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CURRENCY RECOGNITION SYSTEM USING IMAGE PROCESSING

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ABSTRACT

The project will develop an advanced system for picking up banknotes images of different countries and returning their amount in verbal indication together with a function to convert the currency expressed. Considering OpenCV and Python programming, the tool will process image input using valuable data sources like webcams and phone photos. The implementation consists of using the SIFT and ORB algorithms that are efficient for extracting key points and their contributions to overcoming currency note detection problems. Having a match, the system singularly shall determine the country and denomination of the note which will be displayed, and the speech output of the result is provided. The Proposed solution is accomplished by integrating the image processing approach, feature extraction, as well as pattern matching algorithms for the currency detection task.

1. INTRODUCTION

1.1 PROBLEM STATEMENT

It can be said that the problem of the currency recognition system is: "Automatic solution required for denomination recognition of different paper currencies." The manual inspection techniques of bygone ages come out to be not only cumbersome but also inaccurate. Based on the above premise, the present work tries to obviate these shortcomings by using computer vision techniques for the precise identification and classification of paper currency notes in an automated way. This

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system makes an efficient and reliable way that can be used instead of manual inspection, thus practicability is increased, thus opening it for use by users who might need to ascertain the denomination of various currency notes fast.

1.2 DESCRIPTION

The mission incorporates devising a system that identifies currency types and outputs denominations as speech synthesis and a conversion function. The model gets any kind of data input like images from a webcam, video streams from a phone, or simple photos uploaded to a computer for testing. Through the procedure of removing particular characteristics of the input images, the system analyzes and compares them with the existing training dataset. If a hit is established, the system finds out the denomination of the currency note by using the input image. Therefore, the final result is generated and then articulated through speaking. This implementation is done in several stages. The first attempt used OpenCV and Python3 programming. A scanner was taken to acquire the image, and preprocessing steps, like cropping, were applied to the image.

This had been used to train the model. The testing set of the images, which were taken using a phone, was utilized here. Differentiation of the corners of the found rectangle is the next task. On the other hand, this is not straightforward and the platform only runs the image through a system of clear top-down images for testing. Feature extraction as well as matching was provided through the OpenCV ORB (Oriented FAST and Rotated BRIEF) algorithm, and SIFT (Scale-Invariant Feature 2 Transform) algorithm. Given that these algorithms were used to remove the highlights and pieces of information via the training and testing photos. SIFT is used in the detection of country and after the detection of country it will move into the detected country folder then ORB is used in denomination detection.

The OpenCV Brute Force Matcher is what was used for matching. The features are passed to the k-nearest-neighbors operator, where it performs multiple comparisons to find the best match. Further, the ratios portion of the features was removed as a result, and a threshold was set for comparing several matches. If this number has surpassed the established upper limit then the largest training image that is a direct match of it is selected. Then, the denomination of the matching training image is also announced. Conclusively the program leverages the gTTS (Google Text

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to Speech) library for the vocal step. The technology in the library is used to render input strings into a form of audible speech. This Currency conversion feature includes currency exchange rate API to obtain the values of currency exchange rates that are used for currency conversion. In the arena of efforts where the development counts as a shared task, the development effort was a collaborative one. Contributions include utility functions, ORB, SIFT and voice output management, initial settings and usages, and the use of masks and image segmentation with classifiers, research of those techniques, collecting images, preprocessing, and utility functions, warping, and obtaining top view of images. GUI (Graphic User Interface) was developed using the Python library Tkinter for the users to have easier and faster interaction with the system. The project scope is on the use of OpenCV and Python3 in the sense of detecting paper currency. To execute the system run the "python3 detect.py" command.

2. LITERATURE SURVEY

The literature focuses on this project that presents research studies and methodologies used in the state-of-the-art currency recognition systems, using computer vision. Early works in banknote recognition: the process of extracting features and matching patterns was developed on a basis that rested on the development of rule-based algorithms. Heuristic was applied for the denomination of the currency and the features on them were mainly handcrafted but were also scanned for duplicate currency notes; most of the time, it worked. If not robustly, it had, for the most part, worked very well. For one, it could scale, most especially given that some variations exist in the design and quality of the currency. Some of the latest developments in the computer vision technique, which has been proposed and studied for implementation in the recognition system, have resulted in the invention of a set of feature extraction algorithms, and from that, SIFT, SURF, and ORB were proposed.

This will allow the key points and descriptors of the given currency images to be extracted, hence retaining effective identification and classification for the currency note. However, the variability in their design shows that one of the challenges in the banknote design feature recognition is in the features of banknote design that are hard, if at all, possible to develop into one universal recognition algorithm. Some of the researchers, in fact, recommend the difficult

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task with flexible and adaptive methods to address this fact, which should adopt changes in currency designs in regions. Another area of focus in currency recognition research is the detection of counterfeit notes. It designs machine learning algorithms to discriminate real currency and counterfeit currency by making a difference in texture, watermark pattern, and security features. In simpler words, these are the algorithms through which great help is given to maintain integrity in financial transactions and fraud of money is prevented.

