach, intestinal infections, weak syndrome intestine, appendix and other health problems [3]. For example, if we eat foods that contain ingredients that are difficult to digest, it will get stuck in the intestines and because diseases listed above. As all know in every dish requires dry pepper and we often take the easy to isolate each seed of 2 dried chilies. As is well known on the conventional method for separating seed of dry chilies takes a relatively long and difficult.

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[3-4].



Fig. 1 – Dried Chili

1) High quality Industrial Chili Seeds Separator Machine

This series dry chili seeds separator is mainly used for separating the seeds from the whole chili, also have the function of dry cleaning and cutting chili. It is made of stainless steel and suits to all kinds of chilies, after cut and seeds removed, the chili flakes is even size. The output is high and seeds and peel are thoroughly separated. It is the necessary equipment for the chilies' further processing. This dry chili seeds separator is mainly used to separate chili seeds from the whole chili. It can remove min.95%-98% chili seeds out. It can only process dry chili. Figure 2 and Table 1 shows high quality industrial chili seeds separator machine and its specification[3-4].



Fig. 2 – High quality Industrial Chili Seeds Separator Machine

Table 1 - Specification of high quality Industrial Chili Seeds Separator Machine

Product Category	Specification
Model	BSR-800
Output	600-1000 kg/h
Overall dimension	2300 x 900 x 950 mm
Machine weight	400 kg
Motor	5.5 kW
Material	Carbon steel or 201 stainless steel

2) High quality 5XZ-6 Gravity Separator for Chili Seeds

This Blow Type Specific Gravity Cleaning Machine is to produce proportion segregation phenomenon under stress of aerodynamic and vibration friction of graininess material. By adjusting wind pressure, amplitude and other parameter, larger proportion material will sink down, move bottom to up under stress of vibration friction; smaller proportion material moves up to bottom. It can remove the foreign matter from chili seeds at the same time, there is an angle on the right of vibration surface, and the stone can be separated. Figure 3 and Table 2

shows high quality 5XZ-6 gravity separator for chili seeds and its specification[3-4].



Fig. 3 – High quality 5XZ-6 Gravity Separator for Chili Seeds

Table 2 - Specification of High quality 5XZ-6 Gravity Separator for Chili Seeds

Product Category	Specification
Model	5XZ-6
Sieve size	1380x3150
Power Kw	13.2
Capacity Kg/h	2000-5000
Weight Kg	2500
Overall Size	4000 x 1670 x 1720

3) Chili seeds separator machine

The chili seeds separator has the Channel groove design, make the chili transport along with the runway. The incision is neatly. Use the hob to cutting the dried chili into segments. Changed the machine's old ways to cut chili. Make the machine higher efficiency. Figure 4 and Table 3 shows chili seeds separator machine and its specification [3-4].



Fig. 4 – Chili seeds separator machine

Table 3 - Specification of chili seeds separator machine

Product Category	Specification
Type	LJ-100
Voltage	220/380(V)
Power Kw	2.2/1.5
Machine size	1780 x 400 x 100 mm
Weight Kg	170

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 Dried Chili Seeds Separator

2.1 Conceptual Design

2.2.1 Component decomposition and function analysis

A block diagram below shows the parts and subassemblies that make up the product in the form of hierarchical structure of component forms functions [4-6]. Advance overall contribute to overall product function. All part has own function that related with each other. Figure 5 shows component decomposition analysis and Figure 6 shows the function analysis of the proposed dried chili seeds separator machine.

