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Indian Currency Recognition for Visually Impaired using Deep Learning Technique

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ABSTRACT: In this paper we summarize the importance of camera- based computing technology. It can help visually impaired people to automatically detect banknotes. A good algorithm for detecting paper money for people who are blind or visually impaired should have the following characteristics: 1) 100% accuracy, and 2) resilience in a variety of situations in a different environment and emergence. Many of the existing currency recognition algorithms are limited to restricted circumstances. In this project we propose a deep learning approach based on high accuracy. This approach is most effective in collecting more information in the classroom and is more effective in dealing with partial closure and change of views. In addition, reading transfer tests show its effectiveness in handling image rotation, measurements and lighting changes. To ensure the durability and standardization of the proposed method, we have compiled a large database of financial papers in a variety of contexts including closures, dense background, rotation, and lighting changes, measurements and views. The proposed algorithm achieves a high degree of recognition for our challenging database.

KEYWORDS: Indian Bank Notes Recognition, Visually Impaired, Transmission Reading, CNN

I. INTRODUCTION

Meanwhile, technology is growing rapidly day by day. By using technology, people solve their problems over time. Modern flexible systems in the real world require a financial recognition system. There are other possible uses in real life such as cash registers, money monitoring systems, currency exchange machines, and a money-monitoring system to help the visually impaired. Vision not only helps us to perform daily tasks but also affects a person's behaviour. Blindness affects a person's mental behaviour; a person with a visual impairment or a person with a normal vision may be less depressed than a blind person with a lack of social interactions and may also have a anxiety disorder. One of the biggest problems for people who are blind is seeing the real thing around them. Man is able to see and recognize things, and then meet the need for security and can trust their nature. For visually impaired people, one of the biggest problems is seeing paper money. The average person can easily identify the amount of money, but for a blind person or a visually impaired person, it is a difficult task to see the money properly. People who are blind and partially sighted need to see money and distinguish between money. According to the World Health Organization (WHO), about 2.2 billion people suffer from poor eyesight. 88.5.5 million people have visual impairment, 826 million people have blindness. By comparison, 217 million people have limited access to visual impairment, and 36 million are blind, the majority of people with visual impairment over 50 years of age. The main cause of visible defects are irregular refractive defects, cataract, macular- related decline, glaucoma, diabetic retinopathy, corneal opacity, and trachoma (Ali & Manzoor). Many people have used a variety of currency recognition techniques, such as the composition, size, and colour of a currency note. The modern power of computer and the availability of a camera make it easy for us to build an efficient system that sees Indian money. There are seven Pakistan currency schemes, varying in size and colour. The proposed approach could see a different Indian currency [10, 20, 50, 100, 200, 500, and 2000], which converts the output into the currency of a currency into a blind or visually impaired person.

II. EXISTING SYSTEM

To recognize the currency, many technologies have advanced. Some of these are discussed below: Xiaodong Yanget al. propose a paper-based approach to the knowledge of the paper currency using the SURF process. But this technology was complicated. The concept of knowing money based on the size, color and texture of paper money

