

Automatic Food Packaging System using Programmable Logic Controller

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Abstract: Food packaging using conventional machine has undelighted results, so it automatic packaging would be the solve that problem. it can more productive and quick. Basically, the working system of this automatic packaging begins with installing plastic on the rollers and installing plastic on the edge of the feeding tube so, the plastic will have a shape also like the tube. The next step is to put food into the container in the machine and the engine is turned on. Next, for the packaging grooves, the plastic will be pulled by the motor, then the bottom of the plastic is glued by the pressing process which later the plastic will form a container in accordance with a tubular mold. Food that has filled the container in the machine is passed through a tube that was previously covered by plastic, then the top plastic is glued by the pressing process. The results of PLC application testing on mechanics by providing a 12 volt power supply to a DC motor in a mechanical system show that the program loaded into the system provides the expected results.

1 INTRODUCTION

The development of technology in the modern industrial era is increasingly rapidly. Especially in control systems, the technology is developing rapidly as well where the current process is in the control system not only in the form of a circuit that using electrically assembled equipment, but also has used a computer program to control it. This situation certainly requires a simple, practical and high-tech supporting equipment (Nanda, 2014). For example, it can be seen at the creation of equipment that can work automatically, thereby reducing the role of humans to do food packaging.

Packaging is a way to protect food products, beverages or the consumable things from damage caused by air. According to several studies showing that packaging is one of the most important considerations that can influence consumer for purchasing products. The packaging of a product can be attractive to consumers if the packaging is well made and neat, so it requires a packaging machine that is simple and easy to use (Simran, 2019). Based on this description, the idea to create a PLC (programmable logic controller) automatic food packaging Machine that could be make easier to the

home industry community to packaging their products.

PLC can be used as a fairly reliable control equipment so it is widely used in industrial equipment, for example in the process of selecting materials, packaging, handling materials, automatic assembly and others. Basically, almost all systems that require control over electricity or electronics require a PLC (Pralhad, 2018, Sasidhar, 2017). So in this research, PLC can be more innovating to create Automatic Food Monitoring System Using PLC (Programmable Logic Controller).

Basically, the packaging system in this study functions to laminate plastic parts that have been filled with food, so that the food is in the form of a vacuum bag. This automatic food packaging system begins with mounting plastics on rollers and installing plastics on the edge of the feeding tube so the plastic will have a shape like the tube. The plastic will be pulled by two motors, then the bottom of the plastic is glued by the pressing process which later the plastic will form a container in accordance with a tubular mold. After the pressing process is finished, the next process is filling in the plastic and the plastic will be pressed once more at the top.

2 RESEARCH METHOD

2.1 LDR (Light Dependent Resistor) Sensor

LDR is one type of resistor whose resistance value is affected by the light received. LDR was made from cadmium sulfide which is sensitive to light. LDR is made from cadmium sulfide which is sensitive to light. Light has two different characteristic: electromagnetic waves and energy particles (dualism of light). The greater the intensity of the incoming light, the more electrons are separated from the bonds. So, LDR resistance will go down when the light illuminates it (Romadhon, 2018). The symbol and physical of the LDR can be seen in Figure 1.



Figure 1: LDR (Light Dependent Resistor) Sensor.

2.2 Ultrasonic Sensor First Section

The ultrasonic sensor is a tool for converting sound quantities into electrical quantities and vice versa. This sensor works using the principle of sound wave reflection so that it can be used to predict the distance of an object with a certain frequency. This sensor is called an ultrasonic sensor because it uses ultrasonic waves.

Ultrasonic sensors work by sending sound waves at frequencies above human hearing. Transducer sensor functions as a microphone for receiving and sending ultrasonic sound. The way the ultrasonic sensor works is by determining the reflected wave from the target to be captured by the sensor, then the sensor calculates the time difference between sending the waves and the time the reflected waves are received (Romadhon, 2018).



Figure 2: Ultrasonic Sensor.

