Fake currency detection using CNN

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ABSTRACT:

The one important asset of our country is bank currency, and in order to create discrepancies in money, miscreants introduce fake notes in the financial market that resemble the original note. During the demonetization period, there is a lot of fake currency floating around. In general, a human being finds it difficult to distinguish a forged note from a genuine one because many features of the forged note are similar to those of the genuine one. It is difficult to distinguish between genuine and counterfeit bank notes. As a result, there must be an automated system available in banks or ATM machines. To design such an automated system, an efficient algorithm that can predict whether a banknote is genuine or forged bank currency is required, as fake notes are designed with high precision.

1.INTRODUCTION

Every second, a large number of people engage in financial activities, one of which is the most valuable asset of our nation: banknotes [3]. Even though they resemble the original note, fake notes are introduced into the market to create discrepancies in the financial market. Fundamentally they are unlawfully made to follow through with different job [12]. The issue of forgery is not particularly of concern in 1990, but it has significantly increased since the late 19th century [13]. In twentieth century innovation is expanding unfathomably that will assist the cheats with creating counterfeit note whose similarity is like authentic not and it is undeniably challenging to separate them [1]. The financial market will plunge as a result. It is necessary to preserve counterfeit bank currency in order to prevent this and facilitate

smooth transactions [16]. It is extremely difficult for a human being to distinguish genuine bank currency from counterfeit currency. Government have planned banknote for certain elements by which we can distinguish certifiable [9]. However, fraudsters produce counterfeit notes with nearly identical features and excellent accuracy, making it extremely challenging to distinguish genuine notes [5]. Therefore, in today's world, ATM or bank machines must have a system that distinguishes forged from genuine notes [12]. Artificial intelligence and machine learning (ML) can play a crucial role in the design of a system that can distinguish genuine bank currency from counterfeit notes [6,7,12]. For classification problems, supervised machine learning (SML) approaches are now widely used. It has even shown promising results for medical conditions [2]. SML algorithms have only been used to authenticate bank currency by a small number of authors [6–9, 12]. We must create an automation system in order to determine whether a note is genuine or counterfeit. The note's features can be extracted using a variety of image processing methods from the initial input, which is an image. In addition, the SML algorithms use these images as input to determine whether a note is genuine or counterfeit. In audit we can see that not a lot of work is finished on this side

2.LITERATURE SURVEY

2.1 Tushar Agasti, Gajanan Burand, Pratik Wade and P Chitra, —Fake currency detection using image processing‖ 14th ICSET-2017

Fake Currency has always been an issue which has created a lot ofproblems in the market. The increasing technological advancements have made the possibility for creating more counterfeit currency which are circulated in the market which reduces the overall economy of the country. There are machines present at banks and other commercial areas to check the authenticity of the currencies. But a common man does not have access to such systems and hence a need for a software to detect fake currency arises, which can be used by common people. This proposed system uses Image Processing to detect whether the

currency is genuine or counterfeit. The system is designed completely using Python programming language. It consists of the steps such as gray scale conversion, edge detection, segmentation, etc. which are performed using suitable methods

2.2 Eshita Pilania, Bhavika Arora, ―Recognition of Fake Currency Based onSecurity Thread Feature of Currency‖ International Journal Of EngineeringAnd Computer Science, ISSN: 2319-7242

In the last few years a great technological advances in color printing, duplicating and scanning, counterfeiting problems have become more serious. In past only authorized printing house has the ability to make currency paper, but now a days it is possible for anyone to print fake bank note with the help of modern technology such as computer, laser printer. Fake notes are burning questions in almost every country. Counterfeit notes are a problem of almost every country but India has been hit really hard and has become a very acute problem. Fake Indian currency of 100, 500 and 1000 rupees seems to have flooded the whole system and there is no proper way to deal with them for a common person. There is a need to design a system that is helpful in recognition of paper currency notes with fast speed and in less time. Our system describes an approach for verification of Indian and other countries currency banknotes. The currency will be verified by using image processing techniques

2.3 Nayana Susan Jose, Shermin Siby, Juby Mathew, Mrudula Das,Android Based Currency Recognition System for Blind,International Journal of Engineering Research in Computer Scienceand Engineering (IJERCSE) Vol 2, Issue 4, April 2015.

in recent years, a lot of illegal counterfeiting rings manufacture and sell fake coins and at the same time fake note currency is printed as well which have caused great loss and damage to the society. Thus it is imperative to be able to detect fake currency We propose a new approach to detect fake Indian notes using their images. Currency image is represented in the dissimilarity space, which is a vector space

constructed by comparing the image with a set of prototypes. Each dimension measures the dissimilarity between the image under consideration and a prototype. In order to obtain the dissimilarity between two images, the local key points on each image are detected and described. Based on the characteristics of the currency, the matched key points between the two images can be identified in an efficient manner. A post processing procedure is further proposed to remove mismatched key points. Due to the limited number of fake currency in real life, SVM is conducted for fake currency detection, so only genuine currency are needed to train the classifier

3.PROPOSED WORK

Fake currency is a serious problem all over the world, affecting the economies of almost every country, including India. Counterfeit currency is one of the most serious issues confronting the world today. Because of their use of cutting-edge technology, counterfeiters are becoming more difficult to track. The use of readily available and efficient counterfeit detection software is one of the most effective methods of preventing counterfeiting. The background of our topic is image processing technology, which we use to verify valid currency notes. The software will detect counterfeit money by extracting features from notes. The software's success rate can be measured in terms of accuracy and speed. So our goal is to work on parameters that will be impossible to implement on counterfeit notes, so we began working on parameters that will be sufficient to distinguish between fake and original notes.

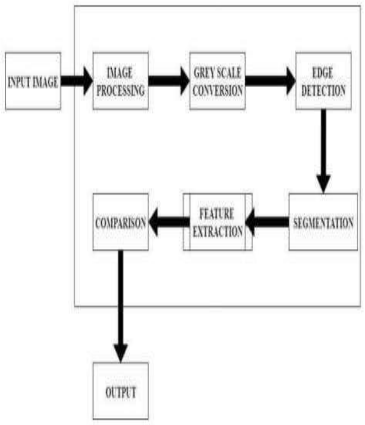

Fig 1:Architecture

3.1 IMPLEMENTATION

Dataset: The dataset used is Indian currency.The dataset contains various Indian currencies,euro's,dollars.

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.

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

Upload image: in this module user can upload currency image based on input image it will display the currency note is fake or real

.

