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Automatic Meat Slicing Machine

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Abstract: A new innovation has been created which is called **AUTOMATIC MEAT SLICING (AMS) MACHINE**. The main purpose of the machine creation is to replace the old-style method in slicing the chicken meat to modern method. **BABARITTOS DELIGHT** supplies Tortillas Wrap to the latest trend of Food & Beverage (F&B) business called Food Truck. The main ingredient of Burritos is slices of boneless chicken meat, where each slice is approximately has to be 5 mm thick. Formerly, the slicing procedure used a normal cutting knife and its production rate was truncated as the demands of the Burritos are going higher by days. This method requires 3 to 4 workers to team up to complete the 30 kg boneless chicken meat to be cut into roughly 5 mm per slice within one and half hour. The AMS machine is predominant to help the company to grow the output of sliced meat and at the same time can reduce the number of workers. The usage of AMS machine is only required one worker for the operation and the output can be up to 30kg per 30mins, which is actually can end up almost 3 times quantity of output and 3 times labor cost-saving. Meanwhile the quality of the sliced meat is much enhanced as most of the slice meat is precisely 5mm thick. The AMS concept design is cutting the meat using several circular cutting blades, where the chicken will be put on the moving conveyor and finally will fall onto the hygienic tray.

Key words: *machine, slicing, meat, circular, blades*

1.0 Introduction

BABARITTOS DELIGHT has supplied Burritos or Tortillas Wrap to the latest trend of Food & Beverage (F&B) business called Food Truck. The company is sold Tortillas Wrap using its own fleet of Food Truck. The main ingredient of Burritos is a slice, boneless chicken meat. The boneless chicken is sliced into thin pieces manually by using cutting knife. Currently, boneless chicken meat, sliced manually by 3 workers. The amount of slicing meats for every worker is 6 kilograms per hour. Due to high demand of Burritos or Tortillas Wrap from Food Truck Business Communities around Klang Valley, the company is facing a pressure to produce more slicing chicken meats. According to Wangang et al. [1], in the past three decades, the total meat production in Asian countries has been mainly increased because of the rapid growth of the economy and population.

Hence, the manual method to slice, boneless chicken meat is no longer practical, tedious, not economical and ergonomically feasible to workers and financially unsustainable to the company itself. Therefore, Automatic Meat Slicing (AMS) Machine has proposed to replace the manual method using knife cutting by the worker.

Thus, the objective of this machine is to Automatize Meat Slicing Machine for boneless chicken meat, lessen the number of workers, to grow the production rate of sliced meat and lastly to reduce the production time.

2.0 Literature review

Studies have been made to do the comparison, study the existing machines which are similar to the concept of the project. Few machines found and these two machines are highlighted to be focused on to precede the project, which are **Semi-Automatic Commercial Electric Meat Slicer** and **Fully Automatic Slicer Machine.**

Semi-Automatic Commercial Electric Meat Slicer
Operates with single blade is made of stainless steel. The axle steel is used a refined design that can slither along smoothly, firm and durable, and confirms to the international sanitation standard. Diameter of blades 220mm/ 8 inch.

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Figure 1: Semi-Automatic Commercial Electric Meat Slicer

Fully Automatic Slicer Machine

Operates with a multiple blade shaft with circular blades. The circular blade is fully developed cutting configuration and proven speed ratios between blade shafts. Diameter of blades 200mm. The minimum distance of blades is 6-8mm, depending on the product. A review of the existing modelling methods from [2] used for machining simulation has shown that the voxel-based space partitioning approach is the most computationally efficient. However, this approach is limited by the need of a very large grid resolution to attain a reasonable accuracy, which makes voxel modelling infeasible in terms of the resulting huge model size and memory requirement.

Figure 2: Semi-Automatic Commercial Electric Meat Slicer

3.0 Methodology

3.1 Flow process

Design Phase

- In the design phase, CATIA V5R20 be chosen due to the capability of this software are helpful to make analysis the actual gap need to keep during assembly.

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Fabrication Phase

- In fabrication phase, there are few main processes involved, which are CNC process, Milling process, welding and grinding processes. The frame of the machine is the first part to develop. Two aluminium plates involved, and the welding process took part while developing the frame. The shaft to hold the circular blades involved milling and CNC process where the 5 mm gap to be created. At the same time, the conveyor, the motor and the inverter, the circular blades bought from the supplier.

