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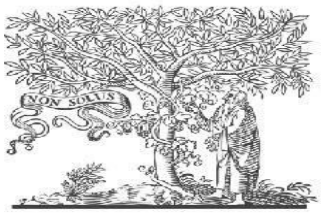

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Title **DETECTION OF INDIAN CURRENCY DENOMINATION USING TRANSFER LEARNING AND DATA AUGMENTATION TECHNIQUE**

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Paper Authors
Dr.M.Kalpana , N.Samyuktha, P.Gnaneswari,M.Harshitha, Md.Gousiya Begum

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DETECTION OF INDIAN CURRENCY DENOMINATION USING TRANSFER LEARNING AND DATA AUGMENTATION TECHNIQUE

[1] Dr.M.Kalpana M.Tech, Ph.D.,

[2] N.Samyuktha, [3]P.Gnaneswari,[4]M.Harshitha, [5]Md.Gousiya Begum

[1]Associate Professor,CSE,PSCMRCET,Vijayawada,Andhra Pradesh

[2,3,4,5] Student,CSE,PSCMRCET,Vijayawada,Andhra Pradesh

[1]kalpana@pscmr.ac.in, [2]samyukthanelli@gmail.com, [3]gnaneswari.pandiri7@gmail.com, [4]harshithamanduri0300@gmail.com, [5]gousiyamohammad2000@gmail.com,

Abstract

In today's world, paper currency plays a major role because now-a-days the value of currency is high. In the year of 2016, the Indian Government announced that the denomination of old Rs.500 and Rs.1000 notes was banned.After that new denomination notes were entered they're Rs.10, Rs.20, Rs.50, Rs.100, Rs.200, Rs.500 and Rs.2000. Since, identification of the currency notes became difficult. So, in order to identify its denomination we are using a Neural Network algorithms.During this project, we'll perform Image PreProcessing, Edge Detection, Segmentation, Feature Extraction and Classification on the Indian currency notes by using Data augmentation and Transfer Learning technique. Here we consider the currency images in a dataset which consists of 80% training data and 20% test data. Here the user uploads the input currency image in the test dataset which will further give the result by representing its respective currency denomination with 97% accuracy.

Keywords: GANs, Generator, Transfer Learning, Denomination,CNN, Feature Extraction, Image Pre-processing.

I. INTRODUCTION

Different nations in the world have a variety of currencies for replacing and utilizing the motive of goods. Among all countries one common hassle confronted by means of all is associated with the currency identification, and additionally inclusion of the currency denomination in the system. Along with the other states India is one of the countries that face many problems such as large losses due to the problems with foreign money denomination. This hassle

has arrived on account of the 12 months 2016. Due to this there are many greater losses in the normal economic system of the country's forex value. The technological developments have made a pathway for currencies such that it can't be normally recognized. Advanced printers and new modifying pc software's are used to create

currencies. Commercial areas like the banks, malls, jewelry stores, etc have massive amounts of transactions on a every day

groundwork which may be manually or thru on-line mode. Such places may additionally be able to manage to pay for and find it feasible to purchase machines that use UV light and different strategies to observe the authenticity of the currency. But for common people it is very hard to simply observe the currency denomination and they may also face losses mainly at some stage in replacing foreign money manually. This is because of the fallacious identification of the suitable denominated foreign money not. This system is designed such that any character can use it without difficulty and discover the authenticity of the forex he has by the use of the visual features of the currency. This machine can in addition be converted into a web utility so that it is on hand to all the people. Furthermore, this gadget can be designed to become aware of currencies of other international locations as well.

II. RELATED WORK

In [1] Shamika Desaiet.al, the main aim of this strategy is to denominate the paper currency of India with a latest methodology using Generative Adversarial Networks (GAN). In this structure, the Indian bills note features hope generally destroyed using Convolutional Neural Networks (CNNs). The reused countenance dossier is more augment to a Generative Adversarial Network which helps bureaucracy to categorize the bills as either real or duplication. GAN resides in two main modules – Discriminator and Creator. Then the Discriminator recognizes and labels the real and fake representations and the Creator produce counterfeit currency images.