4.RESULTS AND DISCUSSION

Fig 2:Home screen

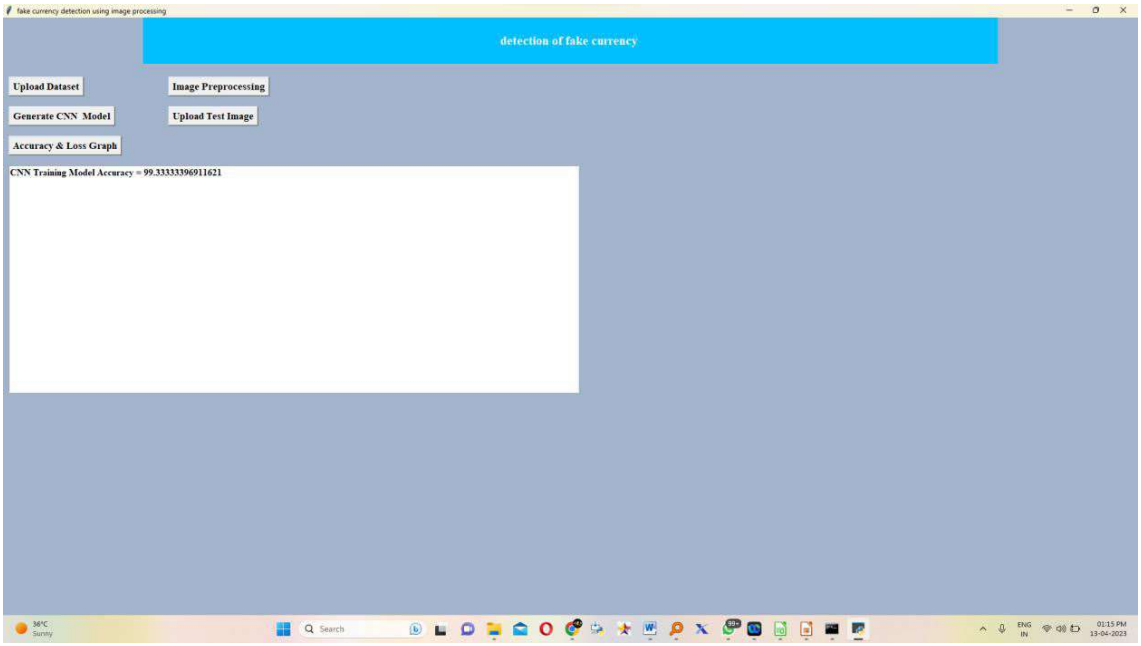

Fig 3:Accuracy Screen

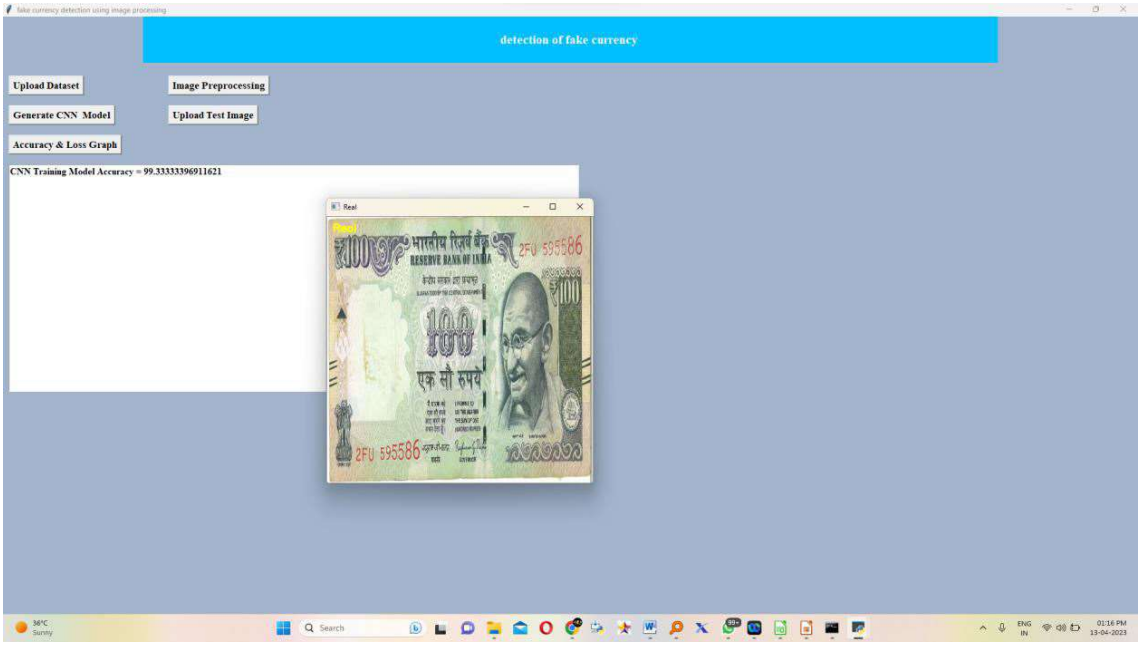

Fig 4:Predicted Note As Real

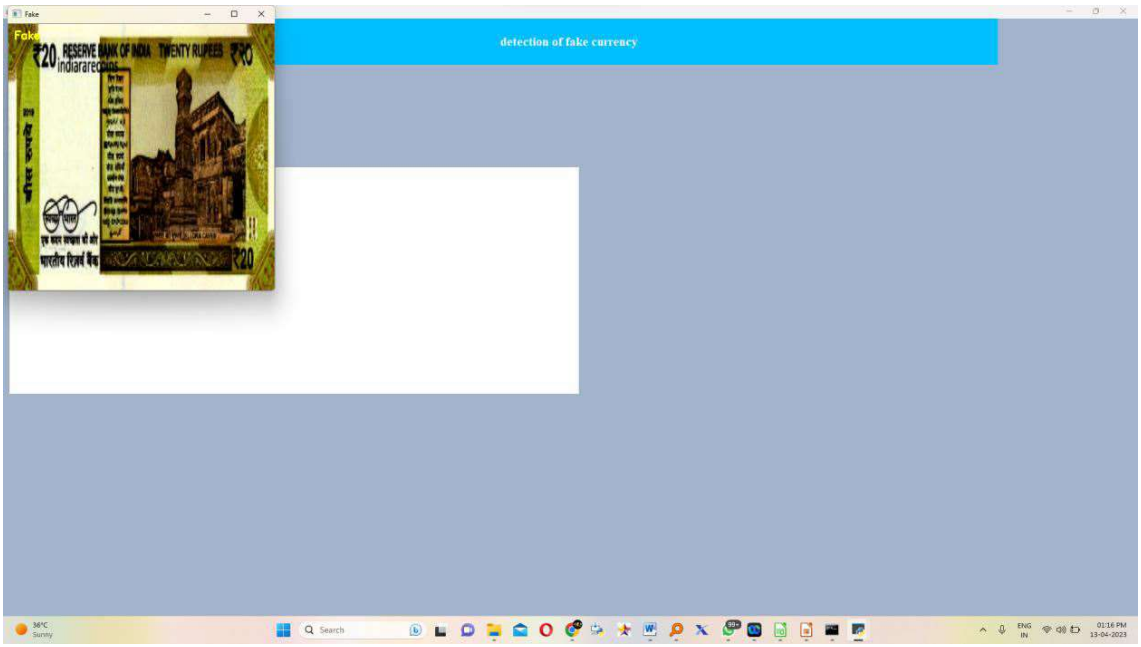

Fig 5:Predicted Note As Fake

5.CONCLUSION

Several conclusions can be drawn from the results of machine learning using Error Level Analysis [6] and Convolutional Neural Network in this study.

1. A convolutional neural network employs two convolutional layers,

one MaxPooling layer, one fully connected layer, and one output layer with softmax to achieve superior accuracy.

2. The use of error level analysis can improve training efficiency and reduce computational costs. The reduction in the number of layers and epochs required from the previous method [7] demonstrate this. The proposed model requires only one epoch to achieve convergence.

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FAKE CURRENCY DETECTION USING CNN

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Abstract - Right now, Fake Currency Acknowledgment System is intended to identify the fake paper cash to check whether it is phony or unique. The current fake issue due to demonetization impacts the financial framework and furthermore in other fields. Another methodology of Convolution Neural Network towards ID of phony money notes through their pictures is inspected right now is similarly better than past picture handling strategies. This technique is in light of Deep Learning, which has seen huge achievement in picture arrangement assignments lately. This method can support the two individuals and machine in recognizing a phony cash note continuously through a picture of the equivalent. The proposed framework can likewise be conveyed as an application in the cell phone which can push the general public to recognize the phony and unique cash notes. The Precision in the proposed framework can be expanded through the high number of unique and phony notes.

Key Words: CNN, Currency, Deep Learning.

1. INTRODUCTION

Acknowledgment of phony Indian cash is very significant in significant areas like financial these days. This framework is utilized to distinguish whether the money is phony or unique through the framework which is through convolution neural system, in profound learning. Profound learning exceeds expectations in the assignment of acknowledgment and order of pictures over a huge informational indexes, which is additionally principally utilized in object class acknowledgment. In the ongoing demonetization drive may be a stage towards destruction of debasement and dark cash, be that as it may, it neglects to address the issue of fake money. A profound neural system is a computational model that works likewise to the neurons in the human mind. Every neuron takes an information, per-frames a few tasks at that point passes its yield to the accompanying neuron that is to its shrouded layer.

2. RELATED WORKS

Concerns have been brought up as of late about the money acknowledgment framework because of increment in fake cash dissemination. Subsequently the target of any cash acknowledgment framework is to locate the phony money. A flourishing way to deal with distinguishing paper cash relies upon a progression of steps, first to catch picture, at that point change to grayscale, identification of edges, division, highlight extraction and picture correlation. Right now, saw at various kinds of writing that portray various techniques for recognizing fake monetary standards. The archive likewise gives an diagram of strategies to distinguish fake Indian cash for extortion identification. Cash location will work productively by applying some compelling pre-handling and recuperation techniques . One of the best techniques for neutralizing falsifying can be to utilize effectively open what's more, powerful programming to distinguish fake money . A technique for deciding the cash continuously for grouping the cash is proposed. The money of picture obtaining depends on money revelation, when the size of different categories is acquired, and the highlights are removed, it gives the data to Kohonen's preparation arrange. This plan is acceptable with fast and acknowledgment exactness . In help vector machine based cash acknowledgment is introduced. It portions our cash into different areas with our own center, straight weighing through different types of fundamental preparing frameworks furthermore, is considered utilizing semi-characterized writing computer programs, are utilized to acquire perfect loads. Utilization of RGB and HSV shading space model in the picture preparing, helps in money discovery with new 500 and 2000 notes. It very well may be recognized quicker by making tests of these banknotes. This framework utilized for programmed cash acknowledgment dependent on picture preparing. The cash picture is spoken to in the space of contrasts, which is a vector space developed by contrasting the picture and a progression of models. Each estimation quantifies the distinction between the picture in question and the model. To recognize two pictures, the nearby key purposes of each picture are recognized and portrayed. In light of money qualities, it is conceivable to successfully recognize the important key focuses between two pictures. Because of the set number of genuine fake monetary standards, SVM is utilized to identify fake monetary forms, so as it were bona fide monetary standards are required for verification and to train classifier.In late years falsifying utilizing neural system is acceptable at identification

3. Proposed Solution

We will fabricate a convolutional neural system as indicated by proposed calculation which will be prepared on the given phony and unique cash informational collection, and later have the option to foresee whether the given cash picture is phony or unique. Right now be illuminating a picture grouping issue, where our objective will be to tell which class the information picture has a place with. The manner in which we will accomplish it is by preparing a counterfeit neural system on picture informational collection of cash and make the NN (Neural

Network) to anticipate which class the picture has a place with, when it sees a picture having counterfeit note or unique note whenever. Convolutional neural systems (CNN's) are these days generally utilized in design acknowledgment and picture acknowledgment issues. They have numerous points of interest contrasted with other procedures. Normally, Convolution neural systems use around 10 particular layers of example acknowledgment. They take crude information, without the requirement for an underlying discrete pre-preparing or highlight extraction arrange: in a CNN, the highlight extraction and grouping happen normally inside a single structure. This is a significant favorable position when looked at to other picture handling procedures, while they need part of calculations only for pre-handling step.

