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A DEEP LEARNING APPROACH TO CURRENCY RECOGNITION FOR THE VISUALLY IMPAIRMENT PEOPLE

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ABSTRACT

Currency recognition for blind people is an important issue as it allows them to independently manage their finances and enhance their daily lives. In this paper a novel system is proposed for currency recognition using computer vision and machine learning techniques. The system utilizes a camera and image processing algorithms to extract features from banknotes and classify them according to their denomination. Currency recognition technology can greatly benefit visually impaired individuals by providing them with the ability to manage their finances independently. Blind people often face challenges when it comes to managing their money, as they cannot distinguish between different denominations of banknotes. This technology can empower them to confidently identify and manage their money, enhancing their daily lives and improving their financial independence. In addition to helping blind people, currency recognition technology can also benefit other individuals and organizations, such as banks, retailers, and vending machine operators. These entities can use this technology to automate their processes and improve the efficiency of their operations. Convolutional Neural Network (CNN) is a deep learning algorithm that is widely used in image recognition and computer vision applications. CNN has been shown to achieve high accuracy in recognizing complex patterns and features in images, making it an ideal algorithm for currency recognition for blind people. To implement currency recognition using CNN, the system would first need to collect a large dataset of banknote images of different denominations. The CNN would then be trained on the preprocessed images, with the goal of learning the underlying patterns and features that differentiate one banknote denomination from another. The training process would involve forward and backward propagation of the data through the network, with the weights and biases of the filters being updated at each iteration to minimize the error between the predicted and actual denominations.

Keywords: Visually Impairment People, Currency Recognition, Deep Learning, Convolutional Neural Network, Optical Character Recognition.

1. INTRODUCTION

Currency recognition for visually impaired people is an important technology that helps individuals with visual impairments to identify different denominations of banknotes easily. This technology involves the use of various tools, such as smartphones, cameras, and specialized software, that can scan banknotes and provide audio or tactile feedback to the user about the currency's denomination. The goal of currency recognition technology is to increase the independence and accessibility of individuals with visual impairments, allowing them to conduct financial transactions with confidence and ease. This technology has become increasingly important as cash continues to be an essential means of payment in many countries worldwide. The inability to recognize different denominations of banknotes can make daily financial transactions, such as buying goods and services, paying bills, or withdrawing money from ATMs, challenging for people with visual impairments. Traditional methods of identifying banknotes, such as asking for

assistance from sighted individuals or using tactile markers, can be time-consuming, inconvenient, and may compromise the user's privacy. Currency recognition technology uses advanced algorithms and machine learning techniques to identify the unique features of different banknotes, such as size, color, texture, and patterns. The technology can be integrated into various devices, such as smartphones, wearable devices, or standalone devices, making it easy for users to access and use. Currency recognition technology has significant benefits for visually impaired individuals, as it enables them to manage their finances independently, increase their confidence, and improve their quality of life. It also promotes financial inclusion by eliminating barriers that prevent individuals with disabilities from accessing essential financial services and participating in economic activities.

The goal of a currency recognition paper for visually impaired people is to develop and implement a reliable and efficient technology that can recognize different denominations of banknotes and provide accessible and easy-to-understand feedback to users with visual impairments. The paper may involve the development of software, hardware, or a combination of both, that can accurately scan, process, and analyse banknotes' visual features and provide feedback in various formats, such as audio, tactile, or visual cues. The paper's ultimate aim is to enhance the independence, safety, and quality of life of visually impaired individuals by providing them with an effective means of identifying and managing banknotes. This technology can also promote financial inclusion and equal access to economic opportunities for people with disabilities, contributing to a more equitable and accessible society. The paper's success can be evaluated based on its ability to accurately recognize different denominations of banknotes, its usability and accessibility for users with different types of visual impairments, and its compatibility with various devices and platforms.

2. RELATED WORK

Wei sun, et.al,…[1] proposes a lightweight neural network model based on dilated convolution and depth wise separable convolution with twenty-nine layers for image classification. The proposed model employs the dilated convolution to expand the receptive field during the convolution process while maintaining the number of convolution parameters, which can extract more high-level global semantic features to improve the classification accuracy. Also, the depth wise separable convolution is applied to reduce the network parameters and computational complexity in convolution operations, which reduces the size of the network. The proposed model introduces three hyperparameters: width multiplier, image resolution, and dilated rate, to compress the network on the premise of ensuring accuracy.