2.3 PLC (Programmable Logic Controller)

PLC is a programmable logic control which is an electronic command that is designed to be able to operate digitally by using memory as a storage medium for internal instructions to perform logic functions, such as counter / counter functions, process sequence functions, timer functions , arithmetic functions, and other functions by programming them. PLC is the same as a microcontroller but here PLC has got standardization as an industrial control device.

Based on its name the PLC concept is as follows:

1. Programmable
It is the PLC's ability to store programs that have been created so that they can be easily changed or reprogrammed
2. Logic
It is the ability of PLC to process arithmetic and logic data input (ALU), which is to perform operations comparing, adding, multiplying, dividing, dividing, subtracting, negation, AND, OR, and so on.
3. Controller
Is the ability to control and regulate the process so that it can produce the desired output.

2.4 The Working Principle of PLC

In principle, a PLC through the input module works to receive data in the form of signals from external input devices. The external input equipment includes switches, sensor buttons. Input data which is still in the form of analogue signal will be converted by an A / D (analogue to digital module) input module into a digital signal. Furthermore, by the central processor (CPU) that is inside the PC the digital signal is processed according to the program that has been created and stored in memory. The CPU will then make decisions and give commands via the D / A output module (digital to analogue module) of the controlled system such as in the form of a relay and

motor which will be able to automatically operate the controlled work system (Sasidhar, 2017). The working principle of PLC can be seen in Figure 3.

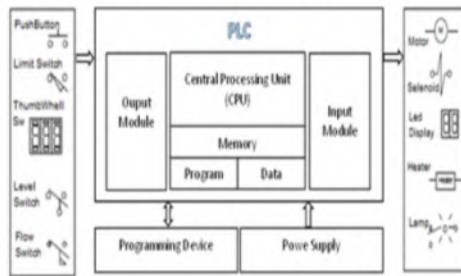


Figure 3: PLC Working Principle.

2.5 Mechanical Design

The following is the design of an automatic packaging machine as shown in Figure 4.

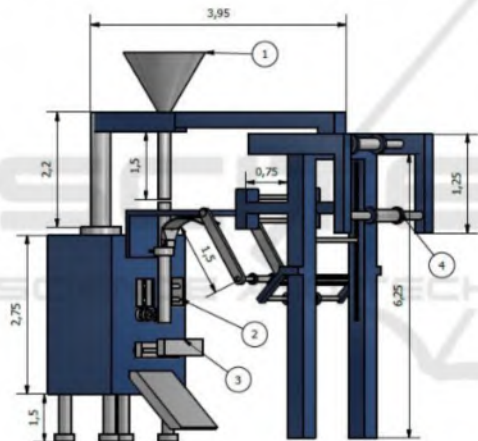


Figure 4: Design of an automatic packaging machine.

Index:

1. Food container
2. Pres plastic backside
3. Pres plastic top and bottom
4. Plastic roller holder

Figure 2.4 describes the working system of an automatic packaging machine:

1. Before the machine is turned on, put the plastic on the edge of the feeding tube, which is on the plastic roller holder.
2. put food in the container, then the machine is turned on. Press the plastic on the back and the press plastic on the bottom, then the plastic will be filled with food after that, the top press.

2.6 Electronic System Design

In this section explains the overall function of the automatic food packaging system using a PLC which is divided into several grooves which are describes in the following block (Sharma, 2017) diagram as shown in Figure 5.

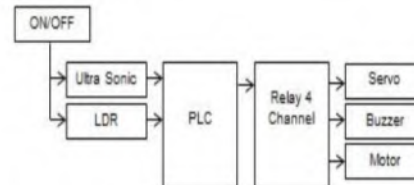


Figure 5: Function block of automatic food packaging system.

The functions of each of the previous blocks are as follows:

1. ON / OFF, to turn on or turn off the system
2. Ultrasonic, as a sensor to determine the existence of plastic
3. LDR, as a sensor to find out whether or not the food will be packaged
4. PLC, to control the system
5. Relay 4 Chanel, to provide voltage for output
6. Servo, as open and close food containers to enters the plastic
7. Buzzer, to provide information if food and plastic are used up
8. Motor, to pull plastic and move the press

3 RESULTS AND ANALYSIS

3.1 The Working System of Packing Device

In Figure 6 described the working system on an automatic packaging machine:

1. The first step is put food in the container, then machine starts.
2. The second step is initialize the LDR sensor which is used to detect food in the container. If the LDR sensor gets light because food not blocked the container, the buzzer will be active which is to notify the operator that the food in the container is finished.
3. The third step is the initialization of the ultrasonic sensor, functions to measure the height of the food (in this case is sugar) in the container. If the sugar is less than 5 cm, the buzzer will be active which is to notify the operator that the container is empty.

