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Currency Recognition Application Using Machine Learning

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Abstract: The motivation for this project of currency recognition is taken from inability to identify paper currencies due to resemblance of paper texture and scale between categories, which is the problem faced by visually impaired and disabled. Indian currencies including the old and new printed currencies have similar texture which could be confusing, through this review and project, we are trying to eliminate this problem to a scale where there should be no issue in monetary changes and exchanges for people with certain vision disabilities. This review shows the ability of image processing techniques and identification through various techniques and through ML algorithms and Image processing methods have been used and also different system around it. The results of certain experiments and outputs with the observations have also been attached below. We are looking forward to using the tensorflow model with various other architectures like CNN architecture and also Keras library for data augmentation. The fully equipped and easy to use android version of application for this currency identifier is the main focus of this project and research.

Keywords: Image processing, Machine learning, Neural Network, Currencies, Classifier, Currency Detection.

INTRODUCTION

The World Organization has estimated about the number of visually impaired people is, globally at least 2.2 billion people have a vision impairment or blindness, whom at least 1 billion have a vision impairment that could have been prevented or has yet to be addressed. Visually Impaired people face one of the problems is that recognition of paper currencies due to similarity of banknotes and currencies. .The ability and performance of today's smartphone devices has been exceptional and could be used to solve so many problems which are faced by many visually impaired people. Automatic methods for paper currency identification became essential and important in day to day life for everyone, capitalizing the availability of such computational power is need indeed. It is very difficult to count different denomination notes in a bunch and it becomes tedious task to identify each and every note. This project proposes an image processing technique for paper currency recognition and conversion to audio output. The extracted region of interest (ROI) can be used with Pattern Recognition and Neural Networks matching technique such as CNN Architecture using Mobilenet. Visually impaired people would be able to use this application, by using voice system in this application which will read the currency aloud.

LITERATURE SURVEY

This system uses an ORB algorithm for detecting & reading text in natural images of Currencies by using a various methods. The authors recognize & classify four different currencies using computer vision. The features are extracted based on texture, color and shapes of 4 different currencies. They use Artificial Neural Network for classification. The average Accuracy rate was 93.84%. [6]

It uses Radial Basis Function Network for classification. The system has an accuracy of recognition 95.37% for the Normal Non-Tilted Images, 91.65% for Noisy Non-Tilted Images and 87.5% Tilted Images.[5]

The survey is based on various papers & performance parameters of the systems that classify them in categories, giving qualitative- quantitative measures. After going through some reference papers, we proposed currency detection which detects & describe local features of images, which can be useful for currency detection. From this research papers, we narrowed down our focus to 3 algorithms which are much more efficient and are giving minimum error in recognition of image. These are ORB, SURF and SIFT.

Following are the comparisons between these algorithms on the basis of time, Key points (kpnts) and match rate. Comparison of the images shows the huge difference between these methods of currency recognition. [1]

Table 2. Results of comparing the image with its rotated image.

	Time (sec)	Kpnts1	Kpnts2	Matches	Match rate (%)
SIFT	0.16	248	260	166	65.4
SURF	0.03	162	271	110	50.8
ORB	0.03	261	423	158	46.2

Table 1. Results of comparing the images with varying intensity.

	Time (sec)	Kpnts1	Kpnts2	Matches	Match rate (%)
SIFT	0.13	248	229	183	76.7
SURF	0.04	162	166	119	72.6
ORB	0.03	261	267	168	63.6

Table 3. Matching rate versus the rotation angle.

Angle →	0	45	90	135	180	225	270
SIFT	100	65	93	67	92	65	93
SURF	99	51	99	52	96	51	95
ORB	100	46	97	46	100	46	97

Although accuracy through this approach of Currency Identification is not giving accurate results greatly, we decided to use approach of using the available Tensorflow model with Mobilenet Neural Network which has high accuracy through pre-trained Tensorflow Model.

Why MobileNet instead of OpenCV and SIFT?

