

The study of relationship between whiteness and temperature of rice

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Abstract—The whiteness of rice is a key factor for making a decision to increase or decrease the power of Milling Roller in polishing process which can be impacted to the using of electric power and rice's temperature. Using more electric power will give more whiteness of rice, but there will be more broken rice too. However, estimating the whiteness needs to use the standard device and needs to be controlled to get the accurate value. In addition, this activity delays the process to set the whiteness value stably. So, to faster estimate the whiteness of rice, this research has developed the prototype device to study the temperature of rice from polishing process plus with the whiteness of rice occurred during the polishing process using the image processing to compare and estimate the whiteness by the standard device. The result from the experiment found that the prototype device has the similar performance to the standard device. It is also faster in measurement and can be used in polishing process

Keywords— rice, whiteness temperature.

I. Introduction

“Whiteness measurement machine” is the equipment that have been developed to measure the whiteness of raw materials include rice, flour, wheat, salt, sugar, and other raw materials which have the flour and rice grain being the component. The equipment will be set the calibration of the process (under the controlled condition) which builds up the relationship between the value measured from the equipment and other standard value that are specified and accepted internationally.

The whiteness measurement machine is used in the polishing rice process at the polishing step. The equipment used in polishing the rice called “milling roller” shown in the Fig. 1. The stone will spin inside the milling roller and the sieve will be at the outside of the milling roller. There are holes between the stone and the sieve to let the rice grain go through by the holes size will be fit to the rice grain. In polish step, the milling roller will be hot because of the polishing to get the whiteness of rice that the producer needs as the Fig. 2.

The problem of using the whiteness measurement machine found in present is the producer has to choose the rice out of the polishing process at random when using in the standard device to check the whiteness value. If the producer cannot get the needed whiteness value, the producer needs to adjust the distance between the milling roller and the sieve by the

adjusted distance can affect to the electric power in polishing which is different follow by each distance adjusted. So, this whiteness measurement method may have the deviation that occurs from human and the value which not match with the real time. Besides, it is difficult to check the accuracy in the aspect of the entrepreneur.

As the polishing process that noted before, adjusting the milling roller distance is the key factor that cause the rice broken in big amount. This also cause to gain more cost of the entrepreneur. So, the researcher has developed the equipment for measuring the whiteness which can be used during processing to faster the system continuously.

This article will present the way to develop the whiteness and temperature of rice measurement system after polished to use the information to find the relationship between the whiteness and electric power in polishing process. The information of how to develop the system will be shown in the research, the result of collecting data and the conclusion hereinafter.



Figure 1. Milling roller

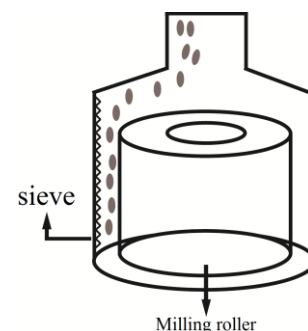


Figure 2. Milling Roller Operation.

I. Related Works

Nowadays, there are many methods to measure the quality of rice. The whiteness measurement is also another method that can identify out into the number by such value will depend on how the user chooses the color system. As seen from [1] which is the color value measurement of rice using to check the quality of rice by image processing technique. The chosen color system to use for comparing is RGB (Red Green Blue) color system and HIS (Hue Intensity Saturation) color system including 3 parts which are Hue, Saturation, and Brightness. The result is RGB color system can show the result of the image from Liquid Crystal Display, LCD which is related with the natural color, and such image can be analyzed correctly. For HIS color system is the color system based on the basic sense of human. So, it is easier to understand and easier to analyze the color of the target object than using RGB color system.

Besides the color used commonly [2], the research has built the new color system to easily calculate the whiteness value. The new color system called “Hue Whiteness Blackness, HWB”. It can separate the color into three parts; Hue, Whiteness, and Blackness by the component of this color system can be converted from HSV (Hue Saturation Value) color system.

