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Inrein App: Spice Detector Using Smartphone Camera Sensor

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Abstract. Indonesia is a very abundant spice-producing country, but not many people know the types of spices due to lack of information. The purpose of this research is to design a mobile-based application that functions as a platform for providing information about spices in Indonesia. The research method used in this study is descriptive analysis with a qualitative approach, while in the process of developing the application using a camera sensor on a smartphone. The results of the study indicate that the Inrein application development can provide information on spices using a digital platform that can be accessed through their respective smartphones. The main concept of this application is the introduction of types of spices to information on the location and use of these types of spices. In addition, this application also has a feature that can provide information on the management of spice ingredients into healthy food or drinks from spices that are detected by the user's camera sensor. The conclusion of the application that we made is able to help users to get information, manage and also benefit from spices.

Keywords: Camera Sensor, Spice Detector, Smartphone

1. Introduction

Spices are one of the biological resources that play an important role in the history of human life. Spices are mainly used by humans for various purposes. Tropical countries are the largest exporters of spices with a significant sales value [1]. Although spices have been known to have various benefits, today's appreciation of spices is very lacking. Many young people today are not familiar with various types of spices. Modernization and changes in people's daily consumption patterns are a real threat to the sustainability of the existence of spices. Because Indonesia has many types of spices, people often feel confused about certain types of spices because there is still a lack of knowledge about spices. Even people sometimes don't know the difference in turmeric, ginger, and galangal. Therefore, we implement sensors on smartphones to find out the spices. This concept is able to bring new experiences and also increase knowledge about spices where users can find out which spices are scanned and also know the benefits of these spices.

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Based on previous research, it shows that in recent years, the implementation of sensors has been widely used. There are many uses of sensors in everyday life such as temperature sensors, sensors for absences, speed sensors and many other sensors [2]. Therefore, we try to make a new innovation by implementing sensors to find out the spices in Indonesia. This method is able to know the spices precisely and clearly [3]. The new sensor model for spices can be used on each smartphone and then scans the spices and can bring up the names of the spices and the exact information about the spices [4].

The purpose of this study is to provide an overview of the implementation of sensors to find out information about spices. So that people know more about spices in Indonesia. Because the Indonesian people, especially young people, do not know about spices in Indonesia.

2. Method

The research method used is a quantitative research method. Object recognition system design. In the object recognition system, the image captured by the camera is processed using image processing techniques before being given to the image recognition system. The information obtained from the output of the recognition system is in the form of the number of objects, types of objects and shapes. The figure below shows diagram of the object recognition system, which can be explained as follows:

The image got from camera sensor; the colour image will convert into a grayscale image to reduce the colour depth.

From grayscale, object detection will be using Ad boost method, if object not detected, then capture image again.

If part of the image is detected as an object by the object detection engine then proceed with the next two options:

- Perform image data storage into the database as well as save the object file as a comparison material.
- If previously the object and image data have been stored in the database, then identify the object using the Eigenface PCA method.

Identify the object using the Eigenface PCA method is show in Figure 1.

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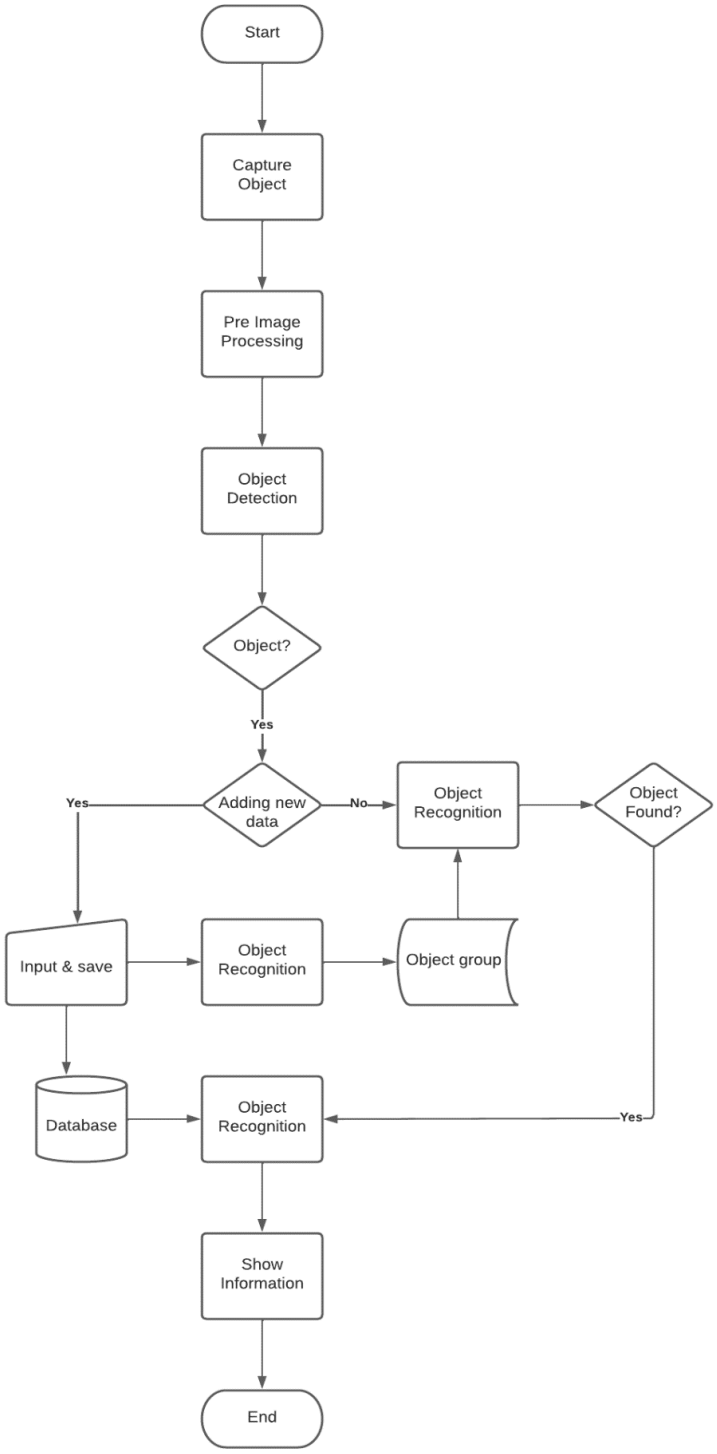