Rushikesh jadhav, et.al,…[2] recognises the currency and identifies denomination by analysing the prominent attributes. Researchers proposed so many methods. Some of them use physical properties (width, length) and few uses internal properties (texture, colour). In the software field every problem has a solution. Using such software solutions, we can save our time as well as energy. In the early 90's there was one method which identified currency notes using image processing. However, their algorithm does not take aspects of authentication of the notes into account. For such a system it was necessary to have an input of the image after that it was performing some tasks over to it. Great advancement of the technologies in the banking sector has resulted in the introduction of self-servicing for making transactions simple and friendly to the customers. Also, we are known with the currency counting machines where this currency recognition technique is used. New techniques related to the recognition are also introduced by these banks like cash deposit by the user itself through the machines without visiting the respective bank. Here currency recogniser is required to check currency and handle it according to the denominations.

Chanhum park, et.al,…[3] implemented the research, the classification of fake banknote using deep learning was proposed, which did not require the pre-classification of banknote images in the denomination and input direction. However, the regions of banknotes were manually segmented from the input image, which requires user's assistance to use this method in actual smartphone. In addition, most previous studies on banknote detection using deep learning have used databases with simple backgrounds or with the application of a slight rotation such that the objects can be easily recognized. Thus, the studies that examine the detection performance using the images captured in various conditions are lacking. Owing to the rapid advancements in smartphone technology, there is an emerging need for a technology that can detect banknotes and coins to assist visually impaired people using the cameras embedded in smartphones. However, these studies also showed degraded performance depending on the changes in background and

environment. To overcome these drawbacks, this paper proposes a three-stage detection technology for new banknotes and coins by applying faster region-based CNN, geometric constraints, and the residual network (resnet).

Tuyen danh pham, et.al,…[4] implemented automatic handling of banknotes are still relevant. These tasks include the recognition of the banknote type and denomination, counterfeit detection, fitness classification, and serial number recognition, which are mostly conducted on automated transaction facilities, such as counting machines or vending machines, based on image processing techniques. Among these tasks, counterfeit detection plays an important role in ensuring the security of transactions because fake bills still exist at various sophisticated levels. Anti-counterfeit technologies, which are now being applied to banknotes in general, consist of various features, such as security threads, anti-copier patterns, watermarks, or hologram patterns. However, the frequent check of counterfeit notes is difficult owing to the large number of bills in recirculation and the complexity of the detection techniques, which involve various detection sensors, such as magnetic, infrared (IR), or ultra-violet (UV) sensors. As a result, it is difficult for general users to check for counterfeit banknotes. Automatic recognition of fake banknotes is an important task in practical banknote handling. Research on this task has mostly involved methods applied to automatic sorting machines with multiple imaging sensors or that use specialized sensors for capturing banknote images in various light wavelengths. These approaches can make use of the security features on banknotes for counterfeit detection. However, they require specialized devices, which are not always available for general users or visually impaired people. Meanwhile, smartphones

Rakesh chandra joshi, et.al,… [5]developed for healthcare services in the last decade. The aim of these advancements is to reduce the cost of the medical diagnosis and to assist the health sector with technology where a person can self-manage the things easily as never before without having the direct supervision from the specialist. However, the people having disabilities were not the primary target of these kinds of advancements. However, there is an urgent need for technologies, which can help and assist in day-to-day lives and can better their living in a simple manner and lead a way to independence. Out of these disabilities, Visual Impairment is much significant. Currencies play an important role as a medium for a transaction to have goods and services. Every country has their own currency in different denominations, which differs in color, size, shape, and pattern. It becomes very difficult for any visually impaired to recognize and count the currency in different denomination. Tactile marks at the banknote's surface vanish or faded away due to continuous use, which suffers visually impaired people to detect and identify banknotes properly by means of touch. The digital image processing is a broad area, which gives the solution to these kinds of problem, where searching and extraction of the patterns as well as identification marks is performed and then match those with original banknotes images. For that purpose, the YOLO-v3 CNN model-based banknote detection and recognition system is proposed which is fast and accurate. Images of different denominations and in different conditions were are collected initially and then, these images are augmented with different geometric and image transformations on images, to make the system robust. These augmented images are then annotated manually, from which training sets and validation image sets are prepared. Later, the performance of the trained model has evaluated on a real-time scene as well as a test dataset.