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using the image histogram was given by Hassanpour. Money can be identified based on electromagnetic findings. The basic premise of this technology is the latest pulse eddy technology. Investigators also discussed the adoption process, in which the image is converted into a gray scale image. To get rid of unwanted noise on a gray scale the central filters are used. Canny detector edge and sobel edge detector are used to detect the edge. To measure the edges of the horizontal and vertical axis around the text region with a gray scale image, using a detector on the canny edge. To measure the edges of the total horizontal axis horizontal axis on a gray scale, a detector is used on the edge of the sobel but the system is not manually operated. The vector support machine can be used to detect the bank number with the help of the algorithm proposed by Shan Gaiet. There is a program, which consists of 2 categories: hardware and software. The Hardware section consists of three main parts: the installation part, the processing part, and the removal part. The input part will receive an image from the camera (CMU cam l). In the process of processing the banknotes and coins are separated by a microcontroller. The output component contains the voice recorder IC and speaker to provide output to the microcontroller in the form of voice and paper currency. One paper represents the fast-track process used for the advanced binarization of text extraction from license plate images captured by a mobile camera. Depending on the color scheme the researchers represented the technology of text extraction and fragmentation of the text image captured by the camera. The limit of this method was to obtain large-size texts with complex lighting changes and the program was very complex. Jian Yuan et al. print a paper representing the text extracted from the signboards by taking a picture with the help of a portable camera. Occasionally there is a financial crisis and bankruptcy due to the use of the camera. In another paper, there are two types of counterfeit identification methods included. One of them is to get Ultra Violet (UV) using lab view and the other is the light separation when transmitted by spending money. The result will be better if both results are good. Bank notes are easily recognizable according to their distinctive colors with a device developed by Mohamed et al. But the result is not so accurate. The system was designed that was reliable in keeping the light on the paper currency. Just rely on banknotes to be tested on a flat glass, and the system detects whether the paper currency is counterfeit or not, and recognizes the value of paper money using an infrared camera. Money can be obtained and seen using neural technology. Words in printed text can be identified by using a portable cursor such as a pencil. A small camera is attached to the cursor. When the user drops the cursor then the voice synthesizer will give the result. For the first time with the help of a pointer, the region is analyzed. If there is more text above the cursor then the image is divided into blocks. Each block is classified as ‘character’. Then the next step is to grab the 'character' blocks. An additional step is image analysis of polarity. If polarity is a game then the pixels of the mass-produced image are converted. Based on the Java platform, the text-reading program is designed to help people with visual impairments. In this case the text is converted into speech. Text from a picture can be obtained using a small representation, a novel-based approach and a non-guarded reading method. More about al. suggest embedded technology. Where the ARM 11 microcontroller can be used for image and video data extraction. Siddharth Mody et al. developed a portable "Text-to-Speech Converter". Speech processor converts text to keyboard input into speech.

III. LITERATURE SURVEY

The work in Paper [1] focuses on developing a system that can operate the industry-wide optical glass eye system that combines visual and visual functions. Database images of paper documents were taken with a portable camera, the appropriate position is taken in photographs using flexible blocking and positioning filters. In order to design a reliable and powerful recognition algorithm system that has the goal of determining an object or set of visual objects that is easy to see and varied enough to serve as the basis for continuous recognition. The system is trained to use the many features of paper money and lessons to easily understand how to use the system with confidence. Common causes of errors occur when a system is developed such as covering the benefit region with one or more fingers, it can cause detection problems. As well as the identification of Banknotes required to obtain counterfeit money, paper [2] proposes a system that not only looks at counterfeit notes but also looks partially, wrapped, wrinkled or possibly inserted for use. This project uses a computer viewing system to obtain multiple currency notes with a different perspective, scales and environment with a dynamic range of light. Use Computer Vision (OpenCV) to speed up the process where by reducing noise and CLAHE increasing variability, the recognition process developed by the Scale Invariant Feature Transform (SIFT), accelerates Robust Features (SURF), Features from the Accelerated Segment Test (FAST), BRIEF based on FAST and Rotated BRIEF (ORB), Binary Robust Invariant Scalable Key points (BRISK). The disadvantage of the system is that in the test images in which most of the coin regions were included, the local ratio of retailers has improved. This is due to the localization of the dots to avoid the removal of detection results with a low level of inliers. Paper [3] proposed a modular model review system that would use the acquisition of features and note Indian currency notes. The main features of the Indian currency are studied briefly so that the system developed can be useful to visually impaired people to find a particular feature of a particular note. In the middle of the numbers, the vocabulary is visible and training separation made with Support Vector Machine (SVM)