Figure 1. Identify the object using the Eigenface PCA method

The Figure above shows a flowchart of object detection (object detection) is done by classifying an image, after previously a classifier was formed from the training data. Object Recognition Algorithm show in Figure 2.

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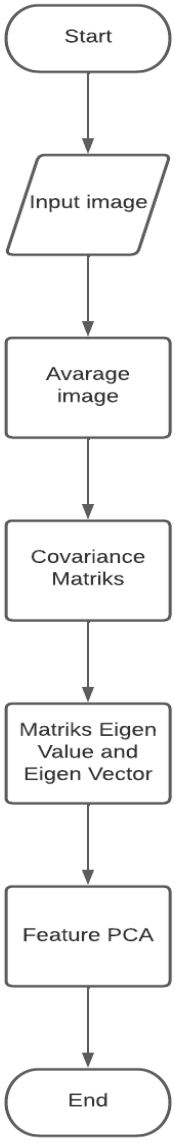

Figure 2. Object Recognition Algorithm

The Figure above provides the Object Recognition algorithm, which is the first step to obtain a set of S by M object images. Each image is transformed into a vector of size N and placed into a set. By performing the calculations developed by Lienhart, Kuranove and Pisarevsky [5].

$$S = \{_{1,2,3,} \ldots,_{M}\}$$

After getting the set, it will get the average image (mean image).

$$\Psi = \frac{}{M} \sum_{n-1}^{M} 1_{n}$$

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Next, look for the set of M orthonormal vectors, un, which best describes the distribution of the data. Vector Kth, uk, chosen as such.

$$\lambda_k = \frac{1}{M}\sum_{n=1}^{M}(u_k^T \phi_n)^2$$

Is the maximum for the subject

$$u_l^T u_k = \delta_{lk} = \begin{cases} 1 \text{ jika } l = k \\ 0 \text{ otherwise} \end{cases}$$

Furthermore, the covariance matrix C is obtained in the following way

$$C = \frac{1}{M}\sum_{n=1}^{M} \emptyset_n \emptyset_n^T$$

$$C = AA^T$$

$$A = \{\emptyset_1, \emptyset_2, \emptyset_3, \dots, \emptyset_n\}$$

$$A^T$$

$$L_{mn} = \emptyset_m^T \emptyset_n$$

So, we get the eigenvector, vl, ul

$$u_l = \sum_{k=1}^{M} v_{lk} \emptyset_k \qquad l = 1, \dots, M$$

Procedure introduction object on Eigenfaces Principal Component Analysis is as follows:

- Change new object be an eigenface component.

First, the input images are compared with the average images and their differences are multiplied by the respective eigenvectors of the L matrix. Each value will represent a weight and will be stored in the vector.

mk = u^T (□ − □) □^{T} = [m1, m2, … , mM]

- Determines which object class provides the best representation for the input image.

□$_k$ = "□ − □$_k$"2

3. Results and Discussion

Figure (see Figure 3) shows the object recognition architecture, which consists of two main parts, namely the interface and the server. In the server there are two main parts, namely the model and data source, the model is an object recognition method or algorithm, consisting of Object detection and Object recognition related to the data source in the form of a dataset (XML file) when object detection is carried out, image data stored in the database MySQL and object files in the form of various spice images in JPEG format.