The currency recognition system has numerous applications, including use in banks, retail, and law enforcement. The technology in currency recognition finds an application in automated teller machines, currency sorting machines, and cash handling systems to 4 make the operation easier, provide security, help for better accuracy, and assist while handling a large number of currency notes. These are actually challenges in the sense that they will have to come up with very strong algorithms that can handle the challenges or even differences that come in terms of the lighting, quality of production of the image, and even the general design of the currency. Further dissemination and development of these most highly technical methods of counterfeiting are going to continue to influence all those engaged in the activity, from researchers to practitioners. Therefore the literature survey provides invaluable insights on the evolution, methodologies, applications, and problems of currency recognition systems using computer vision. It shows that investigation and innovation that are in more demand so that the systems offer recognition in accuracy, reliability, and scalability in an economy based on digitization and globalization.

3. SYSTEM DESIGN

3.1 SYSTEM ARCHITECTURE

The lineal perception of a computer vision-based currency recognition system will be discussed. The system is made up of a complex bunch of processes that are interconnected in a very complicated manner to identify images of currency notes of a specific currency. We can observe that this is happening due to the algorithms deciding which features of the image should be isolated and then matching them against known patterns of the currencies, thus the algorithms are deciding on the denomination of the notes identified. Feature extraction acts as a first step in similar systems, which are based on the algorithm of ORB, SIFT, or

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SURF, key points, and descriptors are found in the input image. Key points are details of a piece of banknote design that differentiate it from others (edges, corners, textures, and other distinctive features of the visual image).

After the input image is taken apart for features, these features are compared to the database which includes a record of past bills through either brute-force matching or k-nearest neighbors (KNN) algorithms. These algorithms seek to identify the most plausible matches across the input features and the patterns that already exist in the database. After that, the system classifies the noted currency notes by the identified characteristics detected in the pictures. A variety of classifiers which include Support Vector Machines (SVM), Random Forests, or Neural Networks can be employed to distinguish currencies by denominations. The system produces results and feedback can be portrayed in the format of banners displayed across the screen which will present the amount recognized plus some extra and take the form of a warning message. This is also simple because the platform could be assisted with text-to-speech (TTS) technology, which allows anyone who struggles with certain sensory capabilities to hear the audio too. Training and algorithm upgrading are vital processes for the recognition system of currency, but the system is also able to upgrade its algorithm by recognizing new design currency motifs, enhancements to stay good, and checks for counterfeiting as well.

This upgradeability is the way by which the modern ATM will be able to satisfy this condition, the new notes validation will be always possible, this type would raise the level of the system's 10 error rate to almost zero. The system is the scalability and performance and, in this regard, the scalability of the system is the main factor that will determine the productivity of the system in the case a highly massive number of currency image files are provided. Optimization techniques: which include multithreading, distributed computing, and hardware

assisted acceleration out there, ensure the machine can expand in real time to hasten processing on applications. Overall, the architecture of the computer vision currency recognition according to the reliability and efficiency criteria will be considered taking into account the similarity or variance of the notes among the notes types and the effects of the image quality or weather conditions on the system.

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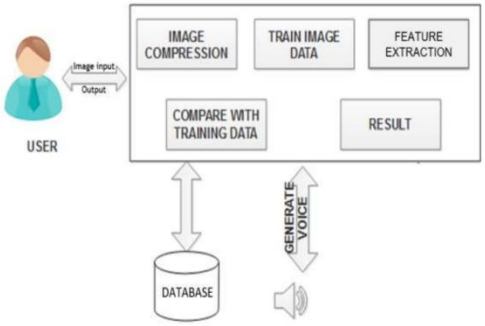

Fig 3.1 System Architecture

3.2 ACTIVITY DIAGRAM The diagram visualises operations of actions across the currency recognition system. This is how the system starts: you simply take a photo of the note and then this is the input for the system. Subsequently algorithms such as SIFT and ORB are used for image compression, feature extraction, descriptors, and finally matching. Based on the results of the analysis, the system just provides denomination and says using voiceen abled technology, denoting the result. Thus, the user gets to know about the exact amount.

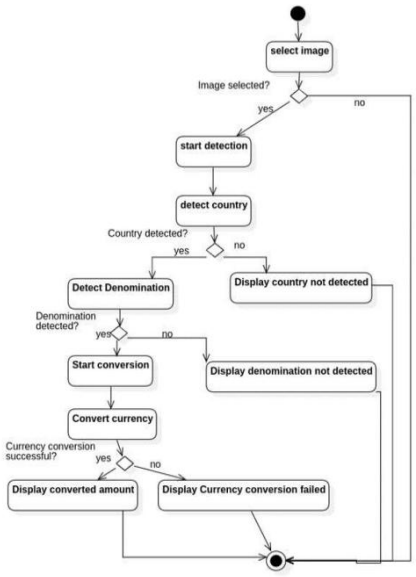

Fig 3.2 Represents Activity Diagram

4. OUTPUT SCREENS

Fig 4.1 Initial User Interface

The output screen represents the basic initial user interface shows buttons and text labels. In the above screen click on 'Open Image' button to upload the image.

