

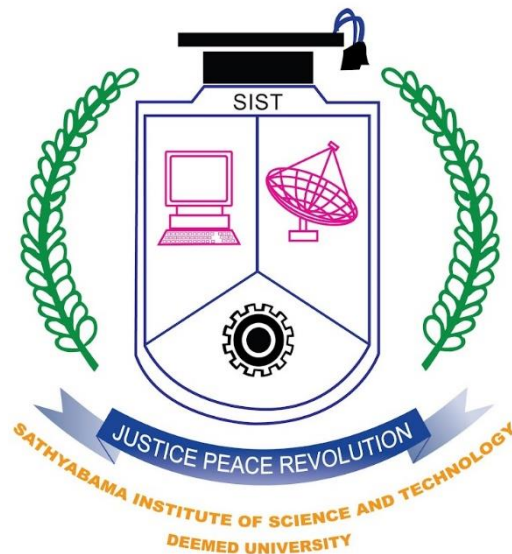
SMART MONEY IDENTIFICATION SYSTEM

Submitted in partial fulfilment of the requirements for the award of
Bachelor of Engineering Degree in Electronics and Communication Engineering

by

Ukanti Bharath Chandra Reddy (39130486)

Kuruva Abhiram (39130252)



DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

SCHOOL OF ELECTRICAL AND ELECTRONICS

SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY

(DEEMED TO BE UNIVERSITY)

Accredited with Grade “A” by NAAC

JEPPIAAR NAGAR, RAJIV GANDHI SALAI, CHENNAI - 600 119

NOVEMBER – 2022



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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of Ukanti Bharath Chandra Reddy (39130486) and Kuruva Abhiram (39130252) who carried out the project entitled "**SMART MONEY IDENTIFICATION**" under our supervision from July 2022 to November 2022.

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SMART MONEY IDENTIFICATION SYSTEM

ABSTRACT

This study introduces a straightforward currency recognition method used on Indian banknotes . The proposed system is based on simple image processing utilities that ensure the process is as fast and robust as possible. Paper currency recognition is an important area of pattern recognition. A system for the recognition of paper currency is one kind of intelligent system which is a very important need of the current automation systems in the modern world of today, And also . It has various potential applications including electronic banking, currency monitoring systems, money exchange machines, etc. The proposed paper represents an automatic paper currency recognition system for paper currency. A method of recognizing paper currencies has been introduced. This is based on interesting features and correlation between images. The method uses the case of Indian paper currency as a model. The method is quite reasonable in terms of accuracy. The system deals with 200 images for each category .The model outputs the detected currency with voice feedback. The proposed algorithm is fully automatic and requires no human intervention.

CHAPTER 1

INTRODUCTION

1.1 Introduction

Object recognition is an important and highly demanded area of pattern recognition. An object can be anything in real life. It can be text in a document, a license plate of a vehicle, an iris in a person's eyes, a sign in a sign language, a face of a person, and so on. Similarly, paper currency recognition is as important as any other object recognition.

According to the Indian authorities, the big proportion of visually impaired people became higher . About one hundred and sixty-five people were visually impaired in line with lakh individuals. Blind people were eighty-two percent of them, and low vision was 18 percent . The latest smartphone development makes it possible to identify currency with an attractive one. In this research work we apply the convolutional neural network models such as Alexnet, Googlenet and VGG16 to detect the value of the currency notes.

In the present situation, the reputation for currency denomination is becoming a vibrant topic for scientists in multiple apps such as blind person currency recognition and fake currency detection for normal people and apps linked to transactions. An important aspect of our normal life is money transactions. Each nation has a distinct currency layout and value. The distinctive skills, colorations, denominations, and the global value for their currency have been retained by each individual county. The denomination can be acknowledged for foreign cash without trouble, but from the real currency, it will become difficult to interpret a fake currency. Particularly suffer in cash exchanges for the visually impaired people. They may not now be ready to properly comprehend one-of - a-kind denominations and are often betrayed by distinct individuals.

Some authors, in the recent years, have contributed to the subject of paper currency recognition systems. These existing paper currency recognition methods, in the literature, mainly involve image processing and/or neural network. This paper deals with a simple, efficient, and very accurate approach in the system design. In designing such a system, it considers different dimensions, areas, Euler numbers,

correlations as features. A different method using radial basis Function networks, is utilized for developing an intelligent system which can recognize paper currency. This research is specifically designed for recognizing paper currency of India. It also includes new series (500,2000,20,100) of currency issued by Indian government as a model currency under consideration. The proposed paper recognition technique has been designed in such a way that it can be used for recognizing paper currency form different values in India. To overcome the problem of recognizing dirty banknotes, the pre-processing stage is also considered.

CHAPTER 2

LITERATURE SURVEY

This section discusses works associated with literature. In recent years, various bank currency identification strategies or algorithms have been used to recognize and classify banknotes from various nations. Computer vision: The writers acknowledge currencies based on computer vision in their approach . They intended a scheme for recognizing four distinct currencies using extraction methods of characteristics. The main characteristic considered were currency texture, colour, and forms. For classification, they used Artificial Neural Network. The median level of accuracy was 93.84%.

