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# Simple automation for pineapple processing combining with karakuri design

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**Abstract.** The processing of pineapple becoming fruitcake has been done for several years using manual process in a Small to Medium Enterprise in rural region. This rural region producing a huge number with less production value of pineapple as there is no modern industry. The purpose of this research is designing a simple automation to enhance the productivity with the combination of karakuri to achieve an efficient process. Efficient process means that to proposed system using a small quantity of energy. The system has been compared with the previous manual system and it is proven to have more productivity, easy to operate and using less energy (electricity in particular). In terms of quality, there is no more defect product such as overcooked so that the designed system is robust. The proposed system is also relatively inexpensive as it is used simple automation.

## 1. Introduction

Dodol is one of the typical foods in Indonesia. Dodol has a soft texture, is generally brown, has a sweet and savory taste. Various kinds of flavors are served including jackfruit dodol, salak lunkhead, mango dodol, jackfruit dodol, dodol durian, and many more. In Indonesia, there are various types of dodol including dodol arrowroot, dodol Betawi, dodol kudu, etc. The various types of dodol depend on the dodol making area. For example, Garut dodol comes from the Garut area of West Java. Dodol enthusiasts are also many, not only from Indonesia but also from abroad. Therefore many produce these foods.

The process of making dodol is preparing ingredients for making dodol. The basic ingredients of making dodol are glutinous rice flour and sugar. To give a variety of flavors can be added to various types of fruits. After preparing the ingredients, peel the ingredients like fruits. After stripping, the fruits are washed clean then blended to be mashed. After the ingredients are ready, all the ingredients are mixed in a stirring pan. After that, the heating process on the furnace. The stirring process is continued at the same time as the heating process. This process takes 6 hours. In the stirring process, the dodol stirrer must stir continuously. This is due to prevent the dodol from burning in certain parts. So causing dodol failed to be produced. With a relatively long time, it requires considerable human energy. This causes the production process to be less effective and efficient. Manually making dodol has a greater risk of injury for the dodol stirrer. This is due to the dodol stirrer standing close to the hot stove to make the dodol. Dodol mixer will feel the hot temperature, causing decreased performance. Also, the transfer of dodol from the furnace to a place for cooling dodol requires a lot of power. This is certainly dangerous for those who move the frying pan from the furnace to the dodol cooler in the event of a work accident. Therefore it is necessary to repair tools in making dodol to help the process of heating and cooling. Improvement of the proposed tool that can help facilitate the stirring process and the process of removing dodol from the heating process to the cooling process. One of the improvements to the dodol mixer is the automatic dodol mixer. This tool utilizes automatic components to stir dodol. The power needed by humans is not too large because it already utilizes the work of an automatic machine. Therefore this tool helps make it easier for humans in the stirring process. In terms of security, this tool is better able to make

workers work safely. In addition to repairing the tools in the stirring process, repairs are also made when transferring the dough from the heating process to the cooling process. Repairing tools is done by using the karakuri system. By using a conveyor, the dough is transferred from the heating process to the cooling process. At the end of the conveyor, the dough is poured into the cooling compartment under the conveyor by utilizing gravity [1]. Based on the description, research was carried out on this dodol mixer.

The purpose of this system design is to make an automatic stirrer that can facilitate stirring in the dodol heating process. Supported by tools that facilitate the transfer of the dough from the heating process to the cooling process by using the karakuri system. Then, improvement is carried out mainly on stirring and heating dodol.

## 2. Method and materials

A conveyor is one of the tools used for material handling, functions to move goods from one place to another. In the dodol stirring tool using a conveyor roller that uses gravity. Conveyors that use gravity are usually used to move things in units in a direction and through a fixed path. A conveyor roller is a type of conveyor whose drive is supported by a series of rollers strung together with a bearing. The conveyor roller is composed of a series of rollers that can rotate but not move to maintain balance and stability on the rollers [2]. Rollers will be arranged with the distance between the rollers adjusted to the load to be transported.