⇩

Installation Phase

- The installation phase mainly involved the wiring and electrical part. The installation of motor linked to the conveyor and to the inverter. The main purpose of installation of the inverter is to ensure the conveyor speed can be controlled by the operator. The electrical part ended up to be 3 phase input to cope with the input power off for the motor. 4 rollers of the machine also installed, located at the base of the machine during this phase. This phase actually consumed the longest time frame as the installation required meticulous work, particularly in the electrical part.

⇩

Testing Phase

- After the installation completed, there goes the testing phase. During this phase, the operation of the machine has been tested, in terms of the electricity, the appropriate speed of the conveyor, and the slicing operation of the meat by the circular blade and the most important mechanism is the thickness of the sliced meat. The time taken to slice the meat also recognized, to ensure the requirements of the company fulfilled. Throughout the testing, there are no problem in the electrical part in spite of the machine require the three phase input.

3.2 Design Phase

Starting with the sketch and drawing, the project design has roughly sketch and end up with computational drawing, which is using an application in a computer (CATIA V5R20). Feng and Jimin [2] did some review of the existing modelling methods that used for machinery simulation and the result show the effectiveness of the FSV-rep in simulating machined workpiece geometry in complex machining process such as multi – axis milling . Few drawings has been sketched and drawn and the best model has been chosen to be the final idea of this project. The work out of identifying the specification of each part (i.e. motor, types of material, size of the circular blades, types of inverter and the size and specification of the size of the main body) took place after the finalize design and concept has been made. For circular blade sizing,

AMS circular blade be designed based on the study from [3] conducted a study in meat packing plants directly measuring the effect of knife sharpness on grip force and cutting moment. They found that blade sharpness had a large effect on the grip forces and cutting moments produced by the meat cutters in the performance of their jobs. Mean grip forces and mean cutting moments were 21% and 33% greater when the blade that was dull, but serviceable was compared to a freshly sharpened knife. About these cutting blade, [4] mention three intrinsic technical characteristic of the knife such as blade steel grade, blade inclination with respect sample and edge angle (sharpened part of blade) need to be consider during design blade selection.

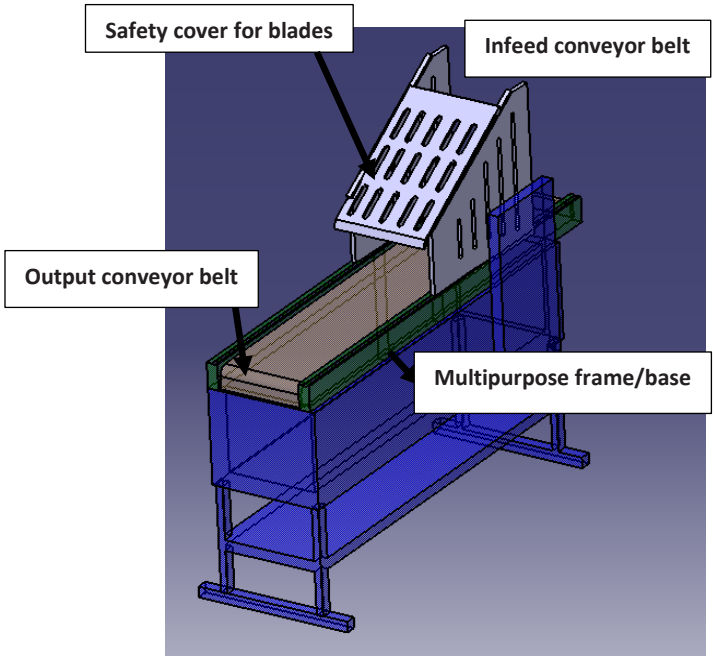

Figure 3: Production Flow for Automatic Meat Slicing Machine.

