Analysis of Water, Light Sensors, and Performance on Appropriate Technology of Rice Drying Process

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**Abstract**. In Indonesia, in general, the drying process of agricultural products is carried out traditionally, including rice, most of the drying of which is carried out conventionally, requiring large and dry land to reduce its air content. Human needs, vigilance, and responsiveness in the management of the drying process are activities to maximize the yield of rice drying. These conditions make the drying process longer, less hygienic and require a large number of workforces. The appropriate rice drying technology is used as a solution to facilitate rice drying process. Automatically, open-closed roof system works by being operated by a DC electric motor and the rice stirring operation by an AC electric motor which receives commands from the Arduino Uno microcontroller system receiving commands and input from the water and light sensors located on the roof. These sensors are used as the initial detection for rain and dark conditions or the intensity of bright sunlight during the rice drying process. The results of analysis show that the water sensor is installed at several points, functioning optimally when the sensor is hit by a signal, subsequently sending a signal to the Arduino Uno by activating the DC electric motor to cover the roof, and the AC electric motor stops operating when stirring the rice in the tank. The LDR sensor, as a light sensor, works to receive the specified light intensity standard and sends a signal to the Arduino Uno to open the roof. The roof cannot be opened if the two sensors are not free from several conditions, among others are wet conditions on the water sensor and the intensity standards that do not meet or are far from the set standards.

1. Introduction

In the farmers opinion as the user of technology, only some farmers were able to and would apply postharvest technology due to different abilities, culture, habits, reluctant to adopt new technologies, and other social problems. Farmer institutions in West Sumatra were generally government facility oriented and the farmer business was not profit oriented [1]. Several rice post-harvest handling processes are needed to produce products ready for consumption, including: 1. threshing process to separate the rice from the panicles, 2. the rice drying process to reduce the moisture content in the rice, 3. the sifting process (cleaning the rice from dirt), 4. the packaging or storage process and 5. the milling process to separate the rice skins and rubbing them to produce white-coloured rice ready for consumption [2]. A rice drying process constitutes one part of the processes that determines the quality of rice due to its relation with the storage and milling processes. Drying is a process of reducing the moisture content of a material to a certain limit thermally [3]. The maximum water content value of rice according to SNI (Indonesian National Standard) standards and which is required by BULOG (Logistics Agency) in its purchase is 14% (Joint Decree of the Head of the Food Security Community Guidance Agency No. 04/SKB/BBKP/II/2002).

The rice drying process generally takes three days, but the time needed can reach one week if the rainfall is high. It can be concluded that rice drying takes up to 54 hours to reach a moisture content of 14.12% so alternative rice drying is necessary to shorten the drying time [4]. several attributes of consumer needs in designing post-harvest rice machines, namely; portable, cheap, multifunctional, lightweight, ergonomic, maximum speed, easy to disassemble, easy to maintain, and easy to find spare parts [5].

A sensor is a device to detect/measure something, used to change mechanical, magnetic, heat, light and chemical variations into voltage and electric current. In the control system and robotics environment, sensor provides similarities resembling eyes, hearing, nose, tongue which will then be processed by the controller as the brain [6]. Input from an application providing command information is received by the control device system, in this case using the Arduino Uno microcontroller device, which is able to convert digital signals into mechanical movements in operating doors for open-closed movements [7].

1. Method

Researchers analyzed the Performance of Appropriate Technology for the rice drying process, particularly in the use of water and light sensors against the weather conditions. The two sensors are used as input to the Atmega328 control system in case of dark and rainy conditions, which are then used as performance operations of the DC motor functioning as an open and closed roof regulator and an AC motor for the rice stirring process. The servo motor of the prototype system is able to move to open and close the clothesline at an angle of 0˚- 90˚ when the water and light sensors detect changes in the weather around the environment, and the system works in accordance with the design having been made [8].

## 2.1. Sensors (water sensor and light sensor)

## The water sensor is designed to detect water during raining as well as to be used to detect the water level. Rain sensor circuits can be made using a resistor component as the main component and an electrode as a water detector [9]. The light sensor is an electronic device/component that functions to convert light quantities into electrical quantities. LDR (Light Dependent Resistor) light sensor constitutes a type of resistor which is light sensitive [10].