SIFT Algorithm: lyad and their team et all created a visually impaired portable currency identification scheme and used Jordanian currencies as a test dataset . Their strategy is based on the algorithm of the invariant transform function (SIFT) scale . It attained the accuracy level of 71% to recognize the currency and 25% for the coin type of currency.

Radial Basis Function Network: The author has created a portable paper currency identification scheme in and has been tested on Saudi Arabia documents. The currencies were recognized here based on picture characteristics and correlations between two pictures. For classification, it utilizes the Radial Basis Function Network. The scheme is 95.37 percent accurate for Normal Non-Tilted Images, 91.65 percent for Noisy Non-Tilted Images, and 87.5 percent for Tilted Images.

Matching Template: Sungwook and their team et al have created an algorithm which can recognize currencies from different countries. This technique identifies currencies based on the distinct currency note size and the multi templates correlation matching value. They achieved 100% precision in classifying and identifying the currencies of five distinct countries.

Image processing: Neoura has proposed the strategy et all which used image processing characteristics to define the currency . Image segmentation, equalization, region of interest (ROI) extraction and then matching the image based on template, correlations between the images taken and the database dataset were the primary operations applied to the picture on their research work. This strategy has accomplished the precision of 89 percent in recognizing the currency. The information set for the Egyptian currency was used to test the scheme.

LBP Algorithm: Jun fang's et al approach identified the currency based on the characters extracted from the image and used the Local Binary Pattern approach to process the image. It achieved the precision of 92 percent.

In , Akash Gupta et al represented a paper of review on currency detection technique in which they have represented the various techniques that are implemented till date. In they have represented the currency detection system for Mexican notes using artificial vision. They have classified the notes based on colour and text features using the RGB space and Local binary patterns.

Indian Currency Detection using Image Recognition Technique : Kalpana Gautam et al GNA University, Punjab, India In this paper, the hybrid algorithm based on PCA and LBP techniques here which basically increase the recognition accuracy by giving the 96% correct recognition. The database of the images should be enough large i.e., should contain the samples of different forms of currency including the clean notes, dirty notes, torn notes. So that an increase in the accuracy. Several different models has been designed and implemented for currency recognition by different authors. In , the authors have implemented the system using convolutional neural networks, one of the concepts used in deep learning. They have prepared the dataset for the notes of Indian currency and for fake notes they prepared dataset from children's bank churn label.

CHAPTER 3

3.1 METHODOLOGY

This work presents a system to detect and recognize banknotes from different denominations using convolutional neural networks with deep training. It involves the following processing steps. The proposed scheme is different from various existing because of its approaches in the recognition phases. Specifically, for example, symmetrical masks have been used for considering specific signs (images) in a paper currency. Using this method, the summation of non-masked pixel values in each banknote is computed and fed to a Neural Network (NN). The output is then connected to the voice module it gives the predicted value in the form of voice using the integrated speakers.

The proposed convolution neural network is trained using large collection of images taken in the different lighting condition such as natural and artificial lighting effects, with variations in the lighting and different rotation, Here, (x, y) coordinates represents the predicted bounding box position for the given input image and $(\hat{x}, \hat{y})$ represents the actual or original positions from the training data.

Profound learning procedures are broadly utilized in applications proper for picture acknowledgment nowadays. Convolutional Neural Network(CNN) is one among the notable systems that were esteemed one of promising strategies in issues of picture recognition. The accuracy of the calculation for cash acknowledgment can be drastically used for training with a major amount of data. Subsequently, acknowledgment can be performed well on a progressing premise and accomplishes high accuracy relying upon the measure of picture performed . Then the detected image result is sent to easy_pytttsx module to give voice feedback.

3.2 BLOCK DIAGRAM

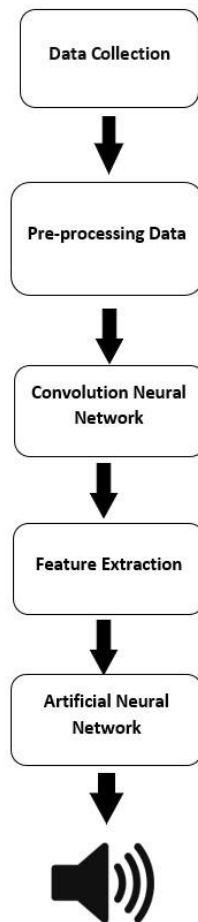


Fig: 1
Block Diagram

The following step was carried out during CNN Training.

1. First, the CNN model should be pre-trained with the primary 11 convolutional layers. The custom 7-class dataset has been used for training with a input measure of 300x300x3.
2. In the next step, input resolution of the image has been decreased to 250x250x3.
3. The complete network has been trained for the rate of parameter setting are almost 35 epochs employing a batch measure of 37.
4. Learning rate plan: for the primary epochs, the learning rate was gradually raised. Train for almost 20 epochs and after that begin diminishing it.
5. Use information expansion with arbitrary scaling and interpretations, and arbitrarily altering presentation and saturation.