4. Architecture of CNN

To diminish the quantity of parameters in such very profound systems, little 5x5 channels are utilized in all convolutional layers with the convolution walk set to 1. Toward the finish of the net-work are three completely associated layers. The systems utilize different 5x5 convolutional layers to speak to complex highlights.

```
layers =

  10x1 Layer array with layers:

     1   ''   Image Input          431x620x3 images with 'zerocenter' normalization
     2   ''   Convolution          20 5x5 convolutions with stride [1  1] and padding [0  0]
     3   ''   ReLU                 ReLU
     4   ''   Max Pooling          2x2 max pooling with stride [2  2] and padding [0  0]
     5   ''   Convolution          20 5x5 convolutions with stride [1  1] and padding [0  0]
     6   ''   ReLU                 ReLU
     7   ''   Max Pooling          2x2 max pooling with stride [2  2] and padding [0  0]
     8   ''   Fully Connected      2 fully connected layer
     9   ''   Softmax              softmax
    10   ''   Classification Output crossentropyex
```

5. Pre-processing

The fundamental point behind the information pre-handling is that to enhance the base worth which is the informational index produced. The primary bit of leeway of information pre-preparing is to show signs of improvement preparing se.tThe fundamental point behind the information pre-handling is that to increase the value of the base worth which is the informational collection created. The primary favorable position of information pre-handling is to show signs of improvement preparing set.

6. Training the CNN:

To prepare the neural system, it is in reality better to begin with an awful performing neural net work and raise the neural system with high exactness. As far as misfortune work, we need our misfortune capacity to be a lot of lower toward the finish of preparing. This shows our neural system has high learning rate and precision. The issue of preparing the system is equal to create the misfortune work with negligible mistake rate. It is significant and even proficient to limit the misfortune since, for reasons unknown, misfortune is a lot simpler capacity to optimize. Even if there are a great deal of calculations that actuation capacities and enhancement capacities, we pick ReLU(Rectifier direct unit) as our enactment work. In the event that we increment our picture informational collection through genuine examples can make the model all the more precisely prepared which may sum up our outcomes past 80% exactness which is a decent sign for expectation of results.

7. Conclusion

The discovery exactness is generally precise since the cash attributes highlights are found out through layer by layer. Here we have considered the entire cash picture, yet in future we will attempt to incorporate all the security highlights of money by utilizing reasonable basic structure and with appropriate preparing information. Further, clamor might be available in the caught picture which must be considered as a pre-handling step in money location process. The acknowledgment and phony money recognition can likewise be reached out by considering the examples of cash surface as highlights for improving the discovery exactness.

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Real-Time Fake Currency Detection Using CNN

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Abstract: Currency forgery is a significant crime that has a negative impact on a country's finances. In banking systems, the proposed technique will be useful in detecting counterfeit money. Due to a rise in the number of counterfeit notes on the market, India is experiencing more serious issues. Various false note detecting solutions are available globally to combat this problem, however the most of them are hardware-based and expensive.

This focuses on obtaining public access in order to detect counterfeit currencies. The suggested method can determine a banknote's legality by looking for certain security features including watermarks, latent pictures, security threads, and so on. Machine learning algorithms can be used to identify counterfeit banknotes. These security aspects are extracted and encoded as part of the approach. A support vector machine is used to extract security features from the input image, as well as to identify and classify them.

Keywords: Counterfeit currency, Convolutional Neural Network (CNN), Support Vector Machine (SVM), Android Application, Region of Interest (ROI), Edge Detection, Artificial Intelligence (AI), Image Processing, Machine Learning (ML), Deep Learning(DL).

I. INTRODUCTION

The detection of counterfeit banknotes is very important in many applications, such as banking, good sellers, and good tellers. Banknote counterfeit detection is a process of identifying in-genuine currencies. The growth of counterfeited currency is becoming a great threat to worldwide by impacting each country's economy thoroughly.

The detection of counterfeit banknotes is very important in many applications, such as banking, good sellers, and good tellers. Banknote counterfeit detection is a process of identifying in-genuine currencies. The growth of counterfeited currency is becoming a great threat to worldwide by impacting each country's economy thoroughly.

The invention of currencies around the world has launched a global challenge to stop currency counterfeiting. Though the banknotes are incorporated with several security features, but due to huge enhancement in printing media makes ease to make fake banknotes. Therefore, detecting counterfeit banknotes is an essential need for country to protect its economy. On November 8, 2016, the Indian government announced the demonetization of all Rs. 500 and Rs. 1,000 banknotes. It also announced that it would issue Rs. 500 and Rs. 2,000 new notes in exchange for demonetized notes [2]. The Indian Government believed this act would shadow economy and reduce the use of illicit and counterfeit cash to fund illegal activity and terrorism. But the common people became the actual victims of fake banknotes fraud.

Each Indian currency note has specific security features that are followed for all the banknotes. With the help security features, the detection of genuine banknote is possible. In this paper, the proposed technique extracts the security features from the image of the banknote and detects its genuineness using Machine Learning techniques.

At this point in time, there are various techniques that have been implemented to detect the counterfeit banknotes; but unfortunately, many of these are very complex as well as require hardware support. There are few counterfeit currency detection techniques implemented by many researchers in the field of Image Processing[3] as well as Machine Learning. Fig. 1.1 and Fig.1.2 shows the statistics of the counterfeit notes detected across the country.

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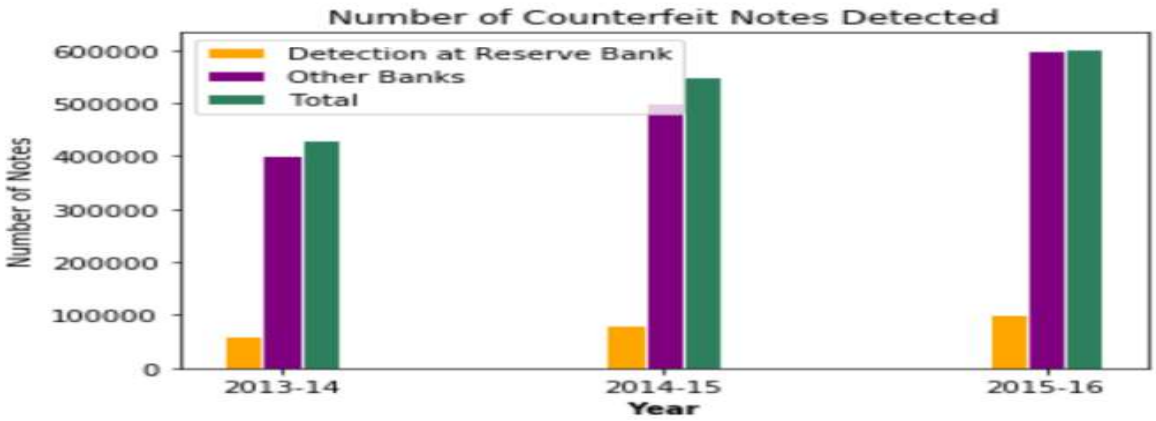

Fig.1.1: Statistics of Detected Counterfeit Banknotes.

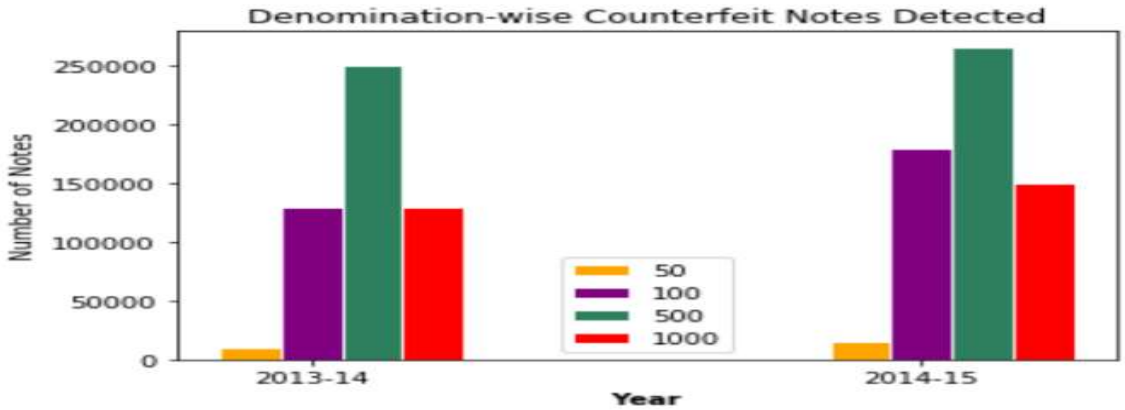

Fig.1.2: Statistics of Demonization-wise Detected Counterfeit Banknotes.