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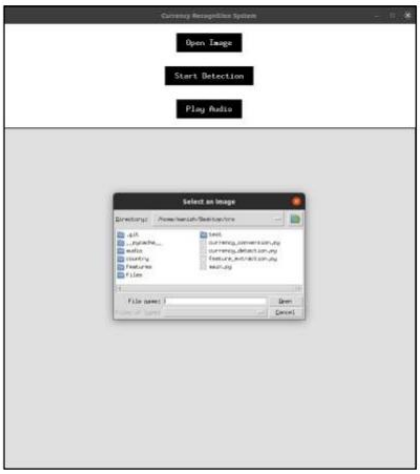

Fig 4.2 File dialog for image selection

User have to select the image file for testing from the file dialog

Fig 4.3 Image selection

Click on open after selecting the image from the files.

Fig 4.4 Selected Image Visualization

Selected image from the files is displayed on GUI. Now click on Start detection.

Fig 4.5 Output Display

After clicking detection process starts and the results (country, denomination) are displayed as text. Now click on 'Start Conversion' for currency conversion after selecting the target country from the combo box such as 'USD' for US. Click on 'Play audio' to listen the voice output of the result.

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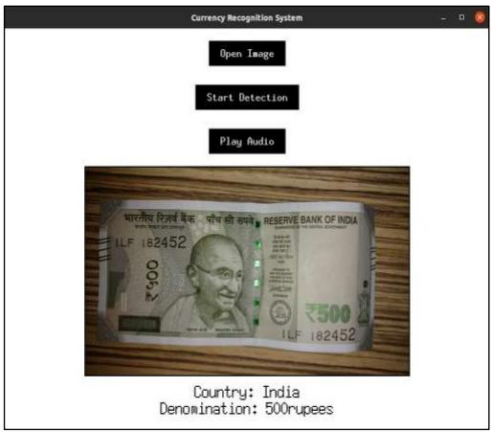

Fig 4.6 Results Display

We can see the Detected Country and Denomination are Displayed as Text.

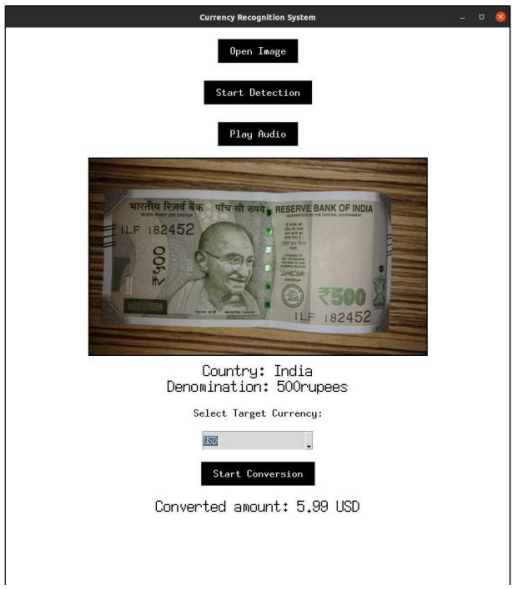

Fig 4.7 Currency Conversion

We can see the converted currency as text and we can listen to the audio of the results.

5. CONCLUSION

In Conclusion, the currency recognition system developed using OpenCV provides a reliable solution for accurate detection along with denomination identification of paper currencies of multiple countries. It identifies the main features from the images taken as input and, with computer vision and machine learning algorithms, searches for a match with its database of known currency notes to alert the user of the denomination of the banknote found in real-time. This current work thus adopted gTTS for voice output, hence making the system generally applicable to a larger scope of tasks, enhancing the system's accessibility and user engagement. On a general basis, the recognition currency system shows great promise to be the technology in computer vision-based automation of tasks that will allow for even more efficiency and reliability in putting up systems for processing currencies.

6. FUTURE ENHANCEMENTS

This is one kind of system designed using OpenCV and Python, recognizing paper currencies for the given purpose, and giving audio output indication for the denomination of the note. It contains key points detection and matching, for which it uses the ORB algorithm. Input images are matched with a database of training data to find matches and produce a speech output showing the

denomination. Future work may further result in a better user experience with improved performance, currency database expansion, better error handling, good integration with mobile, and an attractive UI. Other potential enhancements that could be made are integration with financial systems, machine learning improvements, and accessibility features along with deployment as a cloud-based solution.

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