Control System in Crusher and Sorting Nutmeg Seed Machine based on Arduino Uno

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Control System in Crusher and Sorting Nutmeg Seed Machine based on Arduino Uno

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Abstract: The aim of this research is to help the businessmen and exporters of nutmeg seeds by designing and manufacturing control system on nutmeg crusher and sorting machine, so that they can accelerate the process of nutmeg seed sorting. This research was conducted at the Production Laboratory, Department of Mechanical Engineering, Manado State Polytechnic. The method used in this research is design and manufacture, that focused on the automatic control section. The design of the nutmeg seed sorting tool uses a cmu pixy camera image sensor and an ultraviolet lamp that serves to light up the color. The working system of this tool will be carried out automatically which is controlled by an arduino uno AT Mega 328 microcontroller.

1 INTRODUCTION

Nutmeg is a medium-stemmed plant with a height of 18 m, has oval or oval leaves that are always green throughout the year. Nutmeg can grow in the tropics at an altitude below 700 m above sea level, humid and hot climates, rainfall 2,000 - 3,500 mm without experiencing a significant dry season period. The major nutmeg producing regions in Indonesia are the Maluku Islands, North Sulawesi, West Sumatra, Nanggroe Aceh Darusalam, West Java and Papua (Rismunandar, 1990). The development of nutmeg planted areas throughout Indonesia until 2013 has reached 140,000 ha with a production of 25,800 tons of nutmeg (Directorate General of Indonesian Plantation, 2014).

Nutmeg is known as a spice plant that has economic and multipurpose value because every part of the plant can be utilized in various industries. Seeds, mace and nutmeg oil are export commodities and are used in the food and beverage industry. Oils derived from seeds, mace and leaves are widely used in the pharmaceutical, perfume and cosmetics industries. Yellow rounded nutmeg when old, fleshy in white. The seeds are thin-skinned, rather hard, brownish black, wrapped in a crimson colored mace. The contents of the seeds are white, when dried to dark brown with a distinctive aroma. Nutmeg consists of flesh (77.8%), mace (4%), shell (5.1%), and seeds (13.1%) (Rismunandar, 1990). Commercially nutmeg and mace (mace) is the most important part of nutmeg and can be made into various products including essential oils and oleoresin. Another product that may be made from nutmeg seeds is nutmeg which is trimyristin which can be used for edible oils and the cosmetics industry (Somaatmaja, 1984).

In the handling of agricultural products, division, peeling and cutting are work that is always done from harvesting until the product is ready for consumption or further processing. For example, vegetables are cut before cooking, tubers and bananas are sliced before frying, pineapple sliced before canning, and grass is cut before being given to cattle. The work of splitting, peeling and cutting agricultural produce in small quantities can be completed manually using a knife or other cutting tool. However, if the amount is large enough, such as stripping coconuts at harvest, stripping manually requires considerable time and labor. High capacity peeling machine is needed, so the effectiveness and efficiency in this case is absolutely necessary (Wiriaatmadja, 1995).

The division of the flesh of the fruit, seeds, and mace is carried out after the ripe nutmegs are collected, the fruit is split and between the flesh, mace and seeds are separated. Each part of the nutmeg is placed in a clean and dry container. The release of mace from the seeds is carried out carefully, from the tip towards the base, in order to obtain a complete mace that is classified as high quality. The seeds collected are sorted into 3 types, namely: fat and

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intact, thin or wrinkled, and defective. (Directorate General of Indonesian Plantation, 2012).

One way to increase the economic value of nutmeg, especially for the export market, is by sorting. The sorting process aims to determine the classification of commodities based on similar quality (Zain et al, 2005). Sorting is fraction sorting activity based on physical characteristics (water content, shape, weight, type, texture, color, foreign matter/dirt), chemical (odor composition and rancidity), and biological conditions (type of damage by insects, microbial counts, and special growth for seeds). In the process of sorting is done by examining indicators such as intensity, color, size, shape, or texture of the fruit (Arivazhagan et al, 2010). The quality of nutmeg itself is determined by various parameters including the parameters of maturity or color index and size (Radityo et al, 2012).

