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Identification of Counterfeit Indian Currency Using CNN

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ABSTRACT: The advancement of colour printing technology has increased the production of counterfeit money notes on a vast scale. Printing used to be done in a printing company, but now everyone has a printer at home and can print the false notes with optimum accuracy. As a result, instead of real currency, we have false currency in our market. Daily reports of fake cash fraud highlight the issue of false currency. The advancement of technology, such as computers, scanners, and copies, has made it easier to produce fake currency, and there is no programme to check whether the currency is phoney or real. India is plagued by numerous issues, including corruption, black money, and counterfeit currency. Because of this issue, phoney currency is created in less time and more efficiently. To address this issue, we created a technology that can distinguish between real and phoney cash. The numerous characteristics of Indian currency are described in this system. There are equipment in banks and other markets that may verify financial legitimacy. However, the average person does not verify each note to see if it is fake or real. The suggested system employs a CNN model to detect whether the cash is genuine or counterfeit. The programme is entirely written in the Python programming language. Steps such as grey scale conversion, feature extraction by hog edge recognition, splitting, and so on are performed using appropriate software.
By using Xception Architecture from CNN model we can achieve higher accuracy than any other model. The proposed system has advantages such as simplicity and high performance. The result will predict whether the Indian currency note is Real or Fake.

Keywords: ***Indian currency, Convolutional Neural Network , Image Processing , Xception Architecture , Deep Learning***

I. INTRODUCTION

Only the Reserve Bank of India is in responsibility of printing currency in India. Once screened and issued into the market, counterfeit banknotes pose a problem that the RBI must address on an annual basis. Significant technological improvements in the printing and scanning industries exacerbated the counterfeiting problem. As a result, counterfeit money has an economic impact and decreases the value of real money. As a result, the need to identify counterfeit currency is greatest. The bulk of approaches. These methods are less successful and require more work to locate fake money. To address the aforementioned issue, we presented the Identification of Fake Indian Currency Using Xception Architecture. Our approach detects counterfeit money by analysing currency images, unlike previous systems that rely on hardware and image processing.
Indian currency data sets for the 2000 and 500 rupee notes are used to train the Xception Architecture to learn the feature map of the respective currencies. The network is prepared to recognise fraudulent currencies in real time after the feature map has been learned. According to a report by the Reserve Bank of India, the number of counterfeit notes detected in the banking system increased by 35% in 2019-20, indicating the need for improved methods to identify fake currency. In this paper, we proposed a method to identify counterfeit Indian currency notes using the CNN Xception algorithm. Model we collected a dataset of both genuine and counterfeit Indian currency notes, and fine-tuned the pre-trained Xception model. Our results demonstrate the effectiveness of our proposed method, with high accuracy in identifying counterfeit notes. This can be useful for financial institutions, law enforcement agencies to prevent financial fraud.

The 2000 and 500 rupee data sets from India are utilised to train the Xception Architecture to learn the feature map of the different currencies. After learning the feature map, the network is ready to detect fake currencies in real time. According to a Reserve Bank of India report, the number of counterfeit notes detected in the banking sector grew by 35% in 2019-20, showing the need for better procedures to detect counterfeit cash. In this research, we proposed employing the CNN Xception algorithm to detect counterfeit Indian rupee notes. Model. We gathered a dataset of authentic and counterfeit Indian rupee notes and refined the pre-trained Xception model. Our findings illustrate the efficacy of our proposed method.

II. LITERATURE SURVEY

"Indian Currency Recognition and Verification Using Image Processing," M.R. Pujar, International Journal of Advance Research, Ideas, and Innovations in Technology [1].They used MATLAB in this paper to extract invisible and visible properties of Indian rupee notes. A digital camera is used to capture the image of the currency note. Image processing is performed on the acquired image

utilising concepts such as image segmentation, image edge information, and feature extraction.

Navya Krishna.[2] proposed utilising CNN to recognise phoney cash notes. The Automatic Fake Currency Recognition System(AFCRS) is designed to detect counterfeit paper money and determine whether it is genuine or counterfeit. The present false issue caused by demonetization has an impact on the financial structure and other industries. This research examines another Convolution Neural Network way for recognising fake notes through their photographs, which is relatively better than previous image processing strategies.

The Automatic Fake Currency Recognition System (AFCRS) is designed to detect counterfeit paper money and determine whether it is genuine or counterfeit. The present false issue caused by demonetization has an impact on the financial structure and other industries. This research examines another Convolution Neural Network way for recognising bogus notes through their photographs, which is relatively better than previous image processing strategies.

