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IDENTIFICATION OF FAKE INDIAN CURRENCY USING CONVOLUTIONAL NEURAL NETWORK

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Abstract: The technological development and researches have been improving in our daily life, the human computer interaction has been becoming the must source in our everyday life. These technologies will help the visually impaired to take part in some of their social activities. So, in order to mix with the surroundings and society and also to be independent in doing their daily routine activities, this project has been initiated as a good start for the blind people. Therefore, there should be an assistive device for the visually impaired people which would allow the blind people to easily navigate or make use of the functionalities of the device to mingle with other people in the society. Cash Recognition and fake note detection for Visually Impaired is a project dedicated towards blind people living. In recent years, deep learning has become the most popular research direction. This project mainly trains the dataset through neural networks. There are many different models that can be used in this research project. Throughout these models, accuracy of currency recognition can be improved.

I. INTRODUCTION

The World Health Organization estimated the number of visually impaired at the global level, based on the latest studies, that there are about 285 million people who suffer from visual impairment worldwide, of whom 246 million people have visual impairment and 39 million people are totally blind. It also estimated that the Eastern Mediterranean Region constitute 12.6% of the proportion of blindness in the world. One of the main problems faced by people with visual disabilities is the inability to recognize the paper currencies due to the similarity of paper texture and size between the different categories. Hence, the role of technology is to develop a solution to resolve this crisis to make blind people feel safety and confidence in the financial dealings. There are two trends in Money recognition research field; Scanner-based and Camera-based. Scanner-based systems assumes capturing the whole paper (like scanner). Such systems are suitable for the Machinery of money counters. While camera-based systems assume capturing the paper by a camera which may capture a part of the paper. Most related works in literature deal with the scanner-based type. For visual impairment usage, it's supposed to enable users to capture any part of the paper by their smart phone and let the system recognize it and tell the currency value.

Modern automation systems in real world require a system for currency recognition. It has various potential applications including banknote counting machines, money exchange machines, electronic banking, currency monitoring systems, assist blind persons etc. The recognition of currency is a very important need for Blind and visually impaired people. They are not being able to differentiate between currencies correctly. It is very easy for them to be cheated by the others. Therefore, there is an urgent need to design a system to recognize the value of currencies in an easy way regardless of rotation, illumination, scaling and other factors that may reduce the quality of the currency such as noisy, wrinkled and striped currencies.

II. LITERATURE VIEW

1. Rajasekaran.C et al.(2018)[1], in this paper they proposed a convenient method of automatic coin and currency identifier which can be placed in temples i.e. the digital hundies, and at first it finds the denomination of currencies and then counts the total. After that it displays on an LCD screen. The image processing consist of the algorithms oriented FAST and Rotated BRIEF for the feature extraction purpose. The result of matched number of features in input images provides high accuracy. It proposes a method of coin and currency which fall into the counted automatically. The coin and currency sorting and counting are carried out accurately.

2. Vipin Kumar Jain et al. (2013) [2] mentioned a new image processing method which will acquire the image and then

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it will extract the ROI. That image will then converted into grayscale and by applying some filters and by applying the neural networks for pattern recognition the denomination value will get identified. The pattern recognition and neural networks matcher technique is used to match or find currency value of each one. Various techniques involved in currency recognition consists of texture, pattern and color recognition. As it concludes with ease of currency recognition with denomination numerals which can be used for currency identification which can be extracted easily from paper currency.

3. N.Panah et al. (2017) [3], in their paper they discussed about the Iranian banknotes detection by applying RGB color model and histogram normalization algorithm. This process will identify the denomination of the currency by using the templates. And also it will remove the noise in the image. So this paper concludes with identifying the value of currency using the image processing methods. And it will do the extraction of interconnected components and at last it will separate the value of currencies. It provides high accuracy in determining the detection and determining the value".

4. "Shaikh Ajij Amirsab et al. (2017) [4], in this review paper authors deals with the fake currency recognition in an automated manner. Using image processing techniques like SVM, neural network feature extraction etc. And the tool mainly used is MATLAB.

