Deep Learning Based Indian Currency Detection for Visually Challenged using VGG16

Nijil Raj N, Anandu S Ram, Aneeta Binoo Joseph, Shabna S

Abstract—Banknote recognition is a major problem faced by visually Challenged people. So we propose a system to help the visually Challenged people to identify the different types of Indian currencies through deep learning technique. In our proposed project, bank notes with different positions are directly fed into VGG 16, a pretrained model of convolution neural network which extracts deep features. From our work the visually impaired people will be able to recognize different types if Indian Currencies.

Index Terms—Deep Learning, VGG16

I. INTRODUCTION

Deep learning systems can provide low cost solutions for the visually impaired. Of these, convolutional neural networks (CNN) and fully convolutional neural networks (FCN) show incredible guarantee regarding the advancement of multi use- ful innovation for the outwardly hindered. CNN have also potential for overcoming challenges caused by moving objects. CNN have additionally potential for conquering difficulties brought about by moving and impeded items. Deep learning CNNs are composed of several layers of processing, each comprising linear as well as non-linear operators, which are learnt jointly, in an end-to-end way, to solve specific tasks.

The term “visual impairment” is employed to explain a large number of conditions that have an effect on clarity of vision and field of vision. Technology is valuable for those with visual impairments, each as a tool for learning and communication and for providing visual stimulation. By employing a laptop with acceptable computer code and hardware the visually impaired user is given access to plain resources. For instance, speech synthesis will scan a word processed file to a visually handicapped person while not the requirement to possess it translated into Braille. The existing system uses banknotes images with different orientation which is directly fed into alexnet, a pretrained model of CNN, the most popular image processing structure of deep learning neural network[3].

In our system the banknotes are detected and classified using the VGG16 model which is a type of convolutional neural network model. The existing system used alexnet which is also one of the pretrained models of CNN. VGGnet is used instead of alexnet because it has the capability of extracting more deep features than alexnet and hence output would be more precise.

II. EXISTING SYSTEMS

Gouri Sanjay Tele,et al., proposed detection of Fake Indian Currency. Security highlights of currency are basic for deciding genuine and fake money. Basic security highlights incorporate watermarks, dormant pictures, security thread, and optically variable ink. In this a methodology for counterfeit currency location extricates the general traits of latent pictures and distinguishing ID mark from the image of money. Extricating properties from images of currency notes can get very intricate as it includes the extraction of some noticeable and undetectable highlights of Indian currency. After demonetization- tion 500 and 2000 are the high esteemed cash notes existing till date so there is a most extreme likelihood that this notes can be duplicated so as to maintain a strategic distance from this they use programming to identify the fake notes utilizing picture handling procedure [1]. Navya Krishna G,et al., proposed Recognition of fake currency note using CNN. The Automatic Fake Currency Recognition System (AFCRS) is intended to identify the fake paper money to check whether it is fake or original. The current fake issue because of demonetization impacts the financial framework and furthermore in different fields. Another methodology of Convolution Neural Network towards recognizable proof of fake notes through their images is inspected in this paper which is relatively better than past image processing strategies. It depends on Deep Learning, which has seen huge accomplishment in image classification lately. This procedure can support both people and machine in recognizing fake notes progressively through an image of the equivalent. The proposed framework, AFCRS can likewise be conveyed as an application in the smart phone which can assist the general public with distinguishing between the original and fake notes. The Accuracy in the undertaking can be expanded through the original fake notes [2]. N.A.J Sufri, et.al., propose a vision Based System for Banknote Recognition Using Different Machine Learning and Deep Learning Approach. They used the rgb values as features and used algorithms DT, NB, KNN, SVM and deep learning alexnet.Both kNN and DTC achieved 99.7% accuracy but both SVM and BC perform better by succeeded to achieve 100% accuracy[3].
Deep Learning Based Indian Currency Detection for Visually Challenged using VGG16

The literature survey concludes that there are many disadvantages with the existing systems. Our proposed method of banknote recognition extracts deep features from banknotes using deep learning VGG 16 Model network. The different Analysis of our literature survey is shown in Table I.

### III. MATERIALS AND METHODS

#### A. Dataset

The dataset used is Indian currency. The dataset contains various Indian currencies of Rs20, Rs50, Rs100, Rs200, Rs500. It has various security features of Indian currency.