In an industry accustomed to that operators use their hands to pick up and move goods and need to walk to and fro to move goods from one point to another. In the concept of Karakuri kaizen teaches that with the Karakuri system the operator does not require a lot of movement and displacement, because the potential for waste will be more and larger. The Karakuri system encourages the handling of a material that will rely on gravity, broad utility and the connection with the Karakuri concept can be used to move material from machine to machine, or machine to operator and vice versa neatly and thoroughly.

Karakuri is a mechanical doll originating from Japan that can move automatically where this doll began to be popular in the 17th century until the 19th century which is commonly used in serving tea. In the usefulness of the Karakuri system itself can be an innovation in streamlining an industrial concept and improving 10 safety and further reduce existing waste. The Karakuri kaizen concept has principles that must be considered, namely:

- Don't use human hands. Minimize touch directly by the operator. Move automatically
- Don't spend money
- Take advantage of the capabilities of all the equipment you have
- Run the system with the wisdom and creativity of everyone on the production floor
- For safety, do not rely on operator alertness. Create a system that can stop automatically if a problem occurs

Data input for making improvement tools is a problem from the current condition, where the dodol mixer still needs human work hands. This is considered ineffective by the author because the dodol mass is quite heavy and requires humans to move the dodol to be processed in the next section. The stages of design are follows:

1. The existence of a problem in the dodol stirrer will make the author's thinking base in making product improvement ideas so that it will produce a design and review the design. In this condition, it is proposed to make roller conveyor help and facilitate human work.
2. The design of the initial design is the stage of sketching improvement tools (roller conveyor) by the writer by considering the existing problems so that the sketch produced will be as needed.
3. The design of technical design is the stage of making a geometric improvement tool (roller conveyor) using certain applications/software as manifestations of prototypes in 2 dimensions.
4. Furthermore, from the technical design, testing can be done whether the design of the tool is feasible to be continued into the actual product.

5. The next stage is the search for ingredients of the product you want to make. These materials can be in the form of iron, steel, polyvinyl chloride pipes, plastics, to small components such as nuts, bolts, and others.

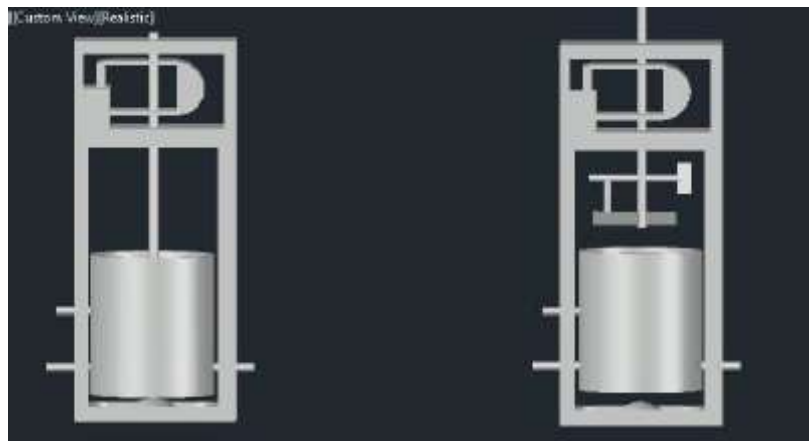
6. After the material search stage is the stage of making/preparing the product. By relying on existing technical designs and available materials, the authors assemble the tools according to the procedure to create prototypes/roller conveyor devices.

7. Furthermore, the testing phase of the device is to determine whether the material and components of the device are capable of running the dodol stirring container. If not, the process will return to the search for ingredients to replace the old material with more suitable ingredients.

8. If all processes have been passed, then the tool can be used as a refinement of the dodol mixer so that it can help facilitate the work of humans in moving the dodol container.

