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Halal and Non-Halal Product Recognition Systems

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In modern times, our lifestyle is becoming based on consumption. That makes the fulfilment of needs inevitable in daily life, in offices, households and schools. Stores that sell goods and food are almost ubiquitous, shops are mushrooming, and franchises are followed by competition among shop owners. The many discounts and various goods and food sold show us, as consumers, that we sometimes see shops close to other stores. Based on the product and the issues above, a portable and mobile application that follows the movements of consumers' "busyness" is necessary. Devices can be made that use smart phones. For example, consumers who come to buy meals will check menus, based on camera images. The mobile device proposed in this paper will then provide halal or non-halal information. It will help identify the product purchased. It has an accuracy of up to 90%. It does not use barcode data that is sometimes damaged and lost. Instead it recognises the pattern of goods which makes it faster. It can recognise a product, even though it is still packaged or sold in units. The product unit detection function avoids the use of barcodes and RFID which cannot identify the product if disassembled or sold per unit.

Key words: *Halal Product, Object Recognition, Information Systems, Retail.*

Introduction

A producer is obliged to inform consumers about halal products. The products sold must guarantee health, nutritional content, specify an expiration time, and most importantly identify whether they are halal, especially in Muslim-majority countries. Currently, we go to the grocery store and sometimes find food products and new drinks are halal, or not. That is especially so if we travel abroad. We are confused because the format and writing of product names differ in each country. Sometimes we can ask the clerk directly, or the cashier if the queue and shop is not so full, but this is still limited due to language barriers (Yunus et al., 2013).

Numerous goods and products do not accord with their purported quality. For example, the actual selling price of food does not always match the shelf price, or sometimes food products have expired or no halal stamp. This is quite contrary to regulations about consumers' rights to get halal goods. Reading the nutritional content of food products sold is the easiest method to uphold these rights. The nutrient content data is always listed on the packaging. Therefore we can find out the nutritional content. However, we face difficulties when the product composition description is in a foreign language. The second method for finding out nutritional content is to use a reader to ascertain the barcode, but only the cashier can do so. The most effective and fastest method is to use image recognition by reading forms and image data with a mobile device. As a result this system is more accurate and faster in ascertaining the halal content of products, as a sign that the food can be recognised, allowed, and consumed by Muslims (Aziz & Vui, 2012).

Current technological developments make it easier for consumers. They can get the desired product by using an information media system, so that products purchased by consumers can be seen clearly. These identities can be in the form of price data, producer names, expiration dates and, most importantly, whether the food is halal. A Muslim is only allowed to eat halal food. Some supermarkets have placed the halal logo on every food item sold. Therefore it is assumed that if Muslims see the halal logo, the food is allowed to be consumed. Some halal logos are made in the same manner across different countries, in accordance with the policies and regulations of every country. Other ways to check whether the product is halal, to check online, by logging on to a producer's or manufacturer's website. Usually the information is connected through a web network or portal. However, this method makes customers wait, just to see brand and product information. In practice, Muslims themselves sometimes have difficulties in recognising approved either halal logos or international acquisitions recognised in several foreign countries, so that the halal product distribution is very important (Razak et al., 2019).

Literature Review

The use of technology in recognising halal products has advantages and disadvantages. The use of halal logos that employ graphic animations is a demand, and in the end we can see variations of halal logos found in supermarkets and other places of sale, so logo design needs to be considered and uniform, to be understood by consumers (Zhu & Dorman, 2009).

To recognise a logo, some applications have been provided with the concept of reading using an algorithm. The latest technology is the application of RFID technology on the halal logo.

Its application helps customers recognise halal and non-halal food on food products. RFID reader systems will read basic information and store it on neural-network data processed with the backpropagation algorithm (Norzali et al., 2008a).

Automatic identification on the halal logo is a system to identify halal food. However, it is very difficult to implement it for consumers, while the use of RFID data has been widely operated and used in the commerce. The use of RFID can help consumers recognise all halal products in the supermarket. RFID itself has three main components; a "reader", an intermediary tool or middleware, and a tagging system. The tagger is used to detect the ID information of the product being sold, and the data is seen through the code installed on the database (Nasir et al., 2011).