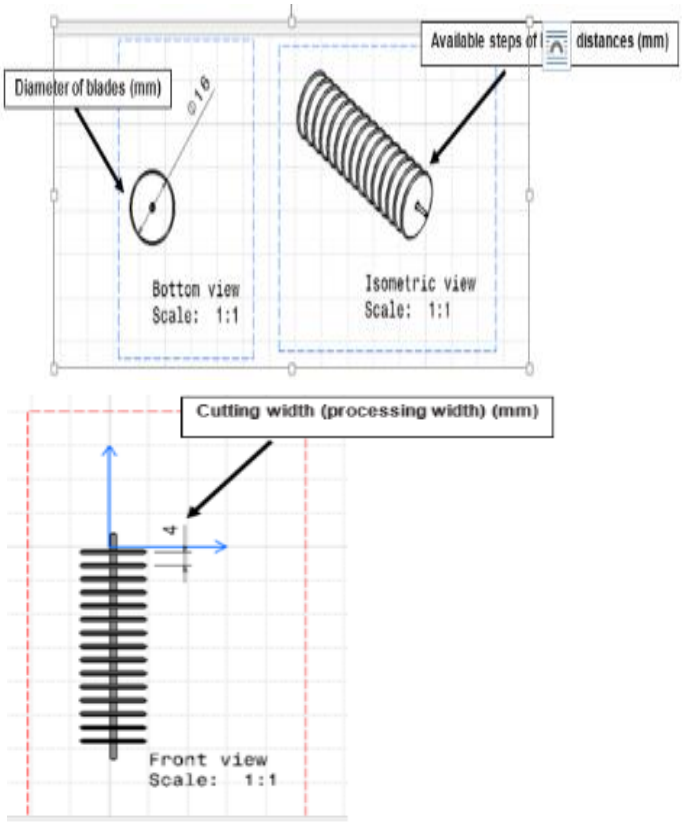

Figure 4: Close-Up View Of Blades Slicer Section For Automatic Meat Slicing Machine.

3.3 Fabrication Phase

In fabrication phase, there are few main processes involved, which are CNC process, Milling process, welding and grinding processes. The frame of the machine is the first part to develop. Two aluminium plates involved, and the welding process took part while developing the frame. The shaft to hold the circular blades involved milling and CNC process where the 5 mm gap to be created. The meat need gap between cutting process to absorb stress occurred At the same time, the conveyor, the motor and the inverter, the circular blades bought from the supplier.

3.3 Installation Phase

The installation phase mainly involved the wiring and electrical part. The installation of motor linked to the conveyor and to the inverter. The main purpose of installation of the inverter is to ensure the conveyor speed can be controlled by the operator. The electrical part ended up to be 3 phase input to cope with the input power off for the motor. 4 rollers of the machine also installed, located at the base of the machine during this phase. This phase actually

consumed the longest time frame as the installation required meticulous work, particularly in the electrical part.

The inverter is set to ensure the conveyor speed can be controlled by workers.

3 phase power supply is needed to control the motor.

Conveyor's speed is controlled by inverter

4 rollers also installed on the base machine during the phase.

3.4 Testing Phase

After the installation completed, there goes the testing phase. During this phase, the operation of the machine has been tested, in terms of the electricity, the appropriate speed of the conveyor, and the slicing operation of the meat by the circular blade and the most important mechanism is the thickness of the sliced meat. The time taken to slice the meat also recognized, to ensure the requirements of the company fulfilled. Throughout the testing, there are no problem in the electrical part in spite of the machine require the three phase input.

Through the testing phase, it can be concluded that the machine capable to slice 1kg boneless chicken in less than 3 minutes.

The approximate time for 1 cycle is less than 5 seconds before the chicken is completely sliced into 5 mm.

4.0 Discussion

There are few factors have to be considered in growing the productivity of the company.

i. Method

The method in producing the product is one of the important factors as it may link to time cycle vs productivity. The traditional or manual method habitually takes longer time in producing any product when it is equal to the machining method. The longer time cycle taken, the lower the productivity may produce.

ii. Budget/money/finance

Budget moreover, is one of the keys of productivity. The company may occupy some money in order to buy a new device in swapping the traditional method to modern method, and however the investments can be seen as a positive investment as it may help the company to grow the productivity in terms of lowering the cycle time and reducing the amount of labor.

iii. Management

Management is a factor of production and an economic resource. Management is responsible for ensuring that labor and capital are effectively used to increase output.

iv. Labor

Labor is also the key point in increase the productivity. A skillful labor may lead to speed up the production.

v. Quality

The quality of the product has to take into account as it is one of the customer satisfaction. Generally, the machined product will give better output compared to traditional method. As for the company, they required the sliced meat to be 5 mm thick and the machine is capable to produce a constant 5 mm sliced meat and the output will always be precise and consistent, when compared to the knife cutting method.