This framework also follows the same method of using the rectified linear units (ReLUs) through all of the CNN structures, and the completely-connected layers. This activation feature is popularly utilized in CNN because it works as a rectifier that lets in the simplest advantageous values to skip and enables to enhance the training pace as well as keep away from the gradient-vanishing, as compared to sigmoid function.

3.3 MACHINE LEARNING

Machine learning is the technique in which is perform a scientific analysis on different algorithm and statistical models. In this approach the use of heuristic algos and approach like Linear Regression, SVM, Naive Bayes, KNN, KMeans Clustering. These all are the different types of working algorithms of Machine Learning . Simple answer is that it takes data as a input, find a patterns in it using algorithms and heuristics approach and give predictions of our test data based on input training data and algorithms learning pattern. In machine learning we need to do feature extraction by self, then we need to train the model. But this approach is not best and optimal solution for our application, so we choose a Deep Learning approach for it. In Machine learning it always go for a solution, but that solution could be an optimal or may be not also (Fig: 2).

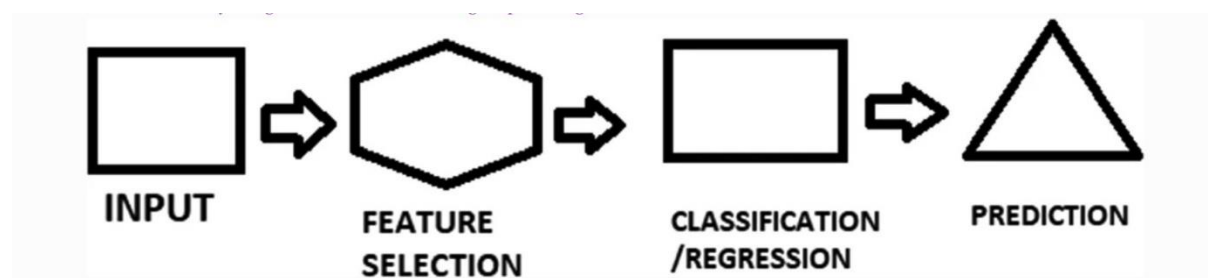


Fig: 2
Working of Machine learning

3.4 DEEP LEARNING:

We mimic the human learning pattern and it create the new algorithm, we call it artificial neural network, it has same structure as biological neural network. There are different types of neural network available; we can use it according to our work. However, most important thing is that to understand a structure of artificial neural Deep learning is the approach in that it mimics the humans learning patterns, we humans learn using Biological Neural Network(which is in-build in our body), In deep learning network. Now let see working of deep learning.

3.5 WORKING OF DEEP LEARNING

Deep learning is becoming the most evolving AI technique in 21st century. In this modern era, we have lots of data, and deep learning needs a data, that's why it becomes so popular in this modern era. We can see the usage of deep learning everywhere like social media, government, IT sector, Cinemas, Search engines. We humans already implemented Face recognition, self-driving car, auto drones and we are continuously evolving like we are in infinity loop of mega evolution of AI. Now let us understand some algorithms that we used in our research Fig:3.

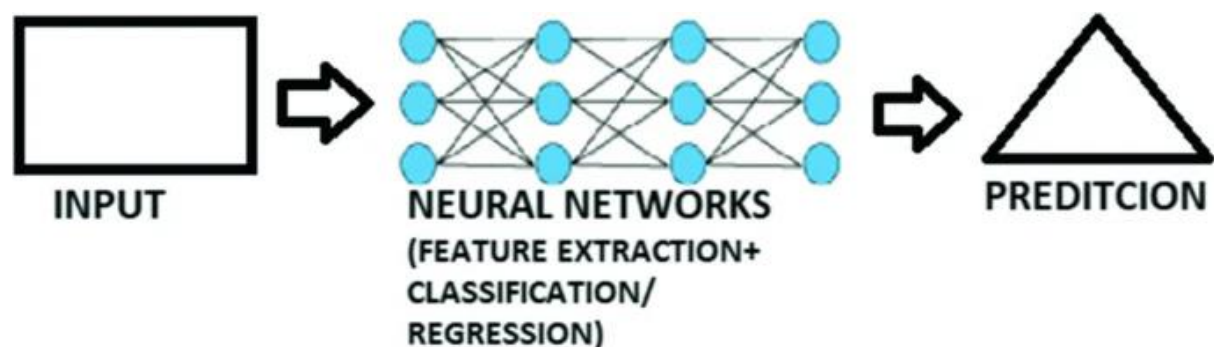


Fig:3

Working of Deep Learning

3.6 CONVOLUTION NEURAL NETWORKS

A Convolutional Neural Network is most popular Deep learning algorithm in which it takes an input image, assign weights and biases to various aspect according to the object in the image. In other algorithms we need to do lots of image processing and hand engineering to achieve the accuracy. But in CNN have the ability to learn these all the characteristics of images . So, we don't need to do a lots of hand engineering in images, CNN will do for us. And also, we can achieve a good accuracy in our work.