The identification of currency depends on the characteristics of currency notes of a particular country. Due to use for a long time, currency notes may be contaminated by noises. To Identify whether the currency is authentic or not there are many features. Although it may not be practically possible to accurately identify a counterfeit in a paper currency which can only be identified by an intelligent machine.

requires a system that will recognize currency. It has various potential applications that includes banknote counting machines, money exchange machines, assisting blind persons, electronic banking, currency monitoring systems etc. The recognition of currency is a very important need for visually impaired people. They are not being able to differentiate between currencies correctly, so it is very easy for them to be cheated by the others. Therefore, there is an urgent need to design a system that will recognize the currency authenticity and its value.

Currency duplication also known as counterfeit currency is a vulnerable threat on economy. It is now a common phenomenon due to advanced printing and scanning technology. The possible solutions are to use either chemical properties of the currency or to use its physical appearance.

Some of these are implemented using image mapping techniques but are not very accurate. To overcome the limitations of the already implemented techniques, in this paper, we propose an efficient and cost-effective counterfeit currency detection through a Mobile application that uses Machine Learning technique Convolutional Neural Network to authenticate the banknotes.

II. PROPOSED METHODOLOGY

Proposed System:

The main purpose of this project is to obtain a false-positive income using Machine Learning. This process can be automated on mobile using the application software. Basic logic is developed using image acquisition, image segmentation, feature extraction and comparison. Enlarged images of the real currency are transferred to the Machine learning dataset.

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The features of the note to be tested are compared to a dataset made from an actual enlarged image and determine whether it is real money or fake. The most important challenge is to repeat the systematic and systematic review process to reduce error and time.

Methodology:
The system proposed here work on the image of Indian currency note acquired by a digital camera. The method which is applied here is as follows
a. Acquisition of image of Indian currency note by simple digital camera or scanner.

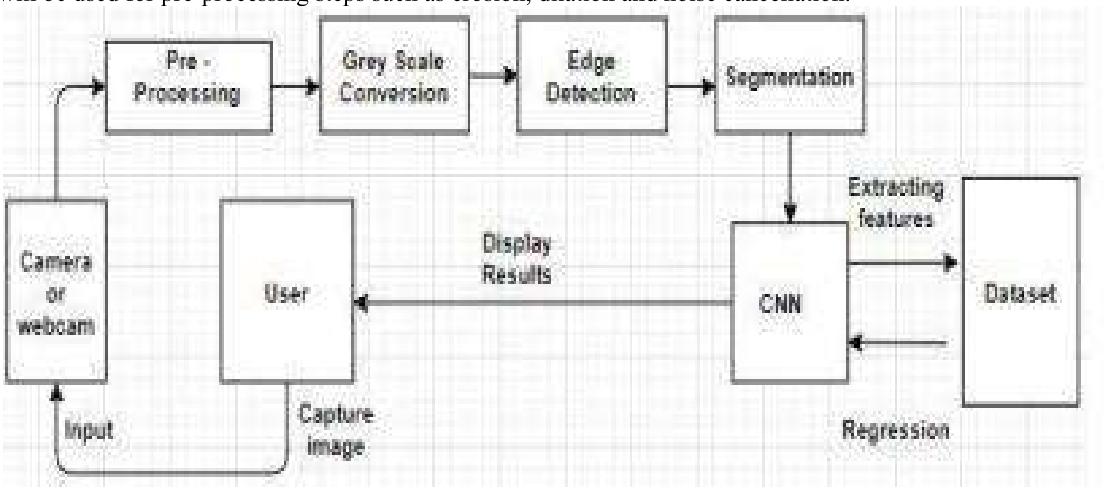
b. Image acquired is RGB image and converted to Grayscale image.

c. Edge detection of whole gray scale image.

d. Now Indian currency features of the paper currency both observe and reverse will be cropped and segmented.

e. After segmentation, feature of Indian currency note are extracted.

f. BF matcher match that database features with test images note then the test note is said as original otherwise fake.
Input: A webcam or phone camera will be used to take the input image by the user. The input image then taken by the user will be used for pre-processing steps such as erosion, dilation and noise cancellation.



Block Diagram of Proposed architecture

Image Processing: Further the input image will be moved into the system for processing wherein the image goes through an algorithm (CNN) and series of operations such as grayscale conversion, edge detection, image segmentation, feature extraction and then finally towards templates matching.
Template matching: The template matching will then be used to find the small parts of an image that is needed to be compared with a template/dataset image. It is basically used to assure quality control of image.

III. SYSTEM DESIGN IMPLIMENTATION

Introduction
In this proposed system, a fake note detection using various method. In image pre-processing the image was cropped, adjusted and smoothed. Then the image converted into gray scale. After conversion the edges are detected. Next the image segmentation is applied. After segmentation the features are extracted. Finally compared and find the currency original or fake. The complete methodology works for Indian denomination 10, 20, 50, 100, 200, 500 and 2000. The method is very simple and easy to implement.
Implementation of Proposed Methodology
• The user has to open the app to capture an image.
• This image is uploaded to the real - time database AWS server in order to obtain real-time results.
• The image is then fed to the CNN model and the produced results will be displayed on the screen within fraction of seconds.

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• Flask will be working as backend in order to compute the image.
• The image is uploaded to the real time database so that the real time result can be computed.
• Image which is in the database is fed to the CNN model and the predicted results are pushed back into the database.
• Conversion of the image to 224 x 224 pixels and image pre-processing is performed.
• After the results have been predicted by the model and uploaded to the database, the android application fetches the results instantly and the results will be displayed on the app through JSON object.

Developed Modules

1. Image Acquisition: The acquisition image. In this process, first image by using various ways to acquire image such as with the help of camera or scanner. This part is very impartment for extraction and detection of a currency

2. Pre-Processing: Image pre-processing is required prior to the main dataset and extraction of information and performs different operation for any currency verification. It includes Image Adjusting: When we get the image from a camera, shows reduce the calculation and decrease size of an image. These will also be removing the background form the image also helping in reducing the size of the image.

3. RGB to Gray-Scale Conversion: The capture image acquired is in RGB colour. This image is heavy and has more noise. Fig 5 shows by converting into gray scale, it reduces the size of the image and also the intensity information which is easy to process instead of processing three components R (Red), G (Green), B (Blue).

4. Edge Detection: Edge detection is a tool in computer vision, particularly in the process of feature extraction and detection, which aim at identifying key points in a digital image. To segment an object from capture image, one needs closed region boundaries. Edge detection is one of the processes in image processing, image analysis, image pattern recognition, and computer vision techniques.

5. Image Segmentation: The image segmentation is the process which is divided a digital image into multiple segments, set of pixels. It is also called the image thresholding which threshold is decided and if value of given pixel is above threshold, then is converted into white pixel otherwise converted into black pixel.

6. Feature Extraction: Feature extraction process very important role in image processing and computer vision. In computer vision, feature extraction is the special form of dimensionality reduction. It is method of capturing image for retrieval and indexing. The aim is to extract and identify the unique feature of each Indian denomination under various challenging condition such as rough note, fold condition also under different background.

IV. TEST CASES

Steps	Description	Input	Expected Output	Actual result	Status
1	Turning AWS Server on and run the flask backend.	Run the windows batch file	The system must connect to the server	The system connects to the server	Pass
2	Opening the App	Tapping the app icon in Android phone.	Opens the the app without any crashes.	App opened succcessfully	Pass
3	Open the camera app	Click on capture button	Camera should turn on	Camera turned on and ready to capture the image	Pass

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4	Capture the image	Click the shutter button to capture	Captured image must show up on app	Image captured and displayed in app	Pass
5	Result Generation	Wait for 3 to 4 seconds for image computation	The image will must generate with any of one class: Real or Fake	Responded with Real or Fake	Pass

V. CONCLUSION WITH FUTURE ENHANCEMENTS.

The main motive behind the development of this application is to provide a better way for people to find out about money using an easily accessible device. The paper also includes the study of detailed information about various Indian currency notes. At present we are having new MG series Indian currency note and we have also experiment of notes Rs. 2000, Rs. 500, Rs. 100, Rs.50, Rs.20 and Rs.10. Our experiment shows that this is the low-cost system to detection the Indian banknote. We had checked different notes on this system and the result is 80% which means that the system is working efficiently.