Fake notes identified by using image processing steps like grayscale conversion, edge detection of the input image and by doing segmentation the characteristics of the image get extracted. And it checks the match with the pre stored images and it get identified.

III. PROPOSED METHODOLOGY

Our system needs to be taught how a currency or object looks like in order to teach him to recognize that currency or object. We must teach the system how an Rs500, Rs2000, currency note and so on looks like before it can recognize it. The accuracy of the system can be increased with the increase in number of labelled images the system takes to train the classifier. This type of learning is known as Supervised Learning. Before starting with the preparation of system's model architecture, collecting proper data to train the model is an important step, in this case data refers to collection of images of various categories which the system must recognize.

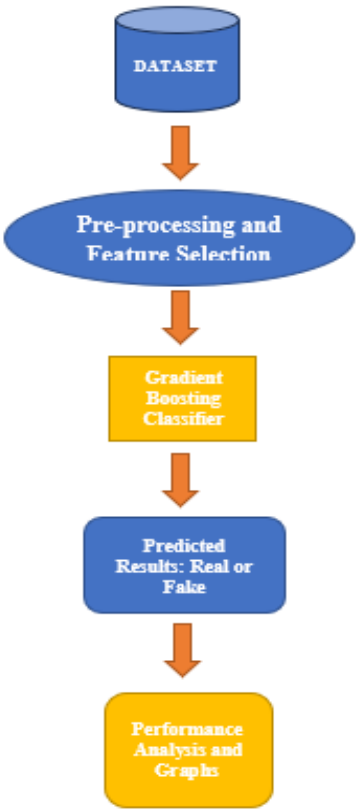

Figure 1. Proposed system

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1. Indian Currency Image Dataset

The image have been collected from various google sources and children's bank of India with Churan label. This data-set is segregated into two types, original notes and fake notes Many categories of Indian currency vary in value estimation, colour utilisation, printing quality, printing medium, and other factors that allow for easy visual differentiation.

In any case, due to the similar measures of the various currencies, content and colour will not at all help the visually impaired individual, and measurement can cause confusion.

A computer can perform numerical computations and cannot interpret images as humans do. So in order to make the system understand, we need to convert the images to numbers. In image processing, there are two common ways to do this:

i. Grey scale:

The original image is converted to grey scale image then the computer assigns a value to each pixel in the image based on the darkness of the pixel. This collection of numbers is passed to the computer in an array for further computations.

ii. RGB value:

The computer extracts each pixel's RGB value (a combination of 0 to 255 ranging from red, green, and blue). These values are passed on in an interpretation array. When the computer interprets a new image, the image will be converted to an array using the same technique, which will then compare the number patterns to the already known objects. Then the computer allocates scores of confidences for each class. Usually the class with the highest score of confidence is the one predicted.

2. Pre-Processing

In a pre-processing step, three major sub-operations are performed that are 1. Normalization, 2. RGB to LAB Conversion 3. Median filtering 4. Image sharpening. Normalization is performed to reduce the computational error while processing the images mathematically and logically. In normalization, 8-bit images are converted into 64-bit double precision IEEE datatype.

