

Design and Development of Mini Model for Mini Tempeh Packaging System: Wrapper Feeder and Soybean Feeder

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Abstract: Tempeh is a soybean-based food that originated from Indonesia. Tempeh are usually packed manually in small industry, which take a long time to pack it. This research objectives is to determine the concept for wrapper feeder and soybean feeder mechanism system, to design and fabricate the prototype of wrapper feeder and soybean feeder. This study is to produce automated packaging machine tempeh for tempeh industry as a traditional food product and focusing on small scales industry so that they can apply this project for their production. The design of the prototype is made by using SolidWorks software. Prototype is fabricated based on the design and operate by using Arduino and electric motor.

Keywords: Wrapper Feeder, Soybean Feeder, Small Scales Industry

1. Introduction

Tempeh is a soybean-based food that originated from Indonesia. Tempeh is an Indonesian word referring collectively to a variety of fermented foods (typically tender-cooked legumes) bound together by a dense mycelium of fragrant white *Rhizopus* mold into compact cakes [1]. Tempeh is popular in Indonesia and Malaysia as it has the necessary characteristics of a dietary staple in that is high in protein and fibre and is rich in other nutrients. It also has the advantage of containing Vitamin B-12, which is a by-product of the fermentation process [2].

These days, tempehs are mostly packed by using plastic wrapping. By giving better quality of health and our environment this packaging of tempeh is wrapping better by using paper. The purpose of using paper is to save the environment. It is estimated that 80 percent of plastic pollutions originated from land-based sources with the remainder coming from ocean-based sources [3]. Process of packaging tempeh are usually done manually in small industry. It took around 1 minute in order to pack one tempeh alone. So, the productivity of tempeh in a day is low. The idea of creating automated system for

packaging of mini tempeh will help to decrease the workload of the workers and increase the productivity of tempeh.

The objective of this study is to determine the concept for wrapper feeder and soybean feeder mechanism system for mini tempeh packaging machine. The prototype is design by using SolidWorks software and the wrapper feeder and soybean feeder system for mini tempeh packaging machine is fabricated.

2. Materials and Methods

2.1 Materials selection

The materials and equipment used in this research is as follows:

Materials	Explanation
Electric motor	A device used to convert electricity into mechanical energy which is opposite to an electric generator. They operate using principles of electromagnetism.
Servo motor	A rotary actuator or linear actuator that allows for precise control of angular or linear position, velocity and acceleration [4].
Plywood	A material manufactured from thin layers or "plies" of wood veneer that are glued together with adjacent layers.
Conveyor	One of many types of conveyor systems. Belt conveyors are the most commonly used powered conveyors because they are the most versatile and the least expensive [5].
Arduino Uno R3	An open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino.cc [6].

2.2 Project flow chart

The project flow chart shows the general process of designing and developing the mini tempeh automated packaging machine. This process begins with the selection of topic for the project and will continue with the preliminary of the study which is reviewing the previous research papers and journals. Then, the topic for the project will be selected and a Gantt chart will be made. Next is the concept design which is based on the material selection, and simulations. If the simulations meet the project market requirement, the project then continue to the next process which is fabrication. Lastly, is the report writing and the submission of the project.

