



# A Deep Learning approach for Indian Coin Recognition based on CNN-RNN

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**Abstract :** Automatic coin recognition and identification system plays very important role in slot machine, vending machine and in several banking connected equipment's. For recognition and detection of Indian coin we've got planned Deep Learning approach during this research. The model is trained on over 1000 pictures and may classify pictures into four object classes like one, two, five- and ten-rupees' coins. The trained model is tested on varied normal and own recorded data sets encompass movement, translated and shifted pictures. During this we tend to use the CNN-RNN approach for coin image recognition. RNN is employed for the mechanically offer the caption of coin supported it practicality. LSTM prevents back propagated errors from vanishing or exploding. That is, LSTM will learn tasks that need memories of events that happened thousands or maybe several separate time steps earlier.

**Keywords:** Coin Recognition, Deep Learning, Convolution Neural Network, Recurrent Neural Network, Long Short-Term Memory.

## I. INTRODUCTION

Coins are the most common currency which has widely used in the world economy and regularly used in people's daily lives [1]. There are several applications that are most commonly used for coin recognition. For example, slot machine, coin-counting machine, coin sorter machine, vending machine, etc [2]. For coin recognition in the traditional days used the mechanical and electromagnetic approach [3]. In this research, we used the image processing for coin recognition. In the mechanical approach, they have used the coin's physical characteristics like height, width, the weight of the coin [4]. In image processing, the coin is recognized based on the pattern of the coin. There are mainly two steps first is the taken image of coin and then compare it with the data-set coin image. Now here we used the higher approach for image recognition is the deep learning approach. Deep learning is primarily based on Convolution Neural Network (CNN) for coin detection [5] and Recurrent Neural Network (RNN) for coin recognizes [6] with victimization and memory storage Long Short-Term Memory (LSTM) [7].

## II. OBJECTIVES

In the mechanical approach, they have used the coin's physical characteristics like height, width, the weight of the coin. In that, if the two different coins' physical structure is the same then the system recognizes they both are the same and then the system is failing. In image processing, the coin is recognized based on the pattern of the coin.[8] There are mainly two steps first is the taken image of coin and then compare it with the data-set coin image. After that, we use the artificial neural network for image processing but there are some limitations to that. ANN uses the feed-forward back propagation neural network which identified for implementation of the selected image and performs on the detection and recognizes the image processing [9]. After that, we implement the image processing at the advanced technology of deep learning that is CNN. But there are a number of limitations with the current CNN based image recognition. first is that there is the receptive field of CNN is generally fixed. its limits the very large input image recognizes capacity.[10] During this we tend to use the RNN approach for coin image recognition. RNN is employed for the mechanically offer the caption of coin supported it practicality.

The research proposes a replacement methodology for up the performance of perennial Neural Networks. LSTM prevents back propagated errors from vanishing or exploding. Instead, errors will flow backwards through unlimited numbers of virtual layers open in house.[11] That is, LSTM will learn tasks that need memories of events that happened thousands or maybe several separate time steps earlier. The parameters want to calibrate the performance system are recognition accuracy and response time. Obtained results shown the out performance of projected methodology over typical systems. So now for the image processing we use the latest deep learning approach which is the RNN-LSTM based.

## III. REVIEW OF LITERATURE

Sr.No	Paper Title	Method/Approach	Publication	Conclusion/Summary
1	"Deep Learning Based Indian Currency Coin Recognition"	Convolutional Neural Network (CNN)	IEEE -2018	In the recognition part, a multilayer convolutional neural network is used to classify proposals and get the final recognition result
2	"Coin detection and recognition in the natural scene."	Multilayer Convolution Neural Network (CNN)	IEEE -2016	This paper proposed a method to detect and recognize the coins in natural scene. In the detection part, the hough detection method is applied to detect the coin areas in the images.
3	"Image Captioning using Google's Inception- resnet-v2 and Recurrent Neural Network."	Google's Inception-resnet-v2, Recurrent Neural Network(RNN)	IEEE -2019	It proposes a fully automatic approach through through a combination of Convolutional Neural Network and a Recurrent Neural Network.
4	"Coin Recognition Method Based on SIFT Algorithm."	SIFT Algorithm	IEEE -2017	SIFT(scale invariant feature transform) algorithm for coin recognition.. It handle the issues of rotations, scaling in a digital image.
5	"Coin recognition with reduced feature set sift algorithm using NN."	SIFT Algorithm Neural Network	IEEE -2016	This reduced feature set is passed to feed forward back-propagation artificial neural network (ANN) for classification and recognition.
6	"An Indian coin recognition system using artificial neural networks."	Artificial Neural Networks(ANN)	2011- Research Journal	The performance of network is evaluated on the basis of mean square error, time taken to train the network.