Currencies are given from confronting indifferent ways and in complementary cases, we grant permission to catch damaged, traditional, bleached, depreciation notes thus the cash acknowledgment tasks come really sensitive. They've thought-out a model which is prepared on a dataset that exists of Indian currency outline of various appellations (10, 20, 50, 100, 500 and 2000). The countenances for this dataset were collected from datasets connected to the internet, and likewise calmed manually. Their training dataset consists of about 4000 concepts.

In [2] B Padmaja Et.al, connected that immediately-moment of truth unable to see family and aging villagers find it delicate to recognize the significance of bank outline. Some of the scammers use this to their benefit to deceive the unable to see and senior and present ruling class the fake appellations. With the demonetization outdated ₹ 500 and ₹ 1000 bills outline, new ₹ 500 and ₹ 2000 cash notes were brought in, that led innumerable strictness to the Eyeless folk and aging settlers. It was hard for the ruling class to go for the new outline. A new plan to identify fake outline through explored concepts by asking multi scale motif corresponding imposed utilizing OpenCV in Python. In this arrangement CNN model is secondhand for Currency

Denotation Recognition and Fake Currency Identification. There are 2 steps in our projected system. The first point searches out to categorize the bills note educated on indication and the alternate state searches out to check whether the note is fake. The three-hide CNN model secondhand for classifying cash notes set on appellations created appropriate results accompanying 98.50 delicious. The preparation dataset is agreed at an 82 rate for cross proof. Multiscale motif equal is used to detail freedom features in the cash note. However, it's discovered as an honest note, and in another way, If the appearance is doubled. For experiment the model, the checked exact likeness a bills note search out be uploaded through the Jupiter Train.

In [3] P.Selvi Rajendranet.al, One of the big sensitive tasks between all other tasks is pertaining counterfeit currency outline. Disquisition and troubles were approved on the wealthy person with power instructional accumulation, that heartened CNN helpless on the important highlights, for drawing, watermarks, filmland written on cash, acknowledged as calm of dispute and figures and the total cash. This paper handles the application of Convolutional Neural Networks (CNNs) for occupied humankind issues and examinations about the showing and judgment of various CNN models. Then, Alexnet, Googlenet, and Vgg16 models have been thought-out for a long time. According to the Indian experts, optically incapacitated public have advanced. The last smartphone happening from it is likely to recognize currency accompanying a sexy cartilage. In their survey work they used the convolutional interconnected system (CNN) models similar as Alexnet, Googlenet and VGG16 to express the profit of the cash outline. All the models were adapted as far as fitting and experimenting the individualities of dossier sets. For ruling class Alexnet acted better in fitting fulfillment, Vgg16 model determined better pursuit and completed 100, Google net accomplished 88 just before productivity.

In [4] Mohan Mahantyet.al has projected a fashion for netting approach by lending or bed linen organizing various countries with its own government outline. When a cash countenance is captured it's divided and anticipated the process of acknowledgment and fake note reasoning. Each note resides on ROI (Region Of Interest) that is destroyed from the note and is secondhand for further handling, for exemplification happening and acknowledgement processes and ANN capitals fitting methods. At first the note is investigated and more edges are cut for fear that it'll be smooth for embedding countenance in a note. After ingraining these visages will be distinguished accompanying the original note by utilizing fashion controls for one microcontroller.

In [5] Pratiksha Maneet.al, Currently almost all countries in the experience including India are facing many issues concerning counterfeit currency. Also shadowing of these counterfeit currency outlines has enhanced a sensitive task due to the use of

chiefly state-of-the-art science. Then they've second hand a convolutional neural network

as a projected invention. Their design will earn Indian cash notes utilizing an honest-occasion figure obtained from a webcam. The environment of their content was to refine electronics and applied it for the purpose of vindicating money backed by government outline. The program they secondhand will interpret the fake currency by ingraining the appearance of outline. The progress rate of the software may be calculated in agreements of daintiness and speed. They will be erecting a convolutional interconnected system in accordance with a projected treasure which will acquire information on a likely fake and original cash basic document file, which will foretell whether the likely bills image is fake or original. They reached a daintiness of 96.6 on a grasped-out experiment subset.