Fake halal logos are sometimes attached to food products. Therefore, some research is needed to recognise a product through the available logos. This research project is the "logo detection and identification system". It functions as an image matching tool or "Image Acquisition." It detects and identifies a suitable halal product and logo, performs data normalisation, processes image data using a neural-network algorithm, for an output displaying whether the original logo data is authentic or not (Norzali et al., 2008b).

The technique of matching an image is known as the Spatial Integrated Macthing Association (SIGMA) method. This algorithm works by reading the relationship between data characters, by looking for correlations and similarities among the objects used. It matches an image pattern that is irrigated with an associate match pattern; it is able to identify an object with a logo size. The Sigma algorithm is highly accurate in matching an image pattern (Xu et al., 2010).
Another halal product can be introduced by using Augmented Reality technology on a smartphone. Augmented Reality can increase phones' already high capabilities, to inform the community before it buys food; this system is utilises existing, notifying, markers on products (Weber et al., 2015).

Data analysis and retrieval occurs through several stages. In the first stage, noise or disturbance to the object is reduced. A mean filter is used with a metric distance between two pixels or about 3 x 3 of the size of the matrix. Information in the image is Red (R), Green (G) and Blue (B) with x1 and y1 axis illustration. The new pixel information is stored at x2 value y2. The noise data is then sharpened again, by the reduction filter in accordance with the different noise characters. The formula for filter and noise calculation can be seen below.

Matrix Calculation Formula

x_1y_1	X_2y_1	X_3y_1
x_1y_2	X_2y_2	X_3y_2
x_1y_3	X_2y_3	X_3y_3

Based on the data, the geometry measurement stage is performed. This parameter will produce an area value, feret angle, and feret minimum. The value of a binary image reaches 75 to 255. The value 0 indicates black. Value 1 indicates white (Schneider et al., 2012).

Comparison of the length of the object is assessed from the ratio value or aspect radio. The (AR) is the ratio of the diameter and parameters of the object. The circularity value indicates the perfect circle shape, if the value reaches 1, which means the shape of the circle is elongated. If the value is equal to 0, it approaches the value of the equation equal to one. The shape of the object roundness is almost close to the elliptical shape of an object. It can be formulated as follows:

Texture Calculation Formula

$$Circularity = \frac{4.\pi.A}{p^2} \ldots\ldots$$

$$Aspect\ Ratio\ (AR) = \frac{L}{W}$$

$$Roundness = \frac{4.A}{\pi.L^2} \ldots\ldots$$

The next stage is texture analysis. This analysis is taken from the shape of morphological data changes, that form an image into two dimensions. The measurement parameters of the texture are the size with angular mode values, angular second, contrast, entropy and mean. Measurement parameters can be obtained by changing the coloured image parameters taken with a degree of grey scale with the calculation formula below (Adnan et al., 2015).

Texture Analysis Formula

$$Gray = \frac{R+G+B}{3} \quad \ldots$$

Whether the accuracy value of image quality is good, in taking an object using a lens, depends on the pixel and lens used. The camera will read the format of an object into RGB format. Then the system will change it to HSV (this colour transformation change is to sharpen the capture image that is not possible with RGB. This change system is called changing the saturation value of an object, or (s). It can be explained by the following formula (Karakose & Baygin, 2014).

Saturation Calculation Formula

$$MAX = \max\{R, G, B\}$$

$$MIN = \min\{R, G, B\}$$

$$S = \begin{cases} 0, & if \quad MAX = 0 \\ 1 - \frac{MIN}{MAX}, & else \end{cases}$$

The data manipulation technique is called filtering. This technique is used to see specific colour changes, by looking at the pixel values of an object and comparing them, whereas if an incompatible colour is found, then the system will display it into a background and the colours used are usually black. Some saturation colours used are RGB, HSV, YCbCr and HSV colours; some are used in research to identify the workings of robots, while HSV colours are very sensitive to light (Simangunsong et al., 2016).

In processing an image, cluttering is carried out. This process is to read a characteristic of the object that we examine, to have the same characteristics and similarities. Cluttering can classify an object based on certain similarities. It is different in each group of data systems. This system is useful for mapping onto the form of several clusters C = {c1, c2, c3, ... cn} (Ming et al., 2004).