3. EXISTING METHODOLOGIES

In currency recognition using machine learning, there are some challenges that need to be addressed. One of the challenges is the variability in the appearance of currency due to different orientations, lighting conditions, and backgrounds. To address this challenge, data augmentation techniques can be used to create additional images with different orientations and lighting conditions. Another challenge is the presence of counterfeit currency, which can be difficult to distinguish from genuine currency. To address this challenge, the model can be trained on both genuine and counterfeit currency images to improve its ability to differentiate between them. Dense Connection, Multi-Dilation, and Depth-wise Separable Convolution layers are all advanced techniques in convolutional neural networks (CNNs) that can improve the accuracy of currency recognition. Dense Connection layers, also known as DenseNet, allow for a more efficient flow of information between layers in a CNN. Traditional CNNs have a series of layers that extract features from the input image and pass them on to the next layer. Multi-Dilation layers, also known as Dilated Convolution, allow for a larger receptive field in CNNs without increasing the number of parameters. Traditional CNNs have a fixed receptive field, which is the area of the input image that a single neuron in the network is sensitive to. Multi-Dilation layers allow

for multiple dilation rates, which means that a single neuron can be sensitive to a larger area of the input image. Traditional convolutional layers perform both operations simultaneously, which can be computationally expensive. Depth-wise Separable Convolution layers first apply a spatial convolution to each channel of the input data, and then apply a point-wise convolution to combine the channels. This reduces the number of computations required, making the model more efficient.

4. PROPOSED METHODOLOGIES

The proposed system for currency recognition using Convolutional Neural Networks (CNNs) would start with the collection of a large dataset of labelled currency images that includes different currencies, denominations, orientations, and lighting conditions. The data would then be pre-processed by removing noise, resizing the images, and normalizing the pixel values. The pre-processed data would then be split into training, validation, and test sets. The CNN model would be designed with multiple convolutional layers, each followed by a pooling layer to reduce the spatial size of the output feature maps. The design would also include Dense Connection, Multi-Dilation, and Depth-wise Separable Convolution layers to improve the accuracy of the model. The output of the convolutional layers would be flattened and passed through fully connected layers to produce the final output. The model would be trained on the training dataset using backpropagation and gradient descent to optimize the weights of the network. During training, the model would also perform data augmentation to increase the size of the training dataset and improve the generalization of the model. After training, the model would be evaluated on the validation set to adjust the hyperparameters of the model such as learning rate, dropout rate, and number of filters in each layer. Finally, the model would be tested on the separate test dataset to measure the accuracy, precision, recall, and F1 score. Once the model has been trained and evaluated, it can be deployed in a production environment where it can be used to recognize currencies in real-time. The system can be integrated with various applications such as ATMs, cash counting machines, and vending machines to automate currency recognition and improve the efficiency of cash transactions.

