# Money Recognition Application

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**Abstract.** It is a big challenge for blind and visually impaired people to recognize the value of money notes when they are doing daily activities. Even though, some money notes already provide special identification marks on it, these identification marks are not effective enough to let them know the value of the money correctly. For some time, the identification marks on the money notes will fades away or the old money notes will not be able to detect the identification marks anymore. This will be more difficult for them to recognize it easily. Thus, Money Recognition Application is developed to help blind and visually impaired people to recognize money notes by informing the value of the money notes on their hand. The development of this application can help user to recognize money notes when they are doing daily activities and save time from looking of other people to ask the value of the money notes. This application is developed using Android Studio and OpenCV library will be included for applying the image processing techniques.

**Keywords:** Money Recognition Application, Currency Recognition System, Colour Histogram, Histogram Comparison, Image Processing.

## 1    Introduction

Money Recognition Application is a mobile-based application that recognize money notes in Ringgit Malaysia for blind and visually impaired people. The ideas to develop this application is due to the difficulties faced by these people during make a transaction or doing payment for goods and services. Usually they will ask for help to know the value of the money on their hand, or sometimes they will touch the braille pattern on the money notes by their own. By using advanced technology today, image processing technology can detect and recognize any object as long as it have any unique pattern or special characteristic that make it differs from others. For money notes, it can be detected and recognized by this application due to the difference in colour that represent for each values. Using colour histogram technique in detecting money notes is very efficient compare to other techniques since every banknotes of Ringgit Malaysia have different colour for each values. Thus, this project aims to apply this techniques to recognize money faster and efficient to be used for blind and visually impaired people.

Every money notes has their own size of paper, colour and unique pattern that represent to its value. For blind and visually impaired people, it is quite difficult to differentiate it even though every money has their own identification mark or braille pattern for them to touch and identify the value correctly. On the other hands, the different size between each money notes will make them confused and unable to distinguish the paper money from one another. Unlike coin, the denomination which can be easily identify by their size and weight. So, this project proposed a solution with Money Recognition Application, where this application will capture the money notes on blind and visually impaired people's hand

and notify them the value of the money. This application also helps these people to recognize money easily and make them faster to accomplish their daily life activities.

Therefore, the objectives of this project is to:
  i.     To analyze how does colour histogram technique can recognize money notes.
  ii.     To design and develop an application to recognize money notes for blind and visually impaired people.
  iii.     To implement the image processing techniques on money recognition application using colour histogram.
  iv.     To evaluate how the application can recognize money using colour histogram.

This project focuses on money notes in Ringgit Malaysia currency only which are RM1, RM5, RM10, RM20, RM50 and RM100. User target that will use this application are blind and visually impaired people. This project will detect the colour of money notes by using colour histogram to recognize its value, and use audio playback to inform the users the value of the money. Besides that, users will capture only money notes by using Android smartphones camera and only will can differentiate between money notes.

## 2     Literature Review

### 2.1     Related Work

There are more than 200 different currencies used in different countries around the world. The technology of currency recognition aims to search and extract the visible and hidden mark on paper currency for efficient classification. Thus, Currency Recognition and Conversion System are implemented, for example in bank, to reduce human power by automatically recognize the amount of value and convert it into the other currencies without human supervision.

Many researchers and developers have been developed several Currency Recognition System with different type of currency all around the world such as Indian Rupees, Euro, Australian Dollar and many more. There are also many studies in currency recognition to determine either the currency is real or fake. There many researchers advancing their achievement into more practical application in currency recognition system to help visual impaired person and old people with reduce vision power, which often could not recognize the correct money that they currently hold.

There are several proposed algorithms and techniques applied by various researchers depends on different currency recognition that are developed. Selecting the right features and proper algorithms are important to makes the system more successful and efficient. The basic requirements for an algorithm proposed as practically implemented are simplicity, less complexity, high speed and efficiency.

### 2.2     Existing Techniques and Algorithms

The objectives of the proposed algorithms in Currency Recognition System is to develop an algorithm which can be easily applied to different currencies that has a good

efficiency and high speed (Chinmay Bhurke, Meghana Sirdeshmukh, and M.S. Kanitkar, 2015). The proposed algorithms are as follows:
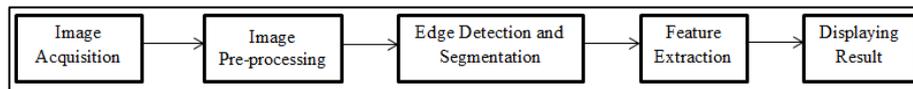


**Figure 1:** Pipeline Algorithms in Currency Recognition System

**Phase 1: Image Acquisition**

An image of currency notes can be obtained by using digital camera or scanner. The image then stored for future processing

**Phase 2: Image Pre-processing**

This operation are required to suppress undesired distortion or enhance some image feature that are important for next processing such as edge detection and segmentation, and calculating colour features.