The image format itself consists of several stages of each data taken by the camera. They will be stored in a file. Each stored file will have a different, characteristic format (BMP). This format is used to record compressed images. The compressed data can be in the form of colour images that are still in the form of binary numbers. The second format is PNG. This image format is in the greyscale image format. It stores colour palette data between 1 to 16 bits. The third format is JPG. This file format is used specifically for storing data images. Format conversion is the most widely used. The last is the GIF format. It is widely used in web applications, and is used because it has a size below eight bits (Gonzalez & Woods, 2019).

The most important process is the alignment of object patterns, the template matching method. It is the most important part of an object. It is the same as the function of the human eye that captures objects by eye and sends them back for brain signals; the image will be processed and if the object matches there will be a name interpretation of the object under study (Singh et al., 2015).

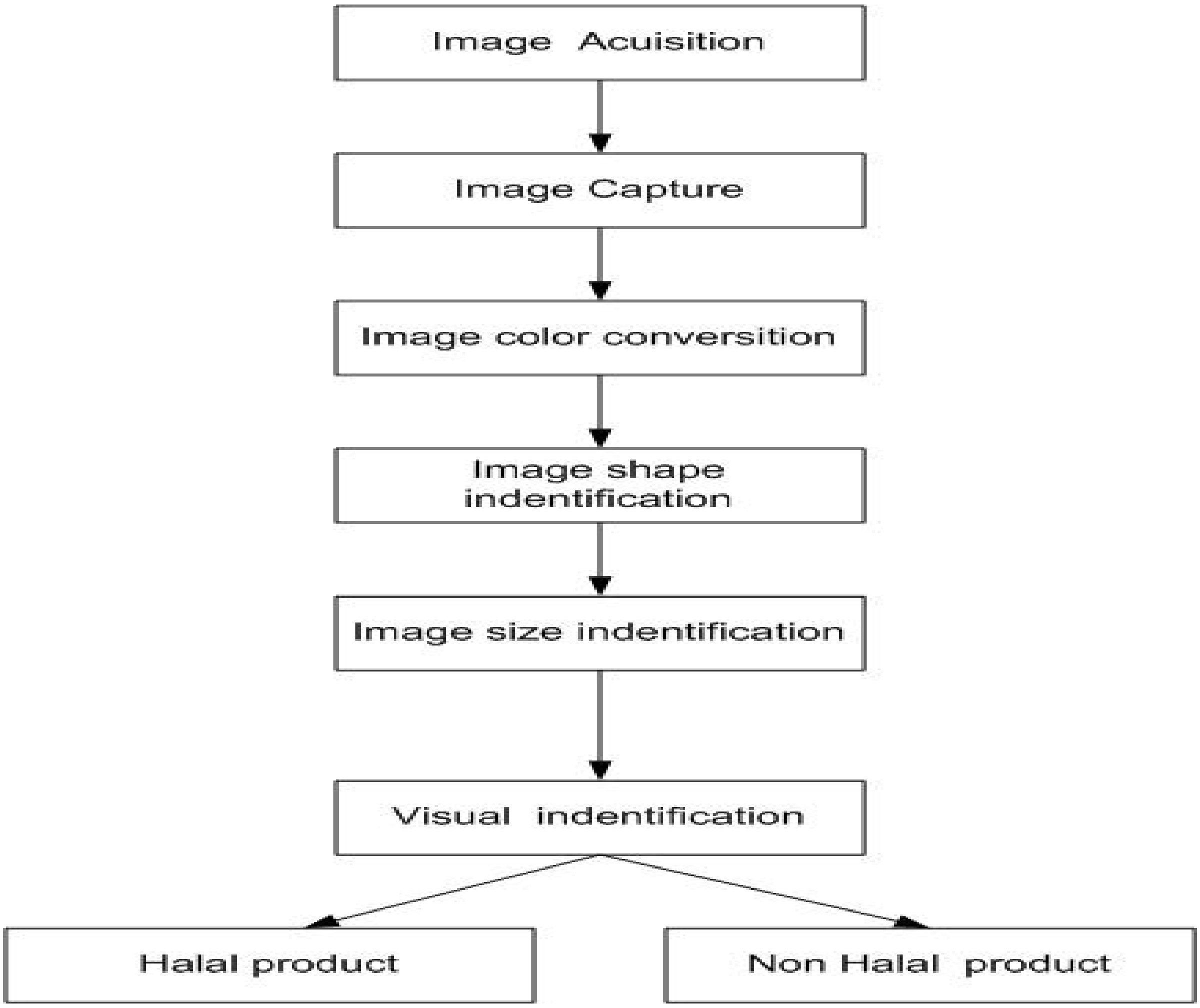
The next shooting technique is cropping. This method determines the boundary of the image object from the left and right position, and the size of the image from the top down. At that position we can determine the binary image boundary. Then, the next stage of the object will be changed according to the shape of the last cropping. This process will provide a margin crop of up to 20% of the main object. The last stage is measuring the accuracy of this process, to measure the success of the system and work performance; measurement parameters use training data with true and false parameter values with the following test formula (Adamu & Shehu, 2018).

