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Detecting Indian Counterfeit Currency with a Convolutional Neural Network

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Abstract: Technology regarding shaded printing has grown lately the rate of notes being copied for fake cash on a big scale. Despite the rise in popularity of electronic financial transactions and the recent decline in utilizing paper money, banknotes continue to be widely used because of their dependability and simplicity of operation. Printing was only available to print business entities years ago, but as of late anyone can use an average laser printer to print money paper with the highest accuracy achievable. In light of this, phony currency has grown to hold the position of bigger issue than real money. Phoney money is a significant issue for India, which has lamented concerns like abomination and hidden money. This problem is addressed by proposing a deep learning-based method to identify the fake Indian rupee. The Utilizing MATLAB, a tool has been locate the fake cash. As a result, the legitimacy of the Indian currency note will be determined.

Counterfeiting is the practise of making copies of legitimate currency. Hence, the Indian government forbids the use of fraudulent currency. In India, the only authority in charge of printing money is the RBI. As soon as they've been accepted and released onto the market, counterfeit banknotes present an annual the difficulty for the RBI. The printing and scanning companies have seen major advances in technology, which have led to an upsurge in counterfeiting issue. Therefore, counterfeit money affects the economy and devalues legitimate currency. The need to spot counterfeit money is consequently greatest. The vast majority of older systems relied on hardware and techniques for image processing. Finding phoney currency requires more work and is less efficient using these methods. To ensure that tackle the aforementioned issue, which involves we suggested the Identification of Fake Indian Currency Using Xception Architecture. By evaluating the images of the currency, our system can recognize counterfeit money.

Keywords: MAATLAB, Machine learning, counterfeiting, Quillbot

I. INTRODUCTION

"Machine learning" is not possible without explicit programming the power of a system composed Using computer algorithms to gain knowledge through practice and improve. Machine learning, an aspect of artificial intelligence, predicts outcomes using data and statistics To be able to gather insights that may be applied to use.

The idea underpinning the innovation is that a machine can produce specific results through training from the data, or events. Machine learning has a close relationship to Bayesian predictive modeling and data mining. The computer applies an algorithm to produce answers after accepting data as input.

Once the model has been established, heretofore unidentified information can be utilized in assessing its efficacy. The model processes the updated input from the user, puts it into a features vector, and then output as a prediction. This is all of the wonderful qualities of machine learning. Retaining the model or revising the rules is not mandatory. Conclusions from fresh information can be made using the prior trained model.

All learning must place within the artificial intelligence brain. A machine's learning process is comparable to that of a person. People learn via experience. The more predictable it is, the greater information we have. By analogy, when Our odds of success are poorer in an unfamiliar setting than they would be in a familiar one. The same training is administered to machines.

Machine learning is supposed to be the fix to this issue. After evaluating an relationship between the inputs and the outputs, the computer outputs a rule. The programmers lack to generate new rules every single time there is new data. As additional data and experiences get incorporated into the algorithms, they evolve to become more successful over time.

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II. LITERATURE SURVEY

A study on banknote recognition techniques using different sensors[1] Though the decrease in the use of currency due to the recent rise in the use of computerized financial transactions, real money transactions are still vital in the global market. Even though it's still prevalent to carry and count currency by hand in everyday situations, large and safe transactions necessitate the utilization of computerized devices like ATMs and banknote counters. In Considering the topic of accurate banknote recognition leveraging various sensors in such automated devices, This essay addresses research that have been carried out in four primary areas: fitness categorization, banknote recognition, detection of counterfeit banknotes, and serial number recognition. The positive and negative aspects of the methodologies utilized in those examinations are also covered. Although past research has demonstrated on a number of surveys on banknote or counterfeit banknote recognition, This piece of work is the initial of its type to analyze all four areas. All around the world, procedures are utilized on banknote processing machinery to identify banknote details (denomination, serial number, reliability, and physical state) through picture or sensor data.

Deep learning-based recognition method for euro and mexican banknotes using real- world photos[2]A reliable and effective system for identifying Mexican and euro banknotes is presented in this article. Making use of neural networks and deep learning with actual scene photos captured in both natural and artificial light, a high rate of banknote detection and classification was accomplished. Convolutional neural networks were fed images in raw form without the need for manual character extraction. Analysis and studies were conducted out on currency based on significant features such as watermarks, portraits on the notes, The significance of the bills indicated by words and figures, and the entire banknote. A Survey on the Identification of Fake Indian Paper Currency[3]In India, The framework is being overrun with counterfeit notes. The identification of fraudulent notes is currently a hot issue for researchers.

The standard paper currency identification system's main goal is To ascertain counterfeit money. The money identification mechanism is necessary and must be extremely precise. A successful method for identifying paper money requires numerous procedures, such as edge detection, feature extraction, picture segmentation, image acquisition, grayscale conversion, and comparison of images. In this essay, we've gone through a distinct kind of literature review that explains many methods of spotting fake money.