4. The fourth step is the plastic press that is on the back of the feeding tube.
5. The fifth step, motor 1 will move which functions to pull the plastic down.
6. The sixth step is the plastic press at the bottom that serves as a plastic container for food.
7. The seventh step is the servo will be active with a delay of 3 seconds to open and close the door under the food container to regulate the contents of the food in a plastic container.
8. The eighth step is the plastic press at the top is to close the plastic container, and the plastic is cut by the knife at the end of the pressing machine. So food can be packed neatly and tightly.

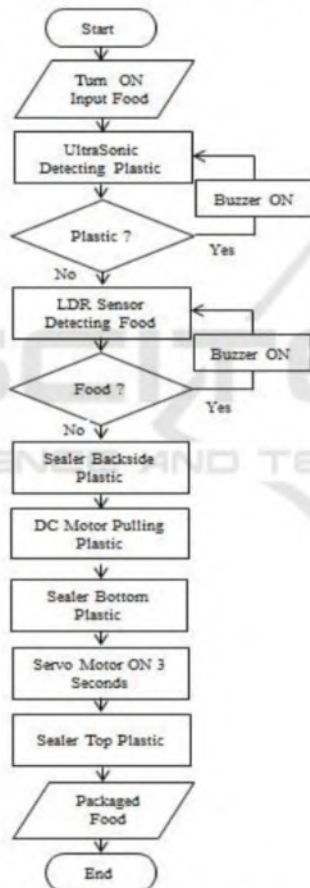


Figure 6: Flowchart System.

3.2 The Physical of an Automatic Packaging Device

After building all the hardware and software components, then in this study testing and analysing the machine that have been made, whether the

machine can work in accordance with the functions and planning of tests that were assembly and then combined in a control system that has been designed.

Tests was done separately by ultrasonic testing, LDR, servo motors and DC motors all worked well with what was expected. After implementing and testing software on Ultrasonic, servo motors, and dc motors, an automatic packaging device can be run can carry out plastic packaging automatically. Figure 7. Shows the physical appearance of an automatic packaging device.



Figure 7: The physical of an automatic packaging device.

3.3 Testing on Food Containers

The LDR sensor is placed in the container, so the LDR sensor will not get light when the food is filled in the container. LDR sensors is good condition if the LDR can detection food in the container.

When the LDR sensor does not get light because it is blocked by food, the system will run. Conversely, when the LDR sensor is exposed to light, the system will stop and the buzzer will activate to notify the operator that the container is empty. Figure 8. Shows that the position of the LDR sensor was located in a food container.



Figure 8: LDR Sensor Position in food container.

3.3 Testing on Ultrasonic Sensors

The ultrasonic sensor is placed in front of the plastic so that it can measure distance between plastic and sensor. This ultrasonic circuit is good condition if ultrasonic sensor can detect a plastic is being used.

The testing will be success if ultrasonic sensor can detect plastic with a distance of 36 cm to 56 cm, if ultrasonic sensor can detect more than 56 cm, the buzzer will be active and notify the operator that the plastic is used up. Figure 9. Shows that the position of the Ultrasonic sensor was located in automatic packaging device



Figure 9: Position of the Ultrasonic sensor.

3.4 Testing on Servo Motors

The initial position of the servo motor is at 0°, this was done so that the servo motor can rotate to close passage of food in the plastic container. Figure 10. shows that the servo motor at condition 0°.



Figure 10: Servo Motor at condition 0°.

The next test is the position of the servo motor 90°. This was done so that the servo motor can rotate automatically to the 90° position and open the passage of food so that it can fill plastic containers. The implementation results are as in Figure 11.



