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# A SMART Phone Currency Reader for the Vision Impaired Individual

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**Abstract:- Globally the number of people of all ages vision impaired is estimated to be 285 million, of whom 39 million are blind by World Health Organization [1] .Due to the growing of population and ageing, these numbers are expected to double by the year 2020.For the millions of blind people living in Sri Lanka, paying for something in cash face major challenges. A new application, "SMART Phone Currency Reader for the Vision Impaired Individual" implement on the android platform as a solution to this problem by taking advantage of mobile camera to detect currency value. There is less number of application have been developed in Sri Lanka for vision impaired people to recognize currency note, but those applications are not support for identify new currency note. SMART currency reader is helpful application with separate implementation of mobile and server, that simple and easy to use and also it will recognize new currency value as quick as possible. The image detected by the in-built mobile camera, will analysis in separate server by applying different types of image processing techniques for identifying the value of the currency note After that the value of the currency note stored in the text file and send to the mobile phone using the KSOAP protocol. The KSOAP protocol responsible to handle the network connection. Finally speak the value of the currency out loud through mobile phone speaker.**

***Keywords:-*** *SCRVII – A SMART Phone Currency Reader for the Vision Impaired Individual.*

SMART phone- A Smartphone is a mobile phone built on a mobile operating system, with more advanced computing capability and connectivity than a feature phone.[2]

Vision Impaired- Visual impairment (or vision impairment) is vision loss (of a person) to such a degree as to qualify as an additional support need through a significant limitation of visual capability resulting from either disease[3]

## I. INTRODUCTION

Today in the world the population of the blindness and the visually impaired are rapidly increased. According to the statistics of the World Health Organization (WHO), there is having 45 million people in the world are blind and 135 million people in the world are visually impaired. So that using these statistics the experts are giving ideas about that there will be 75 million people blind by 2020 [1](if trends continue).And also their research about the blind community they find out that 90%of the worlds blind people live in developing countries and 33.3 million of the world's blind people live in developing countries.[1]

Vertical order of heavily printed dots processing according to the denomination appears on the left-hand side of the newly released currency note in Sri Lanka, to help the blind people to recognize the denomination. [4]. Blind people can in turn find the corner containing the Braille dots and read them to know the amount they are holding. According to the information gathered from blind federation of Sri Lanka, researchers were able to find, this method is not compatible with newly released currency note in Sri Lanka.

There are several ways such as a wallet with many drivers, folding currency note, for the purpose of identify currency notes and coins independently without getting aid of electronic devices. But each method has its own limitations.

They are,

- Bulky
- Expensive
- Poor in accuracy due to restrictive processing power.
- Most of the existing devices work for only one set of currencies.
- Less portable.

A SMART Phone Currency Reader for the Vision Impaired Individual (SCRVII) is created to overcome many of the above-mentioned disadvantages.

SCRVII Server is a software package that can perform with fully functional, highly user friendly and accurately.

Also, the main advantage is without used any external hardware’s users can get the service thorough the mobile phone, so that it is provide the user friendliness.

## II. METHODOLOGY

SCRVII contains the following 4 major components,

- Image capturing and object recognition.
- Handling the communication between Mobile Application and the Remote Server
- Color detection
- Template matching

*A. Image capturing and object recognition.*

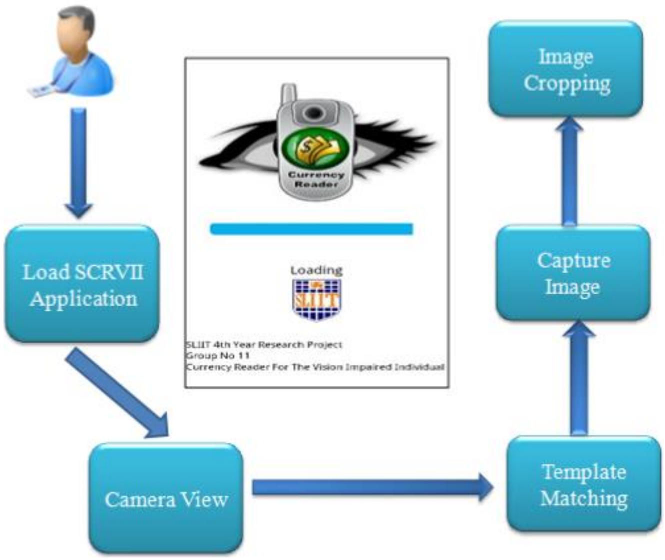


Fig 1: Image capturing and object recognition.