Although counterfeit cash is printed with precision, the Crime Investigation Department (CID) claims that it is detectable with some effort. Local racketeers' currency is easily detectable since they employ the photographic method, hand engraved blocks, lithographic procedures, and computer colour scanning. The watermark on counterfeit notes is created by utilising opaque ink, painting with white solution, and stamping with a dye etched with the picture of Development of an analytic tool for software-based vehicle condition assessments for resale. Gandhi, Mahatma. Tourists are the most vulnerable to phoney money since they do not know how to tell the difference between fake and real currency notes. Counterfeit currency detection using deep convolutional neural network (2019) presented by Prof Kiran Kamble, Anuthi Bhansali, Pranali Satalgaonkar, Shruthi Alagundgi [3]In this relevant paper, many recognition techniques are implemented to recognize images, recognize faces, recognize car license plates, and recognize human behaviours. Currency is the primary average for circulation, and Various countries' currencies have different qualities. However, when the value of currency grows, there will be an increase in counterfeit currency. Counterfeit money might damage these nations' interests. As a result, one of the hottest subjects and a critical issue at the moment is how to use recognition technology to the genuine of money (Zhang, 2018).

Potluri et al. [4] used Convolution Neural Networks to detect counterfeit currency notes. This proposed Mobilenetv2-FCD has been taught to detect Indian counterfeit cash.

The suggested network detects counterfeit notes with an accuracy of 85%. The network may be trained to recognise each country's money and used accordingly.

Babu et al. [5] suggested an image processing-based system for currency recognition and the detection of counterfeit Indian currency banknotes. People find it difficult to understand monetary types from other countries. The goal is to aid those who are unable to identify which country's currency note was used.

This framework employs banknotes, which vary in size, texture, and colour. Prof Kiran Kamble, Anuthi Bhansali, Pranali Satalgaonkar, and Shruthi Alagundgi [6] In this relevant paper, many recognition techniques are implemented to recognize images, recognize faces, recognize car license plates, and recognize human behaviours. Currency is the primary average for circulation, and Various countries' currencies have different qualities. However, when the value of currency grows, there will be an increase in counterfeit currency. Counterfeit money might damage these nations' interests. As a result, one of the hottest subjects and a critical issue at the moment is how to use recognition technology to the genuine of money (Zhang, 2018). Visual examination was used in the past to identify and genuine money, particularly currency notes. Our eyesight cannot sense everything; sometimes, it is not easy for humans to distinguish genuine currency from auth genuine entice currency without the aid of technology.

Fake currency Detection using Basic Python Programming and Web Framework (2020) presented by Prof Chetan More, Monu Kumar, Rupesh Chandra, Raushan Singh[7] Currency duplication also known as counterfeit currency is a vulnerable threat on economy. In counterfeit notes, the watermark is made by using opaque ink, painting with white solution, stamping with a dye engraved with the picture of Development of an analytic tool for software-based vehicle condition analysis for resale. Mahatma Gandhi. Tourists are the most vulnerable people to fake currencies, because they don't know the proper and precise way of finding the difference between fake and real currencies note.

Identification of Fake Indian Currency using Convolutional Neural Network R.Sumalatha, B.Jayanth Reddy and T. Venkat Ram Reddy(2022)[8] India had reviled the problems like defilement and dark cash and fake of money notes is likewise a big issue to it. To handle this problem, a deep learning-based framework is proposed to identify the fake Indian currency. The MATLAB tool has been used to identify the fake currency. The outcome will classify whether the Indian currency note is Real or Fake.

Fig 1 : Currency note front side

1: A see-through register with the denominational numeral 2000.

2: Latent picture of the denomination 2000.

3: Devnagari denominational numeral.

4: Mahatma Gandhi's portrait in the centre.

5: The micro letters 'RBI' and '2000' on the banknote's left side.

6: Security thread with windowed lettering and a colour shift from green to blue when the note is tilted.

7: Guarantee Clause, Governor's signature, Promise Clause, and RBI insignia to the right.

8: Watermarks for Mahatma Gandhi's picture and electrotype (2000).

9: Number panel with numerals increasing in size from tiny to large on the top left and bottom right sides.

10: 2000 in colour changing ink (green to blue) on the bottom right.