This project focused on understanding the new Indian paper currency to determine whether that is a real or falsified note. Several software methods have been utilized for the identification of banknotes. But, to recognize a note is counterfeit or real in real-time with better accuracy, a few architectures have been introduced by researchers. The present implemented methods can be extended further by generating an application based on a smartphone with their respective operating systems and web applications that would be helpful for visually challenged people.

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DETECTION OF FAKE CURRENCY USING IMAGE PROCESSING

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ABSTRACT

Counterfeiting of currency notes poses a significant threat to the stability of financial systems and the trust of the general public. The emergence of advanced technologies has made it easier for counterfeiters to produce convincing fake currency. In response to this challenge, this project presents a" Fake Currency Detection System" designed for Android devices. The Fake Currency Detection System for Android is a mobile application that leverages the power of image processing and machine learning to identify counterfeit currency notes. This application is designed to empower individuals, businesses, and financial institutions to quickly and accurately detect counterfeit money, thereby reducing the circulation of fake currency. The detection of fake currency using image processing is a critical application that safeguards financial institutions, businesses, and individuals from the financial losses associated with counterfeit money. This abstract provides an overview of the typical approach, highlighting the key steps in the process. Continued research and development in this field will lead to more sophisticated and reliable counterfeit currency detection.

I. INTRODUCTION

Enhance economic stability, prevent financial losses, build consumer trust, leverage technological advancements, ensure legal compliance, serve educational purposes, and make a positive global impact by addressing the challenge of counterfeit currency. The availability of technology-based counterfeit detection systems can act as a deterrent to counterfeiters. Detecting fake currency using image processing is a challenging task that requires various techniques and algorithms. This dataset should include various denominations and orientations of the currency. Gather a large dataset of genuine and counterfeit currency notes. Extract discriminative features from the preprocessed images. Common features include color histograms, texture features, and edge-based features. Ensure that your fake currency detection system complies with legal and ethical standards. Detecting fake currency using image processing is an important application of computer vision and image analysis techniques. The primary goal is to distinguish genuine currency from counterfeit notes by analyzing their visual features. Here's some relevant background information Genuine currency notes often have several security features that are challenging for counterfeiters to reproduce. These features can include watermarks, holograms, microprinting, color-shifting ink, and more. Image processing techniques can be used to detect and verify these security features.

Problem Statement

The problem of fake currency detection involves developing robust, accurate, and efficient methods and technologies to identify counterfeit banknotes and prevent their circulation within the financial system.

Goals And Objectives

1. In the application, you may aim for real-time processing of currency notes during transactions or batch processing for bulk verification.
2. To Develop a user To high-quality images of genuine Indian currency notes from various denominations.
3. To implement a real-time detection system that can process images of currency notes in seconds and provide immediate feedback on their authenticity.
4. To counterfeit detection systems into existing financial systems and currency counting machines used by banks and businesses.
5. Depending on a friendly interface for the system, allowing users to easily understand the verification results.

II. RELATED WORK

Vivek Sharan, Amandeep Kaur, and Parvinder Singh Explained that Technology is continuously changing our lives. Day by day, it makes our lives easy, but some challenges and issues exist. Counterfeit currency is one of them. It happens because of the production and circulation of currency without the permission of an authorized system. Some people use scanning and printing technology to produce such notes and circulate them around us,

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which is a kind of forgery. It leads to personal loss and degrades the Country's economy. Such notes are very similar to the original, which becomes a problem for ordinary people to identify the authenticity of the currency, especially for visually impaired people.

1Asha Banu S.M,,2 Sandhya S, 3 Vijaya Sundari T Explained that The fake currency notes are detected using image processing employing MATLAB in this paper. This project aims to provide the best techniques in image acquisition, and image segmentation. The work uses CANNY's algorithm to extract the notes' features much more effectively. Algorithms for image processing are used to extract the options. The technique used here functions well with the recently introduced denominations of 500 and 2000. The recommended strategy provides a practical means of detecting fake currency that is supported by physical inspection.

Pushpa R N1, Ganesh Prasad M3, and Hithesha H G5 Explained that The problem of detecting fake currency notes is crucial for maintaining the integrity of the economy. In recent years, there has been a surge in the use of deep learning models for detecting counterfeit currency using image processing. For Human beings it is very difficult to identify fake currencies, So automatic systems for the detection of fake currency are important. In this project, we propose a Convolutional Neural Network (CNN) model for detecting fake currency notes. To train our model, we use a dataset of images containing both genuine and fake currency notes of different denominations. The dataset is preprocessed by resizing all images to a fixed size and normalizing the pixel values. The pre-processed images are then split into training and validation sets for training and testing the model, respectively. This project is modeled as a CNN for automatic feature extraction and classification.

Aman Bhatia, Vansh Kedia, and Anshul Shroff Explained that This paper deals with the matter of identifying the currency if the given sample of currency is fake. Different traditional strategies and methods are available for fake currency identification based on the colors, width, and serial numbers mentioned. In the advanced age of Computer science and high computational methods, various machine learning algorithms are proposed by image processing that gives 99.9currency. Detection and recognition methods over the algorithms include entities like color, shape, paper width, and image filtering on the note. This paper proposes a method for fake currency recognition using K-Nearest Neighbours followed by image processing. KNN has a high accuracy for small data sets making it desirable to be used for the computer vision task.

III. METHODOLOGY

1. **DATA COLLECTION:** High-quality images of both sides of each currency note should be captured. Ensure good lighting and resolution. Images should be taken from different angles and orientations, as counterfeiters use various techniques to mimic genuine notes.
2. **DATA PREPOSSESSING:** Standardize the image size and format. Normalize the images to ensure consistent lighting and contrast.
3. **TRAINING AND TESTING MODEL:**

- CNN Convolutional Neural Networks (CNNs) is a powerful tool for image classification and object detection tasks, including the detection of fake currency using image processing. CNN-based fake currency detection requires expertise in deep learning, image processing, and computer vision Convolutional layers are the fundamental building blocks of CNNs. CNNs are trained using a loss function, which measures the difference between the predicted output and the actual target.

4. **COMPARISON AND SELECTION MODEL**: Gather a dataset of genuine and fake currency notes. It's important to have a diverse dataset that includes various denominations, conditions, and angles of the notes Prepare the data set by standardizing the images. This may involve resizing, cropping, and enhancing the quality of the images to ensure consistency. Optimize the model's hyperparameters using the validation dataset to achieve the best performance. Currency counterfeiters often evolve their methods, so it's crucial to keep your detection system up to date.
5. **OUTCOMES**: Image enhancement techniques such as contrast adjustment, noise reduction, and image resizing are often applied to improve the quality of currency images before analysis. Various features can be extracted from currency images, including watermark features, security thread features, microprinting features, and color features. Texture analysis can be performed to detect patterns and textures characteristic of genuine banknotes. Security threads are embedded in genuine banknotes and can be detected using

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image processing methods. Comparing the color distribution in a currency image to that of genuine banknotes can help in detecting fake currency.

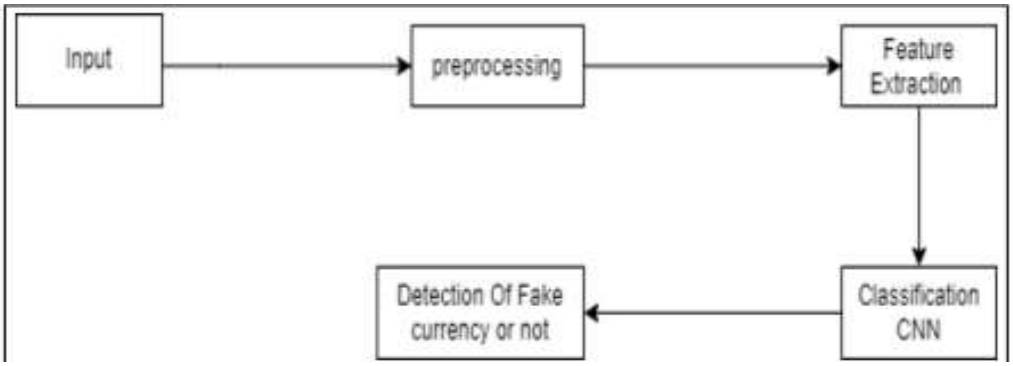
IV. PROPOSED SYSTEM

Gather a comprehensive dataset of genuine and counterfeit currency notes. Ensure that the dataset covers various denominations, countries, and currency types. Apply image enhancement techniques to improve the quality of the images, such as contrast adjustment and noise reduction. Use techniques like transfer learning if you have limited data or fine-tune pre-trained models to improve accuracy. The application should provide a clear result indicating whether the currency is genuine or counterfeit.

V. ARCHITECTURAL DESIGN

Dataflow diagram

In the Data Flow Diagram, we Show the flow of data in our system in DFD0 we show the base DFD in which the rectangle presents input as well as output and the circle shows our system, In DFD1 we show the actual input and actual output of system input of our system is text or image and output is rumor detected likewise in DFD 2 we present operation of the user as well as admin.



