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CURRENCY RECOGNITION SYSTEM FOR VISUALLY IMPAIRED PEOPLE

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Abstract: For a normal person, recognition of currency notes is an easy task but this is not the case for a visually impaired person. A visually impaired person is one who has partial visual impairment or someone who is completely blind. They face a lot of difficulties in day-to-day activities including monetary trans- actions. They have difficulty in recognizing the paper currencies due to similarity of paper texture and size between different categories of currency notes. Institutions like banks can afford expensive hardware to resolve this issue of currency recognition but for common people especially the visually impaired people cannot use this expensive hardware. The aim of this project is to help such people and provide them with a cost effective solution. The idea of a currency recognition software is proposed in this project which will help in distinguishing different currency notes. This system will be developed in the form of an Android application and will be implemented using image processing techniques and will help in identifying currency notes.

Keywords - *Currency recognition, visually impaired people, Image processing techniques, Counterfeit currency notes, Tensor Flow*

I INTRODUCTION

According to the survey conducted by the CIA, there are around 180+ currencies presently circulating in the world[1]. Each of these currencies has varying features such as size, color, and texture. Unlike the olden times, the trade and com- merce between countries have increased in all sorts of levels. The need for acquiring knowledge about all the currencies by the banks has been extremely important. However, for any visually impaired person to recognize each note correctly is something is problematic. Thus the need for an efficient automated system that helps in recognizing currency notes is essential. Of the 285 million people across the globe who are visually impaired, 62 million are from India (about 15 million of these are completely blind). Visual impairment significantly affects the quality of life of these populations and limit daily activities especially using cash for financial transactions. Also, due to their impairments, they are often taken advantage of and can be cheated on by fake currency. Hence, it is essential to design a system that identifies authentic notes. In August 2019, RBI has also recognized this issue and it has proposed the idea of launching a mobile application for the visually impaired and they are looking for vendors for the same. The National Association of the Blind had filed a petition claiming that the new currency notes and coins posed a great difficulty for the visually impaired in identifying and distinguishing between them. Hence our motivation is to solve this problem which is faced by the visually impaired people in India. The basic concept is to develop an Android application that will work entirely on voice commands. Basically, it will scan a currency note and then the system will extract the important features of the currency note. After the system identifies the value of the note, it will give the output in audio form. This application will be easy to use for visually impaired people. The objectives which are taken into consideration while researching this topic are going to be as follows:

-The main objective of currency recognition system is to help visually impaired people to identify the currency value with the help of image processing techniques.

-Another objective is to get accurate result in various light conditions and implement the android application

with an easy Graphic User Interface (GUI) using voice commands.

-The system will work entirely on voice commands and hence will be easy to use, accessible and affordable for visually impaired people.

Since we are targeting the visually impaired people for using this system, it introduces many additional challenges. The user might be unaware of the surrounding conditions such as lighting, contrast, saturation and even whether the currency note is properly visible in front of the camera or not. The system should be flexible towards a wide variety of images that are likely to be captured by the target user. Using the application should be simple for a person who is visually impaired. It should have a camera that should open with voice command and that once started requires no input from the user. Therefore, the problem requires innovative techniques that can recognize the currency note in diverse environments reliably and efficiently.

II LITERATURE SURVEY

Suriya Singh, et al. [2] proposed visual object recognition on a mobile phone and an application for recognizing currency bills using computer vision techniques, that can run on a low-end smartphone. The solution provided uses a visual Bag of Words (BoW) based method for recognition. Segmentation of the bill using an algorithm based on iterative graph cuts is carried out. Then, the formulation of the recognition problem as an instance retrieval task is done. This system is an example of instant recognition that can run on mobile devices.

Sonali Bhagat, et al. [3] implemented the algorithm for recognition of currency with the help of MATLAB. In this method, the classification of the various features is done using hamming distance. Confusion matrix which is used indicates the number of correctly recognized notes and also errors that have occurred while recognition. The result of this system is integrated with the graphical user interface (GUI). This system could be implemented where transactions are involved and currency recognition is necessary.

Prof. Rajesh Babu, et al. [4] proposed the system which gives an approach to verify the Indian currency notes.The verification of currency notes is done by the concepts of image processing. The system describes the extraction of various features of Indian currency notes. The MATLAB software is used to extract the features of the note. Recall and precision are calculated from results taken out of the data set and the metrics considered for identifying a genuine note are the serial number, security thread, identification mark and Mahatma Gandhi portrait.

Vedasamhitha Abburu, et al. [5] proposed a system for the recognition of currency notes using image processing techniques. The proposed method can be used for recognizing both the country of origin as well as the denomination or value of a given banknote. Only paper currencies have been considered. This method works by first identifying the country using certain areas of interest and then identifying the denomination value using various characteristics such as shape, color, size or text and other specific features on the note.