11: On the right, the Ashokan Pillar insignia.

For Visually impaired: Intaglio or raised printing of Mahatma Gandhi picture, Ashoka Pillar insignia, bleed lines, and identity mark for the visually handicapped.

12: On the right, a horizontal rectangle with the number 2000 in raised print.

13: Raised print with seven angular bleed lines on the left and right side.

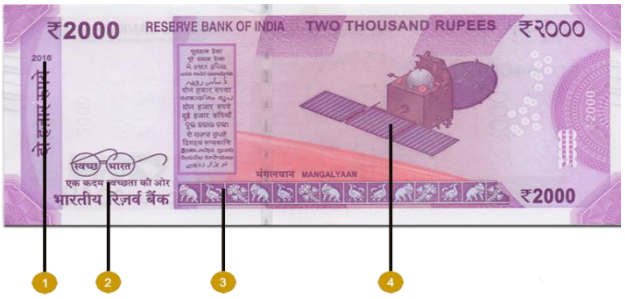


Fig 2 : Currency note when reversed

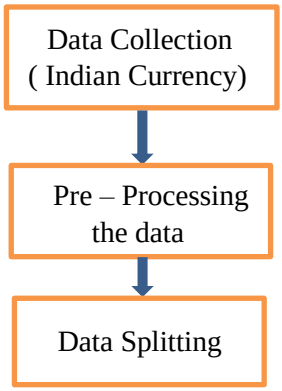
1: The year the note was printed.

2: The Swachh Bharat logo and tagline

3: Language panel in the centre

4: Mangalyan motif - representing the country's first interplanetary venture

IV. METHODOLOGY



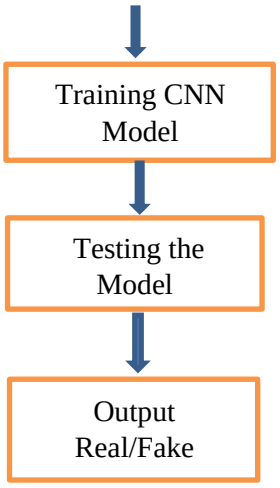


Fig 3 : Flow Chart

1. Data Collection: We obtained a dataset of authentic and counterfeit Indian rupee notes from Kaggle.(Notes of 500 and 2000 rupees)
2. Pre-processing: This method suppresses undesired distortion and enhances some image qualities that are crucial for subsequent processing.
3. Spitting Data:

A) Training: Using our training set of photos, we can now train our network. Once trained, we can evaluate how well the classifier performs on a testing set. After selecting Xception for our model, which is a pre-trained network. This expedites the training process**.**

B) Testing: A subset of the dataset is used to test the CNN model, and the model predict whether the currency note is authentic or false using the test set.

4. Evaluate: Finally, we should evaluate our trained network by presenting each of the photos in our testing test to the model and asking it to guess whether the dollar note is real or phoney.

CONVOLUTIONAL NEURAL NETWORK

Convolutional Neural Network (CNN) is a more advanced type of artificial neural networks (ANN) that is commonly used to extract features from grid-like matrix datasets. For example, visual datasets such as photos or movies, where data patterns play a significant role.

CNN architecture :

The input layer, Convolutional layer, Pooling layer, and fully connected layers make up a Convolutional Neural Network. Convolutional Neural Networks (CNNs) are a form of deep learning model that excels at analysing visual input like images and movies. They have transformed the field of computer vision and are widely utilised in a variety of applications such as picture classification, object recognition, image segmentation, and others.

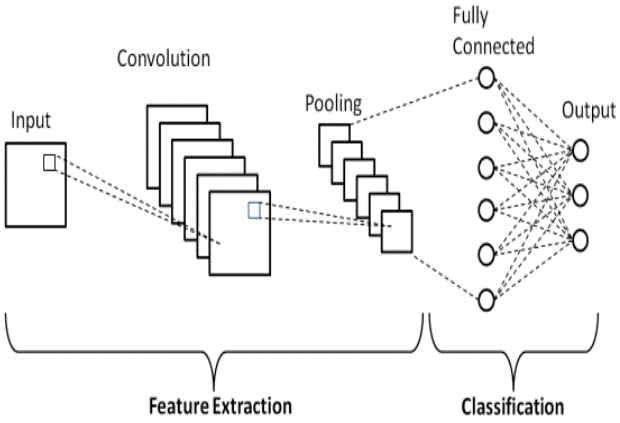


Fig 4 : CNN Architecture

CNNs are distinguished by their capacity to automatically learn hierarchical representations of incoming data via a series of convolutional layers. These layers are made up of filters or kernels that execute local operations on the incoming data and capture spatial patterns. Convolution is performed by taking the dot product of the filter and a tiny patch of the input data and sliding the filter over the input to compute activations at multiple spatial positions. Pooling layers are often added after the convolutional layers in CNNs.