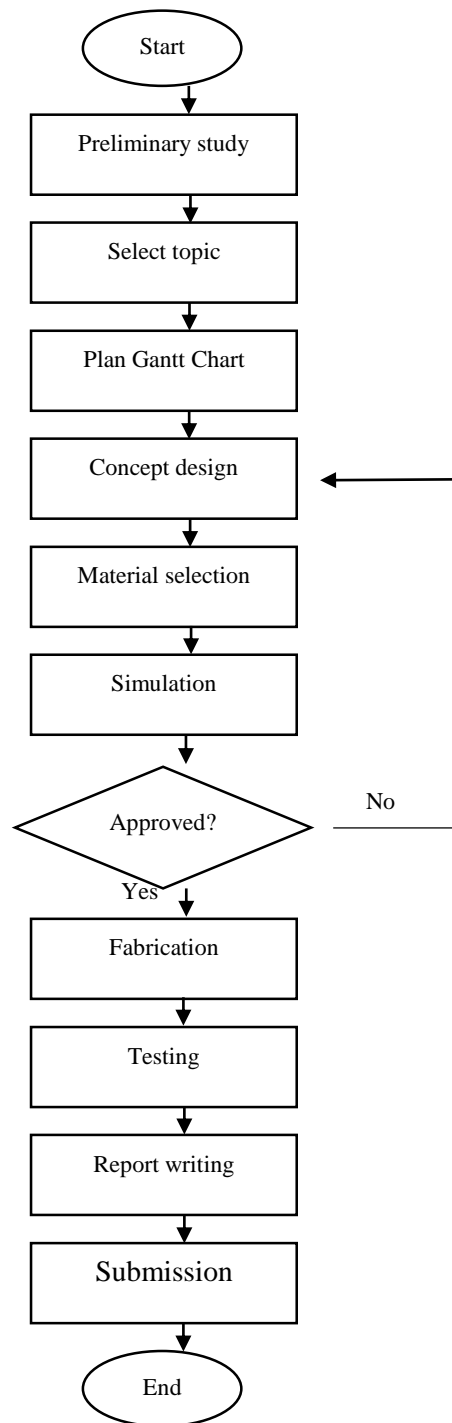


Figure 1: Project flow chart

2.3 Preliminary design of wrapper feeder and soybean feeder

For this project, there are one design idea for the wrapper feeder and soybean feeder parts of the machine.

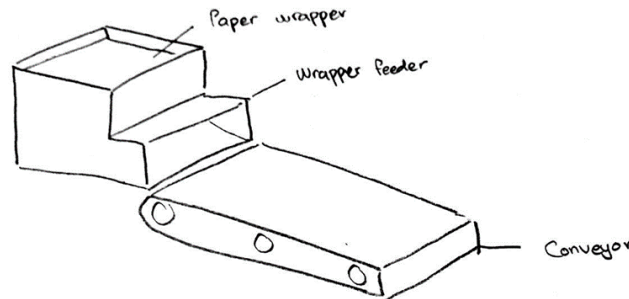


Figure 2: Idea for wrapper feeder

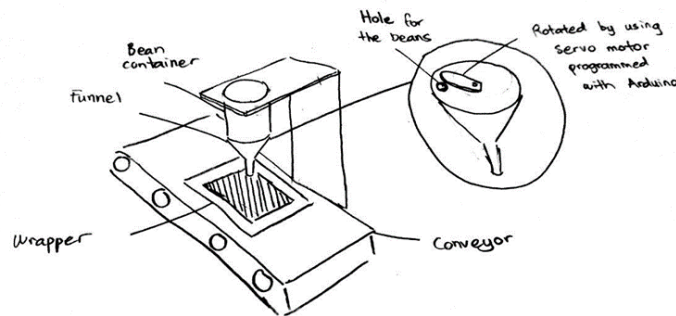


Figure 3: Idea for soybean feeder

Table 1: Design pros and cons for wrapper feeder and soybean feeder

Item	Pros	Cons
Wrapper feeder	The design is not complex	Wrapper paper might not come out
Soybean feeder	Beans output can be timed using Arduino	Soybeans might get stuck at the funnel

2.4 SolidWorks drawing selection

From the preliminary design, the pros and cons were considered. A type of wrapper feeder was designed to be used. The soybean feeder was also designed by using the SolidWork software.