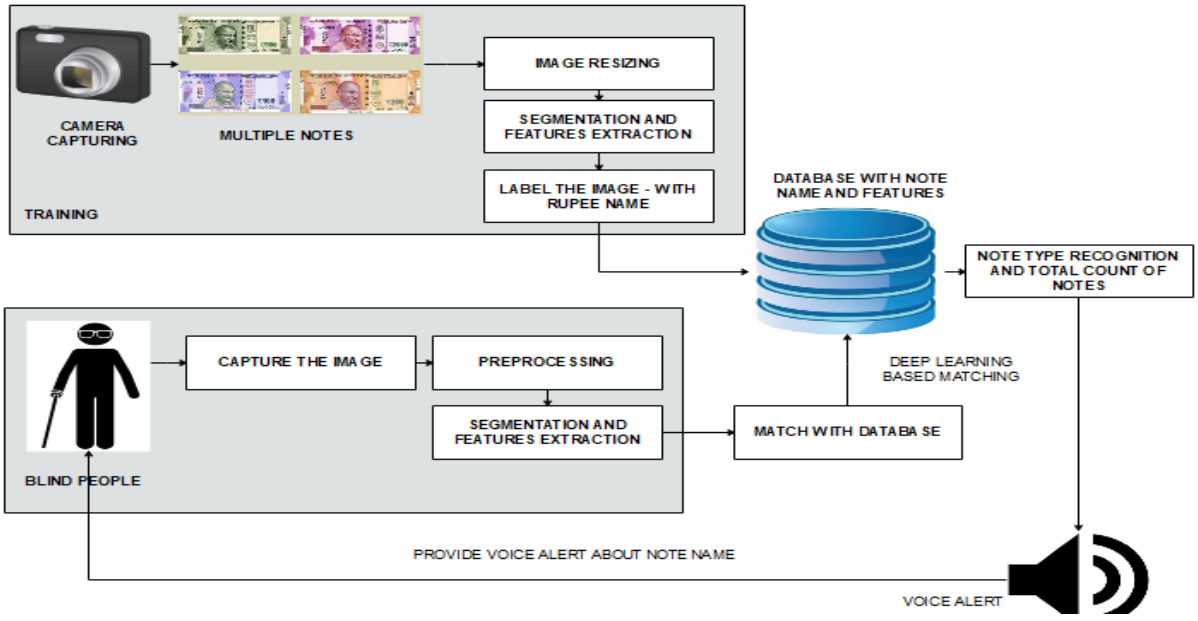

Fig 1: System architecture

5. EXPERIMENTAL RESULTS

In this study, we can collect the Currency datasets from KAGGLE website. It includes the notes with labels such as 10, 20, 50, 100 and so on. The performance of the system can be measured in terms of training accuracy. Achieving high training accuracy for currency recognition involves several key steps. Initially, a comprehensive dataset encompassing various currency denominations, lighting conditions, orientations, and backgrounds must be collected. This dataset serves as the foundation for training the recognition model, ensuring it accurately represents real-world scenarios. Preprocessing techniques are then applied to enhance the quality and diversity of the dataset, including resizing, normalization, and

augmentation to improve model generalization. Next, an appropriate model architecture, typically a Convolutional Neural Network (CNN), is selected based on the task complexity and available computational resources. During model training, optimization algorithms and hyperparameters are carefully tuned to maximize performance.

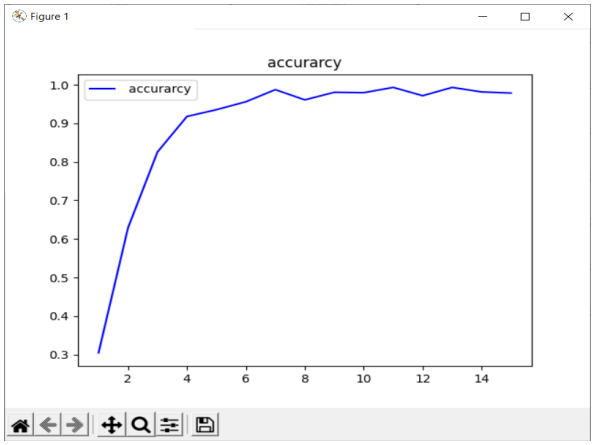

Fig 2: Training accuracy

The proposed system provides improved training accuracy in currency recognition and the accuracy rate is 90%.

6. CONCLUSION

The implementation of a voice alert system can add an additional layer of accessibility and user-friendliness to the currency recognition system. It can also help increase the system's usability in various settings, such as in retail stores, banks, or vending machines. In addition to providing a useful tool for blind individuals, currency recognition systems can also have practical applications in various industries. For instance, banks, retail stores, and vending machines can benefit from currency recognition systems in streamlining their operations and reducing the risk of errors or fraudulent activities. Currency recognition systems can also help governments and financial institutions in tracking and monitoring the circulation of currency notes. By accurately identifying and classifying different denominations of currency notes, it becomes easier to trace the movement of money, prevent counterfeiting, and identify patterns in cash flow. However, developing a robust and reliable currency recognition system requires careful consideration of various factors, including the quality of image capture, the choice of machine learning algorithm, and the diversity and size of the training dataset. Additionally, currency recognition systems must be designed with user privacy and security in mind, as they involve handling sensitive financial information.

CONFLICT OF INTERESTS

None.

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