Pooling is used to reduce the spatial dimensionality of feature maps, lowering processing needs and controlling overfitting. The most common pooling operation is max pooling, which selects the highest value within a set of values.

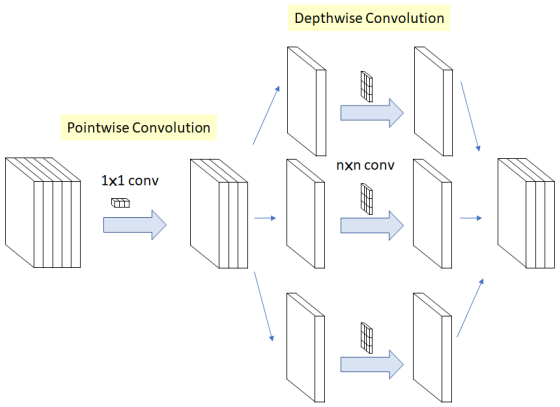
The output of the convolutional and pooling layers is often routed via one or more thick layers, which execute the final classification or regression operation. These layers transfer the high-level features learned by the previous layers to the desired output. Furthermore, CNNs can learn to extract useful features from raw data automatically, decreasing the need for manual feature engineering.

XCEPTION ARCHITECTURE :

The Xception (Extreme Inception) architecture was introduced by François Chollet in 2016 as a deep convolutional neural network (CNN) model. Xception's fundamental idea is to divide standard convolutions into two operations: depth-wise separable convolutions and point-wise convolutions. This factorization minimises computational complexity and parameter count while preserving or even boosting network performance.

A filter convolves through the full input volume in a conventional convolutional layer, generating a dot product at each place. When dealing with high input volumes, this technique is computationally intensive. Depth-wise separable convolutions, on the other hand, divide the ordinary convolution into two distinct operations: depth-wise and point-wise convolutions.

The pointwise convolution is followed by a depth wise convolution to form the modified depth wise separable convolution. As previously stated, the original depth-wise separable convolutions as typically implemented (for example, in TensorFlow) perform channel-wise spatial convolution first, followed by 11 convolution, whereas the modified depth-wise separable convolution perform 11 convolution first, followed by channel-wise spatial convolution.



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The pointwise convolution is followed by a depth wise convolution to form the modified depth wise separable convolution. As previously stated, the original depth-wise separable convolutions as typically implemented (for example, in TensorFlow) perform channel-wise spatial convolution first, followed by 1x1 convolution, whereas the modified depth-wise separable convolution perform 1x1 convolution first, followed by channel-wise spatial convolution.

The data initially passes through the input flow, then the middle flow, which is repeated eight times, and finally the exit flow. It is worth noting that all Convolution and Separable Convolution layers are followed by batch normalization.

In most traditional classification tasks, the Xception architecture outperformed VGG-16, ResNet, and Inception V3.

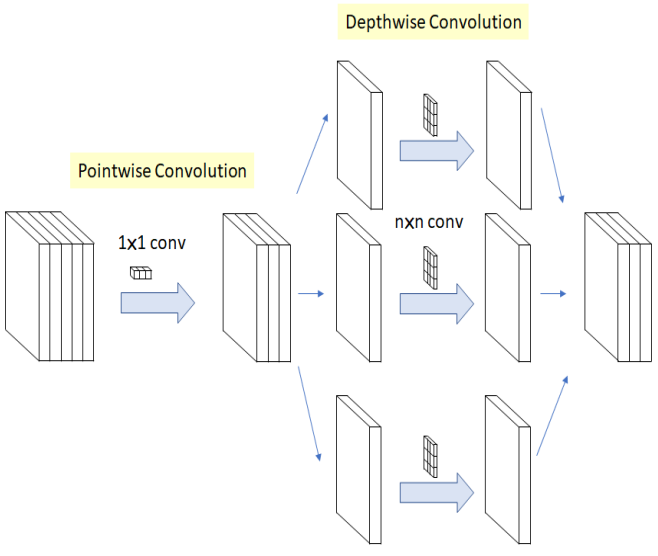


Fig 5 : Depth-wise separable conversion

How does Xception Architecture works ?