4.1 Analysis for worker's productivity

Table 1
Worker's productivity data analysis

Before (manual)	After (Using AMS)
Total Productivity : 30 kg Total time to produce 30 kg = 1.5 hour Total Number of workers : 3 Total Number hours of works = $\frac{3\text{ workers}\times 1.5\text{ hours}}{\text{day}} = 4.5\text{ hours.workers/day}$ Worker's productivity = $\frac{30\text{ kg/day}}{4.5\text{ hour.worker/day}} = 6.67\text{kg/hour.worker}$	Total Productivity : 30 kg Total time to produce 30 kg = 0.5 hour Total Number of workers : 1 Total Number hours of works = $\frac{1\text{ workers}\times 0.5\text{ hours}}{\text{day}} = 0.5\text{ hours.workers/day}$ Worker's productivity = $\frac{30\text{ kg/day}}{0.5\text{ hour.worker/day}} = 60\text{ kg/hour.worker}$

From the data in Table 1, it can be concluded that the worker's productivity increased by almost 800%, which is from 6.67 kg/hour worker to 60 kg/hour worker.
The machine is capable to slice the meat up to 60 kg per hour and the machine only requires a worker to handle it. The company can save the labour cost and in the same time the productivity of the sliced meat can be increased.

5.0 Conclusion and recommendation

The automatize meat slicing machine has been successfully made. The main objectives of this project are fully accomplished where the machine has helped the company to reduce the number of workers where the machine only requires one worker to operate AMS Machine. Therefore other workers previously in manual cutting section can be transferred to other sections. The salary cost has been reduced up 5 times. Hence, with higher order/demand and with less worker, the company can generate 2 to 3 times profit margin.

The production rate of the sliced meat also has been enhanced, where the current method used by the company can only produce 30 kg sliced meat within 1.5 hours, with the help of 3 workers against using the machine whereby the 30 kg sliced meat can be produced in only 30 minutes. The speed of production time also may lead to cut off the production time of the company. Productivity of slicing boneless chicken meat increased up to 3 times by using automatic methods against manual knife cutting. Therefore the company fully capable to meet the demand of Burritos or Tortillas Wrap from Food Truck community. The company can actually save two main affected factor to the production rate, which are production time and the number of workers. At the same time the output quality of the sliced meat is much better since the cut is accurate 5 mm per slice and more even.

AMS machine is one of the technology have shown force greater than humans, forcing workers and businesses to adapt – or perish. Yet governments such as Public Private Research network play a key role in shaping how technology advances. The sooner governments, in partnership with the rest of society, examine the future impact of this structural shift, the sooner they can act to ensure the shift benefits society.

5.1 Recommendations

Due to time and budget constraint in completing this project, few minor modifications have to take into consideration so as to ensure this project can be operated as well as it should be, which are:

i. The thickness of the sliced meat can be varied by making the gap of the blades to be adjustable; in case the company needs to differ their thickness of the meat for their business of food and beverage purpose.

ii. There are few sharp edges found surrounding the machine. This may lead to safety precaution failure if no modification made to those sharp edges. Consequently, we use span to cover up those sharp edges as a temporary action. Henceforward the machine's edge has to be modified by rounded all the sharp edges using the grilling machine.

iii. The inappropriate location of the motor, which may lead to water leaking while washing the blades. The momentary action is to cover up the motor by plastic when the washing takes place. The motor should be retained on the side of the machine, so that there is no disturbance of water leaking while the washing take part.

iv. To ensure the machine is portable-friendly, the number of roller has to be added to 6 rollers. Difficulty found when moving the machine as the weight of the machine is not an equilibrium between the left side and right side. To encounter this problem before the addition, roller added, 2 people needed to move the machine to balance the machine while moving it.

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