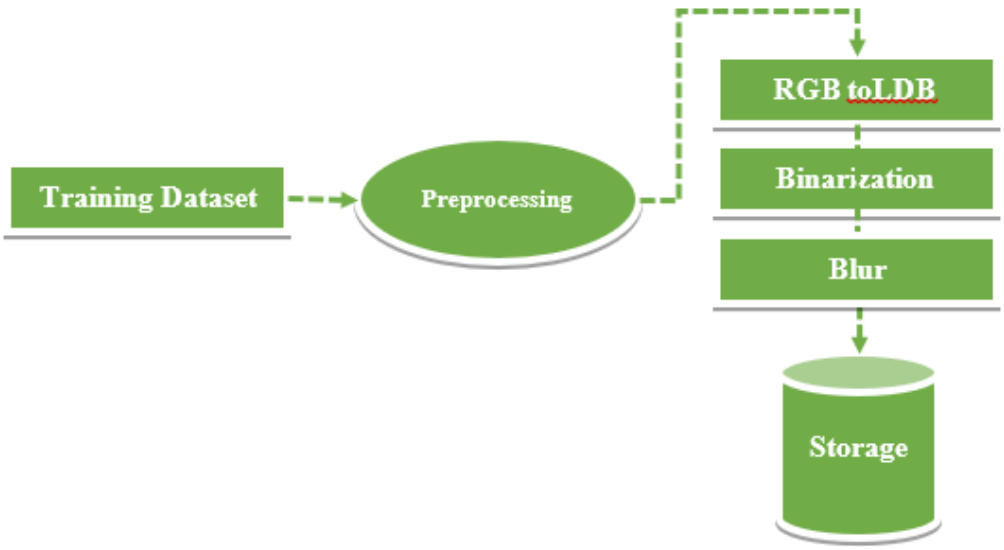

Figure 2. Preprocessing

3. Segmentation

In this module the pre-processed dataset consists of images of currencies, so individual currency must be extracted from the currencies using segmentation Connected Component Labelling (CCL) method. The result of segmentation gives images of different size and shape due the variable height and width of currency. Carping images will not be suitable because we may lose some portion of images. Also resizing may cause poor image quality due to different aspect ratios of different images. So padding the original images in the white space of size which maximum size in our data set.

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Figure 3: Segmentation Steps

4. Feature Extraction

Feature extraction one of most import step for distinguishing currency and currency like pixels from images. The currency has certain characteristics that can be distinguished from other kind of pixel. Such highlights are Colour, Number, stroke, texture, size and shape. Colour and Numbering features can be directly grouped from co-occurrence matrix. Texture features are obtained from histogram bins of the image and Shape and Size features are extracted from template matching. These features are one of the prominent sources to detect and classify the currency region in the image. Principle Component Analysis (PCA) is a method of identification of data patterns in which data are expressed in order to highlight similarities and differences.

Figure 4: Extracting the features

5. Classification

In this module we applied DCNN. The Deep Convolutional Neural Network (DCNN) is one of the most widely used methods for handwriting recognition. Before entering into Convolutional Neural Network, the image must go through pre-processing first.

The following are the steps of Pre-processing:

1) Input the image you want to recognize.
2) Do cropping or warping. The goal is that the image part that does not want to be recognized is lost.
3) Set the image size. Image size should be all the same.

CNN generally consists of three layers: convolutional layer, sub-sampling layer, and fully connection layer. But it can also be inserted another layer like softmax layer. Each layer linked to the previous layer. The softmax layer works to improve the accuracy of image detection.

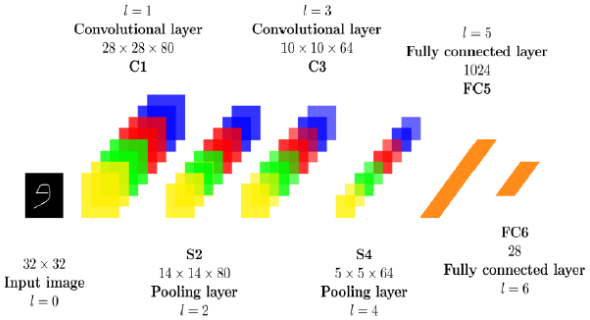

Figure 5: The example of CNN architecture

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In Figure 5. is an example of CNN architecture without inserted an additional layer. The number of layers applied to CNN is not always the same, depending on the need. Differences in recognizable handwriting language also affect what layers will be used and how many layers. Additional layers inserted on CNN are optional. If an additional layer is inserted on CNN there will be an effect, for example, if the softmax layer is inserted into CNN then the handwriting recognition accuracy will be higher than CNN which is not inserted the softmax layer.

Below are the layers in the Convolutional Neural Network (CNN):

1) Convolutional Layer Convolutional layer is the basic layer that builds a CNN. In this layer, the convolution process is performed. The convolution operation of this image serves to extract the input image feature. The final convolution layer to maintain the spatial position and gray level information of the convolution feature map.