3.7 WORKING CONVOLUTION NEURAL NETWORKS

A Convolutional Neural Network have a n number of layers which can learn to detect different features from an image data, and the output of each processed image is used as the input to the next layer. The filters or we can say processing like edges, increase complexity, adjust brightness. CNN can perform feature identification classification of images, sound, audio, video and text .

CNN is composed of an input layer, an output layer, and many hidden layers in network. These layers perform learning operation on the given data, Convolution function, Activation function and pooling are hidden layers (Fig: 4).

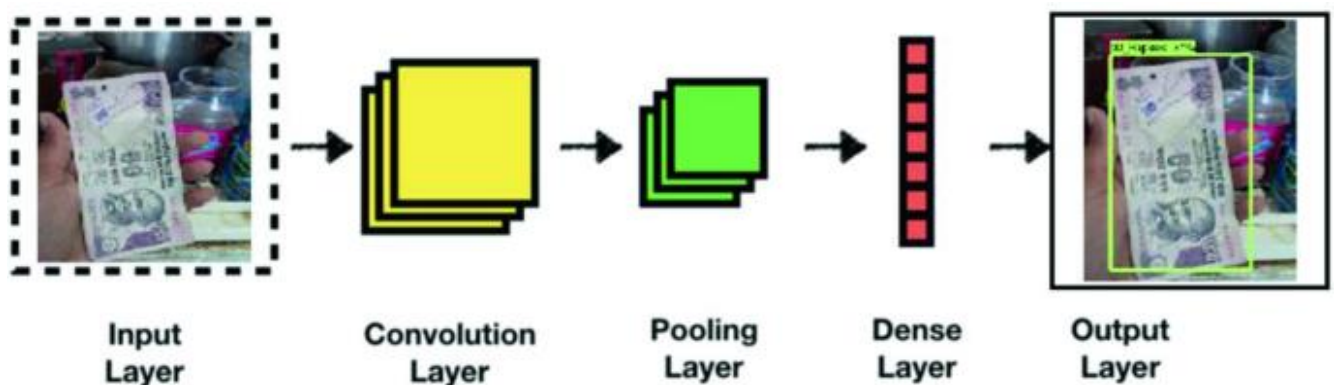


Fig:4

Convolution Neural Network

- **Convolution** It have set of convolutional filters, which find features from images, so images pass through these all filters.
- **Rectified linear unit (ReLU)** is useful for mapping negative values into zero so it's maintaining positives values, so this is one kind of activation function, we have many more choices like Sigmoid, hyperbolic tangent, but choosing a layer for a model is a depends on your data. It affects the accuracy.
- **Pooling** performs the non-linear down stamping which can reduce the number of parameters then the network needs to learn and simplify the output .
- **Dense** layer is collections of neurons. It describes how neurons connected to the next layer of neurons (In short, each neuron is connected to every neuron in the next layer). It is also known as Fully Connected layer .

These operations iterative on neural network layers, in which each layer learning to identify different features.

3.8 TRAINING TIME DECREASES WITH GPU

A convolutional neural network is trained on hundreds, thousands, or even millions of images. When we have to work with lots of data then we can use GPUs for processing and computing. It can decrease the model training time and after training we can use our model in real world application.

3.9 TOOLS AND TECHNOLOGY USED

PYTHON PROGRAMMING LANGUAGE.

Python is programming language like C, C++, C#. It is an interpreted high-level programming language. Guido van Rossum created it, and it was first released in 1991. Python coding style is so comfortable for programmer, it has indentation feature, so our code structure always stays good and understandable for other. Python is dynamically type language and also, it's have garbage collection so we don't feel to worry about unnecessary garbage in programming, it supported Procedural programming, functional programming and also object oriented programming. With OOP user can write clear & logical code for small- and large-scale project.

3.10 EXPERIMENTAL APPROACH

3.11 PRE-TRAINED MODEL

A pre-trained model, a name defining this term, it means model is trained on large dataset. You can use directly pre-trained model, in this just you have to feed your data and it can train on your data, but it is already learnt on the large dataset, now you are re-training model so it will give you a better result. This learning approach is called Transfer learning. For example, you trained network on one lakhs image and now you are retraining it on 500 images for a classification purpose. There are some Transfer learning models like Googlenet, Imagenet, Alexanet, VGG16, VGG19, RCNN Inception and many more models you can use from TensorFlow, keras and pytorch .

3.12 CURRENCY DATASET

In this part, we are discussing how we made our currency dataset, we captured images from 48 MP camera, every image has 4k*3k dimensions, let see some samples of our currency dataset. We used real world as a background because of image clarity and also to get detected in real world (Fig: 5).