Figure 1 demonstrates how user loads the application and how the system identifies the features of the currency note. Initially user has to load the SCRVII application by giving voice commands. Then the application automatically goes to cameras interface. When user moves the camera on top of the currency note, application will automatically identify.

*B. Handling the communication between Mobile Application and the Remote Server*

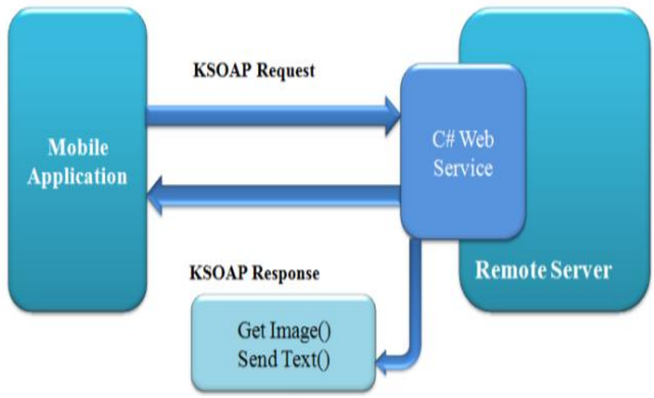


Fig 2: Handling the communication between subcomponents.

Figure 2 describes how the communication happens between mobile phone and remote server. KSOAP is used as the communication protocol. KSOAP specially designed to deal with small, embedded devices like mobile phone. KSOAP is a lightweight and efficient SOAP library for the Android platform. SOAP toolkit provides great functionality, relative simplicity and ease of use for the developer [5]. First captured image is converted into byte stream and send it to the server through c web service using KSOAP protocol. Inside web service two functions are implemented to get the image for image processing and for send the response back to the mobile phone.

*C. Color detection*

Input for the color detection algorithm is the image that defines the region of interest. Color detection algorithms access each pixels of the image and convert each pixel into an approximate color type (e.g. Green, Blue, Red, etc.) based on its HSV (Hue, Saturation, Value) color components. In the image below, show some pixels are converted to red, some to Orange, and some to green etc.

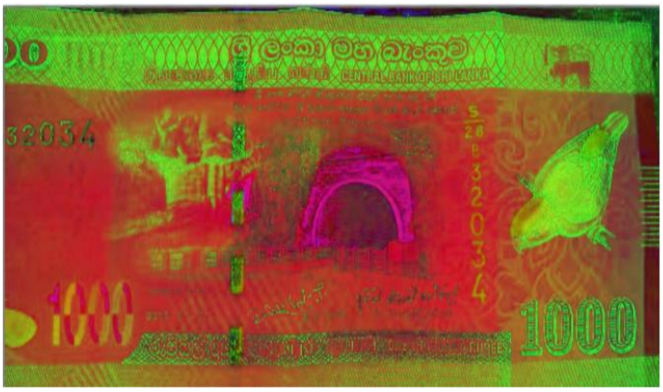

Fig 3: RGB to HSV converted image.