Measuring the whiteness percentage from the reflection of light using the photodiode is also another method that the research used [3] by letting light reflect through the lens and go toward to the photodiode. Then the photodiode will convert the light power into the electric sign. An Analog to Digital converter, A/D converter will convert the electric sign into the digital sign. Finally, the result will be shown in term of percentage at the LCD which the machine will be able to measure the whiteness by each level of the 0.019 volt sign will equal to 0.5 % of the whiteness

I. The theory used

They chose color system is also another factor in the digital image processing that can affect to the calculating to get the wanted result such as RGB color system [4]. In each pixel of the color image will include with 3 color values which are red color value, green color value, and blue color value. The color image also includes with the color sign which have to be separated before analyzing the image element next. In fact, the character of the color is a thing that human can see and recognize the best, however, the number of the bit using to replace the color value in each pixel can affect to human’s seeing and the result of representing the color level in the different amount of bit too. See that the gradient of the color replaced by 24 bit per pixel can provide the continuity of color gradient better than replacing by the 8 bit per pixel.

Aside from RGB color system; there is HSV [5] color system that people like to use for the image processing too. Usually, if talk about the color, human will think of the various shades of color including with the spectrum color gradient. The HSV color system will be called Hue such as red, yellow, or purple, etc.

The next important thing is the Saturation or S value which the saturation of color will identify the color value referring the whiteness value itself too, for instance, red is the most saturation color that has no whiteness mixing. On the other hand, mixing the white color into red color, the outcome is red will be change to be pink color by the Hue value still stay the same, but the saturation value is decreased in form of percentage value of 0-100 percent.

The final one is Value (Brightness of color). It is the description of the light coming from the color, for example, red car will look bright in day time, but the brightness of red car will be decreased if such car is in night time because there is less reflective light on the eyes by the percentage value will be from 0-100 percent.

I. The detail of development

This research has developed the whiteness and temperature measurement system of rice after polished for using the data to find the relationship between the whiteness and temperature using in polishing.

A. System overview

The operation of the system can be divided into 4 main steps which are recording the image, recording the rice temperature, transferring all information to the computer through the wireless network, and processing the image as shown in the Fig. 3.

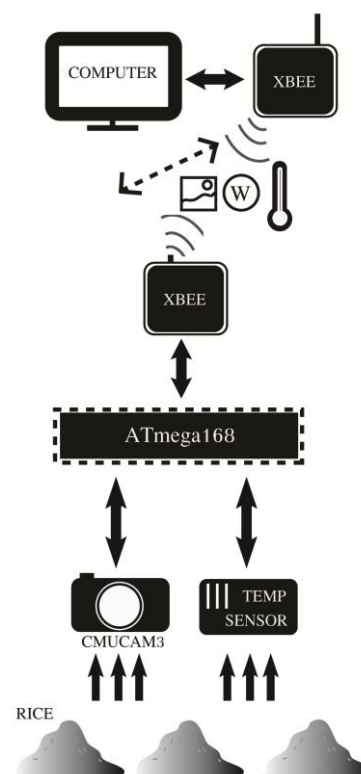


Figure 3. System overview.

B. Designing and developing the system

This research has used the wireless network in receiving and transferring the data by the developed system will include with 2 main parts which are the part of sensor node and the part of coordinator. The following are the functions of each part.

Sensor Node is the equipment installed in milling process at the polishing step to record the image and measure the temperature while the rice is flowing along the groove. The composition inside the sensor node is shown in the Figure 4.

Coordinator is used to control the transferring and receiving data of the sensor node. Each node will be worked respectively to preventing the collision of data. It also evaluates the image, calculate the whiteness value, and record the temperature value sent from the sensor node. This part will use computer as the main controller.

When the image is sent to the computer, the computer will process the image to cut some parts of image that will not use in whiteness calculation as shown in the Fig. 5 and Fig. 6.

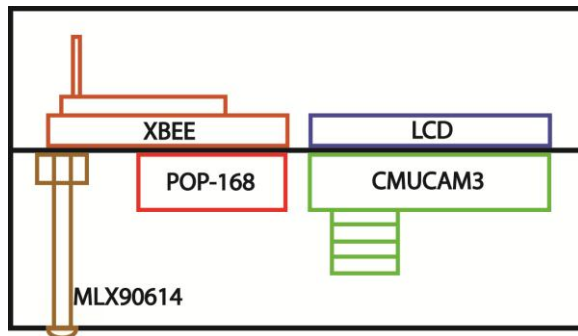


Figure 4. Sensor node.