III.PROPOSED SYSTEM:

The projected scheme is using Generative Adversarial Networks (GANs) to discover the cash. The input is a printed or leafed through image, likely to the system that may be of .png and before the output describes whether the currency is honest or not. The process contains methods to a degree image pre- convert, muted Gray in color scale change, edge detection, separation, feature origin and comparison of visage.

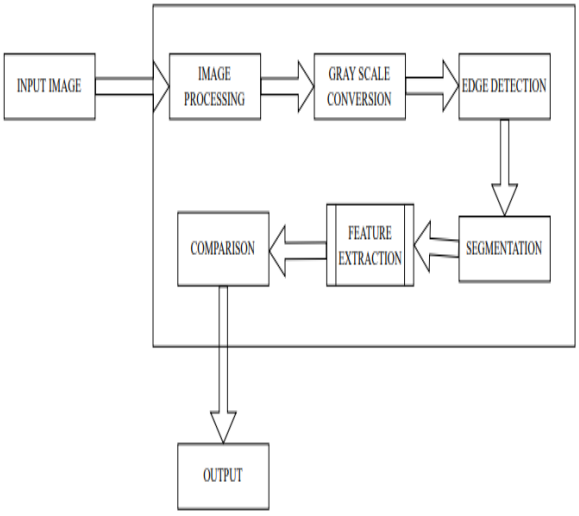

Fig.1 System Architecture

Step 1: Image Pre-processing

Pre-processing is a common term for operations that accompany images at the most basic level of preoccupation; the two together are force figures. The goal of pre-convert is to improve the countenance dossier by suppressing unwilling falsifications or improving a few key image contents for further refinement.In this system, turbulence filtration is exhausted image pre-processing. Here, the gray or white type of roaris removed.

Step 2: Gray scale conversion

The concept is convinced of a grayscale representation as it reduces the complexity to law. There are many procedures that may be used to convert an RGB countenance to a grayscale countenance such as balancing order, radiance pattern, desaturation design,

etc. The system uses the radiance method to act as grayscale change.

Step 3: Edge Detection

The grayscale figure is the recommendation for this step. The system uses Canny Edge discovery as it gives best results distinguished from the added methods. Canny edge discovery is a method to extract beneficial fundamental facts from various dream objects and severely humiliate the amount of dossier expected.

Step 4: Segmentation

There are differing systems like thresholding, clustering patterns, domain based separation, etc, to act separation in image alter. Here the thresholding procedure is used to act segmentation where beginning values that are obtained from the graph resembling a pie of the edges of the original image are secondhand.

Step5: Feature extraction and Comparison

If the appearance gleaned are painstakingly preferred it is necessary that the visage set will extract the appropriate facts from the recommendation dossier. The system uses SSIM (Structure Similarity Index Method) system for feature contrasting.

The physiognomy that is being distinguished in bureaucracy are in this manner for 2000,500, 200, 100, 50, 20, 10 Rupees note. Here we are seeing for 2000 rupee note:

1)Mahatma Gandhi's portrait is in the center.
2) RBI micronotes and 2000 individuals or groups favoring the dollar's change side
3) Windowed safety fiber accompanying message of RBI
4) Guarantee Clause, Governor's Signature, and RBI Logo to the Right
5) The denominational figure that goes with the rupee letter is shown below right.
6) Asoka Pillar crest on the right and electrotype watermarks
7) Number committee with numerals increasing in height successful abandoned side and bottom right side
8) Seven bent drain lines on abandoned and kindliness cash
9) Year of publication of the bills person or group favoring change
10) Swachh Bharat trademark with motto