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filters. The proposed system is gaining momentum by training the cascade object detector at MATLAB and therefore the HOG dictionary used to detect the Ashoka Pillar mark on the coin where the CIE LAB Colour Space model was used for colour currency analysis. The delta-E distance between training and data testing to distinguish the type of currency and the similarity of the identification marking template, both end with 100% accuracy. However, the colour image histogram and Markov's chain of texture analysis show very low accuracy as different banknotes can have the same colours and textures, thus reducing efficiency. The life span of a bank cannot be predetermined but can be harmful to the body such as contaminants caused by excessive sweating, oil germs, and mud- borne pathogens that can accumulate. To prevent these spoiled notes from aging and to prevent them from spreading, a database of new and old paper money is read on paper [4]. Image acquisition and pre- adjustment, feature selection and output, and the construction of the partition model were project phases. The Modified SMOTE Algorithm has been used to strengthen old banknotes. The paper currency model was developed using the traditional Support Vector Machine (SVM) algorithm. By analysing the research, the many advantages are that such a method can improve the accuracy of the popularity of about 20% and solve the problem of recurrence to some degree. But the main problem is the absolute and therefore the relative value of the old bank money samples is far away but those of the latest bank account and therefore the dataset is usually not equal. In the field of banking, sorting, counting, sorting, sorting and deleting can be time consuming. This paper [5] suggested a response using TMS320C6416 DSK as a DSP enhancement platform, SV253A4 as an image sensor, XRD98L23 as a sensor processor and can eliminate rapid collection of bank image symbols and use TMS320 company's + 4 / 2C photo / video library. -TI pre-screening bank image as a central filter and acquisition of Sobel operator edge to satisfy the image quality requirement and collection speed to complete identification features. But this approach is even more complicated due to the involvement of many complex sensors and hardware systems. There are devices already available within the market but they do not work for Malaysian funds and the devices are very expensive. The purpose of this project [6] is to create something cost-effective to help blind people to separate Malaysian paper money. Currency Note Recognizer (CNR) detects various features of the Banknote and provides the output in sequence in the form of buzzer burst sounds. The ATMega328P-PU microcontroller will identify various notes to the input provided from TCS230 and send the fixed audio pattern to the buzzer as a signal. Due to the protection of the color sensor using a light shield, the output waves were within a very short distance so the system was simple. But if you look at the larger scope, this method does not work very well, because the type of project has certain limitations.

IV. PROPOSED SYSTEM

A. Image Retrieval

The first stage of any image viewing program. After the image is detected, various processing methods can be applied to the image to perform many different functions. Performing image acquisition in image processing is always the first step in the flow of work because, without the image, no processing is possible. There are various ways to get a picture with the help of a camera or a scanner.

B. Image Processing

The main goal of previous processing is to increase image visibility and improve the impact of data sets. Image editing is one of the most common actions required prior to key data analysis and data extraction. Photo adjustment, also called photo restoration, includes distortion adjustment, noise reduction, and the sound introduced during the photography process. Image adjustment can enhance the accuracy of the test. It involves machine learning and in-depth learning algorithms to identify currency types.

C. Remove Background

As shown in the architecture, the images are taken in a variety of environments, depending on the lighting conditions and background while the money in the photograph itself can be damaged. Image segregation is important in reducing data processing and removing unwanted features (background) that will involve decision-making.

D. Feature Extraction

Feature removal is a special type of size reduction. When the input algorithm is too large to be processed and the input data is not required it will be converted into a set of reduced values. Converting the input data to a feature set is called a feature output. If the extracted elements are carefully selected it is expected that the preset components will extract the related data from the input data to perform the required function using this reduced size instead of the full-size input.

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E. Match input image with datasets

To ensure image similarity, the internal function of the transfer of learning is to see the data through the appropriate process of extracting the feature and similar to the same content in the images. The way to learn to transfer is to use the knowledge gained from the previous work and improve contact with each other.

F. Audio output generation

Recognized text codes are recorded in script files. We then use text in speech converter to load these files and display the audio output of text information. Blind users can adjust speech, volume, and language according to their preferences.