2) Subsampling Layer Pooling Layer (Subsampling). Serves to change the input feature into a representation of statistical results of the features around it, so the resulting feature size will be much smaller than the previous feature. Most of the subsampling on CNN uses Max pooling.

3) Fully-Connected Layer As a classifier on CNN, this layer is a CNN architecture consisting of input layer, hidden layer, and output layer.

4) Softmax Layer The softmax layer is the last layer on CNN. Softmax Layer is used to present output to the form of probability. Very useful for classification. The softmax layer is used to classify characters. The softmax function has a value between 0 and 1. The class with the maximum value will be selected as the class for the image, while the smaller value means not including the main image to be detected. Here is the equation:

$$f_i(x) = \frac{e^{x_i}}{\sum k^{e^{x_k}}}$$

Where xi is the input value, k is the number of kernels, and x is a vector of scores. Where fi is the element to i at f

The stages of the CNN method for image recognition in writing as below:

1) Pre-Processing: The image is resized, if too large then the calculation will be high or too small will be difficult to adjust to large networks. Larger images are cut and padding will be applied to smaller images to get the standard size.

2) Creation of datasets: If no open source dataset is available for handwriting characters to be detected, it must be built in a new dataset, but if a dataset is available then an existing dataset can be used.

3) Final Data Determination: A large dataset is required to train CNN. To achieve this, the images that have been obtained are modified and changed to get a large number of variations.

4) Classification: The CNN end layer is the Softmax layer and the softmax layer is used to classify the given input image.

5) Testing: The test module is related to the test image. The test images were obtained by splitting the randomly enlarged dataset.

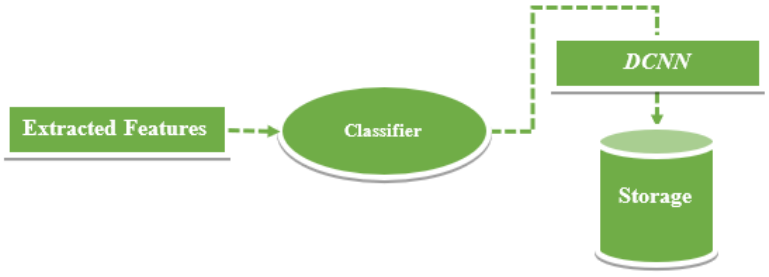

Figure 5: Classification

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IV. RESULTS AND ANALYSIS

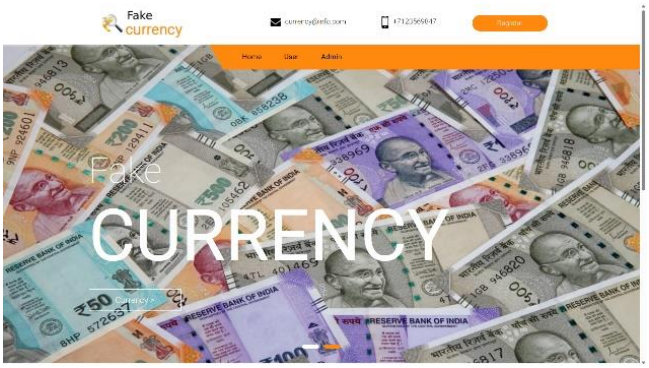

Figure 6: Identification of fake currency

The suggested approach is thought to operate precisely for Indian currency of Rs. 500 and Rs. 2000 and requires little to no effort to use in order to identify various properties of a cash note.