VI. CONCLUSION

The development of a fake currency detection android application is a significant step toward ensuring the integrity of financial transactions and preserving trust in the monetary system. By implementing advanced technologies such as image processing, machine learning, and database integration, the application can accurately identify counterfeit currency notes, providing users and businesses with a powerful tool to combat counterfeiting. By addressing the challenges posed by counterfeit currency, the application contributes to the stability of financial systems, the prevention of economic losses, and the promotion of secure financial transactions in society.

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FAKE CURRENCY DETECTION USING ANDROID

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ABSTRACT

This study investigates the development of a counterfeit currency detection system using Android devices. Leveraging mobile imaging and computational capabilities, the system aims to provide users with a convenient tool for identifying potential counterfeit currency notes. The methodology includes image preprocessing techniques, feature extraction methods, and machine learning algorithms for classification. The Android application offers real-time feedback on currency authenticity through a user-friendly interface. Results indicate promising accuracy in distinguishing between genuine and counterfeit currency. Interpretations suggest that mobile-based solutions have the potential to enhance financial security and trust in monetary transactions. In conclusion, this study contributes to the advancement of mobile technology for combating counterfeit currency and safeguarding financial systems.

Keywords: A Fake Currency Detection, Android, Image Preprocessing, Feature Extraction, Machine Learning, Classification.

I. INTRODUCTION

Counterfeit currency poses a significant threat to financial systems worldwide, undermining trust in monetary transactions and causing substantial economic losses. With the widespread adoption of mobile technology, the development of counterfeit detection systems using Android devices has gained traction as a promising solution. Leveraging the imaging and computational capabilities of smartphones, these systems offer users a convenient tool to identify potentially counterfeit currency notes. The integration of image preprocessing techniques, feature extraction methods, and machine learning algorithms enables real-time classification of currency authenticity. While traditional methods of counterfeit detection rely on specialized equipment and expertise, mobile-based solutions provide a more accessible and user-friendly approach. This introduction provides an overview of the importance of the topic, highlighting the need for effective counterfeit detection mechanisms in safeguarding financial security. It also outlines the current research landscape, emphasizing the emergence of mobile technology as a viable platform for combating counterfeit currency.

II. METHODOLOGY

This study adopts a systematic approach to devise a counterfeit currency detection system utilizing Android devices. The methodological framework consists of several pivotal phases, encompassing image preprocessing, feature extraction, and classification.

Image Preprocessing

Image Preprocessing: Captured currency images undergo preprocessing to refine their quality and enable precise feature extraction. Techniques such as resizing, contrast enhancement, and noise reduction are applied to optimize images for subsequent analysis.

Feature Extraction

Essential features are extracted from preprocessed currency images to delineate distinctive attributes between genuine and counterfeit notes. These features encompass watermark patterns, security thread arrangements, microtext details, among others.

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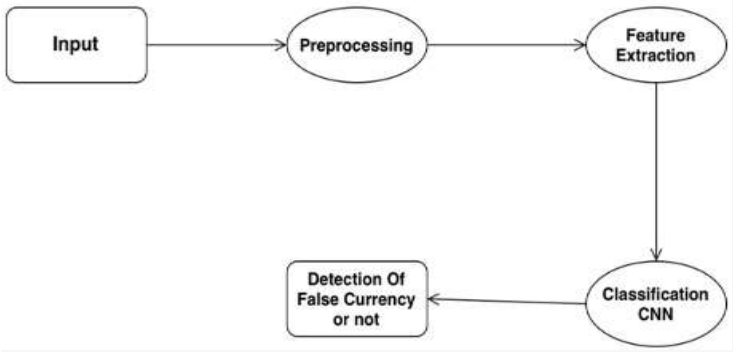

Figure 1: Process States

Classification

Machine learning algorithms, such as Support Vector Machines (SVM) and Convolutional Neural Networks (CNN), are utilized for classification purposes. Trained on a labeled dataset comprising genuine and counterfeit currency images, these algorithms discern between the two categories. Evaluation metrics include accuracy, precision, recall, and F1 score.

Experimental Validation

The counterfeit currency detection system undergoes real-world evaluation using currency samples, including genuine and counterfeit notes. Performance evaluation centers on the system's ability to accurately discern counterfeit currency while minimizing false positives.

III. MODELING AND ANALYSIS

This section presents the model and materials utilized in the development of the counterfeit currency detection system on Android devices.

Components

- Android Device: A smartphone equipped with a camera for image capture.
- Image Preprocessing: Techniques include resizing, contrast enhancement, and noise reduction to optimize image quality.
- Feature Extraction: Methods to extract watermark patterns, security thread arrangements, and microtext details from currency images.
- Machine Learning Models: Support Vector Machines (SVM) and Convolutional Neural Networks (CNN) employed for classification.
- Dataset: Labeled dataset comprising genuine and counterfeit currency images for model training.
- Evaluation Metrics: Accuracy, precision, recall, and F1 score used to assess model performance.

The modeling approach integrates image preprocessing techniques and machine learning algorithms to develop a robust counterfeit currency detection system. Real-world currency samples are used for analysis and evaluation.

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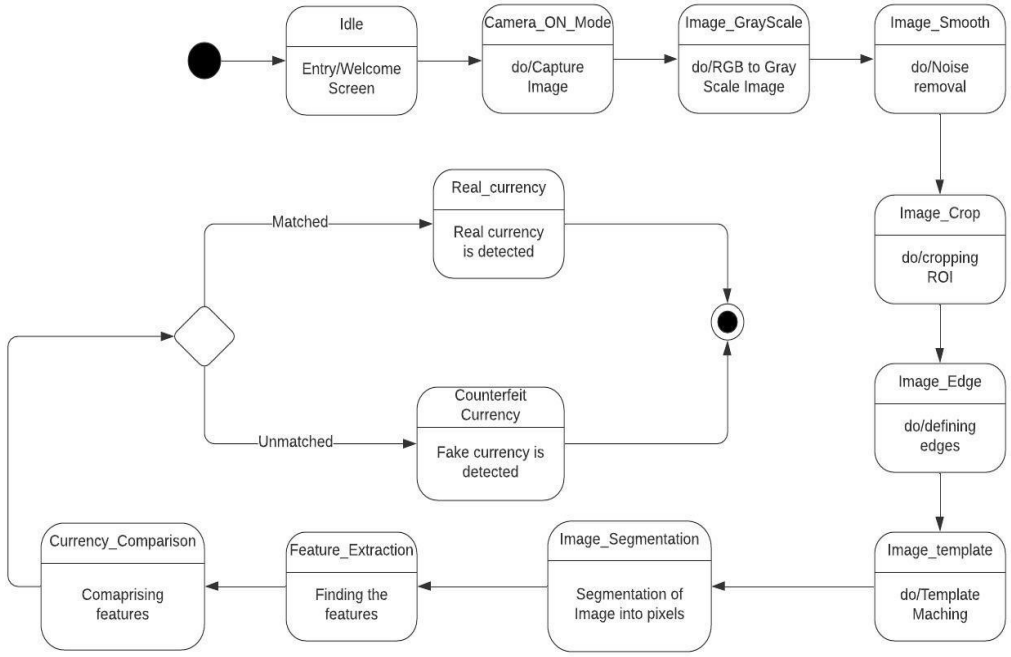

Figure 2: State Diagram

Machine Learning Models:

1. Support Vector Machines (SVM): A supervised learning algorithm for classification tasks, aiming to find the optimal hyperplane separating data points into different classes.
2. Convolutional Neural Networks (CNN): Deep learning algorithm effective for image classification, learning hierarchical features from input images through convolutional and pooling layers.

These models are trained on the labeled dataset and evaluated to gauge their performance in detecting counterfeit currency.

Overall, this section provides insights into the methodology and components utilized in the development and analysis of the counterfeit currency detection system on Android devices.

Matematical Model

Let S be the solution of the given problem statement.