Then it see if there is a certain color type that is most dominant in that small region, such as if 60% of the pixels into the currency note are detected as red pixels, gray pixels, and etc. .Then it will classify the currency note as green, with this much of confidence. According to the color have defined.

```
Yellow 1%,

Green 67%,

Aqua 0%,

Blue 0%,

Purple 0%,

Pink 0%,

currency value is 1000
Color of Currency Note: Green (67% confidence).
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Fig 4: Output of the color detection function

*D. Template matching*

The currency note template images are categorized inside the folders according to the value of the currency note. In each folder various types of template images are stored. According to the detected value from the color detection component it redirects to the relevant category of currency note templates and do the template matching until get the correct matching result.

SURF (Speed Up Robust Features) [6] algorithm is used to perform template matching function. SURF is becoming one of the most popular feature detector and descriptor in computer vision field. It can generate scale-invariant and rotation-invariant interest points with descriptors. Evaluations show its superior performance in terms of repeatability,

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distinctiveness, and robustness. The calculation and matching of SURF is also very fast, which is desirable in the real-time applications. SURF is selected as the interest point detector and descriptor based on the following reasons:

- Currency note image could be taken under the conditions of rotation and scaling change. Interest points with descriptors generated by SURF are invariant to rotation and scaling changes.
- Computational cost of SURF is small, which enable fast interest point localization and matching. In this section we provide a brief summary of the construction process of SURF.

SURF analyzes an image like the one in Figure 5 and produces feature vectors for points of interest ("ipoints").

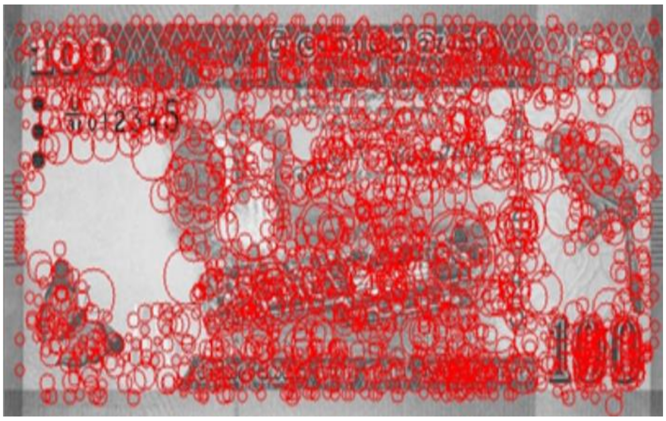

Fig 5:- The SURF application identifies points of interest within an image.

A feature vector describes a set of interest points, consisting of the location of the point in the image, the local orientation at the detected point, the scale at which the interest point was detected, and a descriptor vector (typically 64 values) that can be used to compare with the descriptors of other features.

A diagram of the application is shown in Figure 6. To find points of interest, SURF applies a Fast-Hessian Detector that uses approximated Gaussian Filters at different scales to generate a stack of Hessian matrices. SURF utilizes an integral image, which allows scaling of the filter instead of the image. The location of the interest point is calculated by finding the local maxima or minima in the image at different scales using the generated Hessian matrices. The local orientation at an interest point maintains invariance to image rotation. Orientation (the 4th stage of the pipeline in Figure 3) is calculated using the wavelet response in the X and Y directions in the neighborhood of the detected interest points. The dominant local orientation is selected by rotating a circle segment covering an angle of 60 degrees around the origin. At each position, the X and Y responses within the segment of the circle are summed and used to form a new vector. The orientation of the longest vector becomes the feature orientation.

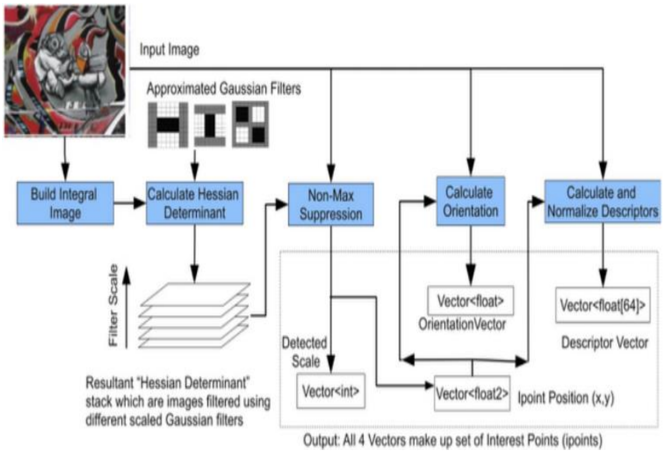


Fig 6: The SURF application block diagram reveals the computational work items.

The calculation of the largest response is done using a local memory-based reduction. The 64-element descriptor is calculated by dividing the neighborhood of the interest point into 16 regular sub regions. Haar wavelets are calculated in each region and each region contributes 4 values to the descriptor. Thus, 16 * 4 values are used in applications based on SURF to compare descriptors.

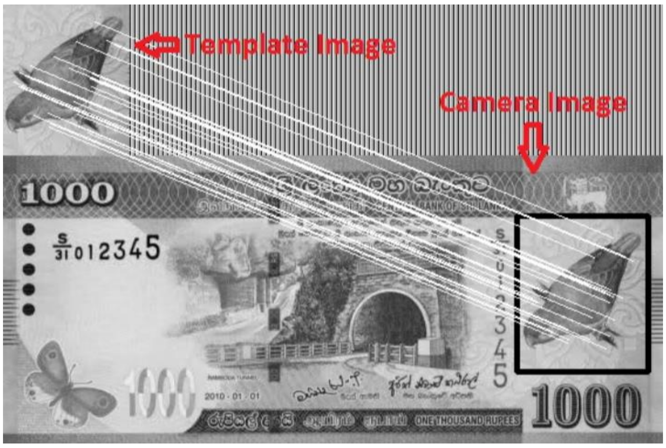


Fig 7: The output of the template matching function

Finally, the descriptor vectors are matched between different images. The matching is often based on a distance between the vectors, e.g. the Mahalanobis or Euclidean distance. Figure shows the outcome of the template matching function. After the confirmation of the currency note the value will be stored in a text file.