- Reliability: MobileNet runs on low end devices and does not requires high processing power as compared to OpenCV algorithms such as SURF and SIFT.
- Performance: MobileNet follows CNN architecture which is faster on Android platform as compared to OpenCV.
- As SIFT works on Feature Detection and descriptor matching, MobileNet is a streamlined architecture that uses depth wise separable convolutions to construct lightweight deep convolutional neural networks and provides an efficient model for mobile and embedded vision applications.
- As shown in below figure Mobilenet Consists of deep neural networks of 53 layers deep including depthwise and pointwise convolution layers, which **automatically detects the important features without any human supervision.**

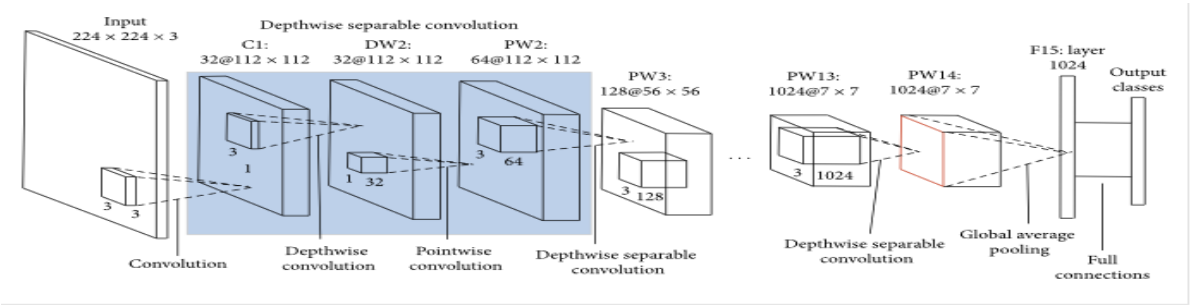


Fig: Mobilenet Architecture.

MobileNet:

- MobileNet is a CNN architecture model developed by Software Engineers at Google for Image Classification and Mobile Vision.
- What makes the MobileNet special is that it takes very less computation power to run or apply transfer learning to. This makes it a perfect fit for Mobile devices or embedded systems.
- Tuning Deep Neural architectures to strike an optimal balance between accuracy and performance of our model is an important part of our project.