### 3. Results and discussion

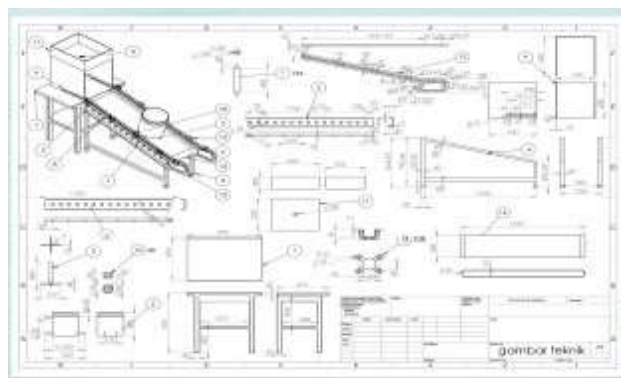
The proposed design tool is improvised from an automatic mixer that has been researched and designed. Then in this design, a tool was added to facilitate material handling on the stirrer automatically so that it was not done manually. The following is an illustration of the design of an automatic trial device with a roller conveyor.



**Figure 1.** Automation process design



**Figure 2.** Combination with karakuri material handling



**Figure 3.** Overall engineering drawing

The motion equipment design is an automatic stirrer equipped with a conveyor roller as a material handling tool. On the machine, the source of engine power is electrical energy used to power the automatic stirrer. In the automatic stirring machine tools, the machines contained are sensors, actuators, microcontrollers, and DC motors.

The mechanism of action of the automatic machine is that the power source that has been given by the machine is activated by humans by pressing the ON button on the machine. So that the electric current will supply power to the DC motor. Furthermore, the DC motor will move the stirrer with rotation. When the stirrer rotates, the RPM sensor used on this machine will detect the speed of the stirrer. After being detected by an RPM signal it will give a signal to the analyzer to adjust the stirrer's rotation speed.

The analyzer used is a microcontroller. This microcontroller will make adjustments to the rotation of the stirrer so that the tool can adjust the initial point which is the initial speed of the stirrer and the setpoint which is the endpoint that indicates the minimum speed indicating that the dodol is cooked. After the dodol is cooked, the machine will stop and the mixer will explain automatically. When the mixer is raised to a certain height, it will be detected by a proximity sensor. This sensor will give a signal to the hydraulic booster. After receiving a signal the hydraulic booster will push the container so that the container will move on the conveyor roller. The container

when moving on the conveyor roller will be held by iron along the conveyor to make it stable. The container will move down with the help of a roller conveyor and gravity.

Automatic stirrer or stirring machine automation already has the initial frame of the machine with an automation tool. Then the manufacturing process is carried out on a material handling tool that is conveyor. With the process of making the frame from the conveyor. After the frame has been made then install the roller on the conveyor frame. After that, the roller conveyor and automatic mixer are assembled and put together.

The way the mixer is working by connecting the power source. Then the engine will start and the motor will work. Next, put the dodol material into the container, then start the engine by pressing the button. After that, the engine will work with the motor drive. This motor will drive the stirrer and work by turning. By using a sensor, the engine will adjust how long the stirrer rotates and the rotation speed. After the dodol is cooked from the sensor signal, the mixer will be lifted. Furthermore, after the mixer is lifted the container will be driven by hydraulic power to push the container towards the conveyor. The container will continue to run until the end, and after reaching the end of the container will rotate and the dough in the container will come out.

The advantage of using this tool is, there is a standard time to do the stirring, so there is no dodol batter that is charred. Also, using this tool does not require human labor to do the stirring for a long period. Then by using a conveyor, material handling can be done automatically so that it does not require human labor to lift the dough as much as 25kg, and by using this tool the dough can be moved immediately.

#### **4. Conclusion**

The prototype that has been tested in this research has given better results than the previous manual process. The system designed has achieved process accuracy of up to 95% and found no defective products in a successful process. The use of Karakuri can reduce the use of electrical energy by 45%. Simple automation combined with the use of Karakuri is a new approach that is very suitable for the conditions of the rural region.

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