## 2.2. Arduino uno microcontroller

ATmega 328. This board has 14 digital input/output pins, 6 pins of which can be used as PWM output and 6 analog input pins, 16 MHz crystal oscillator, USB connection, power jack, ICSP header, and reset button [11]. In supporting the microcontroller to be able to be used, just connect the Arduino Uno board to the computer using a USB cable or a voltage source which can be obtained from an AC-DC adapter or battery in its operation. The Arduino Uno is of a credit card in size. Despite its small size, the Arduino Uno board can make it easier for users to create various electronic projects [12].

## 2.3. Electric motor

An electrical motor is a machine that converts the electrical energy into mechanical energy. Motors are broadly classified into two types AC motors and DC motors. The AC motors operate on alternating current where as the DC motors operate on the direct current. The input to AC motor is alternating current/voltage and its output is in the form of torque, similar is the output of DC motor it differs from AC motors at its input side, i.e. the input of a DC motor is the direct current/voltage [13].

1. Result and discussions



**Figure 1.** Flowchart of the research design

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| D:\JuRNaL-Karya Ilmiah\Analisis Sensor Pengering padi\picture 2.png**Figure 2.** Construction of appropriate rice dryer technology | Screenshot_2019-07-05-14-34-02**Figure 3.** Roof performance during open and closed conditions |

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| **Table 1.** Weather Sensor Program Design |
| **Weather Conditions** | **Water Sensor** | **Light Sensor** |
| Hot | X | X |
| Cloudy  | X | A |
| Rainy and Cloudy  | A | A |
| Hot and Rainy  | A | X |

A = Functioning to close the roof

X = Not functioning

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| --- |
| **Table 2.** Sensor Testing on DC Electric Motor |
|  | **Light Sensor** | **Water Sensor** | **DC Motor**  | **Roof Conditions** |
| Conditions | Bright | Wet | Counterclockwise | Closed |
| Bright | Dry | Clockwise | Open |
| Dark | Dry | Counterclockwise | Closed |
| Dark | Wet | Counterclockwise | Closed |

**Table 3.** Sensor Testing at AC Electric Motor

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Light Sensor** | **Water Sensor** | **AC Motor** | **Working Conditions** |
| Conditions | Bright | Wet | Off | Stopped |
| Bright | Dry | On | Active |
| Dark | Dry | Off | Stopped |
| Dark | Wet | Off | Stopped |

Tables 1 and 2 explain that the condition of the two sensors must be free from interference either cloudy and / or rainy by activating a DC electric motor to open the roof. Tables 1 and 3 explain that the two sensors must also be free from interference to activate the AC electric motor to rotate the mixer for the rice drying process.

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| --- | --- | --- |
| **Figure 4.** Sensor Checking | **Figure 5.** Rice Drying Process | IMG_20190711_170046**Figure 6.** Type Rice Mixer |

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| **Table 4.**The ability of mixer rice using an AC Electric Motor ¼ HP and a gearbox with a final rotation of 31 rpm and drying time 11.00 - 15.00 WIB. |
| Types of mixer | early weight of rice (kg) | final weight of rice (kg) |
| single plate and double plate | 6.5 | 6.1 |
| single plate and single plate | 6.5 | 6.2 |
| single plate and double harrow | 7 | 6.6 |
| double plate and single harrow | 7 | 6.5 |
| double plate and double harrow | 6.5 | 6.2 |
| double plate and single harrow | 6.5 | 6.2 |

# Types of mixer

Types of Mixer

**Figure 7.** The Ability of Variation Mixer

Table 4 and Figure 7 show that the double plate and single harrow types have greater drying ability than other types of mixers with a decrease in rice mass of 0.5 kg/day.

1. Conclusions

The rain sensor functions optimally when the sensor is exposed to water splashes (rain) and the light sensor works on the intensity of sunlight in accordance with the setting, then the two sensors send a signal to the Arduino Uno microcontroller by activating the electricity supply to the DC Electric Motor to open the roof and the AC Electric Motor stirring the rice dryer. The roof and the performance of the rice mixer cannot be reopened if the two sensors are not free from the conditions that are allowed to function. For example, the water on the sensor and the intensity obtained which is still far from the set standards. The type of mixer that was effectively used in the experiment was a double plate and single harrow with a decrease in rice mass of 0.5 kg/day.

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