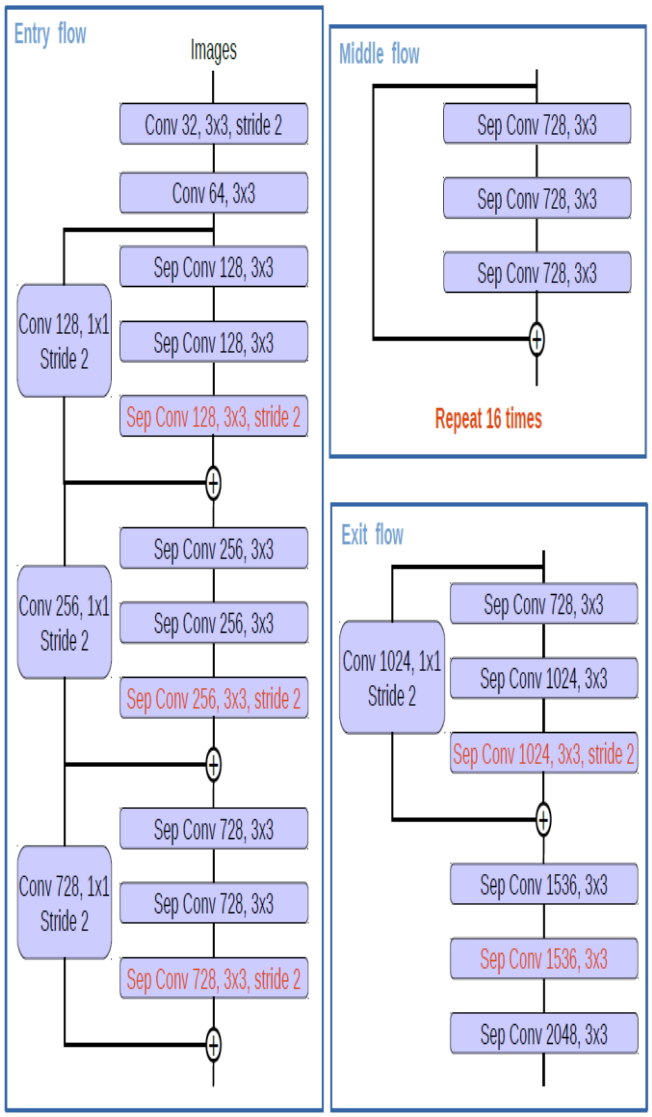


Fig 6: Flow chart of Xception Architecture

V. RESULTS

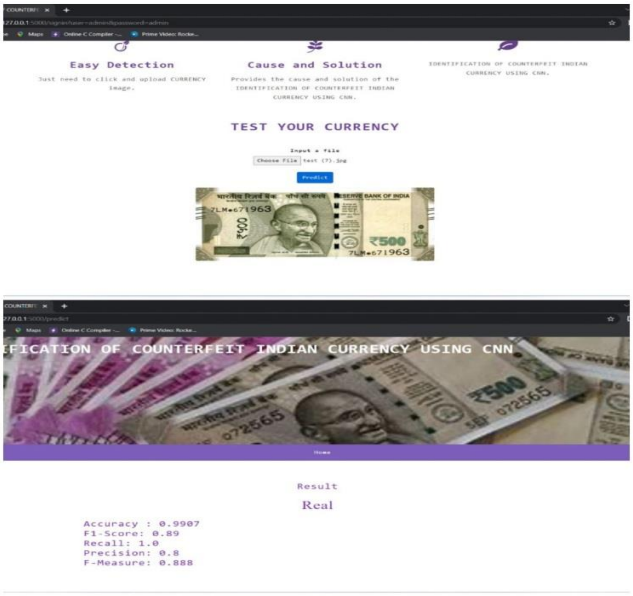
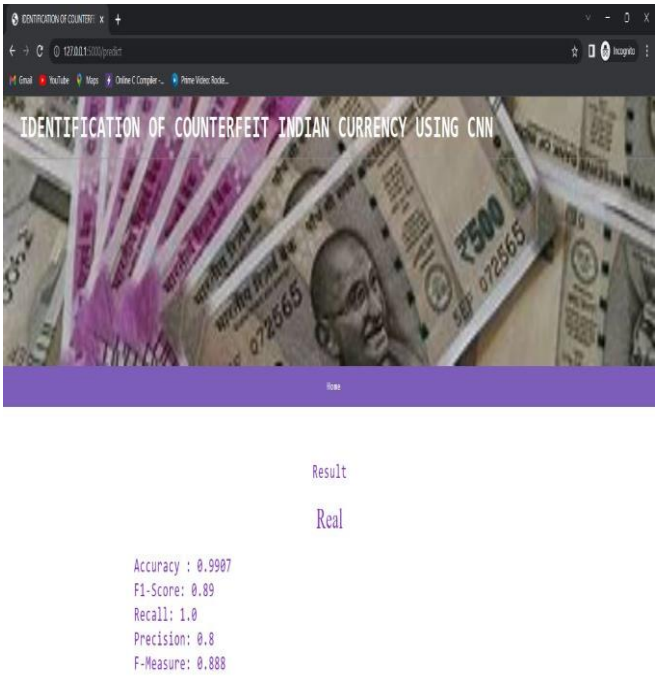


