Classification of layers of Raw Mokusaku Using HSI model in Python

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Abstract*— Mokusaku also known as wood vinegar, is a type of an organic fertilizer that was first introduced in Japan. In 2011, Yokomori introduced this technology in province of Benguet and since then farmers uses it. In order to produce a Mokusaku, it must be extracted from a three layered raw Mokusaku. Through image processing, the developed system will be able to classify each layer which will be extracted with pumps. HSI model in Python language was used due to difference of lightness/darkness of each layer. With this method, it will be easier and faster to extract the Mokusaku compared to the traditional that uses syringe for extraction which takes up a lot of time. The proponents recommend to develop a program or use another model that will determine the layers faster and more accurately.

Keywords*— image processing, automation, HSI model, extraction, Mokusaku

I. INTRODUCTION

Organic Fertilizer is a great help especially to those farmers who need an affordable fertilizer. Agriculture is one of the many areas which particularly needs further advancement in technology [20]. It has been a common practice for the farmers to use fertilizers to increase production and have a better quality of products. Over the years, farmers have been continuously developing alternative fertilizer that can be a good substitute to the fertilizer that is out in the market. Two of these methods are vermicomposting and bokashi. In this day, people are still finding ways on how they can produce their own organic fertilizer and there is another organic fertilizer called mokusaku that is being introduced in the market.

Mokusaku is an organic fertilizer that is introduced first in Benguet in the year 2011. [6] The production of this organic fertilizer is hard for it takes time to produce a liter of it. The procedures are [1] burning, [2] cooling, [3] sedimentation and [4] extraction. The first procedure deals with burning of materials such as banana waste, coconut husk, dried leaves. The second one is the cooling wherein the vapor that comes from burning process goes to a tube that has a cooling body through wiping wet cloths. The vapor becomes liquid as it condenses. Next thing is sedimentation or layering where they leave the produce raw wood vinegar to naturally do the layering where it takes 3-6 months. Lastly is the extraction wherein the mokusaku will be extracted from the other layers of the produced raw wood vinegar by means of a syringe. These are all done in the traditional way. Through this idea, the proponents desire to make local farmers know about this fertilizer. In line with this goal, the production of the mokusaku will be advancing through the help of technology.

This paper intends to discuss more specifically with the process of image processing and extraction of Mokusaku itself. To achieve this, image processing using HSI model as an algorithm will classify the three layers namely, [1] oil, [2] mokusaku and [3] tar. After classification, Mokusaku will be extracted from the three layered liquid using pumps. These procedures will be done by the use of technology to achieve the goal of having an easier way of extracting Mokusaku without the use of syringe.

II. IMAGE PROCESSING

Image Processing is a rapidly growing technology [9]. It is a method that converts the sample image to a digital signals and applies the operations that is suitable for the given image. One of the steps in acquiring a data for a given sample image is by analyzing and manipulating,which it includes data compression and image enhancement and spotting patterns that are not visible to the naked eye [10].

There are two methods in image processing; the Digital Image Processing (DIP) and Analog Image Processing (AIP). The analog image processing refers to the alteration of image through electrical means. Digital image processing refers to the processing digital images by means of of a digital computer [11]. The principle advantage of Digital Image Processing method is its versatility, repeatability and the preservation of original data precision [14]. In this study, the most suitable method of image processing that will be used is the digital image processing to preserve the original data on the image and to extract the data needed for this study. Figure 1 shows the various phases of processing digital techniques to maintain the originality of information while extracting the desired data from the image.[10].

There are several models used in digital image processing [15]. One of its models is the color image processing. This kind of image processing can distinguish hundreds or thousands of different color shades and intensities [13]. This image processing has two major areas which is the pseudo color image processing and full color image processing [16]. Pseudo-color processing is a technique where black and white's grey levels were manipulated to result in an assigned color [16] while the full color are images that are acquired and processed in full color [17]. The full image processing will be used to analyze the sample images that will be gathered and an application of color image processing will be applied such as the HSI model.

