

# COMPARATIVE STUDY ON KERAS AND CNN WITH KERAS FOR CURRENCY RECOGNITION

Ebin I<sup>1</sup>, Dr Naveen J<sup>2</sup> and Dr. Vijayakumari V<sup>3</sup>

<sup>1,2</sup> Dept. of CSE, School of Engineering and Technology, CHRIST (Deemed to be University), Bangalore.

<sup>3</sup> Dept. of ECE, Er.Perumal Manimekalai College of Engineering, Hosur

**Abstract:** Image processing is the key step in machine learning in order to recognize the object or image by the computer vision. In this paper, the Indian currency detection and recognition is implemented using machine learning methods namely Keras and Convolutional neural Network (CNN) algorithm with Keras. The hardware components used are ESP32 camera module which is interfaced with Raspberry Pi Pico and coding is done in python. The comparative study on these methods is made based on percentage of prediction accuracy. Our system can recognize the denomination value of currency efficiently and provides the dataset for the comparison of usability of these methods.

**Keywords:** CNN, Keras, Comparison, Dataset, Currency recognition, computer vision

## 1. INTRODUCTION

Currency detection and recognition is vital in today's world as it is useful in various sectors. Radial Basis Function Network is used for classification. 110 Saudi Arabian currency images were used of which 10 were tilted at 15 degrees by finding correlation between the image which is based on Radial Basis Function Network. The system has four main tasks such as image acquisition, pre-processing including noise removal, feature extraction, classification and recognition. A high resolution scanner was used to acquire the image of the currency. First the acquired image is converted into grey scale image, then to black and white image. Then the edge of the currency is detected using Canny's edge detection method [1]. Pattern recognition and neural networks matcher technique are used to identify the Indian currency and find the value of the paper currency. Then the image is converted to gray scale and filters such as Average filter and Laplacian filter is applied to remove the noise. By applying Multilayer Neural network based matcher, the currency can be identified. This method is easy and efficient way to identify as it uses denomination numerals for identification. It is useful in counting note bunch easily [2]. Currency Recognition System uses an algorithm based on frequency domain feature extraction method. Image histogram is processed to adjust contrast. Median filter which is the most commonly used filter is used to remove salt and pepper noise. Then the feature of the currency such as color, texture etc. is used to recognize the currency based on the sub-band images [3]. The various challenges in implementing OCR such as scene complexity, conditions of uneven lighting, skewness blurring and degradation aspect ratio and tilting etc. In preprocessing phase, the captured image is processed to remove noise by converting the actual image into grey scale image.

In segmentation phase the text is isolated from the image. In normalization phase the segmented text are minimized in a particular size. In feature extraction phase the features of the currency are extracted in order to build feature vectors. In classification phase the inputs are distributed with respect to detected information to their comparing class [4]. To identify fake currency notes which is helpful in the banking sector. Once the image is captured, image processing techniques are implemented on the image. The currency with various characteristics is cropped and segmented [5] The denomination value is recognized by extracting the characteristics such as size, color, or text on the note. Firstly, the image is preprocessed by removing the extraneous noise which is done by applying a denoising filter. Then the image is converted into a binary image by adaptive thresholding which is helpful in identifying the empty region. The unique template is chosen to have less computation. Once the

country identification is done, it follows three approaches to identify the denomination. It follows size ratio, color and text extraction as some countries have similar currency notes. Therefore k-means clustering algorithm is used to identify currency notes of different countries with similarities [6]. image processing techniques in currency recognition to make it easy for Forex bank to recognize the currency of the countries all over the world. After pre-processing steps such as denoising and converting the image into binary image using adaptive thresholding, empty spaces of the currency are recognized. These empty spaces are segregated into clusters and these clusters help us to find the origin of the currency. Later the value of the note is found based on the empty regions. It follows three different approaches such as ratio of measurement, pigment and text clipping. The ratio of measurement is done by Euclidean distance. For finding the value using color or pigment, is done by k-means algorithm. The text clipping method is done by comparing the text with the standard templates. WAMP server which is a development environment by Microsoft and it used to make web applications with Apache, Php and MySQL databases. This enables to produce a copy of the production software. Python is used as the programming language [7]. implemented an automatic currency recognition system which is helpful for the visually impaired people in differentiating various Indian currencies with image processing techniques. It uses libraries of OpenCV to run on the android platform. SIFT also known as scale invariant feature transform is designed to be used on grey scale images and this is compared with colored local invariant. SURF which is also known as Speeded up Robust Feature is a patented algorithm consists of two main steps namely feature detection and description [8].

Therefore, in today's world the advancements in the field of machine learning have evolved to a greater extent. After surveying the advantages and disadvantages of these methods we have proposed the comparison of the Keras and CNN algorithm with Keras for currency recognition so that the stakeholder will be able to choose the method for right usage.