Measurement Formula Accuracy

Abrasion = (correct amount data/ incorrect amount data) x 100%
The next most important stage is taking the tracking process on an object. That means the system will follow the object, and automatically retrieve a new information object tracking system on image processing. This tracking has decreased accuracy, due to image noise, dimension size, the image changes, the object is blocked by other objects; further the size of the object is complicated and the last is real-time data retrieval, and so that the accuracy is not reduced we need a reference value taken from the colour, shape and size taken on each object frame (Dash et al., 2012).

Research Methods

Figure 1. Product Recognition Stages



Stages of Product Recognition Method

1) Image Acquisition

Image acquisition is the calibration of the lens used when shooting. This is performed because the smart phone lens has a different pixel sharpness. Therefore it needs adjustment, so that the application can take the position of the image with the best pixel size.

2) Image Capture

Image capture is the taking of pictures of products or objects acquired by the customer. The product can be shot in a unit way or with many products at once.

3) *Image Colour Conversion*

The colour conversion system recognises the product from the colour of the product itself. The unique colours that exist on the product are usually different from each other even with different packaging.

4) *Image Shape Identification*

Shape identification is a product recognition process in terms of packaging. It is not uncommon to find products sold in sets or units. Therefore, the system tries to make these shapes, as measure of accuracy, from the introduction of a halal and non-halal product.

5) *Image Size Identification*

The last stage is size identification. The system must be able to recognise halal products that are still in packages or have been sold in units, because the halal barcode and logo systems are sometimes not installed on the product.

6) *Visual Products*

This is the output of the application. The system not only recognises a halal barcode or logo but also recognises it directly in the form of "Product Recognition." This system has higher accuracy because it does not rely on barcode and RFID systems which are sometimes illegible by machines.

Implementation and Testing Result

The system testing uses several existing product samples, in product recognition. The application goes through several stages, namely colour, shape and size. The system display provides information about a product that is "halal" or "non-halal".