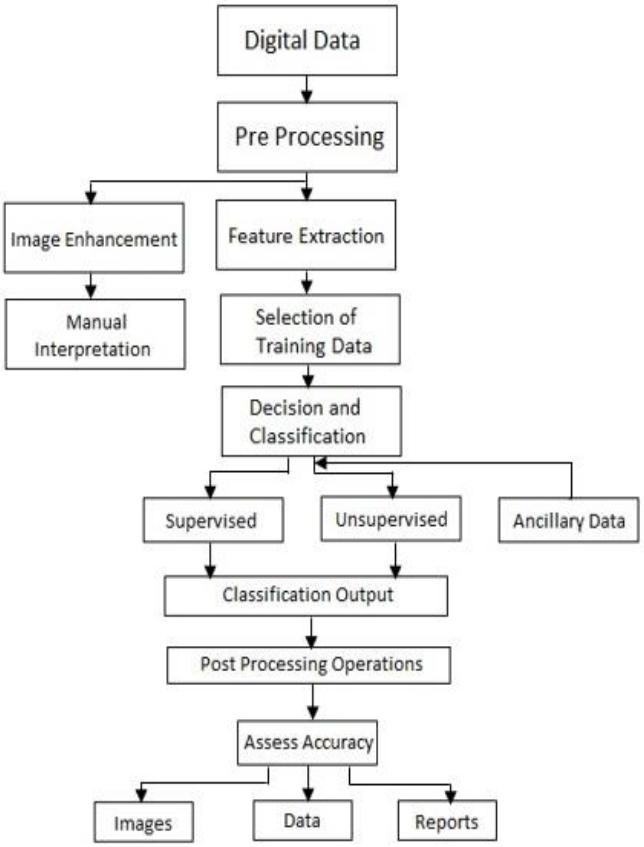

Figure 1. Different phases in digital image processing

The Hue, Saturation and Intensity (HSI) is a color model application. It processes color image based on the perceived color of human vision according to its color sensing properties [18]. Figure 2 exhibits the HSI model that shows the palette that represents the color. The components of hue have colors that form of an angle between zero to three hundred and sixty degrees (0-360); the value for red is zero, 60 degrees for yellow, 120 degrees for green, 240 degrees for blue and 300 degrees for magenta. the components for saturation represent the quantity of the color that contaminates the white color. The range of Intensity is between zero and one, wherein the value for black is zero and 1 for white [19].

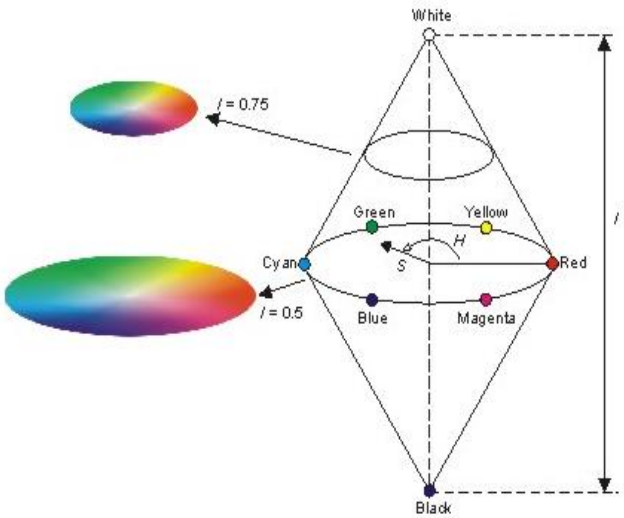

Figure 2. The HSI Model

III. METHODOLOGY

The study is divided into two parts, the classification of the layers and the extraction mode. The proponents developed a program for classifying oil, mokusaku and tar to separate each layer easily. After classification, a pump will extract the middle layer which is the Mokusaku.