Mr. Viranchi N. Patel, et al. [6] proposed a method, Canny Edge Detector which is used for segmentation and for classification, the NN pattern recognition tool is used which gives 95.6 percent accuracy. The technique of currency recognition using the Neural Network Pattern Recognition app is implemented by extracting central face value using canny edge detector method and the database is prepared. Finally, the database is trained using the NN pattern recognition app is carried out and recognition is possible.

Shubham Mittal and Shiva Mittal [7] presented a deep learning-based method for the identification of denominations of Indian Currency Rupee notes from colour images. A classification framework has been implemented using the concept of transfer learning where a large convolutional neural network pre-trained on thousands of natural images is employed for classification of images from new classes. An image dataset is prepared by pre-processing and augmentation of images captured in varying environments and lighting conditions. Experimental results prove it to be employable for the development of dedicated portable systems for the identification of banknote denominations.

Anilkumar B, et al. [8] proposed the k-nearest neighbor's algorithm (k-NN) for classifying the banknotes. The information comprises of the k-nearest training cases in the feature space. The yield relies upon whether k-NN is utilised for classification or relapse. The result is either valid or false and it depends on the testing inputs. Text-to-speech is utilised to tell the client by the estimation of the paper note which gives a simple interface for the ease of the client. Straight forward image processing methods like thresholding, noise removal, edge detection and segmentation are used to extract ROI and facilitate the template matching procedure.

III PROPOSED SYSTEM

Figure 1. Currency Recognition System android application

The methods which are available for the recognition of currency are mostly hardware methods and are not feasible for the common masses. The novelty of the system is that it is cheap and easily accessible to the visually impaired people in India. Using the application should be simple fora person who is visually impaired. It will consist of a camera which will open with voice command and that once started requires no input from the user. In short, the problem at hand requires innovative modules that can recognize the bill in diverse environments reliably, robustly and efficiently. And these needs are met efficiently with the new system with better GUI. The currency recognition system is very easy to use as shown in Figure 1.4, when the android application is opened, a single tap on the screen will open the camera. After the camera of the phone is opened, the user can capture the image with a single tap anywhere on the screen. The system will be developed to check different currency notes of 10, 20, 50, 100, 500 and 2000 rupees. The Application will give audio output of the currency denomination. The system simply extracts feature of currency which are matched with original currency features and immediately displays result with accuracy. The parameters which are going to be considered for currency recognition are as follows:

I. Currency value area

II. Intaglio printing

III. Serial number

IV. Identification mark

V. Satyamev Jayate logo

VI. Reserve Bank of India logo

Pre-processing:-

The aim of pre-processing is to improve the quality of the image and remove unwanted noise so that further process- ing is easier. The four categories of pre-processing methods include pixel brightness transformation, geometric transforma- tion, methods which use neighbourhood of the processed pixel and image restoration.

Greyscale Conversion:-

Figure 2. Image after Greyscale Conversion

Greyscale conversion is used to change the brightness of the image without regard to position in the image. Greyscale transformation can be performed using look-up tables. The aim is to acquire an image with equally distributed levels over the whole brightness scale.

Edge Detection:-

Figure 3. Edge detection in image

Edge detection aims at identifying points in a digital image at which the image brightness changes sharply or has no continuous pattern. At such points, organization is done into a set of line segments known as edges. Edge detection is an image processing technique for finding the boundaries of objects present in an image.

Feature Extraction:-

Feature extraction is a special type of dimensional reduction. When the input of an algorithm is too large to be processed and it is not needed then the input data will be converted into a reduced representation set of essential features. If the features extracted are

carefully selected, it becomes easier to achieve the desired output. As the system has to perform the required task using this reduced representation instead of the focusing on large size input.