**Phase 3: Edge Detection and Segmentation**

Edge detection is image analysis for finding region boundaries and binary image is required. This step is simply separated the background and foreground and separate the region of interest (ROI).

**Phase 4: Feature Extraction**

This process is to extract required information from the cropped ROI. From the binary image, the dimension of the currency and the aspect ratio can be found out. Then the aspect ratio of the target image is compared with the ideal aspect ratios of all the denomination of the particular currency. The other features extracted are H, S, and V of particular blocks of the currency. It divided the currency in number of blocks and extracted HSV values of the entire pixel and takes average of their H, S, and V features and again compares them with the values from the database of original image stored.

**Phase 5: Displaying Result**

The figure above shows the examples result of Currency Recognition System that successfully recognizing EUR and INR banknotes. Each column in the image provide output of different pre-processing techniques.

**Figure 2:** Example Result for INR Recognition
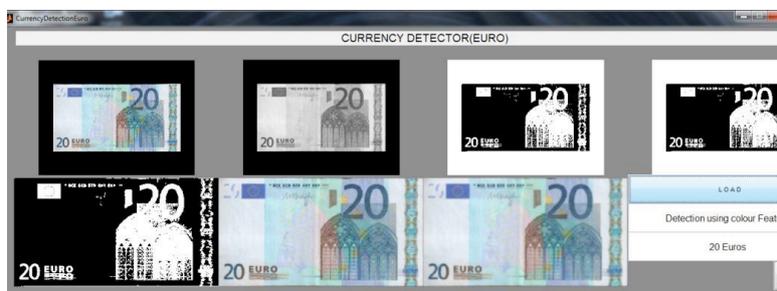


**Figure 3:** Example Result for EUR Recognition

### 2.3    Proposed Techniques and Algorithms

Some researcher had used image histogram based on which plenitude of different colour in a paper currency was calculated and compared with the one in the reference paper currency. Based on colour component analysis of currency notes, a researcher suggested that currency notes have at least one colour which is more prominent and that had been utilized by them to recognition. RGB Colour based classification had also been used by many authors to classify currency notes based on the fact that each notes, only one of these colour component is uniquely prominent. However some other authors considered classification based on analysis of colour histogram, hue, saturation and intensity value. They suggest that advantage of HSV colour space that it is closer to human conceptual understanding of colours and has the ability to separate chromatic and achromatic components.

### 2.4    Comparison

Most of the system that have been developed related to currency recognition use similar algorithms, which are image acquisition, image pre-processing, edge detection and segmentation, feature extraction, templates matching and validation the output. Although the algorithms used are quite similar, but different techniques in image processing are used for the feature extraction. For instance, image histogram, texture model and others. This is

because of the currency type are different according to their country. They are different to one another in term of paper size and its features on the banknotes. Different uses of the system leads to the different types in feature extraction techniques.

## 2.5 Summary

Various algorithms have been proposed for reliable Currency Recognition System with different type of currency in different countries around the world. Most of the work done in recent years related to the currency recognition has been nearly perfectly successful and mostly confined to colour, pattern, texture and so on. The framework of the existing method is used and the focus is highlighted on image acquisition, image pre-processing, edge detection and segmentation, feature extraction, templates matching and validation the output. Most of the researchers and developers proposed this kind of techniques is for simple and comparatively less time consuming which made it suitable for real-time application.

## 3 Methodology

This section presents the methodology that is used in this project. **Figure 4** shows the main segments to guide this project on its design and development cycles. The step involved in this project are include colour histogram calculation and histogram comparison.
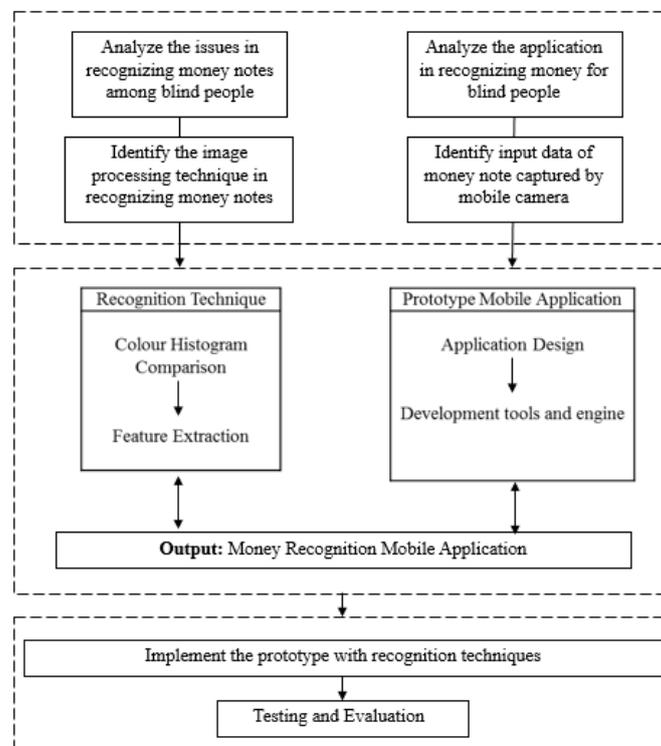