We have divided section 11 of the Indian notes. But it may be confusing, one might think that there are only 7 categories of Indian Cash. But after making money the Government of India has introduced 10, 20, 50, 100, 200, 500, 2000 notes. And 10, 20, 50,100 old notes are currently in use. In E: g where we combine the old 100 note with the new 100 note. These notes have a completely different color combination, the number of pixels. So if we try to combine this note in one class of Rs 100 the model does not provide an accurate model because of the different color pixel values. That is why we have classified the Rs 100 class as "New Rs 100 class" and "Old Rs 100 class". In this way, it can be achieved in some way with better accuracy and effect.

V. DEEP LEARNING ARCHITECTURE

Connectionist buildings have been around for over 70 years, but new buildings and graphical processing units (GPUs) are bringing them to the forefront of artificial intelligence. In-depth learning is not one way but there is a section of algorithms and topologies that you can use for a wide range of problems. While in-depth learning is not new, it is experiencing explosive growth due to disruptions of highly rooted neural networks and the use of GPUs to accelerate their implementation. Big data also feeds this growth. Because in-depth learning depends on training neural networks and model data and rewarding them based on their success, where there is more detail, it is better to build these in-depth learning frameworks. The number of constructs and algorithms used for in-depth learning is broad and varied. This section examines six in-depth study structures covering the past 20 years. Notably, short-term memory (LSTM) and convolutional neural networks (CNNs) are two of the oldest methods in this list but also two of the most widely used methods in various programs.

A. *Supervised Deep Learning*

Supervised learning refers to a problem area where clearly written references are labeled within the data used for training. In this section, we introduce a higher level of well-known deep learning structures - convolutional neural networks and duplicate neural networks, and more.

1. Convolutional Neural Networks

CNN is a multilayer neural network that was naturally inspired by the visual cortex of animals. The design is very helpful in the use of image processing. The first CNN was created by Yann LeCun; at the time, buildings focused on handwriting recognition, such as translating postal code. As a deep network, the first layers recognize the features (such as edges), and then the layers later reassemble these elements into high-quality input features. The LeNet CNN architecture consists of several layers that use feature extraction and partition (see next image). The image is divided by the receiving fields that feed to the convolutional layer, and then excludes features from the input image. The next step is compilation, which reduces the size of the extracted elements (by using a sample below) while storing the most important information (usually, in most cases). Another step is made to mix and match the feed that is a fully integrated multilayer perceptron. The final layer for this network release is a set of nodes that identify image elements (in this case, the node for each specified number). You train the network through back distribution. The use of in-depth layers of processing, mixing, cohesion, and a fully integrated phase opened the door to a wide range of applications for in-depth learning networks. In addition to image processing, CNN has been used successfully in video recognition and in various applications in the use of natural language.

Sample requests: Image recognition, video analysis, and natural language processing

2. Recurrent Neural Networks

RNN is one of the basic network infrastructure where some deep learning structures are being built. The main difference between a standard multilayer network and a duplicate network is that rather than a complete feed

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connection, a duplicate network may have relapses in the previous layers (or in the same layer). This response allows RNNs to keep in mind previous installments and model problems over time. RNNs contain a rich architectural set (we will look at one popular topic called LSTM next). The main difference is the response within the network, which can manifest itself from a hidden layer, output layer, or a combination of these. An image with circles and arrows showing the relationship between network input, output, hidden and context layers. RNNs can be produced on time and trained by standard back distribution or by using a different back- propagation system (BPTT).

Example request: Speech recognition and handwriting recognition

1. LSTM Networks

LSTM was created in 1997 by Hochreiter and Schimdhuber, but has grown in popularity in recent years as RNN's development of various applications. You will find LSTMs in products you use every day, such as smartphones. IBM used LSTMs on IBM Watson® to recognize the landmark recognition of conversationalspeech. LSTM has moved away from the normal neuron-based network structure and introduced the concept of a memory cell. Amemory cell can store its value for a short or long time as an inputfunction, allowing the cell to remember important information and not just its final component. The LSTM memory cell contains three1.gates that control how information enters or exits the cell. The input gateway controls where new information can enter the memory. Forget control gateway where a piece of existing information is forgotten, allowing the cell to remember new data. Finally, the output gate controls when the information contained in the cell is applied to the output from the cell. The cell also contains the weights, which control each gate. The training algorithm, usually BPTT, adjusts these weights according to the default network output error. Image with arrows and arrows showing the LSTM memory cell and information flow through various gates Recent applications for CNN and LSTM have developed image and video encoding systems in which the image or video is embedded in the native language. CNN uses image or video processing, and LSTM is trained to translate CNN output into native language.