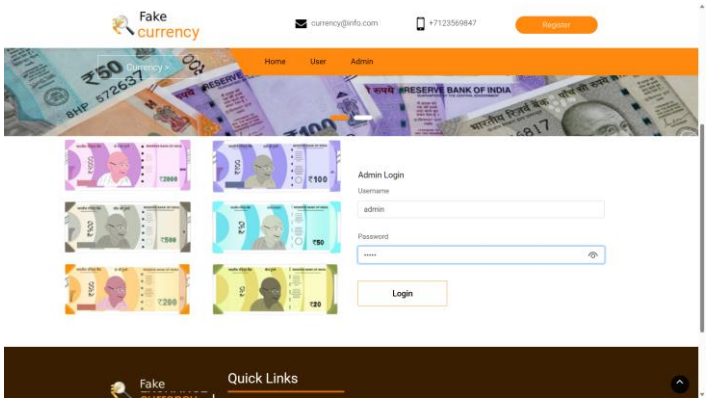

Figure 7: Login ID

The User has to login with their respective username and password to move further.

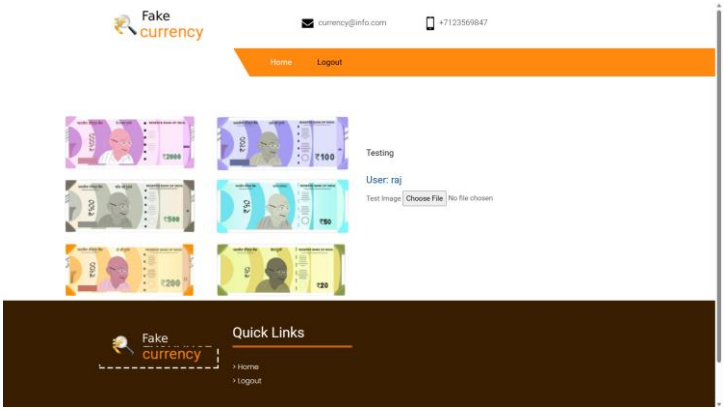

Figure 8: Upload File

A web application that reads uploaded images displays the results as shown in Fig. 9—either the real note, a false note, or a request to upload the image again after reading the image and returning the predicted value.

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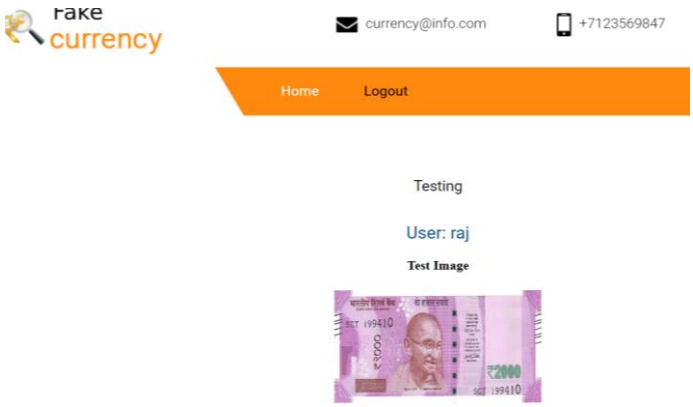

Figure 9: Prediction output

An image processing principles are used to detect fake Indian rupee notes. A prediction output is shown in the figure 9. This system is inexpensive. For Indian currency, the mechanism is functional for denominations of 500 and 2000. Additionally, the technology offers reliable and accurate findings.

Performance Analysis:

Figure 10: Performance analysis

The following Graph represents the number of real and fake 500, 2000 currency presents in the training phase.

V. CONCLUSION

The number of counterfeit notes on the market is rising quickly day by day. Different technologies are currently being utilised to assess whether a note is genuine or fraudulent money. The use of CNN in this study to identify counterfeit Indian cash has been suggested. We have chosen CNN as our paradigm for this proposed system's fake currency detecting process. Since the monetary distinctive attributes are gradually learned, the detection accuracy is at its highest. Here, the entire money picture has been taken into account, but in the future, we'll work to incorporate all of the security characteristics of cash by using appropriate structural design and training data. The acquired image may also contain noise, which must be taken into account as part of the pre-processing step in the currency detection process. By taking into account the surface patterns of the cash as characteristics, the recognition and fake currency detection can also be improved. The outcomes demonstrated the CNN's effectiveness, with Training Accuracy of 94.25% and Validation Accuracy of 97.52%.

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