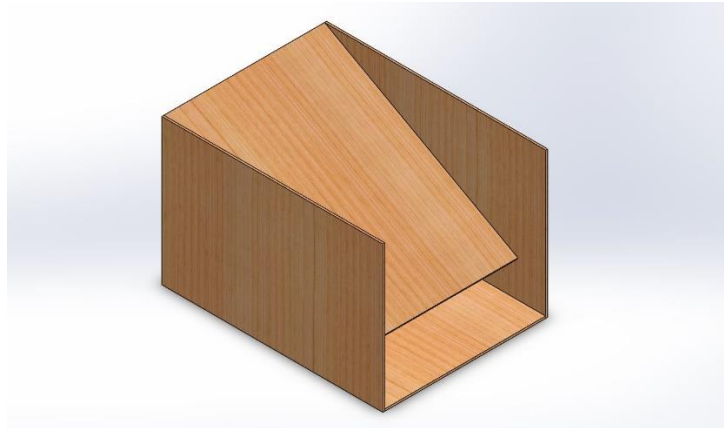


Figure 4: SolidWorks design for the wrapper feeder

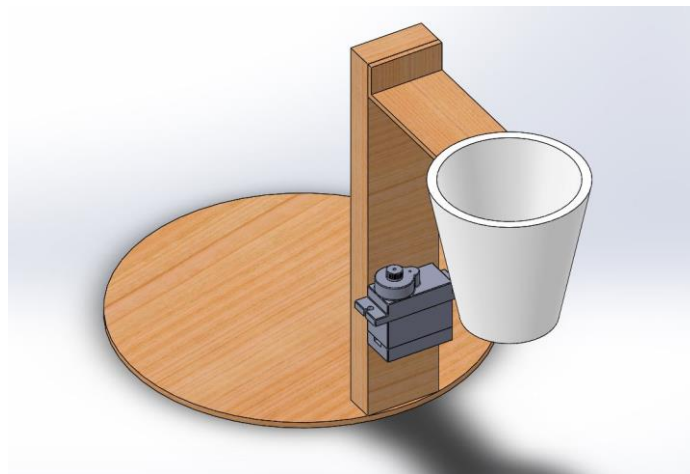


Figure 5: SolidWorks design for the soybean feeder

3. Results and Discussion

This topic will discuss on the result obtained from testing process. The process begin by designing the paper feeder and soybean feeder using the SolidWorks software, run the simulation test in the software for the material used. Mechanism of the prototype will also be discussed.

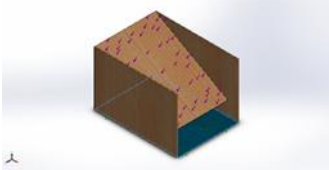
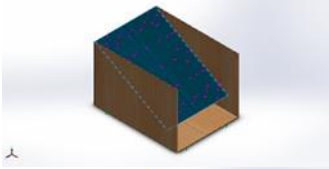
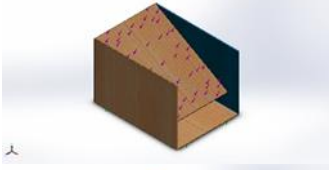
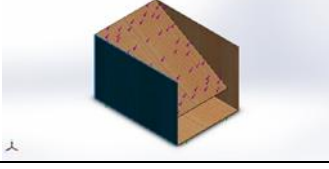
3.1 Simulation result

The purpose of simulation applied on this design is to analyze whether the material used is suitable or not. To minimize the cost used in this project, a suitable material selection is needed. In this simulation test, the material selection is Cedar wood and Polyethylene Terephthalate.

- Running the simulation test on the selection material for paper feeder which is Cedar wood.
- Running the simulation test on the selection material for soybean feeder which is Polyethylene Terephthalate.