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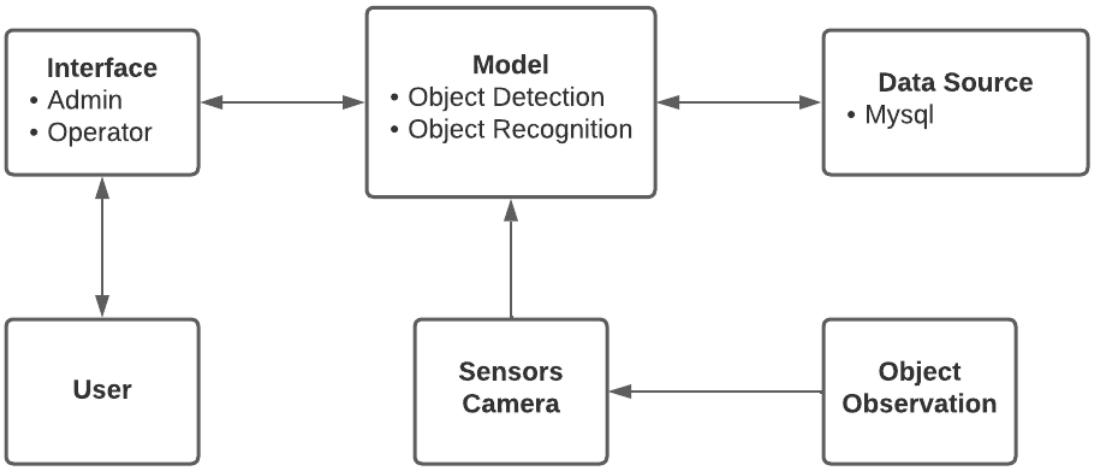

Figure 3. Data stored in the database MySQL and object files

The results of the development of the object recognition system application are composed of: Object Detection, Object Recognition and Database manipulation.

- Object Detection

  From grayscale objects (see Figure 4) will be detected with object detection as shown in the following figure.

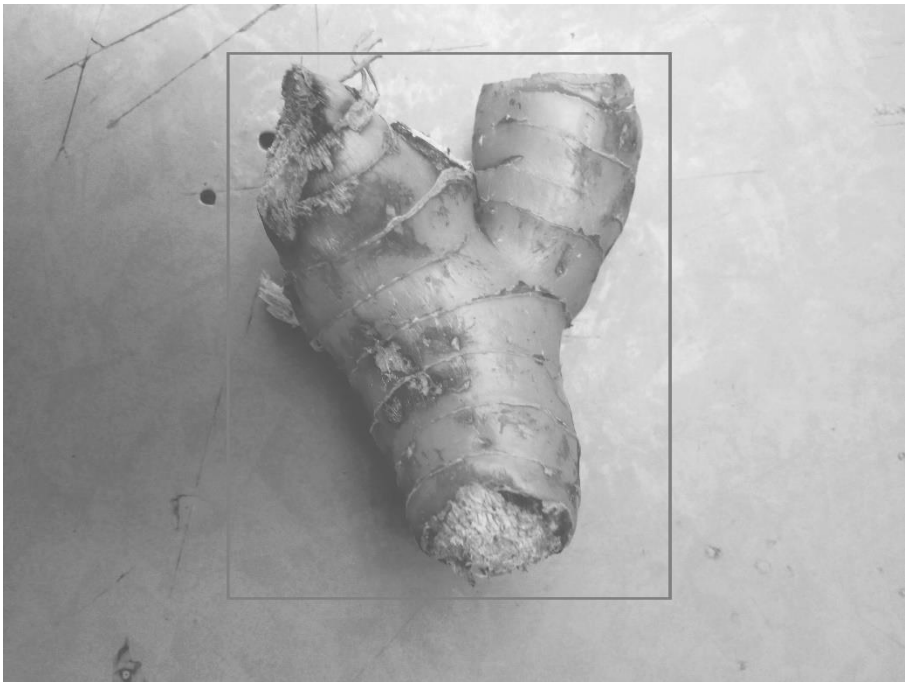

Figure 4. Grayscale Object

- Object Recognition

The next step is cropping the image to be identified using the Eigenface PCA object recognition method. The image of the object in the image will be the image of the training data stored in the object database.

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Figure 5. Object Recognition

After doing testing to 10 responses, the following table shows the results of the tests carried out.

Table 1. Test Result

Test Type	Level of Truth	Error Rate
Object recognition by lighting level	90%	10%
Recognition of objects by shape	73%	27%
Object recognition based on object distance and camera sensor	83%	17%
Object recognition based on quality	82%	18%
Average value of validity	**80%**	**20%**

From the testing of object samples, the results of the discussion include:

- If the light on the object is above 400 lux, the object can be recognized properly, but if the light is below 400 lux, the sensor will detect incorrectly.
- If the lighting is in normal conditions (more than 400 lux), the sensor results can detect based on the quality of the object, such as if there are damaged parts on the object that can still be recognized properly.
- Object recognition is also affected by shape. From the shape test, it turned out to be quite significant in influencing the application in recognizing objects.
- Inrein application will effective detection object at 0.30 meter - 1 meter when using smartphone camera.
- The time it takes the smartphone to identify the object (recognition to identification) is less than 3 seconds.

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4. Conclusion

The recognition system is able to do object recognition well if it is based on the level of lighting and the distance of the object as well as the sensor on the camera. Spices identification applications can help people to know the shape and characteristics to the benefits of each type that they want to know.

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