a. Experimental Set-up

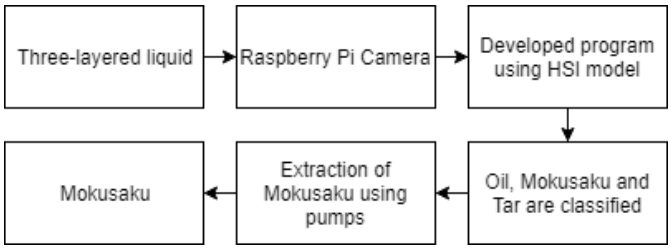

Figure 3. Process of image processing and extraction

Figure 3 shows the block diagram of how the system works. The three-layered liquid will be captured by Raspberry Pi Camera in real-time. The developed program using HSI model will then classify each layer. After classifying the oil, Mokusaku and tar part, the Mokusaku will be extracted using pumps. The tar part will be left in the container and Mokusaku is then extracted.

b. Hardware Design

The support holder of the container for the produced raw mokusaku for the centrifuge system was fabricated on an angled position to simulate the concept of centrifugation. Because of this setup, the recommended image recognition for the extraction of mokusaku is the HSI model due to the color properties [7] presented after the segmentation of raw mokusaku. With this technique, the control module, which is the Raspberry Pi can determine the height that will be extracted to get the mokusaku itself.

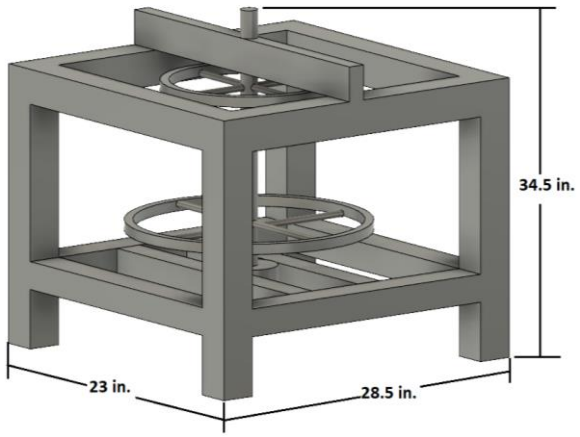

Figure 4a. Initial sketch of the centrifuge

Figure 4a shows the plan for the centrifuge system from the container to be used to the possible materials needed for the whole centrifuge system.

Figure 4b. Actual design of centrifuge system

Figure 4b shows the final and the actual prototype of the centrifuge system. The containers were made from acrylic tube as planned. Major changes were made due to some considerations on the motor that was used.

figure 4c. The produced raw Mokusaku

Figure 4c shows the containers with raw Mokusaku after undergoing the centrifuge system. Tar can evidently be seen separated on the lower part of the container.

c. Flowchart

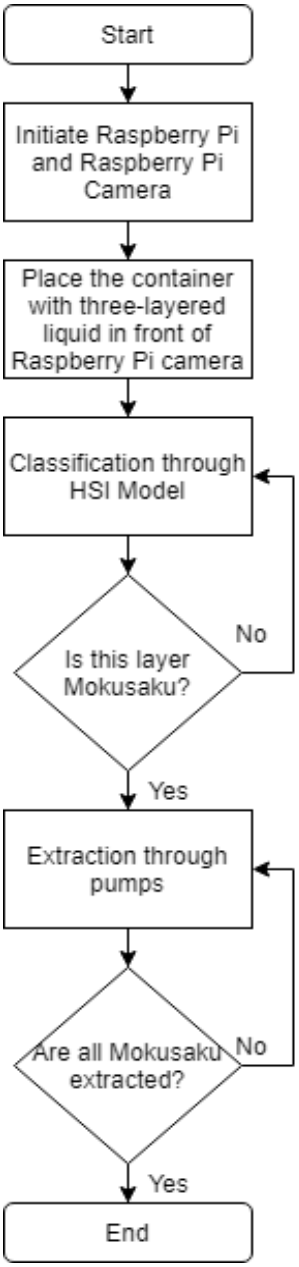

Figure 5. Flowchart of extraction of Mokusaku

Figure 5 shows the flowchart of how the program works. The flow starts in initializing the Raspberry Pi and Raspberry Pi camera that will be used for image processing. The container that contains the three-layered liquid should be in front of the Raspberry Pi for classification through HSI model to start. The program will then identify the height of the layers. Once the layers are identified, Mokusaku will be extracted through pumps by clicking the extraction button. If all Mokusaku produced was extracted, the program will end.

