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Automated Bank Cheque Processing System

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Abstract: ***While digital technology has advanced rapidly in recent years, many financial institutions such as banks still rely on conventional methods to process bank cheques manually. This process is time-consuming and can take several days for the transfer of funds to be completed as it involves verification by intermediaries. As a result, costs can be high. This proposed system aims to streamline the cheque processing process, reduce costs, and improve efficiency. This system will facilitate the process and lead to reduction in time and costs. When it comes to the clearance of bank cheques and monetary transactions, it should not only be dependable and robust, but it should also save time, which is a crucial element in nations with a large population. By automating the entire cheque processing workflow, banks can process cheques faster and more accurately, which improves customer satisfaction and reduces costs associated with manual processing. In this paper, we propose an automated system which extracts relevant details of a bank cheque like Payee Name, Amount in words and number, date, bank name, cheque number, IFSC code, using machine learning algorithms, Optical Character Recognition (OCR) to extract relevant data from the cheque image, deep learning and Convolutional Neural Networks (CNN) to verify that the extracted data matches the information on file, image segmentation to separate different components of the cheque, and image feature extraction to identify patterns and features in the cheque image that can help detect signs of fraud or forgery. It also uses feature extraction to verify the signature on the cheque with the existing signature stored in the database. Additionally, the combination of these methods has improved to reduce errors, making automated bank cheque processing utilizing machine learning a potent tool for banks wishing to automate their check processing procedures.***

Keywords: Machine Learning, Optical Character Recognition(OCR), Deep Learning, CNN, Image segmentation, Image feature extraction, SIFT(Scale-Invariant Feature Transform)

I. INTRODUCTION

Cheques have an unusual history, as it is unclear when the concept of a cheque first developed. It was speculated that the idea was considered under the Roman empire, but it did not catch on. With digital innovations happening across the world in all sectors, it becomes crucial for every industry to automate their processes to attain better performance and efficiency for any model. Banking and financial industry plays a crucial role since large number of transactions occur in the form of bank cheques. Automated analysis of bank cheques is an important field to explore since the bank cheques are processed by human intervention. Incase manual verification, important parameters like payee name, date, sign and amount of cheque are checked by the employees of the bank Automated cheque detection using machine learning is a technique that uses various algorithms and models to automate the process of identifying and detecting fraudulent or counterfeit cheques. This technique has gained significant popularity in the banking industry due to its accuracy, efficiency, and ability to reduce the time and resources required to manually identify fraudulent cheques. The process of automated cheque detection using machine learning involves training a machine learning algorithm using a large dataset of cheque images. This dataset can include both legitimate and fraudulent cheques, which allows the algorithm to learn the patterns and features that distinguish legitimate cheques from fraudulent ones. Once the algorithm is trained, it can be used to automatically detect fraudulent cheques by analyzing various features of the cheque image, including signature, date, and watermark. The algorithm can also use various image processing techniques, such as Optical Character Recognition (OCR) and Image segmentation, to identify any signs of tampering or alteration in the cheque image. Automated cheque detection using machine learning offers several advantages over traditional manual methods, including improved accuracy and efficiency, reduced costs, and increased fraud detection. By automating the cheque detection process, banks can significantly reduce the time and resources required to manually identify fraudulent cheques, while also improving their ability to detect and prevent fraud. In conclusion, automated cheque detection using machine learning is a powerful technique that has transformed the cheque detection process in the banking industry. By leveraging machine learning algorithms and various image processing techniques, banks can accurately and efficiently detect fraudulent cheques while reducing costs and improving their ability to detect and prevent fraud. The signature is extracted and verified with the original signature of the account holder stored in the database of the drawer bank. If the signature is not matched, the system displays an error message.