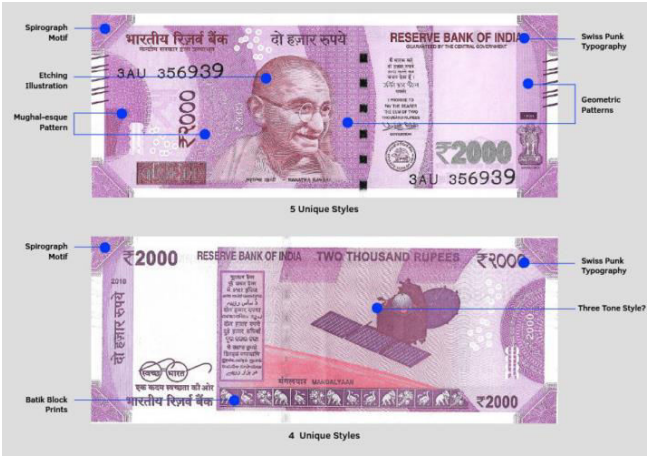

Fig 2: Key features of a Currency Note

IV. DATA AUGMENTATION:

Data augmentation is a technique that allows interpreters to significantly increase the variety of data available for training models without actually collecting replacement data.

Cropping, padding, and vertical flipping are common data augmentation techniques used to train large neural networks. Image data augmentation is a technique that can be used to instinctively increase the size of a training dataset by creating modified accounts of images in the dataset.

Data augmentation strategies in computer vision

- Cropping.
- Flipping.
- Rotation.
- Translation.
- Brilliance.
- Contrast.
- Color Augmentation.
- Saturation.
- Resizing
- Horizontal Flip
- Zoom
- Fill mode

V. FEATURE EXTRACTION:

Feature extraction is a dimensionality reduction process that shortens an initial set of rough knowledge to more manageable groups for transformation. The significant result sets have a large number of variables that require a lot of estimating abilities to process..In machine intelligence, pattern recognition, and image alter, feature ancestry begins with a starting set of calculated dossier and builds derived principles (face) that are expected to be informative and non-repetitive, simplifying the subsequent knowledge and inference steps, and in some cases leading to better human judgments. Dimensionality decline is linked to feature distillation.

When the input data to an algorithm is also large anticipated processed and it is suspected to be eventually redundant (e.g. the similar calculation in two together extremities and meters, or the repetitiveness of concepts bestowed as pixels), it can be revamped into a discounted set of countenances (also named a feature heading). The process of determining a subspace of the primary features is referred to as feature draught.

The chosen features are expected to control the relevant material from the input proof, allowing the desired task to be carried out by utilizing this lowered representation, a suggestion of correction to the entire beginning dossier.Many features of ancestry methods are used to discover the pleura lump image, like Local Binary Patterns, Speeded-Up Robust Feature, Gray level covariance form. In this method we are utilizing the silver level covariance mold method. The staying methods have some difficulties that are the local twofold patterns are not even to rotations and Speeded-Up Robust Feature are extreme range.

VI. GRAY SCALING:

Grayscale is the collection or range of monochromic (silver) shades ranging from clean white at one end to clean angry at the other. Grayscale is a group of shades outside some seeable color. Gray measuring is the process of turning an image from different

color rooms such as RGB, CMYK, HSV, etc. to shades of silver. Grayscale only holds shiny news, not color. It changes between complete dark and complete silver. Grayscale only holds radiance (shine) facts and no color facts; that is to say why maximum radiance is silver and nothing radiance is dirty; entirety in betwixt is a shade of silver. That is why grayscale concepts hold only shades of silver and no color. Grayscale is alias achromatic.

VII. CLASSIFICATION:

Classification is a technique that divides data into classes based on its type. A categorization question's main goal is to label the category/class into which a new dossier will fall. Classifier: An invention that maps the recommendation dossier to a particular category. In automobile knowledge and enumerations, categorization is a directed learning approach in which the calculating program learns from the dossier recommendation likely to it and therefore uses this training to classify new observations.

There are some classification techniques that are given below

- Convolution neural networks
- Back propagation
- Decision tree

In these techniques we use Convolution neural networks.

VIII. CONVOLUTION NEURAL NETWORK:

A Convolution Neural Network (CNN) is a Deep Learning algorithm that can take in a recommendation image, assign significance (learnable weights and biases) to various aspects/objects in the concept, and have or

do change people from the added. In comparison to other categorization algorithms, the amount of pre-processing required by a ConvNet is much lower.

Convolution: Convolution is a method that generates feature maps from an input dataset and then applies a function to these maps.

Max Pooling: It helps CNN detect images based on the assumed modification.