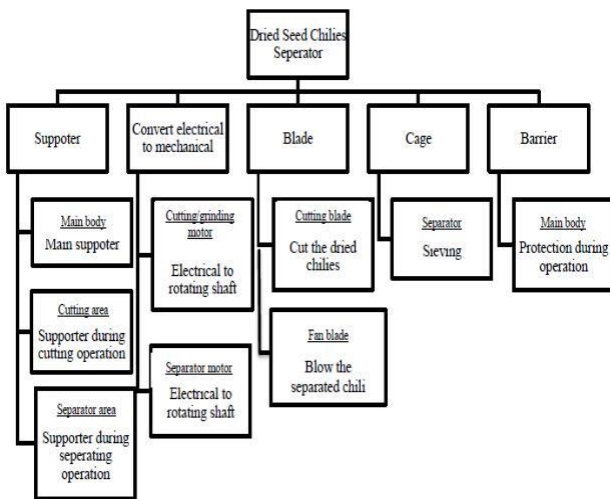


Fig. 5 – Component Decomposition

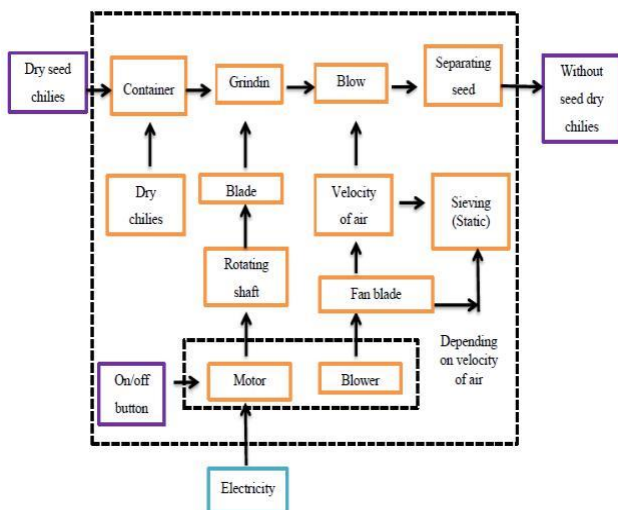


Fig. 6 – Function Analysis of Dried Chili Seeds

Separator 2.2.2 Concept Selection

After the process of identifying the components and related function for operating the machine, selection for the suitable concept for each function is made. Table 4 shows the final concept selection for our product.

2.2.3 Product Sketching

After done with the concept selection, all selected concepts are combined into a complete structure. Figure 7 shows the preliminary sketch of the proposed concept. The concept uses one blower for the separating process, blender motor as a cutting mechanism for cutting process and add sieving net below the separating process.

Table 4 - Specification of selected concept

Function	Specification
Energy source	Electricity
Frame material	Stainless steel
Frame shape	90 degree
Frame joining method	Welding
Cover material	Aluminum
Separator motor type	Fan motor
Cutting method	Blender motor
Cutting blade material	Stainless steel
Fan blade material	Plastic
Switch type	Push button
Container shape	Cylindrical
Cage material	Stainless steel

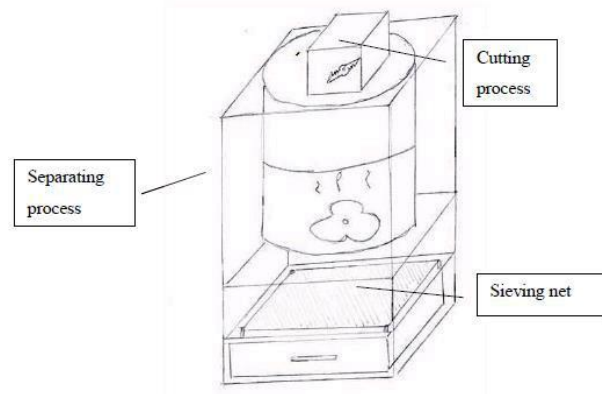


Fig. 7 – Sketching of the proposed concept

2.2 Embodiment Design

2.2.1 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 [5]. 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 8.

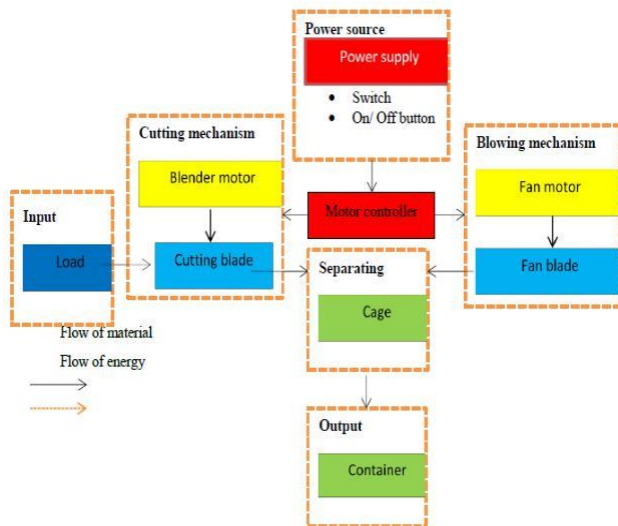


Fig. 8 – Schematic diagram of dried chili seeds separator

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. Figure 9 shows the list of standard and special purpose part.

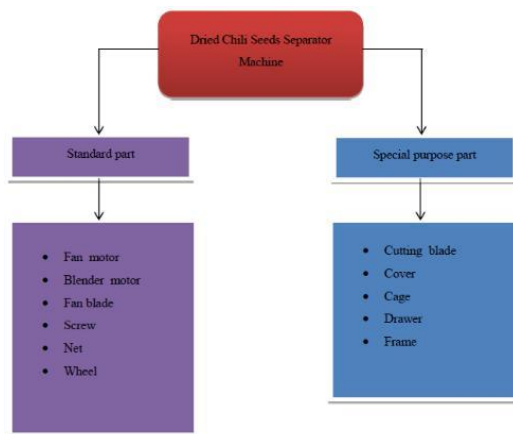


Fig. 9 – Configuration design of Dried Chili Seeds Separator Machine

2.3 Detail Design

2.2.1 Detail Drawing

Part drawing shows the detail of part design in term of its dimension and material. The dried chili seeds separator machine has been divided into several parts, of which the

mainly part is the main frame, cage frame, collecting drawer, sieving drawer, cage, and fan blade, motor and other. Main frame and cage frame are the main support of this product. Overall, the dried chili seeds separator machine has 28 parts as shown in Figure 10.