Catching fake money with multiple-Kernel support vector machines[4]Establishing a reliable system for spotting counterfeit money is essential for company operations. Right now article, we propose an approach to detect counterfeit money using multiple- kernel SVMs. A support vector machine (SVM) is designed to lower erroneous rates. Every banknote is broken down into partitions, and the luminance histograms of the partitions furnish the input to the algorithm. Each part has an connection to a distinct set of kernels. A linearly The method of weighted combination has been employed to combine many kernels into only one combined matrix. It is possible to ascertain the optimal weights for kernel matrices in combination using semi-definite programming (SDP) learning. There are two ways of lowering the sheer number of false coin forensic investigations.

The microstructures of counterfeit coins were analyzed using a metallic microscope, and X-ray fluorescence (XRF) was utilized for a quantitative analysis which demanded no earlier preparation. Manganese, iron, zinc, nickel, copper, and chromium, cobalt, and lead were all identified with XRF. Through cluster analysis, the six main elements of the counterfeit coins—Cu, Ni, Fe, Zn, Mn, and Cr—were grouped. Considering the amounts of iron, chromium, and zinc, the 89 counterfeit coins could be split up into three categories, as per to the analytical results. Using a metal microscope, a few bent micro-structures were seen along the edge, at the letter and figure positions, and at the chemical etching site.

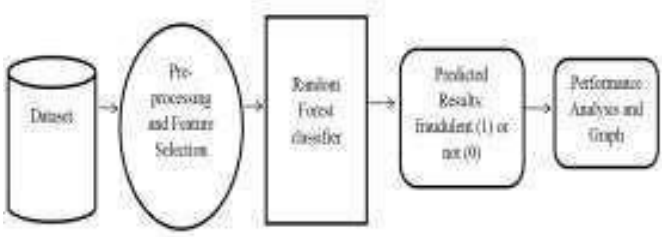

Fig 1.Proposed architecture

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III. EXISTING WORK

Yeh, Chi-Yuan, and colleagues proposed a methodology for fake banknote acknowledgment that relies on various bit support vector machines. To limit bogus rates, a Support Vector Machine (SVM) is developed. Each banknote is divided into parcels, and the framework's contribution is based on the luminance histograms among the parts. Each parcel is connected with its own components.

M. Hida and others A metallic magnifying lens was used to study fake coins' microstructures and X-beam fluorescence (XRF) for a quantitative assessment with essentially no pre-treatment. XRF identified Manganese, iron, zinc, nickel, copper, and chromium, cobalt, and lead.

The bogus Indian currency has been discovered in the current system using Alexnet, Resnet50, Darknet53, and Googlenet.

Compared to newer models like VGGNet, GoogLENet, and ResNet, AlexNet is NOT deep enough.

The use of large convolution filters (5*5) is discouraged shortly after that. The fundamental drawback of ResNets is that error detection gets challenging with deeper networks. Additionally, learning could be quite ineffective if the network is too shallow.

The current image processing system has generic procedures including picture acquisition, edge detection, grayscale conversion, feature extraction, image segmentation, and decision-making. Due to the difficulty of feature extraction, the disadvantage of these techniques is a reduction in detection efficiency.

IV. PROPOSED METHODOLOGY

Our relevance in this system is to concentrate on the recognition of bogus currency that is pervasive inside the Indian market. In our approach, counterfeit currency is found by detaching the security thread component from the currency note. We implemented our suggested method utilising Xception Architecture to identify bogus cash.

The photos of currency note dataset is created To give instruction to the suggested system. Images of notes worth 2000 and 500 rupees are created using augmentation. Augmentation techniques like as resizing and rotating are accustomed to expand the overall amount of records. After augmentation, each money photo has a label utilized additionally, it is kept in a specific folder.

V. FUTURE ENHANCEMENTS

1. Improved Model Accuracy

- **Advanced Architectures:** Integrate more advanced CNN architectures such as EfficientNet, ResNet, or InceptionNet to enhance the accuracy and robustness of the detection model.
- **Hyperparameter Tuning:** Perform extensive hyperparameter tuning to optimize model performance.

2. Real-Time Detection

- **Edge Computing:** Implement the detection model on edge devices like smartphones or embedded systems to enable real-time counterfeit detection.
- **Optimized Inference:** Use model optimization techniques such as quantization and pruning to reduce the model size and inference time for real-time applications.

3. Enhanced Dataset

- Data Augmentation: For superior model generalization, deploy data augmentation techniques to increase the quantity and diversity of training data.
- **Synthetic Data:** Generate synthetic counterfeit currency utilizing Generative Adversarial Networks to create images (GANs) to further enhance the dataset.