Figure 1. Stages of System Testing

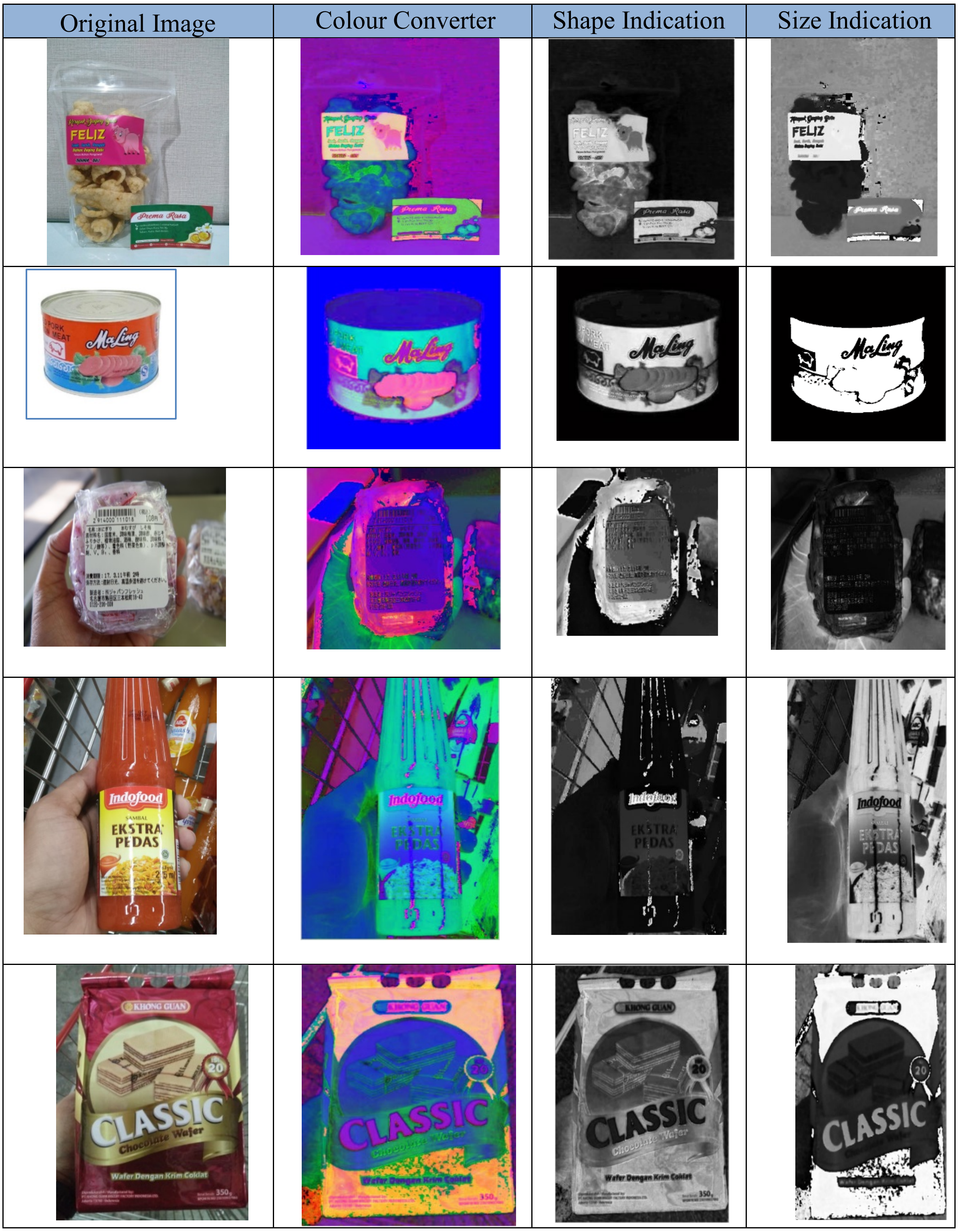


Figure 1 is the stage of testing the system as to the detection of halal and non-halal products, using randomly sampled data. During testing, the system reads and recognises the product through a system that detects the colour of the packaging. It can be seen in the testing table of each package put through the colour detection system. A unique colour is displayed, and the product name becomes clearer through colour gradation techniques. The third stage is the identification of shapes. The change in area size may occur in the market. Applications do not only detect packaging on the inside or incoming packaging, which is in a good condition. They also detect packaging that has changed due to its position or when packaging becomes different. The packaging may be stored in an upturned position or facing backward. However, this displacement will not prevent the system from recognising the pattern of goods wherein placement and rack position sales sometimes differ. The last stage is size identification. This identification is the most important part of product recognition. The system identifies the size and shape of the product packaging, because sometimes we find that the same products differ in size. The system is not affected by size changes. The patterns and shapes of products have been identified from the beginning with gradations of colour, so that product recognition becomes more accurate. This halal recognition system can run multiplatform, and can be implemented in various kinds of applications and different programming languages.

Figure 2. Source Code Colour Segmentation with Language C

```
Img = handles.Img;
[tinggi,lebar,~] = size(Img);
hsv = rgb2hsv(Img);

H = hsv(:,:,1);
S = hsv(:,:,2);
V = hsv(:,:,3);
```

Figure 2 is the process of reading colour segmentation using C language. The source code above C language transforms RGB colour into HSV. The output of this system is that the application automatically displays the height and width of the studied object.