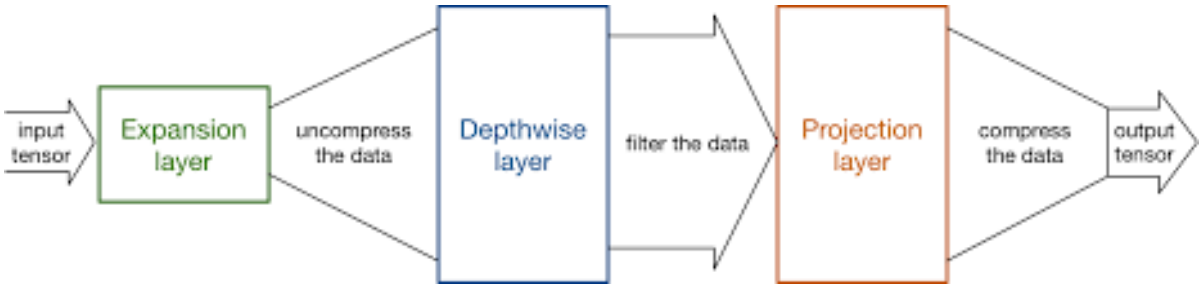


Fig : Block Diagram of Mobilenet

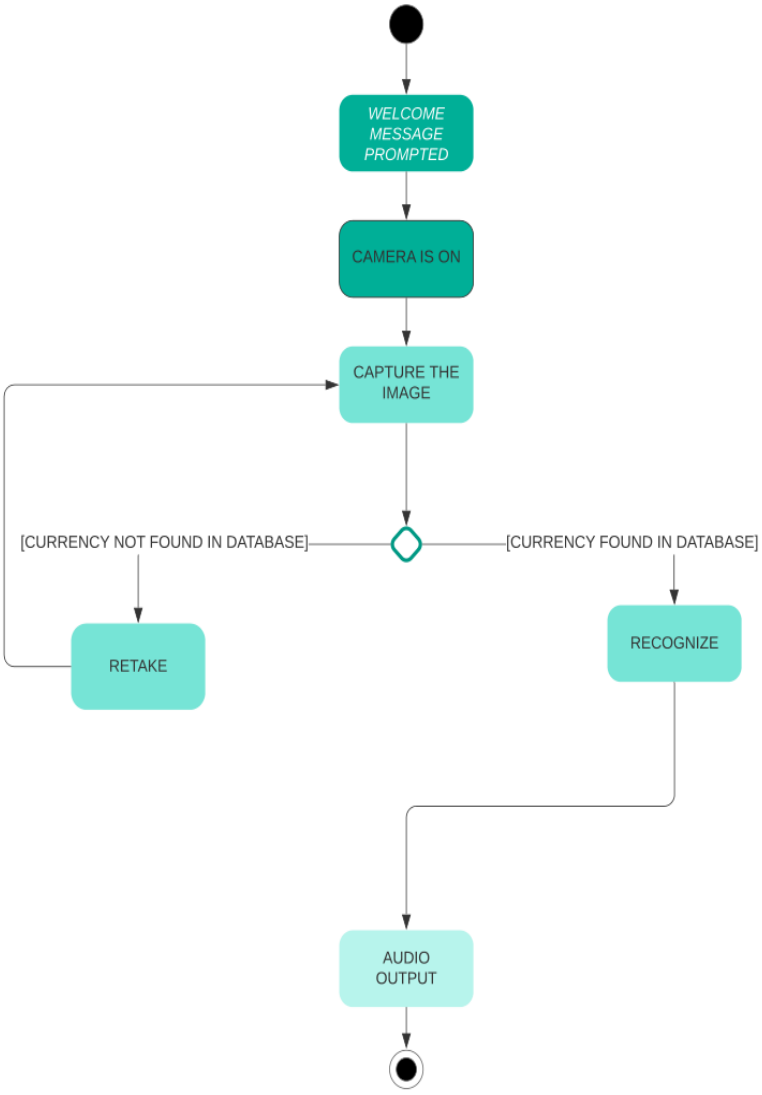
Available Currencies in INDIA:

ALGORITHM

1. Obtain the image of the target currency using camera from the smartphone, each frame captured from the camera is directly compared with the available dataset.
2. Each frame when compared to the available dataset of Pre-trained Currencies, decide the output of the currency in the form of confidence.
3. The MobileNet which is convulation of Neural Networks preprocesses the captured images to desired array with RGB values and compares each image captured with tensorflow pretrained dataset already available inside the application.

4. The confidence is displayed on the screen, and when it reaches a certain level of confidence it decides and presents the audio Output of favourable currency.
5. This Procedure is followed for each captured Frame through Camera.

DATAFLOW MODEL



Google's Teachable machine is used for training the datasets using 1200 Images for all currencies with 7 classes, with a further scope of transfer learning. These Classes consist of 10, 20, 50, 100, 200, 500 & 2000 rupee notes. We defined Epochs as 100 and Batch size of 32 for each dataset. The obtained model then tested with different currencies on the basis of several factors such as scale, distortion and light conditions.

Obtained Results:

Experiment Results: After testing the datasets 100 times on different currencies of 10, 20, 50, 100, 500 & 2000 the achieved accuracy among all the currencies under different conditions such as scaled, distorted, blurred and different angles captured currencies is 92%. This accuracy could still be improved with more number of better dataset and model training, which could be future scope for this application.

Conclusion: There are too many automatic systems built based on image processing techniques, including preprocessing, edge detection, image segmentation, and feature extraction to efficiently identify paper currency

recognition and coin recognition. We tried to build and deploy the currency recognition system using keras library and describe the information regarding Currency recognition with the help of several research papers. We conclude there are different system designed for currency detection and which can be further improved with the help of different technologies such as neural networks, image processing, machine learning.

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