#### B. Feature Set

The deep features are extracted by VGG16 on its own. The deep features from each banknote are extracted and classified. The VGG16 design consists of twelve convolutional layers, maximum pooling layers, four fully-connected layers and a 1000-way softmax classifier. Using these layers the VGG16 extracts deep features from the banknotes. The existing system uses alexnet but it extracts less features from the banknotes than alexnet. Therefore VGG16 is preferred for greater accuracy results.

#### C. Algorithms Used

1) **Convolutional Neural Network (ConvNets):** It is a DL algorithm which accepts an input image, assigns importance to numerous aspects/objects in the image and be in a position to differentiate them from one another. The pre-processing required is far lower as compared to other algorithms used for classification. They have the ability to learn these filters/characteristics.

   (5 classes of notes). Then random snaps are taken out of these classes of notes, 15 images of 11 positions are considered. These positions are at random angles so that when the user inputs the image, the denominations are correctly predicted. The 11 positions are discussed below:

   - P1: Image at straight focus (horizontal or vertical)
   - P2: Image at backside focus (horizontal or vertical)
   - P3: Image at left flip (front side)
   - P4: Image at right flip (front side)
   - P5: Image at left flip (back side)
   - P6: Image at right flip (back side)
   - P7: Image folded to half from upper side at straight focus
   - P8: Image folded to half from lower side at straight focus
   - P9: Image folded to half from upper side at backside focus
   - P10: Image folded to half from lower side at backside focus
   - P11: Image folded to 1/4th from lower at straight focus.

So from the above a total of 165 images for each of the currencies is taken.

### IV. METHODOLOGY

**Our system extracts deep features from the inner layers.**

**A. Classification**

Classification represents the matter of distinctive to that of a group of classes a new observation belongs, on the idea of a training set of data having observations whose category membership is known.

**B. Test & Train Set**

A training dataset could be a dataset of eg’s used for learning, that is to fit the parameters for eg, a classifier. A test dataset could be a dataset that is independent of the training dataset, but follows a similar likelihood distribution as the training dataset. If a model fit to the training dataset conjointly fits the test dataset well, a lowest overfitting takes place. A much better fitting of the training dataset as hostile to the test dataset mostly points to overfitting.

**C. Algorithm**

VGG16 is a CNN model. It extracts deep features by its own from the banknotes. Convolutional networks are merely neural networks that use convolution instead of general matrix multiplication in an exceedingly minimum of one of their layers.
1) Building blocks of CNN: Convolutions: Mathematical operation that slides one function over the opposite and measures integral of pointwise multiplication.

Strides: It shows how quickly window slides. Stride two suggest that window moves by two pixels at a time.

Pooling: Downsampling feature maps.

DNN: Fully connected DNN for classification

Fig. 3. Architecture

The input to the primary convolutional layer is of mounted size of vary 224 x 224 RGB image. The image is distributed through a stack of convolutional layers, wherever the filters were used with a small receptive field: 3x3 (which is that the smallest size to capture the notion of left/right, up/down, center). In one in every of the configurations, it to boot utilizes 1x1 convolution filters, which could be seen as a linear trans- formation of the input channels (followed by non-linearity). The convolution stride is mounted to one pixel; the spacial artifact of conv. layer input is specified when convolution, the spacial resolution is preserved , i.e. the artifact is 1-pixel for 3x3 conv. layers. spacial pooling is administered by five max-pooling layers, that follow a number of the conv. layers. Max-pooling is performed over a 2x2 element window, with stride 2. In this there is three Fully-Connected (FC) layers followed by an output soft-max layer.

V. RESULTS AND DISCUSSION

| TABLE II ACCURACY OF PROPOSED SYSTEM |
| No. of Epochs | Accuracy |
|---------------|----------|
| 1             | 98.95    |
| 2             | 98.80    |
| 3             | 99.07    |
| 4             | 99.07    |
| 5             | 99.07    |
| 6             | 98.73    |
| 7             | 98.40    |
| 8             | 98.95    |
| 9             | 99.33    |
| 10            | 99.07    |

VI. CONCLUSION

Our system proposes a vision based deep learning technique that can recognize and classify Indian Currencies were well developed. VGG16 was found to extract deep features from the input image. Our system gives a better accuracy of 99.07%. The existing system uses Alexnet with extracts less features. Therefore VGG16 is used which is capable of extracting which more deep features. From this, the visually impaired people able to improve their quality of life by reduce the dependency to other especially during outside activities.