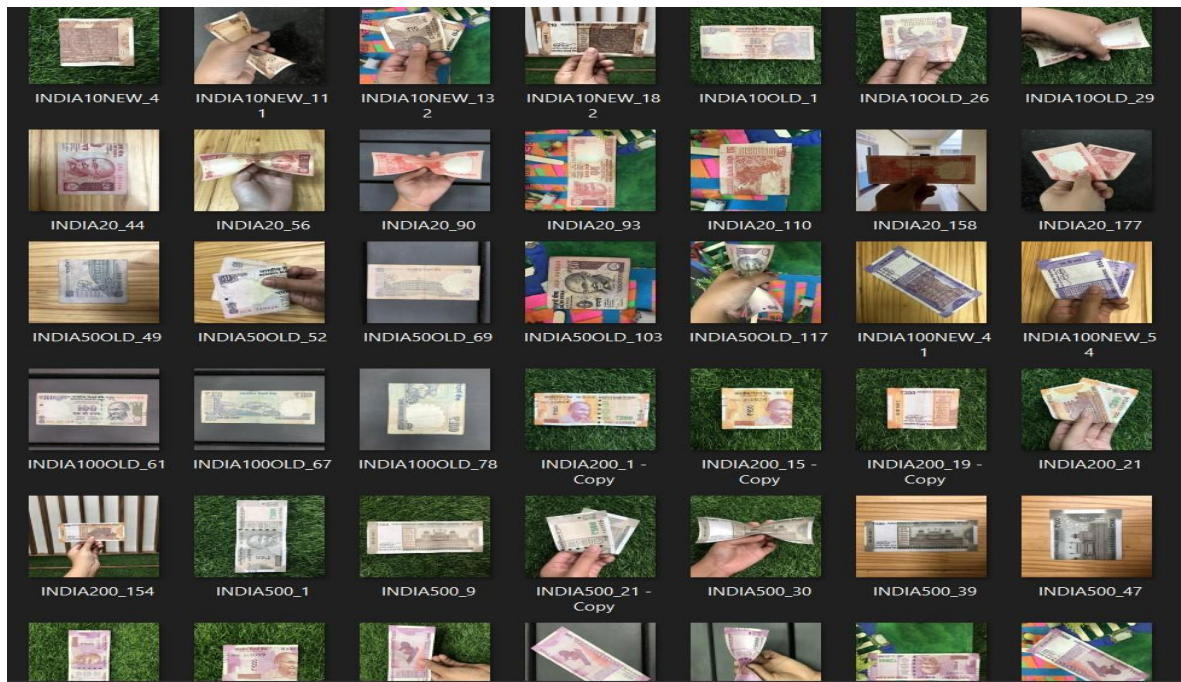


Fig: 5
Dataset

CHAPTER 4

LIBRARIES USED

4.1 NUMPY

NumPy is the fundamental package for scientific computing in Python. It is a Python library that provides a multidimensional array object, various derived objects (such as masked arrays and matrices), and an assortment of routines for fast operations on arrays, including mathematical, logical, shape manipulation, sorting, selecting, I/O, discrete Fourier transforms, basic linear algebra, basic statistical operations, random simulation and much more.

At the core of the NumPy package, is the Ndarray object. This encapsulates n -dimensional arrays of homogeneous data types, with many operations being performed in compiled code for performance. There are several important differences between NumPy arrays and the standard Python sequences:

- NumPy arrays have a fixed size at creation, unlike Python lists (which can grow dynamically). Changing the size of an Nd array will create a new array and delete the original.
- The elements in a NumPy array are all required to be of the same data type, and thus will be the same size in memory. The exception: one can have arrays of (Python, including NumPy) objects, thereby allowing for arrays of different sized elements.
- NumPy arrays facilitate advanced mathematical and other types of operations on large numbers of data. Typically, such operations are executed more efficiently and with less code than is possible using Python's built-in sequences.
- A growing plethora of scientific and mathematical Python-based packages are using NumPy arrays; though these typically support Python-sequence input, they convert such input to NumPy arrays prior to processing, and they often output NumPy arrays. In other words, in order to efficiently use much (perhaps even most) of today's scientific/mathematical Python-based software, just knowing how to use Python's built-in sequence types is insufficient - one also needs to know how to use NumPy arrays.

4.2 PANDAS

pandas is a software library written for the Python programming language for data manipulation and analysis. In particular, it offers data structures and operations for manipulating numerical tables and time series. It is free software released under the three-clause BSD license. The name is derived from the term "panel data", an econometrics term for data sets that include observations over multiple time periods for the same individuals. Its name is a play on the phrase "Python data analysis" itself. Wes McKinney started building what would become pandas at AQR Capital while he was a researcher there from 2007 to 2010.