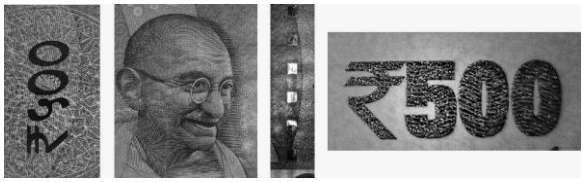

Figure 4. Feature Extraction of desired features

System Flowchart:-

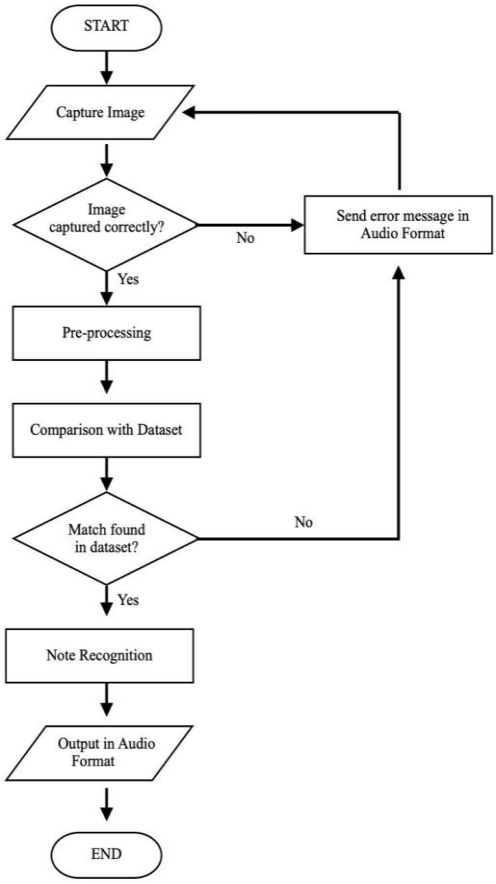

Figure 5. Flowchart of the Currency Recognition System

In this system flowchart, firstly an image is captured by the target user. In this case, there are two main decisions that are needed to be taken for the system to work. One is to check whether the image captured by the user is noise free and the special features through which the note is recognized are present in the image. If not, the user will get an error message in an audio format. This system flowchart is a physical design tool that shows the operations that will be performed in the currency recognition system.

IV ALGORITHM

Image recognition using tensorflow:-

Tensorflow is a powerful framework that functions by imple- menting a series of processing nodes, each node representing a mathematical operation, with the entire series of nodes being called a ”graph”. Tensorflow is basically a software library which is used in the system for numerical computation using data flow graphs where:

Nodes in the graph represent mathematical operations.

Edges in the graph represent the multidimensional data arrays (called tensors) communicated between them.

Steps in the algorithm :-

Step 1 - Collect images.

A lot of images need to be collected so that comparison becomes easier and the system becomes more accurate. In case of Currency Recognition System, various notes of 10, 20, 50, 100, 200, 500, 2000 are to be captured in different light conditions and in various angles to attain

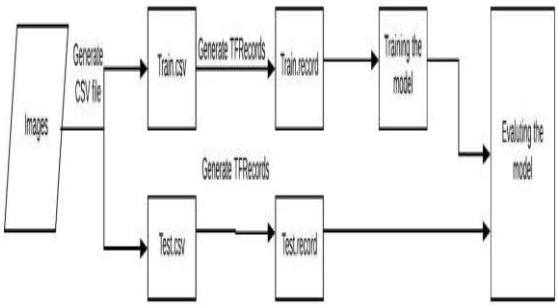

Figure 6. Flowchart of the Tensorflow system

efficient results. A dataset needs to be created taking these images into consideration and this dataset should be kept secure.

Step 2 - Train the model to learn from the images

After collecting enough images, the next step is to train the model. Docker container can be used to get an already set up TensorFlow environment. This operation can take several minutes depending on the number of images present and the number of training steps specified.

Step 3 - Optimize the model

Now, the model is ready. To use the trained model on a mobile device, it needs to be optimized first, using a tool named optimize for inference, that removes all nodes that are not needed, among other optimizations.

Step 4 - Import the model in the Android application. The optimized model is now to be installed in the android application. After the android application is ready, it can execute the Currency Recognition System efficiently.

Step 5 - Test the trained model in application developed. Install the developed Android Package Kit (APK) in the users' phone. Test its working for currency notes in different conditions. This step is necessary because it helps in testing the system that has been implemented. If any inaccuracies are found in this step, they need to be solved by checking the training data or increasing it for better results.

V RESULT AND DISCUSSIONS

The idea behind the Currency Recognition System was that it should work efficiently based on voice commands only. Using Android Studio and Tensorflow methods, this was easily implemented. The application can be opened using Google Assistant by using voice commands and then the further processes can also be performed using voice commands by using text-to-speech tools. Tensorflow had many advantages which gave it an edge over other algorithms and hence was selected for the implementation of the system.

VI CONCLUSIONS

In the proposed system, to deal with the problem of visually impaired people of recognizing notes, a solution is taken into consideration wherein by applying various image processing techniques, currency recognition is possible. The complete methodology works for 10, 20, 50, 100, 500, 1000 2000 currency notes. The method is very easy to implement. This technique is very adaptive to implement inthe real-time world. Not only does the system identify the currency denomination, but it also gives the result in the form of audio output. This project will be helpful to those people who are visually impaired.

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