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4. Multi-Currency Support

- **Cross-Currency Detection:** Extend the model to detect counterfeit currencies from multiple countries by training it on a diverse set of currency images.
- **Transfer Learning:** Employ transfer learning to adapt the existing model to new currencies with minimal additional training.

5. Robustness to Variations

- **Environmental Factors:** Ensure the model's robustness against variations in lighting, angle, and occlusions commonly encountered in real-world scenarios.
- **Wear and Tear:** Create the model immune to detect obsolete counterfeit notes.

6. Integration with Financial Institutions

- **Bank Integration:** Collaborate with banks and ATMs to integrate the detection system, thereby enabling automatic counterfeit detection during cash deposits and withdrawals.
- **Retail Integration:** Implement the system in retail points of sale (POS) for real-time detection during transactions.

7. User-Friendly Interface

- **Mobile Application:** Provide a straightforward application for phones that lets users quickly examine and identify banknotes.
- **Augmented Reality (AR):** Utilize AR technology to provide real-time feedback on the authenticity of currency notes through the smartphone camera.

8. Security Enhancements

- **Blockchain Integration:** Implement blockchain technology to track and verify the provenance of currency notes, thereby reducing the possibility of counterfeiting.
- **Encrypted Data Transmission:** Make certain that every data transfer related to currency verification are encrypted to prevent tampering and unauthorized access.

9. Comprehensive Analytics

- **Fraud Analytics:** Develop a comprehensive analytics dashboard to track counterfeit detection statistics and trends.
- **Reporting System:** Create a reporting system for users to report suspicious currency notes, helping authorities to track and combat counterfeiting activities.

10. Regulatory Compliance

- **Adherence to Standards:** Make certain that the detection system complies with regulatory standards set by financial authorities and central banks.
- **Continuous Updates:** Regularly update the blueprint for keep up with new counterfeiting techniques and evolving regulatory requirements.

By implementing these future enhancements, the project can sigOn the ImageNet dataset, the suggested system model Xception somewhat outperforms Inception v3, while massively outperforming it on a bigger image classification dataset. The actual fact that it possesses the same number of model parameters as Inception is crucial since it indicates improved computational efficiency.

More precise than the current system, faster processing, and accurate detection thanks to the layer-by-layer learning of the attributes describing the monetary properties. (224,224). After that, use pictures for building a numpy array.

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VI. IMPLEMENTATION

Dataset

In order to obtain the training and testing input dataset, we implemented a system in the initial module. The dataset is stored in the folder model. The dataset comprises of 232 photos of Indian cash, both real and false, and includes test and train images. Below is a link to the dataset.

Indian currency Information is available at the following Kaggle URL: https://www.kaggle.com/datasets/jayaprakashpondy

Importing the necessary libraries

In the subsequent module, we will import the right libraries to determine counterfeit Indian cash. We're intending to be employing Python for this. We must load the required book collections prior to we can use them to build the core model, segregate the Sklearn-generated training and test data, Use PIL to transform photos into numerical arrays, and then utilize additional libraries such as pandas, numpy, matplotlib, and tensorflow to interface with them.

Retrieving the images

We can retrieve those images collectively with their labels. Since Every single Among the pics require the same size To be able to be recognized, they should then be resized to Building the model When it comes to image acceptance, Convolutional neural systems have demonstrated to be highly effective. Recognizing the convolution operation is necessary to understand what defines CNN from common neural networks.

CNN repeatedly analyses an image once it is entered to look for specific traits. The two primary elements that are changed for this scanning (convolution) are stride and padding type. The first convolution process gives a collection of new frames, as demonstrated in the representation below. These frames as observed In the subsequent column (layer). Every frame has details regarding a specific element and whether the feature as observed in the scanned image.

SAVING THE TRAINED MODEL

Assuming you're ready to use your trained and tested model in a production-ready atmosphere, the initial action that has to be taken is store it into a.h5 utilizing a library, an or.pkl file such as pickle.

Ensure that the Pickle is setup correctly in your setting.When having been imported into the module, the model will be emptied into an.h5 file.

VII. CONCLUSION

The quantity of counterfeit notes available for purchase is steadily rising day by day. Nowadays, a number of technologies are being employed to ascertain whether the note is authentic or fraudulent cash. This study proposes Xception Architecture to recognize fake Indian cash. Conclusions demonstrated that the Xception Architecture worked well; it achieved 97.00% Validation Accuracy and 93.34% Training Accuracy.

Furthermore, as a preliminary step stage in the money identification process, it is necessary to consider the prospect of noise in the collected image. Identifying and spotting counterfeit money can also be developed by integrating the surface patterns of the cash as features that will enhance the accuracy of detection.

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