LIBRARY FEATURES

- Data Frame object for data manipulation with integrated indexing.
- Tools for reading and writing data between in-memory data structures.
- Data alignment and integrated handling of missing data.
- Reshaping and pivoting of data sets.
- Label-based slicing, fancy indexing, and subsetting of large data sets.
- Data structure column insertion and deletion.
- Group by engine allowing split-apply-combine operations on data sets.
- Data set merging and joining.
- Hierarchical axis indexing to work with high-dimensional data in a lower-dimensional data structure.
- Time series-functionality: Date range generation and frequency conversions, moving window statistics, moving window linear regression date shifting and lagging.
- Provides data filtration.

4.3 MATPLOTLIB

Matplotlib is a plotting library for the Python programming language interface based on a state machine (like OpenGL), designed to closely resemble that of MATLAB, though its use is discouraged. SciPy makes use of Matplotlib.

Matplotlib was originally written by John D. Hunter. Since then it has had an active development community and is distributed under a BSD-style license. Michael

Droettboom was nominated as matplotlib's lead developer shortly before John Hunter's death in August 2012 and was further joined by Thomas Caswell. Matplotlib is a NumFOCUS fiscally sponsored project.

Matplotlib 2.0.x supports Python versions 2.7 through 3.10. Python 3 support started with Matplotlib 1.2. Matplotlib 1.4 is the last version to support Python 2.6. Matplotlib has pledged not to support Python 2 past 2020 by signing the Python 3 Statement.

INSTALLATION:

Windows, Linux and macOS distributions have matplotlib and most of its dependencies as wheel packages.

Run the following command to install matplotlib package :

```
(python -mpip install -U matplotlib)
```

4.4 TENSORFLOW

TensorFlow is Google Brain's second-generation system. Version 1.0.0 was released on February 11, 2021. While the reference implementation runs on single devices, TensorFlow can run on multiple CPUs and GPUs (with optional CUDA and SYCL extensions for general-purpose computing on graphics processing units). TensorFlow is available on 64-bit Linux, macOS, Windows, and mobile computing platforms including Android and iOS. Its flexible architecture allows for the easy deployment of computation across a variety of platforms (CPUs, GPUs, TPUs), and from desktops to clusters of servers to mobile and edge devices. TensorFlow computations are expressed as stateful dataflow graphs. The name TensorFlow derives from the operations that such neural networks perform on multidimensional data arrays, which are referred to as tensors.

CHAPTER 5

5 WORKFLOW

STEP 1: Collection of Data and cleaning it

Collecting samples for the dataset is the big task in the project building, as the dataset is the responsible thing for the coming output of the classification model. Before passing it through the classification model the dataset should be cleaned as it contains some images which will affect the model during image recognition. For this model nearly 1400 images were collected. Then these images were cleaned to get a better classification model. Sometimes background-coloured images affect model generated, so discarding them is best option. So, image cleaning is important.

STEP 2: Converting image to metrics using open CV

OpenCV (*Open-Source Computer Vision Library*) is a mainly aimed at real-time Computer vision. Originally developed by Intel, it was later supported by Willow Garage then Itseez (which was later acquired by Intel). The library is cross-platform and free for use under the Open-source Apache 2 Licence. Starting with 2011, OpenCV features GPU acceleration for real-time operations Fig:6.

OpenCV is a library that performs traditional computer vision algorithms. The TensorFlow + Keras framework is a go-to option for anyone who wants to work with deep learning. OpenCV version 3.x has introduced DNN and Caffe frameworks to solve deep learning problems .

To work with an OpenCV library, you need to install it in the virtual environment using `pip install OpenCV-contribution-python`. The `cv2` package provides an `imread()` function to load the image. It also reads a PIL image in the NumPy array format. The only thing we need to convert is the image colour from BGR to RGB. `imwrite()` saves the image in the file.

STEP 3: Model Building

Every image is a 2D matrix of pixels of different values with RGB colours. Images consist of pixels in a grid. Every image processing is involved with 3 basic steps - 1) Importing images using appropriate image importing tools 2) Image pre-processing/ analysing and manipulating images. 3) Analysed output. Here in the

project, we used TensorFlow for Image Classification. Images used are . CNN concept is that not all pixels are needed to identify features of an image or classify them. Steps involved in image classification are dataset, Convolution, ReLU layer, Pooling, Flattening, Neural Connections, converting generated model to tflite model and Exporting model to Flutter application.

Convolution: Convolution basically is a combined integration of two functions, and it shows you how one function modifies or affects other functions.

$$(f * g)(t) = \int_{-\infty}^{\infty} f(\tau)g(t - \tau)d\tau \quad (1)$$

(1) is an example of convolution.

There is input image

$$x \in R^{H \times W \times D} \quad (2)$$

(2) (where D = 3 where it represents RGB image format layers and H x W is pixel matrix size) and a feature detector matrix . Here we apply convolution on each red, green, and blue layer separately , so we can represent each image as R HxW . Suppose the dimension of the image is n x n and the feature matrix is f x f.