ACKNOWLEDGMENT

We take this opportunity to express our sincere gratitude to all those without whom this project would not have been a success. First of all, we owe our thanks to the Almighty for providing us the strength and courage to complete the project. We express our deep and sincere gratitude to our guide Dr. Nijil Raj N, Head of the Computer Science and Engineering Department, Yonorus College Of Engineering And Technology for providing valuable advice and timely instructions, without which we could never have been able to complete the work in time.

REFERENCES

1. Gouri Sanjay Tele, Akshay Prakash Kathalkar, Sneha Mahakalkar, Bharat Sahoo, and Vaishnavi Dhamane. Detection of fake indian currency. International Journal of Advance Research, Ideas and Innovations in Technology, 4(2):170–176, 2018.

2. Naga Sri Ram B Yamini Radha V Rajarajeshwari P Navya Krishna G, Sau Pooja G. Recognition of fake currency note using convolutional neural networks. 4(2):182–186, 2018.

3. [3]N. A. J. Sufri, N. A. Rahmad, N. F. Ghazali, N. Shahar, and M. A. As’ari. Vision based system for banknote recognition using different machine learning and deep learning approach. In 2019 IEEE 10th Control and System Graduate Research Colloquium (ICSGRC), pages 5–8, 2019.

4. Qian Zhang, Wei Qi Yan, and Mohan Kankanahalli. Overview of currency recognition using deep learning. Journal of Banking and Financial Technology, 3(1):59–69, 2019.

5. Hung-Cuong Triih, Hoang-Thanh Vo, Van-Huy Pham, Bhagawan Nath, and Van-Dung Hoang. Currency recognition based on deep feature se- lection and classification. In Asian Conference on Intelligent Information and Database Systems, pages 273–281. Springer, 2020.

6. Kan Chen, Jiang Wang, Liang-Chieh Chen, Hao Yuan Gao, Wei Xu, and Ram Nevatia. Abc-cnn: An attention based convolutional neural network for visual question answering. arXiv preprint arXiv:1511.05960, 2015.

7. NA Jasmin Sufri, NA Rahmad, MA As’ari, NA Zakaria, MN Jamahudin, LH Ismail, and NH Mahmood. Image based ringgit banknote recognition for visually impaired. Journal of Telecommunication, Electronic and Computer Engineering (JTEC), 9(3-9):103–111, 2017.

8. Snigdha Kamal, Simarpreet Singh Chawla, Nidha Goel, and Balasubra- manian Ramani. Feature extraction and identification of indian currency notes. In 2015 Fifth National Conference on Computer Vision, Pattern Recognition, Image Processing and Graphics (NCVPRIPG), pages 1–4. IEEE, 2015.
AUTHORS PROFILE

Dr. Nijil Raj N is currently working as a Professor and Head of Computer Science and Engineering department, Younus College of Engineering and Technology, Kollam, Kerala. He is having 16 years of teaching experience in UG and PG level. He has completed the Doctoral Degree from M. S. University, Tamilnadu, in Computer Science and Information Technology. His research area is based on Computational Biology, Machine Learning and AI, and Image Processing. He has published more than 15 papers in national and international journals. He was post graduated from M. S. University, Tamilnadu in M.Tech and MCA also MBA from MG University Kottayam, Kerala.

Anandu S Ram is currently pursuing BTech degree in Computer Science and Engineering from Younus College of Engineering and Technology, Kollam, Kerala under A P J Abdul Kalam Technological University, Trivandrum, Kerala.

Aneeta Binoo Joseph is currently pursuing BTech degree in Computer Science and Engineering from Younus College of Engineering and Technology, Kollam, Kerala under A P J Abdul Kalam Technological University, Trivandrum, Kerala.

Shabna S is currently pursuing BTech degree in Computer Science and Engineering from Younus College of Engineering and Technology, Kollam, Kerala under A P J Abdul Kalam Technological University, Trivandrum, Kerala.