Fig 7 : Choosing the file from the data set

After Exploring the dataset we should choose the while



which we want to predict

Fig 8 : Model Predicting the currency note is Fake

After choosing the file the trained model predicting that the currency note is Fake

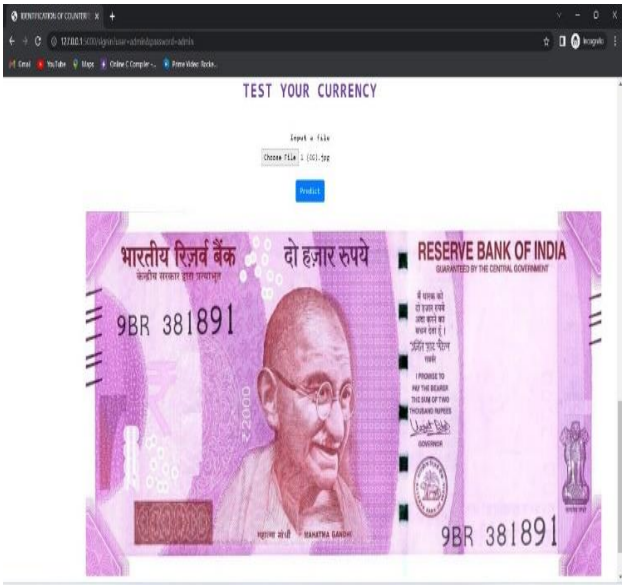


Fig 9 : Model Predicting the currency note is Real
After choosing the file the trained model predicting That the currency note is Real

VI. CONCLUSION

We proposed a method to detect counterfeit Indian currency using CNN model i.e Xception Architecture. This architecture has more accuracy than any other architectures in CNN.

Through analysis of the currency images, our technique detects counterfeit money. Indian currency data sets for the 2000 and 500 rupee notes are used to train the Xception Architecture to learn the feature map of the respective currencies. The network prepared is to recognise fraudulent currencies in real-time after the feature map has been learned. The suggested method takes less time and effectively detects forgeries of the 2000 and 500 currencies. The Accuracy obtained is 96.6% in this model.

FUTURE DIRECTIONS

- For future development system can be integrated with other systems, such as Automatic Teller Machines (ATMs) to detect counterfeit notes during transactions.
- Collecting a large-scale dataset of images of both genuine and counterfeit Indian currency notes can improve the accuracy of the system.
- In conclusion, the future scope of identification of counterfeit Indian currency using CNNs is vast with numerous opportunities for research and development. Multi-modal analysis, real-time detection, and integration with blockchain are some potential areas for future research and development.

References

[1] M. R. Pujar. “Indian Currency Recognition and Verification using Image Processing”, International Journal of Advance Research, Ideas and Innovations in Technology .

[2] Navya Krishna proposed utilising CNN to recognise phoney cash notes. The Automatic Fake Currency Recognition System(AFCRS) is designed to detect counterfeit paper money and determine whether it is genuine or counterfeit.

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[7] Fake currency Detection using Basic Python Programming and Web Framework (2020) presented by Prof Chetan More, Monu Kumar, Rupesh Chandra, Raushan Singh.

[8] Identification of Fake Indian Currency using Convolutional Neural Network R.Sumalatha, B.Jayanth Reddy and T. Venkat Ram Reddy.