Fig.3.1 Literature Survey

## IV. METHODOLOGY

The mainly proposed system divided into two parts first is coin detection and another is the coin recognize. In the phase of the Coin Detection, we detect the images from various phases like noise filtering and region finding and all. In the phase of the coin recognition train data-set coin image and the grey scale image data-set recognition using the RNN-LSTM approach. The architecture of the proposed Indian coin recognition system implemented in python programming is discussed in the following subsections.

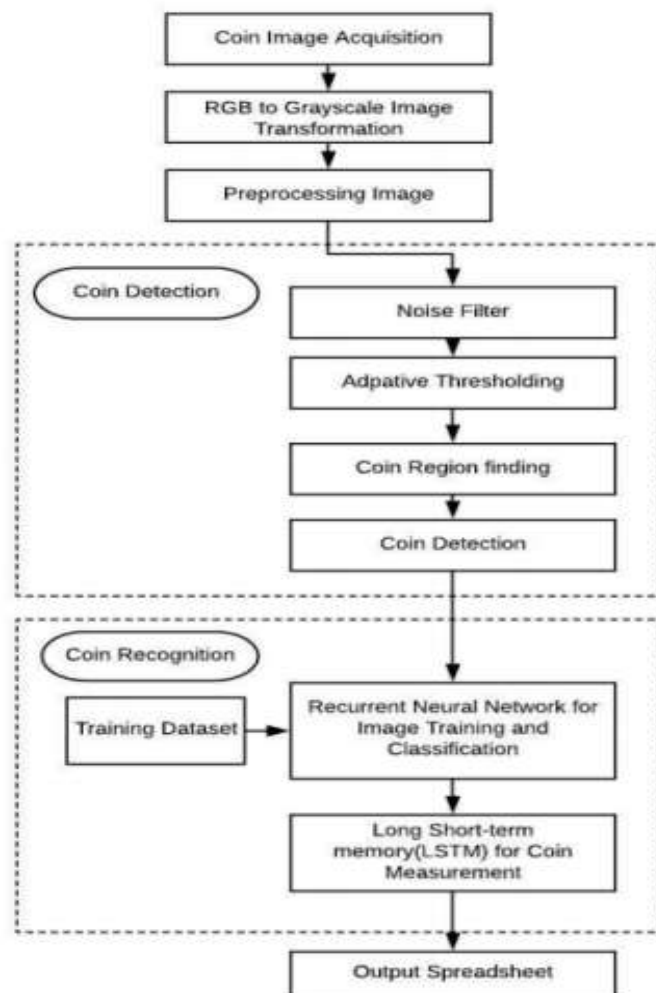


Fig.4.1 Proposed System Architecture

**a) Coin Image Acquisition:**

Select Image acquisition is the first phase of the image processing of coin recognition. The image is acquired use of a high scale resolution camera. In this phase, RGB images of Indian coins are captured.[18].