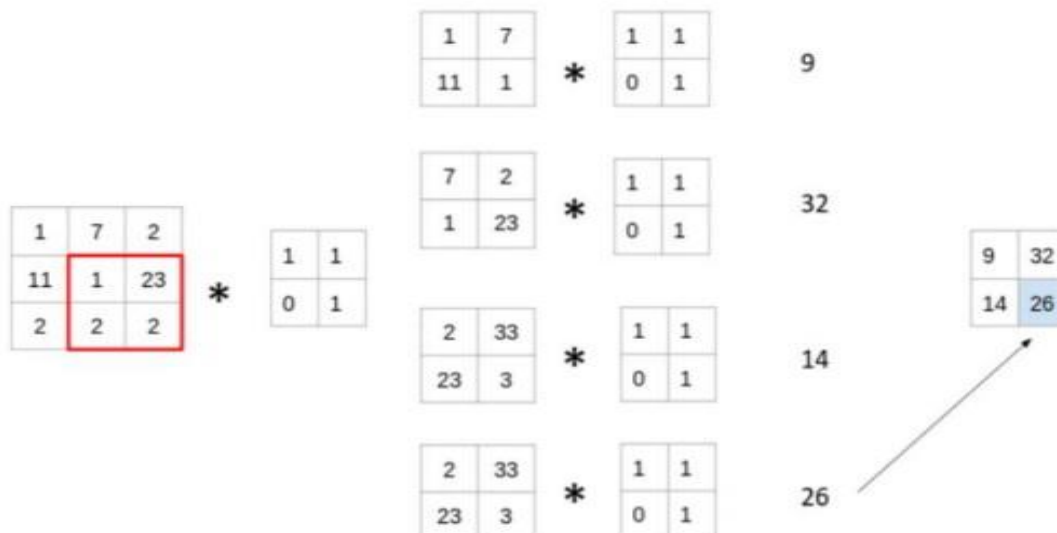


Fig: 6

Convolution of image matrix

In the given diagram, we can see the use of convolution. These feature matrices or convolution kernels are used to detect various things like edges, horizontal and vertical ones, or other features. After convolution, i.e., multiplying each value of matrix with each value of kernel, we get a matrix of

$$(n - f + 1) \times (n - f + 1)$$

(3) which is a Feature Map. We can create multiple feature maps for targeting each feature on notes and for each feature we must create separate filters.

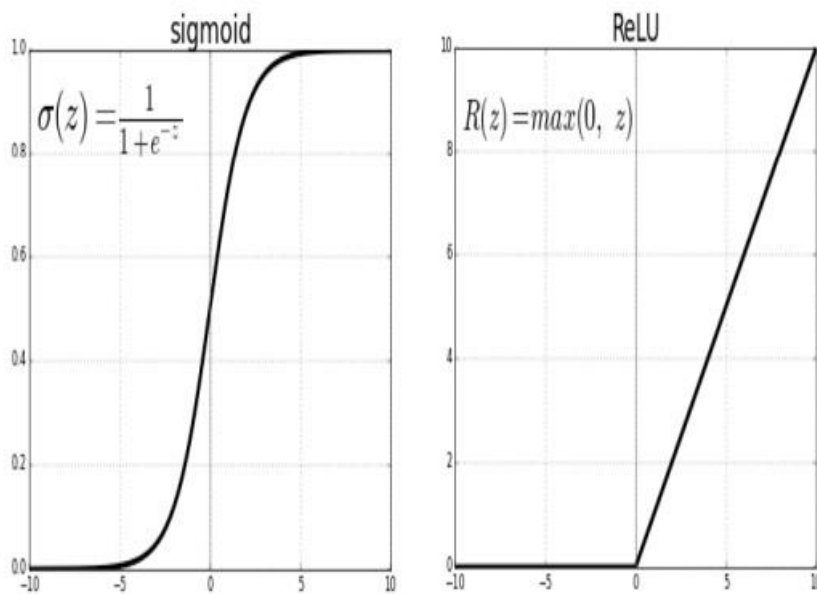


Fig: 7

Variation Graph for Sigmoid and ReLU functions

ReLU layer:- We use Rectifier function because we want to increase nonlinearity in our image or in our CNN. Rectifier acts as that filter. If we apply ReLU, it makes everything below 0 the same value or flattens it.

Pooling:- Pooling is needed especially for orientation correction of currency notes. In the dataset we have images which are rotated or sometimes slim or fat, but we want the neural network to recognise all of them as the same note. We need to make sure that our neural network has a feature called spatial invariance meaning that it doesn't care where features are in cases like rotation or whether features are a little bit different. Various types of pooling exist like mean or max pooling.

Flattening:- Pooled feature map is converted to linear matrix or one long column. Now we run a Neural Network considering this linear matrix as input.

Full Connection: - In this step we run Neural Network and Neural Network using Backpropagation and Gradient Descent builds the whole Neural Network.

Suppose we have neural network of one layer

$$Z = W_T \cdot X + b \quad (4)$$

in (4) Here W_T are randomised weights matrix ; X is image which is input, and b is randomised bias matrix and Z is output. We apply sigmoid function or can apply ReLU function on Z .