Example apps: Photo systems and video captions

2. Gated Recurrent Unit(GRU) Networks

In 2014, the simplification of the LSTM was introduced called a duplicate gate unit. This model has two gates, it removes the exit gate that exists in the LSTM model. These gates are the renewal gate and the reset gate. The update gateway indicates how much previous cell contents should be retained. The reset gateway explains how to install new inserts and previous cell contents. The GRU can model the standard RNN by setting the reset gate to 1 and the update gate to 0. GRU is simpler than LSTM, can be trained very quickly, and can work better on its performance. However, LSTM can be very specific and more data can lead to better results.

Example application: native text compression, handwriting recognition, speech recognition, touch recognition, photo captions

B. *Unsupervised Deep Learning*

Unattended reading refers to a problem space where there is no target label within the data used for training. This section discusses three in-depth supervised reading structures: custom maps, auto encoders, and restricted Boltzmann machines.

1. Self-Organizing Maps

Self-mapping (SOM) was developed by Dr. Teuvo Kohonen in 1982 and was widely known as the Kohonen map. SOM is an uncontrolled neural network that creates collections of input data set by reducing the input size. SOMs differ from the traditional artificial network in a number of ways. The first notable difference is that the metals act as a node elements. After a standard installation, random input is first selected. Random weights close to zero are applied to each element of the input record. These weights now represent the input node. Several combinations of these random weights show variations of the input node. The Euclidean distance between each of the output nodes and the input node is calculated. A node with a small distance is declared as the most accurate representation of the input and is marked as a very similar unit or BMU. With this BMUs as central areas, other units are also calculated equally and allocated to a group that is the distance from it. The range of points around BMU weights is updated based on proximity. Radius is reduced. Next, in

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SOM, no activation function is used,and because no target labels can be compared against it there isno point in calculating error and backward.

Application example: Size reduction, high-dimensional input to2-dimensional output, bright range effect, and group visibility

2. Autoencoders

Although the history of the development of auto encoders is complex, the first known use of auto encoders was discovered to be LeCun in 1987. This variation of ANN is made up of 3 layers: input, hidden, and outgoing layers. First, the input layer is embedded in the hidden layer using the appropriate encodingfunction. The number of nodes in the hidden layer is much lowerthan the number of nodes in the inlay layer. This hidden layer contains a compressed representation of the original input. The output layer aims to reconstruct the installation layer using the decoder function. During the training phase, the difference between the input and the output layer is calculated using the error function, and the weights are adjusted to minimize the error. Unlike traditional unregulated learning strategies, where there is no data to compare results, auto encoders learn continuously using back-to-back spreads. For this reason, auto encoders are classified as self-monitored algorithms.

Sample requests: Reduction, data consolidation, and data compression/decompression

1. Restricted Boltzmann Machines

Although RBM became very popular later, it was originally founded by Paul Smolensky in 1986 and is known as Harmonium.RBM is a 2-layer network. Layers are layers that are installed and hidden. As shown in the following figure, on RBM all nodes in the hidden layer are connected to all nodes inthe visible layer. In the traditional Boltzmann machine, nodes within the input and cache layer are also connected. Due to the complexity of computers, the nodes within the layer are not connected to the limited Boltzmann Machine. During the training phase, RBM calculated the possible distribution of the training set using the stochastic method. When training begins, each neuron activates randomly. Also, the model contains hidden options. While hidden discrimination is used in previoustransfers to build activation, visible bias helps to rebuild inputs.Because in RBM the reconstructed inputs are always different from the original inputs and are known as production models. And, because of the built-in randomness, the same speculation produces different results. In fact, this is the most important difference from the auto encoder, which is the determining model.