## 2. Proposed System

In this paper, we have implemented the comparison of Keras and Convolutional Neural Network Algorithm with Keras methods for the Indian Currency Detection. The currency is captured as an image using the ESP32 camera module which is controlled by the Raspberry Pi Pico microcontroller. This module has an inbuilt wifi which is connected to a hotspot in which the PC is also connected. Once the module is connected successfully, the Keras and the CNN with Keras, which is written in python is executed in the PC. The image captured by the camera is processed using these methods by extracting the features in the Indian currency note and the value written in the currency is extracted for further matching. An image with currency notes is pre-provided as a data for the matching to occur and also a poor image is provided in order to detect the unsupported image. These images are interfaced using the code written in python. Once the numerical value in the currency is extracted, it is matched with the pre-provided images and the results are printed with percentage of prediction accuracy. This process is repeated for both the methods and the results are tabulated. Based on the usage and needed accuracy from our project, the stake holder can choose the algorithm in-order to implement currency detection

### 2.1 Steps to incorporate Keras:

- 1) Defining the layers of model and their interconnection
- 2) Convert the code into a machine level code
- 3) Train the model based on the data
- 4) Check for the errors in the model
- 5) Make predictions on model using new data

## 2.2. Convolutional Neural Network (CNN) algorithm With Keras

It is a deep learning based image classification algorithm which takes an input image and creates a model with sharing of parameters which is generally represented in the form of cuboid. It is often used in computer vision with image processing techniques. CNN is widely used because of its high accuracy.

## 2.3. ESP32 CAM with Raspberry Pi Pico

To capture the image of the currency we have used ESP32 CAM. It is a camera module which consumes less power and small in size. It is widely used in IoT applications such as wireless video monitoring, QR identification and so on. Microcontrollers are tiny computers which has less storage and controls the peripheral modules. Raspberry Pi Pico is used as the microcontroller which is known for its efficiency and small size. It is also popular because of its availability at low cost and is shown in Fig1.



**Figure 1.** ESP32 CAM with Raspberry Pi Pico Module

## 3.Results

The experiment was done with Indian Currency notes of value Rs.20, Rs.50, Rs.100, Rs.200, Rs,500. Both the methods were implemented successfully and the system was able to recognize the currency value. Our system, after capturing the image and processing the data from the image, compares the extracted information of that currency note with other currency notes also, to check for the probability of being the other currency also. Using this our system provides the dataset of accuracy in prediction which is tabulated. These results are shown in the figures2 and 3.

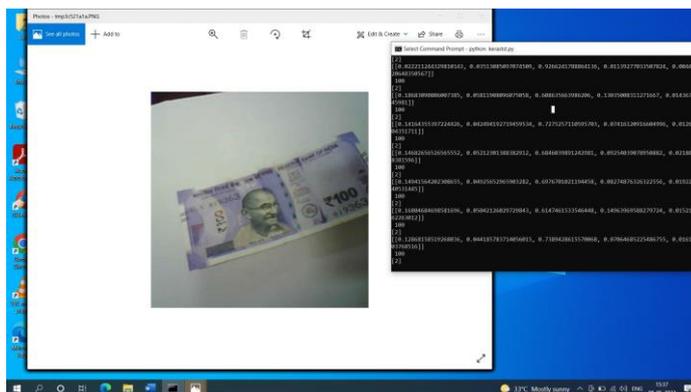


Figure 2. Keras Recognizing Rs.100

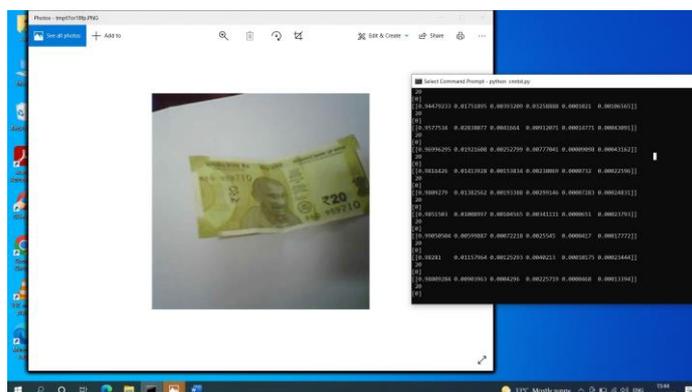


Figure 3. CNN with Keras Recognizing Rs.20

The test 1 is conducted with natural room lighting and test 2 is conducted with artificial lighting and test 3 is conducted with 75% lighting on the currency.

Table 1. Keras Results in finding the denomination value of Indian Currency

Currency Value	Test 1	Test 2	Test 3
Rs.20	0.99557	0.99573	0.99412
Rs.100	0.39255	0.43850	0.06347
Rs.200	0.03570	0.02577	0.03603
Rs.500	0.12327	0.14152	0.07581

Table 2. CNN with Keras Results in finding the denomination value of Indian Currency

Currency Value	Test 1	Test 2	Test 3
Rs.20	0.99050504	0.98281	0.98809284
Rs.100	0.1977145	0.2124583	0.15121333
Rs.200	0.12152962	0.1691687	0.2632334
Rs.500	0.13006985	0.15260725	0.2647243

## 4. Conclusion

The currency recognition system which is helpful in various fields is developed using the machine learning techniques. In order to implement this system, we use several image processing techniques along with neural networks in order to build an efficient currency recognition system. Our proposed method will be a helpful information in choosing the right method for currency recognition with efficiency in accuracy. In future, various image enhancement techniques will be employed and an android application may also be developed using these methods to help the visually impaired people.

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