ReLU function:

$$F(x) = \max(0, x) \quad (5)$$

Sigmoid Function :

$$S(x) = \frac{1}{1 + e^{-x}} = \frac{e^x}{e^x + 1} = 1 - S(-x). \quad (6)$$

$$O = \sigma(Z) \quad (7)$$

$$O \in (0, 1) \quad (8)$$

If actual output is O' and we are getting O as output. Let Error be E . Gradient Descent equation :

$$W' = W - (\text{learning rate}) \times \frac{\partial E}{\partial w} \quad (9)$$

For CNN we have a filter matrix as our gradient of parameter.

$$Z = X * f \quad (10)$$

$$f' = f - (\text{learning rate}) * \frac{\partial E}{\partial F} \quad (11)$$

$$= f - (\text{learning rate}) * \frac{\partial E}{\partial O} \cdot \frac{\partial O}{\partial Z} \cdot \frac{\partial Z}{\partial F} \quad (12)$$

This is how we correct mistakes by backward propagation and correct filter matrix. This is how we make correct filters which can be applied on images, and we get correct recognition of currency notes.

5.2 Accuracy per Class

For this model it is necessary to check the accuracy of every denomination to check the currency note correctly. As on the teachable machine we created the model of different classes containing the denominations, and then setting proper epoch value the below accuracy achieved. For this image processing project, we included all the Indian denominations ranging from 10 to 2000.

	precision	recall	f1-score	support
0	0.67	0.83	0.74	46
1	0.82	0.94	0.88	34
2	0.89	0.85	0.87	40
3	0.88	0.81	0.85	37
4	0.97	0.80	0.88	44
5	0.88	0.88	0.88	42
6	0.79	0.73	0.76	37
accuracy			0.83	280
macro avg	0.84	0.83	0.84	280
weighted avg	0.84	0.83	0.83	280

Classes

- 0 indicates 10 Rupee Notes
- 1 indicates 100 Rupee Notes
- 2 indicates 20 Rupee Notes
- 3 indicates 200 Rupee Notes
- 4 indicates 2000 Rupee Notes
- 5 indicates 50 Rupee Notes
- 6 indicates 500 Rupee Notes

5.3 FUTURE SCOPE

Nowadays, technology is growing on a large scale. The proposed system can be extended towards coin detection also for fake currency recognition. Denomination of other countries other than India can be added also comparison between them can be achieved. When an image is loaded from the outside into the training folder then it is not giving 100% accuracy. We can improve this problem by optimizing the system.

CONCLUSION

Thus, the different methods proposed in this paper were implemented successfully and verified by performing experiments over the model. CNN is found to be the best feature for performing the technique by using tflite modules. Accuracy of 95% achieved by performing the classification of models. Also, the detection of the coins is performing well in this method.

IEEE Standards

IEEE P2840™ - Standard for Responsible AI Licensing

The standard describes specifications for the factors that shall be considered in the development of a Responsible Artificial Intelligence (AI) license. Possible elements in the specification include (but are not limited to): (1) What a 'Responsible AI License' means and what its aims are (2) Standardized definitions for referring to components, features and other such elements of AI software, source code and services (3) Standardized reference to geography specific AI/Technology specific legislation and laws (such as the EU General Data Protection Regulation – GDPR) as well as identification of violation detection, penalties, and legal remedies. (4) The specification lists domain specific considerations that may be applied in developing a responsible AI license. The proposed standard shall not require the use of any specific legal text or clauses nor shall the proposed standard offer legal advice.

IEEE P2841™ - Framework and Process for Deep Learning Evaluation

This document defines best practices for developing and implementing deep learning algorithms and defines a framework and criteria for evaluating algorithm reliability and quality of the resulting software systems.

P3110™ - Standard for Computer Vision (CV) - Algorithms, Application Programming Interfaces (API), and Technical Requirements for Deep Learning Framework

This standard establishes the application programming interfaces (API) model of the computer vision systems and specifies the functional and technical requirements of the API between the computer vision algorithm, deep-learning framework, and the data set in the process of algorithm training phase. This standard is suitable for the adaptation and invocation of computer vision algorithms using deep learning frameworks.

P3123™ - Standard for Artificial Intelligence and Machine Learning (AI/ML) Terminology and Data Formats

The standard defines specific terminology utilized in artificial intelligence and machine learning (AI/ML). The standard provides clear definition for relevant terms in AI/ML. Furthermore, the standard defines requirements for data formats.

Constrains

A minimum of 256GB of storage is needed for this project. And a 8GB of ram is needed for the ML/DL model to train and to sustain a high rate of computation. For improved performance, the graphic card should have at least 2 GB of memory. The Anaconda's Jupyter Notebook has been used to develop, train, test, and validate models. PyCharm provides smart code completion, code inspections, on-the-fly error highlighting and quick-fixes, along with automated code refactoring's and rich navigation capabilities.

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