IV. DATA AND RESULTS

The following figures are the data that has been gathered through trials in corresponding results. Figures 6a-6d shows the height measurement of the raw mokusaku, tar and the result after centrifugation of raw mokusaku.

Figure 6a. Height measurement of raw mokusaku

Figure 6a shows the height measurement of the produced raw mokusaku. This measurement is also a parameter that is needed to get the total volume of the produced raw mokusaku which is one of the data needed in this study.

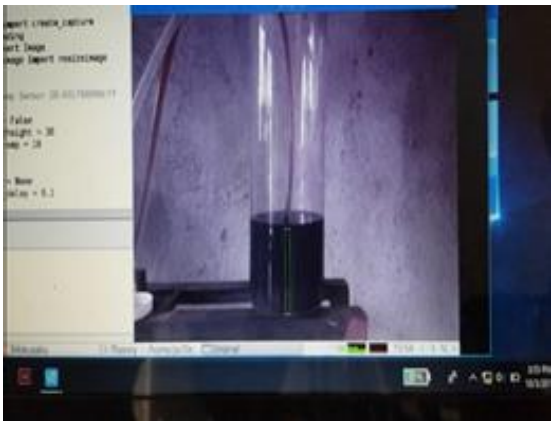

Figure 6b. Image capture of height of raw mokusaku

Figure 6b shows the captured image done by the camera of the system. The image shows how the image processing works to determine the height measurement of the produced raw mokusaku.

Figure 6c. The result after using the centrifuge

Figure 6c shows the result after the produced raw mokusaku undergone to the centrifugation. Centrifuge is the process made by the researcher to hasten the process of layering or sedimentation of the raw mokusaku compared to the traditional way that takes up to 3 to 6 months to have a layered raw mokusaku.

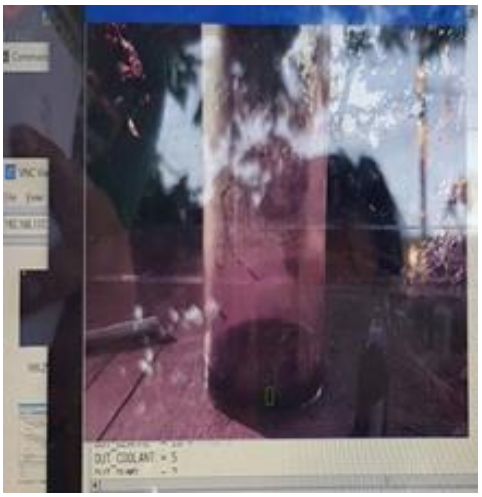

Figure 6d. Height of the tar after the extraction of mokusaku

Figure 6d shows the image done by the camera of the system. It is the result of the extraction of mokusaku from the raw mokusaku. The image shows the height measurement of the tar after the process of extraction.

V. CONCLUSION

The classification system for the raw wood vinegar can detect the layering made by the produced mokusaku. This means that the method used for image processing, HSI model in python is effective and efficient to use. The pumps were also effective for extracting the Mokusaku from the three-layered liquid which made it easier than the traditional syringe extraction. Figure 7 shows the finish product or the extracted Mokusaku from the three-layered liquid.

Figure 7. The extracted Mokusaku

Figure 7 shows the final output of the system which is the extracted mokusaku. This product will be diluted to water with a corresponding no. of liters depending on where will it be used.

VI. RECOMMENDATIONS

The researchers would like to recommend to other that has desire in this project to find another algorithm that can be used for classification of mokusaku. Since this is the first time for image processing to be used on extraction of Mokusaku, other algorithm may have a more accurate result in this type of study. Researchers would also like to recommend to find an alternative way of extraction without the use of pumps or have a better design for extraction of Mokusaku within the container.

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