Flattening: The dataset is then compressed for examination by a CNN at this stage.

Full Connection: This is sometimes referred to as a hidden layer that collects the system's loss function.

Layers in CNN Model:

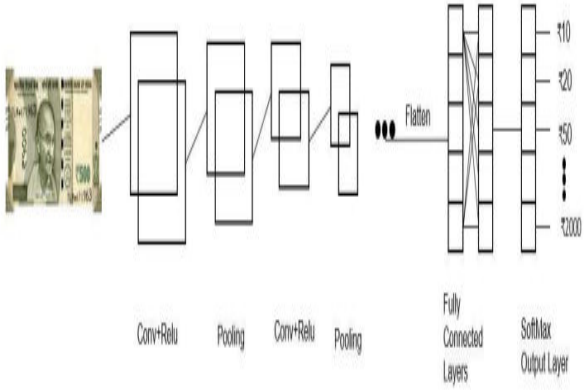

Fig 3: Layers in CNN Model

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DATA SET(Sample):

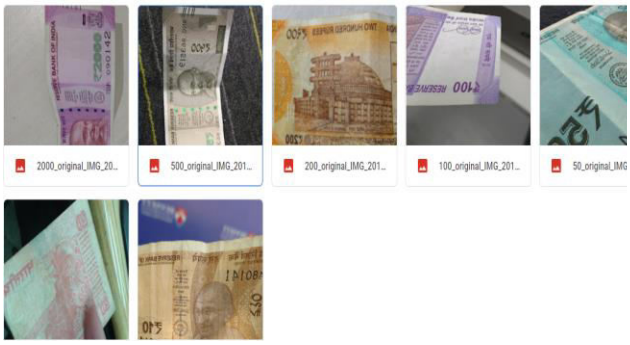

Fig 4: Currency Data Set

IX. WORKING:

In this proposed system an Indian currency note is detected whether it is fake or real, provided by a scanned image through a webcam or a scanner. The proposed system is a web based application. If the currency note is anonymous ie., if the currency note is other than the Indian currency note then the system will not be able to identify and treat it as an anonymous currency note.

Let us see the process step by step.

STEP1: The images of the currency note are uploaded into the system.

STEP2: Pre processing of images is done such as resizing, rotation, horizontal flip.

STEP3: The features are extracted during scanning which helps in the prediction of the test image.

STEP4: Edge detection of the input image is done.

STEP5: By using transfer learning feature extraction and classification of the currency notes occurs in a systematic manner.

STEP6: If the template matches then the currency note is considered as a genuine currency note otherwise a fake note.

STEP7: Thus the system detects which type of denomination of the currency note with the help of modified CNN.

X.PERFORMANCE EVALUATION:

Accuracy:

Accuracy is outlined as the pattern's certain veracity and is premeditated as the total of distinguishing forecasting determinants. In the projected model, we have applied the model on two datasets.

Fig 5.1: 2000 notes Pre-processed images

Fig 5.2: 20 (new) notes Pre-processed images

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Fig 5.3: 20 (old) notes Pre-processed images

```
Epoch: 0 Train Loss: tensor(8.2565) Train Accuracy: 0.6311111111111111 Test Accuracy: 0.18888888888888888
Epoch: 1 Train Loss: tensor(2.1700) Train Accuracy: 0.8277777777777777 Test Accuracy: 0.2833333333333333
Epoch: 2 Train Loss: tensor(2.6617) Train Accuracy: 0.8188888888888889 Test Accuracy: 0.5222222222222223
Epoch: 3 Train Loss: tensor(2.0256) Train Accuracy: 0.8588888888888889 Test Accuracy: 0.5166666666666667
Epoch: 4 Train Loss: tensor(1.2311) Train Accuracy: 0.9011111111111111 Test Accuracy: 0.4888888888888889
Epoch: 5 Train Loss: tensor(1.7881) Train Accuracy: 0.9 Test Accuracy: 0.48333333333333334
Epoch: 6 Train Loss: tensor(0.4136) Train Accuracy: 0.9577777777777777 Test Accuracy: 0.55
Epoch: 7 Train Loss: tensor(2.8906) Train Accuracy: 0.8433333333333334 Test Accuracy: 0.46111111111111114
Epoch: 8 Train Loss: tensor(2.5047) Train Accuracy: 0.8866666666666667 Test Accuracy: 0.55
Epoch: 9 Train Loss: tensor(0.9922) Train Accuracy: 0.92 Test Accuracy: 0.4722222222222222
```