The process of sorting fruits and seeds is still using conventional methods, namely the use of human labor (manual). This has the disadvantage that human judgment is still subjective and inconsistent with fruit objects and repetitive work can cause burnout. For this reason, it is necessary to apply a system that can carry out the sorting process automatically (Febyan and Slamet, 2017).

In this study, we will try to combine a sorting machine in the form of a conveyor using an image sensor. This research was also developed based on previous studies. Diah et al (2012) designed an automation model based on color and size using TCS3200 sensors and ultrasonic sensors. Al Amin et al (2013) designed separators using laser and photodiode detection sensors. Mochammad et al (2017) implemented a sorting system based on color and temperature using the NRF24L01 wireless module.

The design of the nutmeg seed sorting tool uses a cmu pixy camera image sensor and an ultraviolet lamp that serves to light up the color. The working system of this tool will be carried out automatically which is controlled by an arduin uno AT Mega 328 microcontroller. With this system it is expected to be able to increase efficiency and effectiveness in terms of nutmeg sorting.

2 RESEARCH METHODS

2.1 Overview of the Nutmeg Sorter Intelligent System

General description of this intelligent system consists of input in the form of an image sensor with cmu pixy camera, ultraviolet lights, and micro switch. After the input detects the data will be sent to the Arduino uno microcontroller and will give an output execution command, where the DC motor will move the nutmeg sorter bar. System block diagram shown in Figure 1.

Figure 1: Block Diagram of the System

2.2 Mechanical Design

The design of mechanical design is shown in figure 2. In mechanical design. This smart system considers several important things, including:

1. The shape and size of the frame is kept to a minimum in order to produce a system that effective and efficient.
2. Circuits on electronic systems are kept to a minimum to avoid error and excessive use of jumper cables.

Conducting grouping of modules and other electronic components to be more orderly and do not interfere with other components.

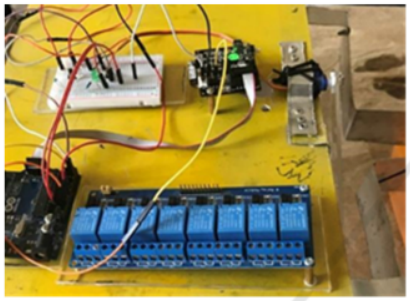
2.3 Electrical Design

The design of the electrical design is shown in Figure 3. In the design of electrically intelligent systems must consider several important things, including:

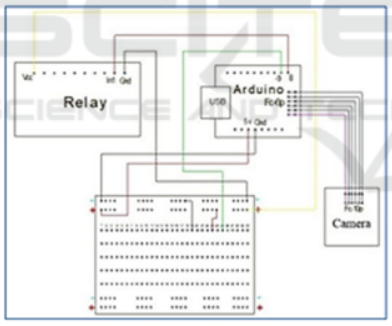
1. The DC source that will be used in this circuit is 12V, where the use of the Arduino Uno module can work at 5V.
2. The microcontroller that will be used in this study is Arduino Uno.
3. Control design to support this application using some software.

The control system design uses C programming language in Arduino IDE to acquire analogue and digital data from the voltage sensor output.

Figure 2: Mechanical Design.



(a) Real Display of Electrical Design



(b)

Figure 3: Electrical Design (a) Real Display (b) Circuit.

3 RESULT AND DISCUSSION

Result of Design and Manufacture

The main part of this intelligent nutmeg sorter system model is the presence of an image sensor in the form of a cmu pixy camera that is coupled with an arduino uno microcontroller controller. After the broken nutmeg seeds come out of the mechanical sorting guide, the nutmeg seeds will enter the conveyors one by one (in line). After that, nutmeg seeds will go into a dark room with ultraviolet lights (Figure 4).

Figure 4: Ultraviolet Light.

If the nutmeg seeds are exposed to ultraviolet light from the lamp, the nutmeg seeds will reflect white if they contain toxins, and will remain dark if they do not contain poisons. In this section the nutmeg will be detected by a cmu pixy camera that functions as an image sensor for the sorting process which will be executed by the separator bar. The sorting indicator itself is distinguished by white and colorless (dark). If the nutmeg seeds that pass through the conveyor are detected reflecting white then the separating bar is active, conversely if a colorless nutmeg is detected by the camera, the separating bar is not active. The overall results of intelligent system design are shown in Figure 5.