**Figure 4:** Overview of the Project Methodology

Money Recognition Application basically is a mobile application consists with image acquisition module, image pre-processing module, image segmentation module, colour histogram calculation module, histogram comparison module and post-processing module which is the result of th reocgnition. **Figure 5** illustrates the process flow of the application.
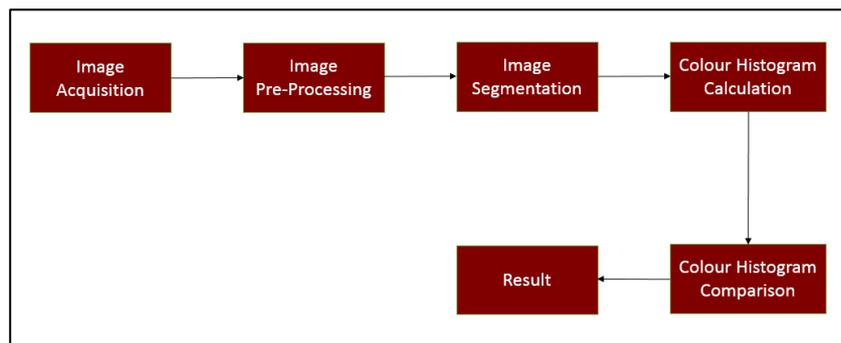


**Figure 5:** Process Flow of the Project

The main part in the process flow of the project as shown in the Figure 5 is 'Colour Histogram Calculation' and 'Colour Histogram Comparison'. In this module, the money image will be process to know the value of the money note. The histogram of the money image obtained from smartphone camera that has been cropped is calculated then is compared with the histogram of sample image of money notes stored in database. Through this process, the value of the money notes is identify and ready to inform the user.

## 4      Implementation

### 4.1      Application Design

The implementation of recognition technique is the main process that is important to ensure the developed application is functional. Colour histogram technique is used as recognition technique to recognize money notes and identify its value. There are two parts that is used in the colour histogram technique which are colour histogram calculation and histogram comparison. Figure 6 illustrates the application framework for Money Recognition Application. The details flow about how the application works is clearly shown in the figure above. This project has been developed using Android Studio software which can only be deployed in Android device.

The application starts with open the smartphone camera and users need to capture the money note as an input image. After an input image is acquired, the application will auto-crop the input image to remove unnecessary part that will affect the process in recognition techniques. Then the cropped image will be used in recognition process to recognize money.  OpenCV library is used to implement the recognition technique in Android Studio

for the process of recognize money. Colour histogram calculation and histogram comparison are involved in the recognizing money notes as its recognition techniques. The input image that have been cropped earlier will been calculate its colour histogram then will be compared with the histogram of the image reference in the database. There are several images of money notes with different value and side that is stored in the database. The image reference is necessarily stored in the database so that every input image is captured by user then will be compared
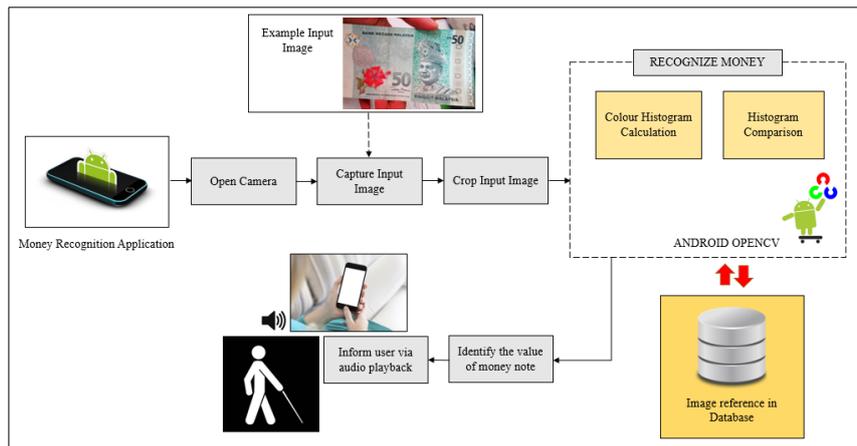