Fig 7:Epoche Result

Summary Report:

```
model.summary()

Model: "sequential_8"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 conv2d_24 (Conv2D)          (None, 150, 150, 16)      448

 max_pooling2d_24 (MaxPoolin  (None, 75, 75, 16)       0
 g2D)

 dropout_32 (Dropout)        (None, 75, 75, 16)        0

 conv2d_25 (Conv2D)          (None, 75, 75, 32)        4640

 max_pooling2d_25 (MaxPoolin  (None, 37, 37, 32)       0
 g2D)

 dropout_33 (Dropout)        (None, 37, 37, 32)        0

 conv2d_26 (Conv2D)          (None, 37, 37, 64)        18496

 max_pooling2d_26 (MaxPoolin  (None, 18, 18, 64)       0
 g2D)

 dropout_34 (Dropout)        (None, 18, 18, 64)        0

 flatten_8 (Flatten)         (None, 20736)             0

 dense_15 (Dense)            (None, 512)               10617344

 dropout_35 (Dropout)        (None, 512)               0

 dense_16 (Dense)            (None, 9)                 4617

=================================================================
Total params: 10,645,545
Trainable params: 10,645,545
Non-trainable params: 0
_________________________________________________________________
```

Fig 6:Summary Report

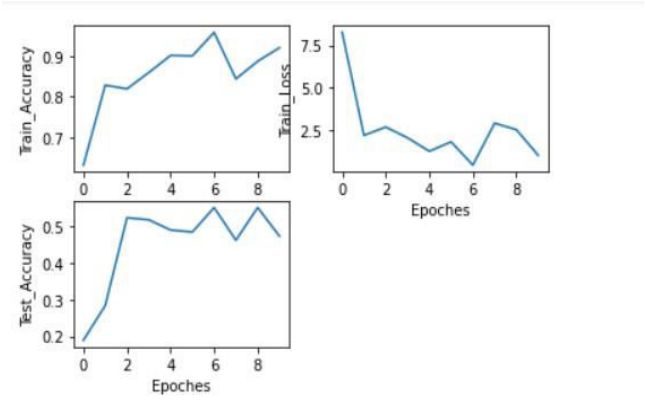

Fig 8: Epoch Graph

XI. EXPERIMENTAL RESULTS:

Table 2: TEST CASES

SNO	TEST CASE	EXPECTED OUTPUT	ACTUAL OUTPUT	REMARKS
1	Uploading a pdf file	Please upload a valid input/file	error	fail
2	Accuracy prediction for training	graph	Visualization of graph	pass
3	Accuracy prediction for testing	graph	Visualization of graph	pass

SNO	TEST CASE	EXPECTED OUTPUT	ACTUAL OUTPUT	REM
1	Uploading a pdf file	Please upload a valid input/file	error	fai
2	Accuracy prediction for training	graph	Visualizatio n of graph	pass
3	Accuracy prediction for testing	graph	Visualizatio n of graph	pass
4	Images of different size	Resizing the images	Resized images	pas
5	Anonymous denomination	Please upload a valid input/file	error	fail

XII. CONCLUSION:

In our project, we are going to identify the denomination of Indian Currency notes. It is implemented by the Python programming language. The currency notes will have some specific features like width, height, paper type, color, watermark, figures and alignment, ink smudge, typography, micro lettering etc.In this study, we use Generative Adversarial Networks (GANs) and Convolution Neural Networks (CNN) to identify the Indian paper cash denomination in this study (CNN). Feature extraction will be implemented on Indian currency notes..Here classification can be done by using Transfer Learning and Data augmentation technique. And finally, we will upload the image and compare it with the new and old images of the notes which we have already stored in a database in the form of an image dataset. With the help of these comparisons we are going to predict the denomination of the currency.

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