## III. RESULTS AND DISCUSSIONS

Mainly Image Processing Technology is used for currency note detection and for value identification as it is very effective. Image processing approach consists with three major steps since research need 100% accurate and effective result. As first step detect the region of interested. The second step involves detecting the color using HSV (Hue, Saturation, and Value) color model. Base on the color basically identify the value of the currency note. Color detection algorithm take very lees amount of time for color identification but the possibility of getting accurate result is about 65%. Because

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color identification depends on many factors such as light condition, illumination and quality of the image. The third step requires using this color for loading templates. Its take considerable amount time to load all the templates and do the matching. In order to increase the efficiency of the application research limited the no of templates that need to be loaded and need to be compared.

## IV. CONCLUSION AND FUTURE WORK

Since the application demands high accuracy, in that case we are identifying the value of the currency note under two functionalities. They are color detection and the template matching. In the Color detection function identifies the currency note using the color. After that load the relevant templates according to the color and matches with the original image. So that can increase the accuracy of the system. Apart of that in the handling the network connection, use serialization and De-serialization. In the SCRVII, the response time should not exceed more than 5 seconds. So that user can get very quick response using the SCRVII application.

An important assumption done while developing the system is that user manual will be provided with the initial product, but under the circumstances the user no need to have a proper user manual. The user only needs some kind of a prerequisite training of the application. We are assuming that user have the basic idea about the manual technologies used to identifying the currency note. According to that the user can identify the Emboss lines which are in the currency note. And also assuming that the user has idea of handling operations in the android mobile phone.

When the project team was performing various phases, we came across some limitations. Among them the application needs to be developed and run ounces running Windows XP or later operating system was an issue. Mainly the server developed using the Language in Microsoft Visual Studio 2008 IDE. (Supporting languages like C++ can be used). And for the image processing functionalities done by using the OpenCV software which uses the C++ language. But the OpenCV does not support for the Visual Studio 2010 IDE. And also, when consider about the mobile application it is only can install for the smart phones which having operating system as the Android.

The presented system can be improved in following ways.

The SCRVII main application is developed for applicable to the android platform. But in future we focus on developing the application in a different high level operating system (Ex:-Apple OS)

In the remote server is performing the identification of currency note value using the image processing. The image processing component consists with the two components. They are Color detection and template matching. But in some situation color identification function does not perform as expected. So that we expect to increase the efficiency of that function.

When consider about the communication between remote server and mobile application, it is handled by using the KSOAP protocol. So, in future we are tried out to use another efficient and reliable protocol for communication.

- And, in the communication handling component basically work by using the web service. So, we are trying out different technologies in order to find out for the preferable communication.
- In the SCRVII application mainly consists with two parts. They are mobile implementation and server implementation. So mainly focus on develop all the implementations of the system inside the mobile phone.

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