Figure 11: Servo Motor at condition 90°.

3.5 Testing on Pres Plastic Backside

The DC motor moves using a relay module with a voltage of 24 V. There are two switches that function as buttons on the back of the plastic press and the indicator light functions as a marker if the press is tightly closed, the indicator light will light up. The implementation results are as in Figure 12.



Figure 12: Plastic press is open.

Press will close when touching switch 1 and the indicator light is on which indicates that the heating wire is active with 1.5 seconds. Then the press will return in an open state and touch switch 2. The implementation results are as in Figure 13.



Figure 13: Plastic press is closed.

3.6 Testing on Pres plastic top and bottom

The moving dc motor uses 2 relay modules. There are two switches that function as buttons on the top plastic press and indicator lights.

The test will be carried out if the top press touches switch 3 then the press is open. As shown in Figure 14.

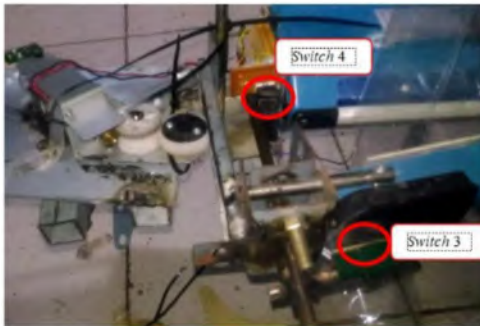


Figure 14: The bottom plastic press is open.

Press will close when touching switch 4 and the indicator light is on which indicates that the heating wire is active with 1.5 seconds. Then the press will return in an open state and touch switch 2. The implementation results are as in Figure 15.

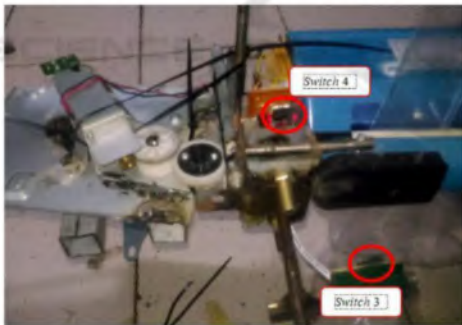


Figure 15: The bottom plastic press is closed.

Table 1: Sensor experiment results.

No	Sensor	Distance to object	Buzzer ON	Buzzer OFF
1	LDR Sensor	LDR>150	✓	-
2	Ultrasonic Sensor	US>=36 cm and US<=56 cm	✓	-
3	LDR Sensor	LDR<150	-	✓
4	Ultrasonic Sensor	US<=35 cm and US>=7 cm	-	✓

In Table 1, it is explained that the sensors used in this tool are the LDR Sensor and Ultrasonic Sensor. When the LDR sensor is not blocked by food or receives more than 150 light, the buzzer will activate and when the LDR sensor is blocked by food or does not receive light less than 150, the buzzer will turn off. If the distance between the Ultrasonic Sensor and the object is more than 36 cm and less than 56 cm, the buzzer will be active, while the distance between the Ultrasonic Sensor and food is less than 35 cm and more than 7 cm, the buzzer will turn off.

3.7 The Experiment an Automatic Packaging Device

From the experiments that had been tried on the automatic packaging system, it produces food wrapped in plastic neatly, and the contents doesn't take into account the weight of the product in each package and only depend on of servo motors that use delay (time) which is functions as a regulator of content on each package. as seen in Figure 16.



Figure 16: The experiment an automatic packaging device.

4 CONCLUSIONS

After some explanation, trial, and analyze we can conclude that:

1. The ultrasonic sensor can detect the presence of plastic when the distance between the plastic and the ultrasonic sensor reaches less than 36 cm and more than 56 cm, the buzzer will turn on, the ultrasonic sensor will read and send a

signal to the buzzer, so the buzzer is active to inform the operator that the plastic empty.

2. The LDR sensor can detect the presence of food in the container, when the LDR sensor receives more than 150 light, the buzzer will be active, and if the LDR sensor receives less than 150 light, the buzzer will turn off.

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