Figure 3. Source Code Colour Segmentation with Java Language

```
public static void main( String args[] ) {
        BufferedImage image = UtilImageIO.loadImage(UtilIO.pathExample("sample Product.jpg"));

        // Let the user select a color
        printClickedColor(image);
        // Display pre-selected colors
        showSelectedColor("Yellow",image,1f,1f);
        showSelectedColor("Green",image,1.5f,0.65f);
    }
}
```

Figure 3, is a colour segmentation system with Java programming. Java programming language colour parameters are easy to use, with the parameters "yellow" and "green". Processing data occurs as "UtilImageIO" or input and output parameters.

Figure 4. Source code for colour segmentation in Python language

```
gray = rgb2gray(image)
plt.imshow(gray, cmap='gray')
```

Figure 4 is a colour segmentation system using the Python language. The source code above image data taken will be converted into RGB format and then transformed into black and white or greyscale.

Figure 5. Source code for colour segmentation with libraries in Python

```
from skimage.color import rgb2gray
import numpy as np
import cv2
import matplotlib.pyplot as plt
%matplotlib inline
from scipy import ndimage
```

Figure 5 is the process of displaying image data processed using Python. This language has an easy library to process image data and has a fast performance and image processing time.

Figure 6. Detection Results on Packaging Products

Figure 6 is the process of detecting objects using applications on packaging products. The system provides a visual appearance and the product includes the category of "non-halal" products.

Figure 7. Detection Results for Canned Product Packaging

Figure 7, above, is the result of reading and checking the program on canned food products. The system recognises the product through packaging and logos on the packaging and puts it into the category of "non-halal" products.

Figure 8. Detection Results on Bottle Packaging Products

In Figure 8, the system detects bottle packaging products. The system recognises the use of labels on the packaging, and recognises the product as "halal".

Figure 9. Detection Results on Biscuit Packaging Products

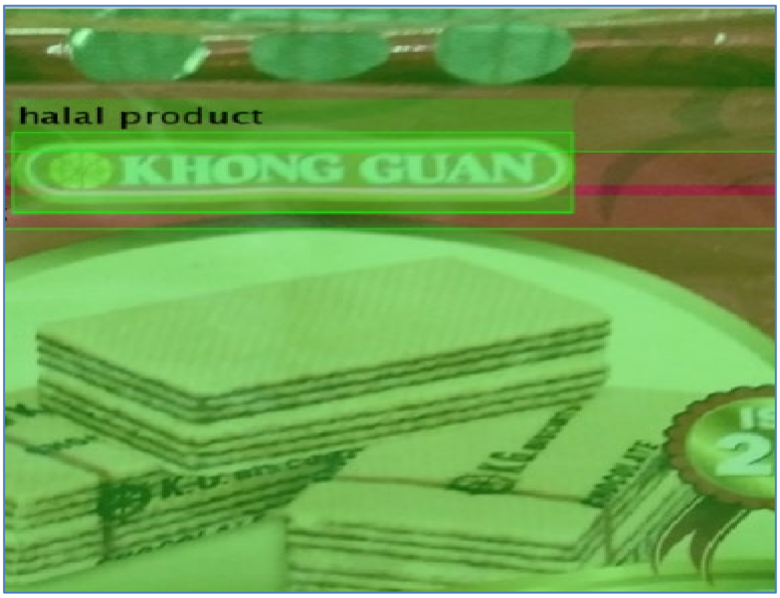


Figure 9 is a system detecting plastic packaging products. The system recognises the characteristics of the product, by recognising the writing and design of the logo. It includes the product in the category of "halal" products.

Conclusion

Halal product pattern recognition applications can be developed with mobile devices, for the ease of users who are busy with activities or travel extensively. The number of different products and types need not worry consumers, because the applications do not read barcodes or halal logos but directly use image recognition. The accuracy of this application is above 90%, compared to barcodes or the introduction of the halal logo. Further, the barcode logo and code can be lost, greatly impeding the recognition of halal products. The application in this paper can run by recognising shape and packaging. It depends on the outside appearance of the product. At this time, product data retrieval requires that the packaging is not damaged or broken, because that could damage the reading and accuracy value. This system uses a separate database. Therefore the speed factor of reading data depends on the mobile signal from the smartphone used. That is because the database is installed via a cloud server. Therefore, the next research step must be ensuring the use of a mobile phone signal and the addition of security features to the cloud server.

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