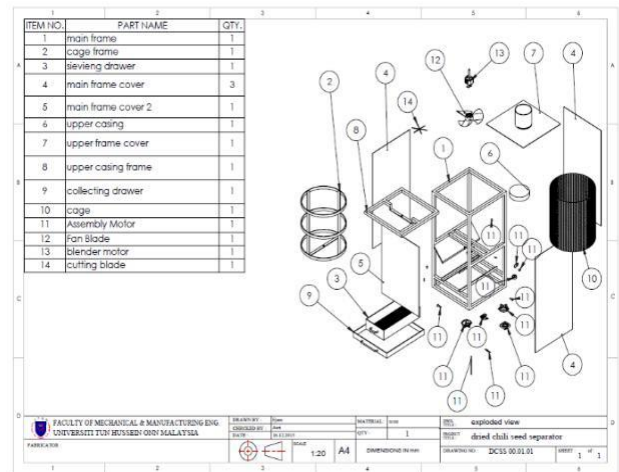


Fig. 10 – Exploded view of dried chili seeds separator machine

Assembly drawing is a detail drawing that shows how all of the parts interact or mate 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 dried chili separator machine are illustrated in Figure 11.

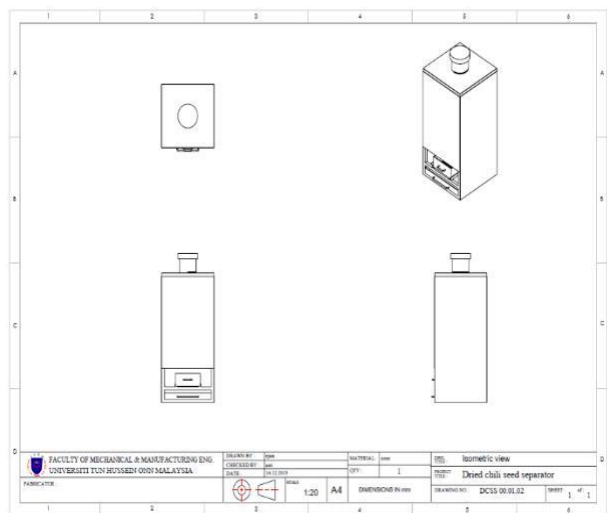


Fig. 11 – Assembly drawing of dried chili seeds separator

2.2.2 Final Product Design Specification

Dried Chili Seeds Separator machine was designed based on design briefing, the analysis of the participatory design project, customer requirement and benchmark of product in order gives a solution to customers to solve their problem. The final product design specification for the Dried Chili Seeds Separator machine is listed in Table 5.

Table 5 - Final product design specification

Criteria	Specification
Performance	To isolate the seeds from dried chili in quick time
Size (dimension)	100 x 50 x 50 cm
Material	Steel, aluminum, plastic, plywood
Estimate lifetime	3 years
Power supply	240V
Number of parts	28 pieces
Safety part	Equipped with protective casing
Ergonomics	Convenient to handle and store, easy to setup and dismantle by single person
Target customer	Small food industry, restaurant and home use

3. Prototype Development

Prototyping is the process of building a system model. In terms of an information system, prototypes are employed to help system designer build an information system that intuitive and easy to manipulate for end users. Prototyping is an iterative process that is part of the analysis phase of the system development life cycle.

3.1 Process Involved

Generally, prototyping can be categorizing into 4 major processes such as prototyping plan, define outline, executable prototype and evaluation report.

3.2.1 Prototyping Plan

In term of prototyping plan, objectives and scopes of the prototyping were established by animating and demonstrating system requirements. This principal is very important by helping customers and developers understand the requirement and limitations of the system. Prototype of this project may be used for user training before a final system is delivered and it may be used for back-to-back testing. As information, the main objective for our project is to separate chili seed from chili skin. For the scope of this project is 500g of chili per operation.