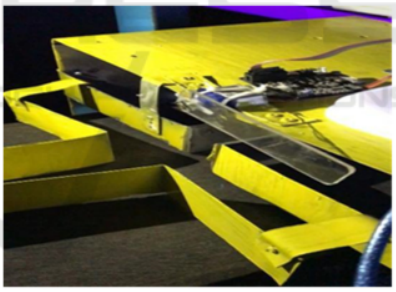


Figure 5: Prototype of Intelligent Nutmeg Sorter System.

Structural and Functional Test

At the structural test stage, testing is carried out aimed at finding out whether the system designed is in accordance with the previously designed concept. This test is done by knowing whether the electronic module is connected correctly so that the system can function properly and has the performance and function according to the design. The test results are shown in table 1.

Table 1: Structural Test.

Component of the System	*Connect to*	Description
Cmu pixy camera	Pin A0	connected
Arduino uno	Pin A1	connected
	Out Pin A2	
Separating bar	Pin A3	connected

At the functional testing stage, the test is aimed to determine whether the voltage flowing in the circuit is in accordance with what is needed. This test is done by testing the output voltage of each component using a multi meter or with a program.

Validation Test

This stage is carried out with the aim to find out which intelligent system has been working correctly or not. Tests carried out by looking at the system output. The output that is produced from the color input that enters the microcontroller is processed with a predetermined value so that it can sort the nutmeg seeds according to the specified indicators.

Figure 6: An image captured from cmu pixy camera.

Furthermore, the control system testing is carried out. At this stage, the intelligent system that is created will be tested whether it is working properly or not. Testing is done by looking at the system output.

Table 2: Example Testing I of Cracked Nutmeg.

No.	*Separating Bar*	Color of Nutmeg	Description
1	Opened	White	Succes
2	Opened	White	Succes
3	Opened	White	Succes
4	Closed	Black	Succes
5	Opened	Black	Failed
6	Closed	Black	Succes
7	Closed	Black	Succes

Table 3: Example Testing II of Cracked Nutmeg.

No.	*Separating Bar*	Color of Nutmeg	Description
1	Opened	White	Succes
2	Opened	White	Succes
3	Opened	White	Succes
4	Closed	Black	Succes
5	Closed	Black	Succes
6	Opened	Black	Failed
7	Closed	Black	Succes

The output produced from the input of broken nutmegs into a dark room equipped with an ultraviolet light and a cmu camera, which then by the microcontroller orders the mechanical system of the dc motor to open or close the separating bar so that it can sort out toxic and non-toxic nutmeg. The example results of this test could be seen in Table 2 and Table 3 and Table 4. The process of this testing is performed 50 times with each using a variety of broken nutmeg. Obtained successful trial data each of 45 times. The success rate achieved is 90%.

Table 4: Example Testing III of Cracked Nutmeg.

No.	*Separating Bar*	Color of Nutmeg	Description
1	Opened	White	Succes
2	Opened	White	Succes
3	Opened	White	Succes
4	Closed	Black	Succes
5	Closed	Black	Succes
6	Closed	Black	Succes
7	Closed	Black	Succes

The output produced from the input of broken nutmegs into a dark room equipped with an ultraviolet light and a cmu camera, which then by the microcontroller orders the mechanical system of the dc motor to open or close the separating bar so that it can sort out toxic and non-toxic nutmeg. The example results of this test could be seen in Table 2 and Table 3 and Table 4. The process of this testing is performed 50 times with each using a variety of broken nutmeg. Obtained successful trial data each of 45 times. The success rate achieved is 90%.

4 CONCLUSIONS

This research produced a crushing and sorting machine that can separate poisonous nutmegs and not through a control system with an arduino uno and cmu pixy camera. The result of the study is an intelligent system which can increase the effectiveness and efficiency of the nutmeg sorting process because it can be done automatically and continuously. The intelligent nutmeg seed sorter system model based on the color produced through ultraviolet lights by using a cmu pixy camera that functions as an arduino uno based image sensor still needs further development to get optimal results. This system is expected to be applied and become a recommendation for nutmeg entrepreneurs, especially nutmeg exporters in North Sulawesi.

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