Figure 5. The rice image before processing

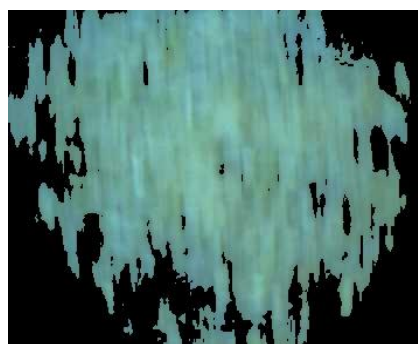


Figure 6. The rice image after processed

After getting the appropriate image, the next step will be the whiteness calculation of such image. The color value from the camera will be in the RGB color system. Whiteness calculation will be in HSV color system that can be converted from RGB value by dividing the color value into three parts which are Hue, Saturation, and Value. From the

study of whiteness calculation [2], it can be calculated from the following equation.

$$\text{Whiteness} = (1 - S) * V \quad (1)$$

S is Saturation. The value is from 0 – 100

V is Value. The value is from 0 – 100

II. Testing usability

To test the usability of the system, the researcher has used the system to test in the real operation of milling in the mill by the environment and the result are shown as follows.

A. The environment of testing

The overview environment in the mill is wide and the most of the space is for the machine working as shown in the 7th image and the 8th image. So, to be safe and convenient in transferring data back to the computer, the researcher has used the 2.4 GHz Xbee-Pro wireless communication module to transfer the data.



Figure 7. The environment in the mill



Figure 8. The environment around the equipment installing area

III. Experiment and Results

In this part will talk about the relationship between the whiteness and the temperature by installing the prototype device at the groove that the rice flows as showing in the Fig. 9 to record the image before transferring to calculate at the coordinator by record the polished rice in the 1st time, 2nd time and the 3rd time. We have gathered the result since November 10, 2012 to December 27, 2012 and the result is shown following



Figure 9. Installation area

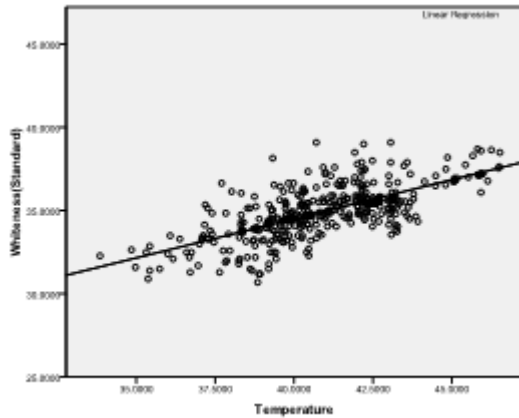


Figure 10. The relationship between the whiteness (standard device) and the temperature of the 1st stone

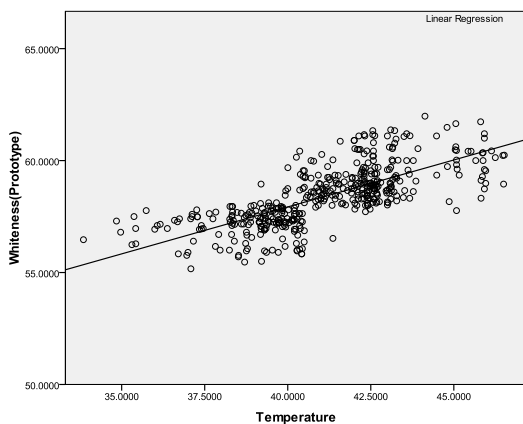


Figure 11. The relationship between the whiteness (prototype device) and the temperature of the 1st stone

From the Fig. 10 and Fig. 11, when analyze the data by using the linear regression, the equation of the standard device and the prototype device are shown as following respectively.

$$y = 0.473x + 15.530, R \text{ Square} = 0.679$$

$$y = 0.419x + 41.155, R \text{ Square} = 0.524$$

From both equations, the slope of the graph shows that the whiteness and the temperature have the same way relationship by the temperature can describe the fluctuation of rice significantly and statistically ($\text{Sig} < 0.05$) in addition, it also can describe the fluctuation of the whiteness at the percentage of 67.9 and 52.4 respectively

IV. Conclusion

This article has presented the prototype device development using temperature and image processing to describe the whiteness of rice by comparing and evaluating the whiteness with the standard device

From the study found that the temperature can describe the fluctuation of the whiteness significantly and statistically. The monitoring prototype equipment has the similar quality to the standard device, but faster in using time for monitoring and work in polishing operation continuously

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