3.2.2 Define Outline

In this stage, the functionality of the prototype is defined. In term of chili seed separation process, the chili will be cut into several pieces using cutting blade rotated by blender motor. Next, the velocity air will blow the separated chili. In this process, the seed of chili will come out and blow away from it skin and this process is occurring in middle cage area. So, the seed will come out from the net installed on the cage and the desired chili skin will remain inside this cage area. The next process is the desired chili will fall down into lower bucket. Once again, in this stage we can separate the chili skin and chili seed due to the net installed on this bucket. Lastly, the desired output will be obtained from all of this process. This process repeated with the new chili and this system work in cycle process. In term of basic feature for the project, this prototype is portable due to the wheel installed on the bottom of this prototype. So, this prototype will be easily moved from one place to another.

As we can see, functionality for all of the prototype components was clearly defined. Each of the prototype

components carried out specific functionality in order to meet the requirement from the customer. Modification on the prototype components could takes place based on feedback from the customer in order to improve the overall performance of the project.

3.2.3 Executable Prototype

In term of developing prototype, several manufacturing process has been involved in this project such as cutting process, welding process, grinding process, surface finishing process and etc. Table 6 below shows processes which has involved in this project by producing the final prototype.

Table 6 - Processes involved for prototype test

Activity	Development process
Cutting process	
Welding process	
Grinding process	
Bending process	
Finishing process	
Painting process	
Assembly process	

3.2.4 Evaluate Prototype

Evaluate the prototype of our project is a very important part of the design and manufacturing process. This evaluation is to identify usability problems, where the user is probed to explain their expectations and problems. Testing and evaluation, simply confirms that our designed dried chili seed separator system will work as it is supposed to, or if it needs refinement and modification. In general, evaluate our project prototype allows us and client to assess the viability of our product and confirming that will it be successful as a commercial product. Evaluation also helps identify potential faults, which in turn allows us to make improvements. During evaluation process of our dried chili seed separator system, component failure has been identified during process. This may mean a component is required to be redesign and not on the entire product. At the present time, testing of our project prototype is by our group members once the prototype is constructed. Testing and evaluation of our project prototype may take a long period of time. Faults and problems may identify at this stage and suggestions for improvement are often made at this stage

3.2 Prototyping (Assemble) Process Time

Manufacturing process is one of the process including in established the prototype. In manufacturing processes which has involved in this project can be divided into two major parts such as fabrication process and assembly process. Total time required for the whole manufacturing process spend 1-week time by completing the final prototype of our project. Effective time management is highly demand in this stages by make sure that prototype of the project can be done in time.

3.2.1 Fabrication Process

In this fabrication process, there was two main parts to be build where the two main parts is main frame and upper frame. Main frame consist many parts installed on it such as fan motor, lower bucket, cage and seed bucket. Upper frame consists of the bracket of blender motor. Process involved in fabrication process consists of measurement process, cutting process, bending process, grinding process, welding process, drilling process and painting process.

3.2.2 Assembly Process

Assembly process is the last stage of the manufacturing process by combining all manufactured part together as one final product. The part involved in this process is fan motor, cage and lower bucket where all this part is installed on the main frame. For the upper frame, the part involved in assembly process is blender motor. Upper frame was combined with the main frame by using hinge. Table 7 shows the duration of each process for both fabrication and assembly process.

Table 7 - Process Duration

Process	Duration (Hour)	Percentage (%)
Measuring and cutting process	2	6.67
Welding process	4	13.33
Grinding process	6	20
Bending process	5	16.67
Painting process	8	26.67
Assembly process	5	16.67

3.3 Final Prototype

A final prototype of dried chili seeds separator 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 12 shows the final prototype product of dried chili seed separator.



Fig. 12 – Prototype of dried chili seeds separator

4. Conclusion

The project has been selected based on the objective stated in the first chapter which is to design chili seed separator where the objective is to separate chili seed with it skin. The input for this product is dried chili and the output is dried chili without seeds. All criteria in term of technical and user requirement have been looking to consist with our limitation on scope of our product.

In this project, we started with performing some research on literatures review to look onto existing product based on information getting from internet, website and books. Then, we

continued with clarifying function in the conceptual design where in this stage we are required to analyze the activity and component with the function for each single part to create decomposition of problem. Moreover, we determined the flow of system in our project by completing the function structure for clearly view in term of components needed. Last but not least, we are arranging physical element to carry out for each function of the component by initial sketching of the product in the embodiment design. Finally, from the sketching we come out with the prototype of Dried Chili Seeds Separator machine. However, there are some recommendations for improvement as follows:

- i. This machine can be fabricated in smaller size. So, it easier to carry this machine from one place to another place.
- ii. Emergency button should be installed on this machine to prevent any incident occurred during operation.
- iii. Minimize the material cost by using hollow bar instead of use angle bar.
- iv. Installation of sensor in the cage on the middle area to reduce the usage of electricity where the motor will operate once the sensors detect incoming dried chili.

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