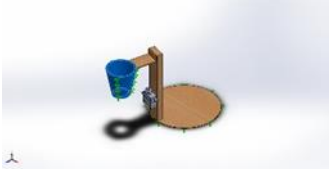
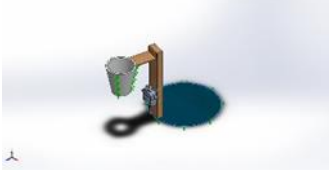
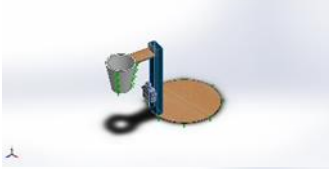
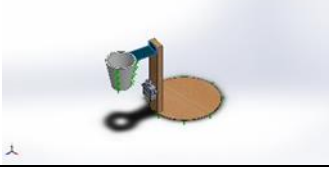
3.2 Mass properties

Table 2: Mass properties of wrapper feeder

Part	Part Name	Mass (kg)
	Base	0.033088
	Inclined surface	0.033088
	Right side	0.029986
	Left side	0.029986

The total mass of the wrapper feeder is 0.12614 kg which is very light so it is very easy to handle. Next, the simulation test will be held for soybean feeder part.

Table 3: Mass properties of soybean feeder

Part	Part Name	Mass (kg)
	Soybean container	0.0252871
	Base	0.0106311
	Pillar	0.015275
	Support	0.00112178

The total mass of soybean feeder is 0.05231498 kg which is also very light and very easy to handle.

3.4 Cost of materials

Table 4: Materials cost

Material	Part	Quantity	Price
Electric motor	Conveyor and wrapper feeder	2	RM25.91
Servo motor	Soybean feeder	1	RM6.00
Plywood	Conveyor, wrapper feeder and soybean feeder	2	RM20.00
Plastic cup	Soybean feeder	1	RM2.00
Arduino Uno R3	Soybean feeder	1	RM57.20
Total			RM111.11

3.5 Mechanism of the prototype

The prototype is divided into three parts that run on different mechanism. The first part is the paper feeder, second is the soybean feeder and the last one is the conveyor. Figure 6 below shows the parts when it is combined together.

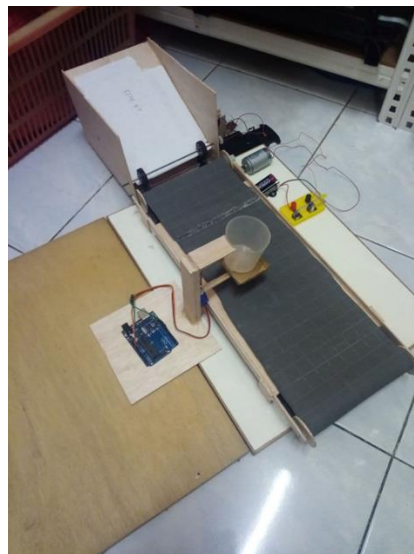


Figure 6: Overall look of the prototype

The first part of the prototype is the paper feeder. The paper feeder will distribute the wrapping paper onto the conveyor belt which will move the paper to the next station. The paper feeder is connected to a 6V DC motor which will move the roller to distribute the paper.

The second part of the prototype is the soybean feeder. The soybean feeder acts as a storage and distributor of the soybean. A hole was punched at the base of the container so that the soybean can fall on the paper below. The soybean feeder use servo motor that is connected to Arduino Uno. On the servo motor, a wooden was attached and it acts as a cover to the hole at the base of the container. When the paper is located below the container, the hand will rotate so that the soybean will fall onto the paper.

The last part of the prototype is the conveyor. The conveyor works the same as any other conveyor that can be found in industry. Its purpose is to move object from one station to another, in this case is the paper. The conveyor is also connected to a 6V DC motor that will rotate the roller so that the conveyor belt will be able to move.

4. Conclusion

This research study has attained and achieved the objectives that has been set beforehand. The concept of wrapper feeder and soybean feeder mechanism system for mini tempeh packaging machine was learned. Based on the understanding of the mechanism, designs were made for the wrapper feeder and soybean feeder. At the end of the research, a prototype of mini tempeh packaging machine was fabricated.

Acknowledgement

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