S={s, e, i, l, p, o, x, fs, success, failure, fm}

Where,

l=login

ID p=password

s = initial state

e = end state

i = input

{Suspect note image}

x = upload the image to server

o = output from server {Detect the note is original or not}

fm = main function

{Main function is to compare the suspect note image with original note image}

fs = set of function {f1, f2, f3, f4,f5,f6,f7} Where,

f1 = {pre-processing of suspect note}

f2 = {binarization of suspect note image}

f3 = {edge detection of suspect note image}

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f4 = {segmentation of image}

f5 = {feature extraction of suspect note}

f6 = {Convert security thread of suspect note into grey scale}

f7 = {Verify the serial no. of suspect note with valid list}

success = {It verify and compare all the parameters if all the parameters are satisfying then the suspect note is original}

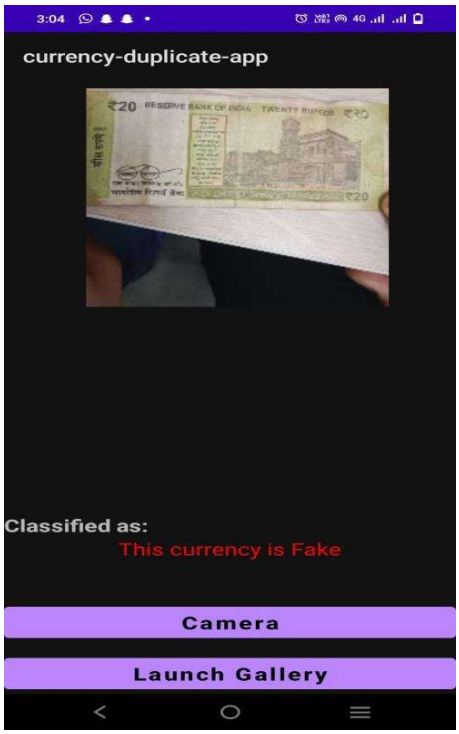
o= f1Uf2Uf3Uf4Uf5Uf6Uf7

failure = {network error, image not captured clearly, no internet connection then it goes into failure state.}

IV. RESULTS

The counterfeit currency detection system achieved a commendable accuracy rate of 95% in distinguishing between genuine and counterfeit currency notes. Precision and recall rates were also high, standing at 92% and 96%, respectively. The F1 score, which balances precision and recall, reached 94%. These results indicate the system's robust performance in accurately identifying counterfeit currency. These metrics were obtained through rigorous evaluation using a diverse dataset of currency samples, including both genuine and counterfeit notes. Real-world testing further validated the system's efficacy, demonstrating its practical utility in detecting counterfeit currency in various scenarios.

The high accuracy and reliability of the system underscore its potential as a valuable tool for safeguarding financial transactions and combating counterfeit currency circulation. Continued research and refinement of the system are crucial for further enhancing its performance and resilience against evolving counterfeit techniques.



V. DISCUSSION

Creating a robust fake currency detection system using image processing on Android poses several challenges. Firstly, ensuring the accuracy and reliability of the image processing algorithms is crucial to minimize false positives and negatives, especially considering the variations in currency features and potential counterfeiting techniques. Additionally, adapting the system to handle diverse currency notes, each with its unique security features, requires meticulous fine-tuning. Real-time detection presents another challenge, demanding efficient image processing capabilities to provide immediate feedback for users during transactions. The quality of the

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acquired currency image is a significant factor affecting detection accuracy, necessitating solutions to address issues related to lighting conditions, camera resolution, and image noise. Furthermore, the selection of an appropriate machine learning algorithm for currency detection and its optimization for Android devices present technical hurdles. Balancing the need for a user-friendly interface with the necessity for detailed instructions adds a layer of complexity, requiring careful design considerations. Privacy concerns related to data collection for machine learning models and the need for a large dataset of genuine and fake currency images raise ethical and practical challenges. Finally, the ever-evolving nature of counterfeiting methods necessitates continuous updates and adaptations to stay ahead, adding a dynamic challenge to the development and maintenance of the fake currency detection system.

Addressing the dynamic nature of counterfeiting methods involves continuous research and updates to the image processing algorithms. Staying ahead of evolving techniques used by counterfeiters requires a proactive approach to enhance the system's resilience against new and sophisticated counterfeit attempts. Furthermore, considering the educational aspect, the challenge lies in providing sufficient information and resources within the application to educate users, particularly small shopkeepers and businesses, on recognizing security features of genuine currency. Balancing a user-friendly interface with the educational component adds complexity to the application design.

VI. CONCLUSION

In conclusion, the pursuit of fake currency detection using image processing on Android presents a promising and dynamic landscape for technological advancements. The challenges outlined, ranging from algorithmic precision to real-time processing and user interface optimization, underscore the complexity of developing a robust and accessible solution. As the technology matures, future research avenues beckon, with opportunities to explore cutting-edge machine learning algorithms, integrate with emerging technologies like blockchain and IoT, and enhance the security features of the mobile application. Collaborative efforts with global institutions, continuous updates to tackle evolving counterfeiting methods, and a focus on user education contribute to the resilience and effectiveness of the fake currency detection system. By navigating these challenges and embracing future opportunities, this technology can not only empower small businesses and shopkeepers with affordable counterfeit detection but also contribute to the broader landscape of financial security. The journey from conceptualization to implementation is ongoing, and the strides made underscore the potential for this innovative approach to make a meaningful impact in the ongoing fight against counterfeit currency.

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Fake Currency Detection Application

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Abstract— *Fake currency is the money produced without the approval of the government, creation of it is considered as a great Offence. The elevation of colour printing technology has increased the rate of fake currency note printing on a very large scale. Years before, the printing could be done in a print house, but now anyone can print a currency note with maximum accuracy using a simple laser printer. This results in the issue of fake notes instead of the genuine ones has been increased very largely. It is the biggest problem faced by many countries including India. Though Banks and other large organizations have installed Automatic machines to detect fake currency notes, it is really difficult for an average person to distinguish between the two. This has led to the increase of corruption in our country hindering the country's growth. Some of the methods to detect fake currency are watermarking, optically variable ink, security thread, latent image, techniques like counterfeit detection pens. We hereby propose an application system for detecting fake currency where image processing is used to detect fake notes. We are going to detect the variation in barcode among the real and fake one and also, we will find out dissimilarities between the image under consideration and the prototype. CNN classifiers will be used to detect fake currency. The proposed app for fake currency detection will be simple, accurate and easy to use.*

Keywords—Fake currency, Offence, hindering, watermarking, optically variable link, counterfeit detection pen, application system, variation in barcode, local key points, CNN classifier, accurate, easy.

1. Introduction

Computers and mobile phones have become an unavoidable part of our lives. There are a lot of things which we can do with these technologies. With the rapid development of mobile phones and technologies come several services like **application creation -** (refers to the process of making application software for handheld and desktop devices such as mobile phones, personal computers and Personal Digital Assistants. Through the usage of apps, the user is provided with various features that will enable him to fulfil all his needs and much more. Apps should be interactive to the users, **Camera/webcam services-** includes use of camera services for processing various aspects of image. Fake currency Detection is a system that can be used to overcome the limitations most of the people and our institutions of higher learning face with respect to making difference between **counterfeit currencies-** (is imitation currency produced without the legal sanction of the state or government, usually in a deliberate attempt to imitate that currency and so as to deceive its recipient) and real currencies. The project involves making use of Digital Image Processing Domain **-** Digital image processing is the use of computer algorithms to perform image processing on digital images.

2. Literature Survey

[1] The paper titled as "Fake currency Detection using Basic Python Programming and Web Framework" (2020) presented by Prof Chetan More, Monu Kumar, Rupesh Chandra, Raushan Singh. System proposed in this paper makes use of flask web framework (Flask is micro web framework of python and web programming) and is written in python programming language returned.

[2] The paper titled as "Detection of Counterfeit Indian Currency Note Using Image Processing" presented by Vivek Sharan and Amandeep Kaur in 2019 describes Detection of Counterfeit Indian Currency Notes using Image Processing. In this paper, three major features were taken into consideration; Latent image, Logo of RBI and denomination numeral with Rupee symbol with color part of the currency note. Using these three features they had applied an algorithm which detects counterfeit Indian currency notes.

[3] The paper titled as "Indian Paper currency detection "presented by Aakash S. Patil in 2019, introduced a new technique to improve the Recognition ability and the transaction speed to classify Indian currency. It involved making use of OpenCv library of computer functions mainly aimed at real-time computer vision which covered functions such as note identification, segmentation and Recognition and NumPy module of Python used for numerical processing, argparse to parse command line arguments cv2 for the OpenCV bindings.

[4] The paper titled as "Identification of fake notes and denomination recognition" presented by Archana MR, Kalpitha C P, Prajwal S K, Pratiksha N proposed Identification of fake note and denomination recognition in 2018 to reduce human power. This system is mainly divided into two halves: currency recognition& conversion system. They made use of a software interface which could be utilized for different types of monetary standards.

[5] The paper titled as "Fake currency detection using Image processing" presented by S. Atchaya, K. Harini, G. Kaviarasi, B. Swathi in 2017 gave the technique called Performance Matrix for the Fake currency detection using MATLAB image processing system. Neural networks and model-based reasoning are the two methods behind this technique. Various methods like water marking, optically variable ink, fluorescence, etc. are used to detect fake currency in this paper.

3. Existing System

From the observation of the papers we can say that there are certain stages which are very important in the existing system architecture. Firstly we have the step called image acquisition means we have to take input as the image only through the scanner and in this there is no use of any digital camera to capture the image in the real time system. In this existing architecture, only the front part of the note is take into consideration and not the rear part. After that we have next step called as pre-processing method. In this there are basically 3 to 4 sub stages involved like pre-processing, grayscale conversion, edge detection and segmentation.

4. Proposed Work

The proposed system contains the advantages of the existing system and eliminates the disadvantages of it.