Application Example: Reducing the size and shared filtering

VI. RESULTS

Results of Conducted Experiment

Model	Size of Dataset	Accuracy
CNN Model	4000	78%
VGG16 Transfer Learning	4000	90

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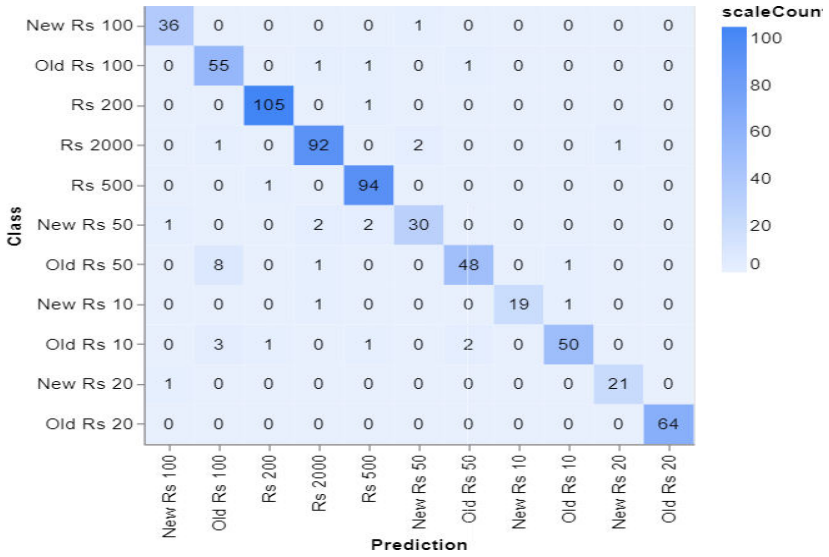
Accuracy per class

CLASS	ACCURACY	# SAMPLES
New Rs 100	0.97	37
Old Rs 100	0.95	58
Rs 200	0.99	106
Rs 2000	0.96	96
Rs 500	0.99	95
New Rs 50	0.86	35
Old Rs 50	0.83	58
New Rs 10	0.90	21
Old Rs 10	0.88	57
New Rs 20	0.95	22
Old Rs 20	1.00	64



VII. CONCLUSION AND FUTURE WORK

We started with a brief introduction to our program again we have discussed the scope and objectives of our project. During the literature research we have had the opportunity to take a closer look the problem people are facing in the current environment, us have reviewed a number of research papers that we are downloading in a few papers and we selected other papers as our basic research papers. We have analysed all the existing structures of our foundation papers and understanding of its operation we have found some errors in the current system. We have saved it all key features of existing programs such as key focus as well some additional features of our proposed program. In this case to study, we have introduced a novel approach to the acceptance of Indian Finance Note. Features from images are extracted using in- depth reading transfer learning. This building consists of two steps: in the first step, we train our mode with using pre- trained construction. In the second section, we use camera, which makes photography again and from there image, remove frames and transfer our model to train it in pre-rail construction, which sees money through very high accuracy. As the proposed process is over well aware of the Indian currency Note, therefore the proposed draft can also be added for future working this particular place. More developments yet The frame will lead to better performance in even viewing Indian Comprehensive Currency Note. The full purpose of the provision visual acuity of visually impaired people is guaranteed with the construction of an effective model solution.

This project helps people who are visually impaired with its interactive program. The project is an attempt to promote how to extract the features of Indian paper money. The work will be very useful in providing visuals for people with disabilities. In the future, the mobile app can be built for foreign currency notes such as Dollars, Euros, Takas, etc. the application interface can also be customized requirements. The best way to use this project obtaining illegal monetary recognition within the same app compiled. In this project, a smart approach is proposed to take out

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the features of Indian currency notes and see them. Our future scope will be to include features related to the conversion of kind of money too.

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