**b) Change number of columns:**

Color images or RGB images take a high amount of time for image processing. This grayscale image conversion is done using the built-in function of python `rgb2gray`. This function converts a 24-bit RGB image into the 8-bit grayscale image. The test image is converted into grayscale image using:  $gray = (0.299*r + 0.587*g + 0.114*b)$ . [19]

**c) Pre-processing Image:**

In the image processing phase, the grayscale image is resized at 256X256. This resized image is passed future on to the next steps. There is an unwanted noise present on the grayscale image. [20]

**d) Noise Filter:**

The input image of the coin is noise affected so we need to apply on it to different filtration techniques and remove that noise. In this model, we use the Gaussian filter techniques for the coin noise filtration.[21]

**e) Adaptive Thresholding:**

After the noise filtration on the coin image this coin image is converted into the binary image. It assigns 1-pixel values for the above threshold and assigns a 0-pixel value for the below threshold. For that, we get the horizontal axis and the vertical axis.[22]

**f) Coin Region Finding:**

For the coin, the region finds we need to use the array. The local maximum accumulation array is considered to be at the center of the coin image circle. Another two-dimensional array of accumulation is defined which is used after detecting the region of the center.

### g) CNN-RNN for Image Training and Classification:

For image processing we use the RNN. In python for the image processing with RNN and CNN use the one library which is the TensorFlow. In this library, there are a number of inbuilt functions that are already available for image processing we used the open cv of that raspberry pi for the coin image processing. [23]

### h) LSTM for Coin Measurement:

LSTM is normally augmented by recurrent gates called "forget" gates. LSTM works even given long delays between significant events and can handle signals that mix low and high-frequency components. [24]. These gating mechanisms let the LSTM control the flow of information and propagate it over long time ranges.

## V. ANALYSIS AND DISCUSSION

The model is the third-generation of the Raspberry Pi Model B which contains the Quad- Core 1.2GHz Broadcom BCM2837 64bit CPU contain 1GB of RAM, Ethernet-based 100, GPIO which extends 40-pin, 2 ports of USBs, 4 Pole output stereo, and composite port video, HDMI cable, CSI camera port for connecting a Raspberry Pi camera, CM43438 wireless LAN and Bluetooth Low Energy on board, DSI port display for connecting a Rasp berry Pi touchscreen display, Micro SD card port for loading your operating system and storing data on the raspberry pi controller, Upgraded switched Micro USB power source up to 2.5A[25]. In raspberry pi OpenCV we need to enter the coding for our experiments. so here we use the Python language for the coding. here we use the python 3 version. Raspberry pi controller provides the OpenCV platform in which we enter the coding for our experiments. mobaXterm software Full X server and SSH support operate on any Remote desktop (RDP, VNC, Xdmcp). In containing remote terminal (SSH, telnet, rlogin, Mosh). This software is easy to use and runs as a portable edition [26].

### Dataset:

There are the three phase of the coin recognition. first step is the data set, second is the training data and third is the coin recognition phase.

### Standard Dataset:

We have collected standard dataset from various angles which contains hundred images of each object category such as one, two, five- and ten-rupees' coins. The resolution of all images is 256x256 with memory size of around 100KB to 1MB.

### Own Dataset:

Own dataset captured by ourselves then datasets are used for the training purpose in this type of datasets we can take the different types of images in various angles. The sample of own recorded datasets containing one rupee, two rupees, five rupees shown in subsequent figures 5.1, 5.2 and 5.3.



Fig.5.1: One Rupees Coin



Fig.5.2: Two Rupees Coin



Fig.5.3: Five Rupees Coin

## A. Result

In the first phase we have trained raspberry pi in a such a way that it is able to identify the different coins and then we kept one- rupee, two- rupees and five rupees coin in front of camera then the trained network identified the given coin as one rupee and two rupees coin which is shown in figure 5.4 and 5.5.