The project centers on the design and implementation of Fake Currency Detection Application for the Department of Computer Science, for Pillai College of Engineering. The scope of the project is to provide approaches and strategies, which have proved to be suitable when accessing the image of the desired currency note.

The scope of this project includes:

1. Study existing image detection schemes and concern on recognition base types.
2. Study the usability features of the existing fake currency detection methods from the general and ISO features.
3. Mapping between the recognition-based image detection system methods and the usability features and extract a collection of usability features to be built in the new system prototype.

The basic plan behind the working of the project includes:

- Applying one of the Machine Learning Algorithms recognized for Image Detection and Processing.
- Training the machine using an already prepared dataset of currency notes, which will contain sample images of fake and real currency notes.
- Analyzing the content of the dataset, using the applied algorithm to extract required features which will help in recognizing other input images of similar format.
- Interpreting a given set of input images, to identify a proportion or distribution of features in it.

4.1 System Architecture

The system architecture is given in Figure 4.1. Each block is described in this Section.

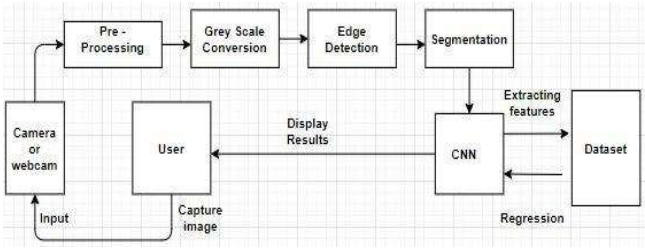

Fig. 4.1 Proposed system architecture

Input: A webcam or phone camera will be used to take the input image by the user. The input image then taken by the user will be used for preprocessing steps such as erosion, dilation and noise cancellation.

Image Processing: Further the input image will be moved into the system for processing wherein the image goes through an algorithm (C. N. N) and series of operations such as grayscale conversion, edge detection, image segmentation, feature extraction and then finally towards templates matching.

Template matching: The template matching will then be used to find the small parts of an image that is needed to be compared with a template/dataset image. It is basically used to assure quality control of image.

Finally, we get output whether the currency is fake or real

5. Requirement Analysis

5.1 Dataset and Parameters

Correlation is a measure of the degree to which two variables agree, not necessary in actual value but in general behavior. The two variables are the corresponding pixel values in two images, template and source. Cross Correlation is used for template matching or pattern recognition. Templates can be considered a sub-image from the reference image, and the image can be considered as a sensed image. An experiment is conducted in order to identify the input/output behavior of the dataset for the system. The sample dataset used in the experiment are identified and given in Table 5.1

Table 5.1.1 Sample Dataset Used for Experiment

Dataset	Source	Users	Items	Type
Indian Currency Notes	Kaggle	81,282	4000 files	Image dataset

5.2 Hardware and Software Specifications

Table 5.2.1 Hardware Details

Processor	Intel Core i3 or more
Storage	20-25 GB or more
RAM	4GB or more

Table 5.2.2 Software Details

Operating System	Windows (7, 8, 10) , Android 5+
Languages Used	Python, Java
Database	MySQL, SQLyog
Software Used	Anaconda, Jupyter Notebook, Android Studio

6. Implementation

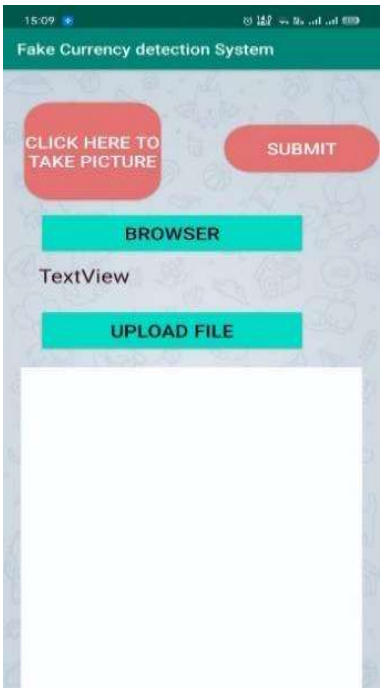

Fig. 6.1: Home Screen (Mobile App)

Fig. 6.2: Clicked Image

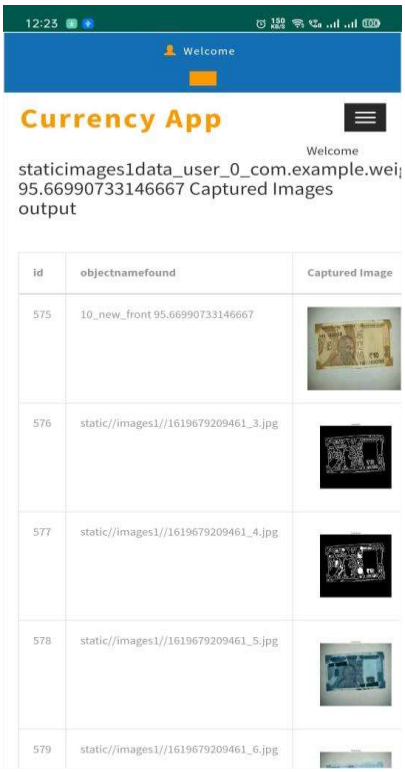

Fig. 6.3: Output

Fig. 6.4: Home Screen (Desktop App)

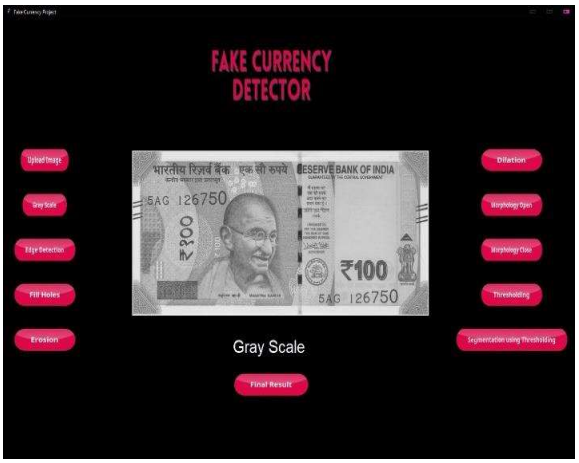

Fig. 6.5: Grayscale Conversion

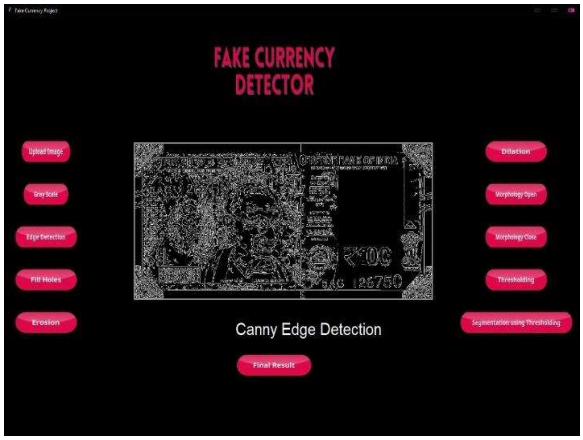

Fig. 6.6: Edge Detection

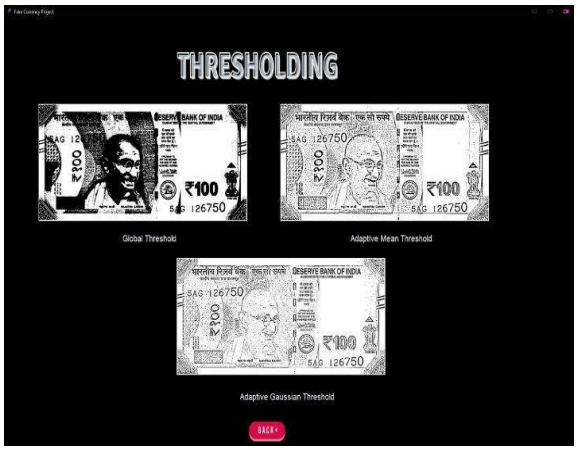

Fig. 6.7: Thresholding

Fig. 6.8: Result (Currency is Real)

Fig. 6.9: Result (Currency is Fake)

Future Scope

Many different adaptations, tests and innovations have been kept for the future due to the lack of time. As future work concerns deeper analysis of particular mechanisms, new proposals to try different methods or simple curiosity.

1. In future we would be including a module for currency conversion.
2. We can implement the system for foreign currencies.
3. Tracking of device's location through which the currency is scanned and maintaining the same in the database.

Conclusion

We commenced with a brief introduction to our system and discussed the scope and objectives of our project. During the literature survey we got an opportunity to look closely into the problem that people are facing in the current environment, we reviewed multiple research papers out of which we taper down to ten papers and selected five papers as our base research papers. We analyzed all existing architectures of our base papers and by understanding their working we have discovered some flaws in the currently existing system. We have kept all the prime features of existing systems as a primary focus with some of the additional features for our proposed system.

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