**Figure 6**: Application Framework

The feature extracted from both colour histogram technique applied will then be used to recognize the value of the money notes. After the application recognize the value of input image, it will notify the user the value via audio playback. OpenCV library to go through the process of colour histogram calculation and histogram comparison.
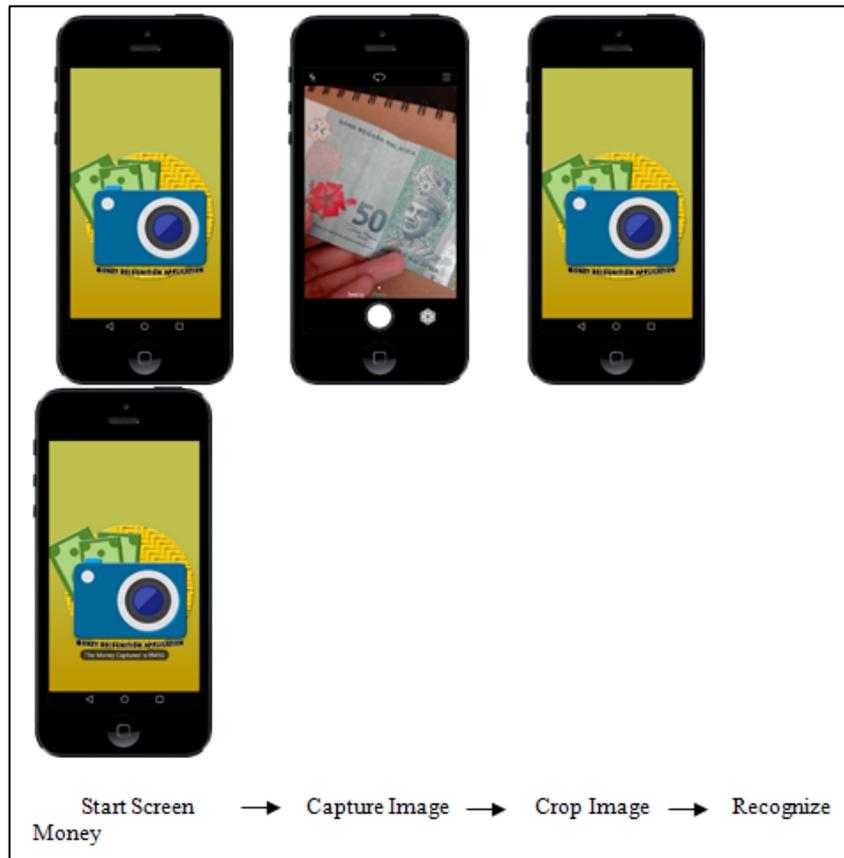


**Figure 6:** Interface Design of the Application

## 5    Result

### 5.1    Recognition Accuracy

This section will discuss about the accuracy of recognition of money notes. There are several image testing that are used for recognize the value of the money notes in this application to get the accuracy percentage.

**Table 1:** Result for Testing Image for Device

| Money Note Value | Accuracy Percentage |
|:---:|:---:|
| RM 1 | 95% |
| RM 5 | 65% |
| RM 10 | 85% |

| RM 20 | 75% |
|---|---|
| RM 50 | 95% |
| RM 100 | 85% |

Using correlation method in compare histogram, two images is been compared between image captured by the user and image reference in the database. If the correlation value is greater or nearer to 1 it means that the image captured is similar to the image reference in the database. This means that the two images having the same value. In **Table 1** above shows the accuracy percentage in recognition of money notes to get the correct value. Money notes value RM1 and RM50 have high percentage which are 95% for both money notes, while RM5 have lowest accuracy percentage.

## 6      Conclusion

There are several limitations that have been identified in this project development. Firstly, the application only recognizes money notes only. It does not recognize coinage which could cover all Malaysian Ringgit currency and could become complete version for Malaysian Ringgit recognition application. The application also only can differentiate between money notes only. Since it only can detect colours, there are many other object that might also be detected as money notes. This is because the application only consist basic detection techniques for recognition as it is intended only for blind people.

There are already planned improvement and modification to overcome the current limitations for the application in the future. If given more time to do further development of the application after this, recognition for both side of money notes with selected pattern on the money notes can be implemented to the application for more accurate recognition. For example, the picture on the back side of every money notes is totally different and each of them was very unique. It will be more functioning if those functions can be included in this application.

Thus, this short paper has highlighted some limitation that has been identified during the development of this project. Moreover, several recommendations to overcome all the limitations has been discussed to improve the project in future work. This shows that there are limitless possibilities to further improve the application using current technology, given time, ideas and requirements to produce useful application to the community. It is believed that, without time constrains, the design and performance of the application could be more interesting and smooth. Thus, it can be conclude that more study should be conducted on similar field of development in order to produce good and interesting end product.

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