- [4] Crain, Louis M. "Automated coin grading system." , U.S. Patent No. 5,224,176. 29 Jun. 1993.
- [5] Capece, Nicola, Ugo Erra, and Antonio Vito Ciliberto, "Implementation of a coin recognition system for mobile devices with deep learning." , 2016 12th International Conference on Signal-Image Technology Internet-Based Systems (SITIS). IEEE, 2016.
- [6] Shi, Junxing. "Modeling Cortical Visual Processing With Recurrent Neural Network.", (2017).
- [7] Sagar, KV Daya, and D. B. K. Kamesh. "An Implementation of Anomaly Detection in IOT DTA Using A Deep (OC-NN) With the Long Short Term Memory Network (LSTM)."
- [8] Rodriguez, Tony F., and Joshua V. Aller. "Methods and systems for determining image processing operations relevant to particular imagery." U.S. Patent No. 8,660,355.25 Feb. 2014.
- [9] Pradhan, Biswajeet, and Saro Lee. "Landslide susceptibility assessment and factor effect analysis: backpropagation artificial neural networks and their comparison with frequency ratio and bivariate logistic regression modelling." *Environmental Modelling Software* 25.6 (2010): 747-759.
- [10] Chen, Yushi, et al. "Deep feature extraction and classification of hyperspectral images based on convolutional neural networks." *IEEE Transactions on Geoscience and Remote Sensing* 54.10 (2016): 6232- 6251.
- [11] Zhengyao Jiang Dixing Xu. "A Deep Reinforcement Learning Framework for the Financial Portfolio Management Problem(pdf)" Retrieved from <https://arxiv.org/pdf/1706.10059.pdf>
- [12] Tajane, A. U., et al. "Deep Learning Based Indian Currency Coin Recognition."2018 International Conference On Advances in Communication and Computing Technology (ICACCT). IEEE, 2018.
- [13] Qiu, ZiHe, Ping Shi, Da Pan, and DiXiu Zhong. "Coin detection and recognition in the natural scene." In 2016 IEEE Advanced Information Management, Communi-cates, Electronic and Automation Control Conference (IMCEC), pp. 653-657. IEEE,2016.
- [14] Bhatia, Yajurv, Aman Bajpayee, Deepanshu Raghuvanshi, and Himanshu Mittal. "Image Captioning using Google's Inception-resnet-v2 and Recurrent Neural Network." In 2019 Twelfth International Conference on Contemporary Computing (IC3), pp. 1-6. IEEE, 2019.
- [15] Xu, Jing, Gongliu Yang, Yuanyuan Liu, and Jingjia Zhong. "Coin Recognition Method Based on SIFT Algorithm." In 2017 4th International Conference on Information Science and Control Engineering (ICISCE), pp. 229-233. IEEE, 2017.
- [16] Farooque, Ghulam, Allah Bux Sargano, Imran Shafi, and Waqar Ali. "Coin recognition with reduced feature set sift algorithm using neural network." In 2016 International Conference on Frontiers of Information Technology (FIT), pp. 93-98. IEEE, 2016.
- [17] Kaur, Loveneet, and Rekha Bhatia. "An Indian coin recognition system using artificial neural networks." *International Journal of Computer Science and Information Technologies* (2014)
- [18] Smith, D., amp; Dunbabin, M. (2007). Automated Counting of the Northern Pacific Sea Star in the Derwent Using Shape Recognition. 9th Biennial Conference of the Australian Pattern Recognition Society on Digital Image Computing Techniques and Applications (DICTA 2007). doi:10.1109/dicta.2007.4426838
- [19] RGB. (n.d.). Retrieved June 24, 2020, from <https://www.mathworks.com/help/matlab/ref/rgb2gray.html>
- [20] Clukey, Steven Andrew. "Architecture for Real-Time, Low-SWaP Embedded Vision Using FPGAs." (2016).
- [21] Chouhan, Siddharth Singh, Ajay Kaul, and Uday Pratap Singh. "Image segmentation using computational intelligence techniques." *Archives of Computational Methods in Engineering* 26.3 (2019): 533- 596.
- [22] Silverbrook, Kia, and Simon Robert Walmsley. "Image processing and printing apparatus." U.S. Patent No. 7,093,762. 22 Aug. 2006.
- [23] Zaccone, Giancarlo, and Md Rezaul Karim. *Deep Learning with TensorFlow: Explore neural networks and build intelligent systems with Python*. Packt Publishing Ltd, 2018.
- [24] Vasudevan, C. (2018). *Concepts and Programming in PyTorch: A way to dive into the technicality*. New Delhi: BPB Publications.
- [25] Raspberry Pi. (2020, June 24). Retrieved June 27, 2020, from [https://en.wikipedia.org/wiki/Raspberry\\_Pi](https://en.wikipedia.org/wiki/Raspberry_Pi)
- [26] <https://www.googleadservices.com/pagead/aclk?sa=L>