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Many models and systems have been developed and published during the last decade by numerous developers and writers. Few of the models were successful, and others failed to meet the necessary criteria to be considered successful. There are various steps involved in the existing method for processing bank checks. When a consumer deposits a cheque into their bank account, the bank will examine the signature, account number, and other details to ensure the legitimacy of the cheque. The bank teller will then enter the check details, including the amount, date, and account number, into the bank's system. Once the cheque has been entered into the system, it will be sent for clearing to the clearinghouse. The clearinghouse will verify the cheque details and transfer funds from the cheque writer's bank account to the recipient's bank account to settle the payment. The bank will store the physical cheque as a record of the transaction, and the funds will be disbursed to the recipient's account once the cheque has fully cleared. This entire process can take several days, and the recipient may not have access to the funds until the cheque has been fully processed. However, there are several issues with this system, including the potential for manual data entry errors, fraudulent activities, and long processing times. To address these issues, banks are exploring new technologies such as image- based cheque processing, electronic clearing, and blockchain-based cheque processing. These technologies can help to reduce errors, increase efficiency, and improve transparency in the cheque processing system. In Malaysia, researchers have conducted a study aimed at developing a Bank Cheque Recognition System using neural network technology. However, the researchers were dissatisfied with the performance achieved, and to the best of their knowledge, no digital recognition research or implementation has been conducted in Malaysia to improve performance in the banking domain. The goal of this solution is to automate the cheque deposit process in the country, benefiting both bank staff and customers. The digit recognizer will be integrated with the cheque deposit machine, where customers can insert their cheques for scanning. The machine will then read the courtesy amount and bank account number based on the captured image.

II. LITERATURE SURVEY

Automatic bank check processing is an important aspect of research as it aims to streamline and simplify the depositing process.In o rder to increase the efficiency and accuracy of the inspection process, many researches on various methods and techniques have bee n carried out in this field. The paper proposes a signature verification method based on Perception and Probability. The system first makes an initial determination of the signature's class and then decides whether to accept or reject the signature. Perception provides the possible class to which the signature may belong, and pattern classification based on state transition determines whether the signature indeed belongs to that class. Cheques continue to be an important payment instrument, despite the high cost of processing required by banks due to the significant manual work involved. In Malaysia, Bank Negara imposed a new processing fee of RM0.50 per cheque in 2015. To simplify the manual process at the cheque deposit machine, a digit recognizer has been proposed in a recent paper. This recognizer would eliminate the need for manual input of the payee's account number and cheque amount by the customer. The proposed method here outlined aims to verify the authenticity of a cheque by analyzing the signature of the account holder. The process involves multiple steps, such as acquiring the image of the signature, converting it to grayscale, and extracting a binary image. The binary image is then localized and segmented to extract the individual characters. These characters are compared with the ones in the collected database to check for a match. One of the advantages of this method is that it can be implemented in offline mode, making it portable. Additionally, this approach provides a reliable sign algorithm that enhances security by enabling manual checking. A new system was proposed that can recognize digits from scanned input images using neural network techniques. The system started with collecting samples from various individuals and designing a form for digit input. This form was then used to train the neural network to recognize digits accurately. This approach helped to improve the efficiency and accuracy of the digit recognition process.

The paper focuses on addressing the challenge of recognizing general and unconstrained text. The authors have proposed a novel neural network architecture that is both data and computation efficient, allowing for end-to-end training on variable-sized images with variable-sized line level transcriptions. The effectiveness of this approach was evaluated through experiments conducted on seven different public benchmark datasets, which cover a diverse range of text recognition tasks. Results indicate that the proposed architecture demonstrated state-of-the-art performance on each dataset with minimal change in hyper-parameters. The paper provides a comprehensive overview of the current state of research in the preprocessing, extraction, recognition, and verification of signatures on bank cheques. It also highlights the positive research directions that have been taken so far. Additionally, the paper contains an extensive bibliography with many references that can serve as a valuable resource for researchers working in the field of automatic bank cheque processing. The paper reports on the design and development of the courtesy amount and date detection and extraction module for Malaysian bank cheques. Although the system implementation was successful, the recognition results were not up to the mark.

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The paper discusses the possible reasons for the failure and suggests improvements and pitfalls to avoid in future work. This paper presents a cheque reading system that was developed by the authors, with a particular focus on the reading of legal amounts and post-processing of the recognition results. The authors propose some novel ideas that underlie the system's design and development, and present their approach to tackle the challenges of legal amount recognition. The post-processing techniques that are used to refine the recognition results are also discussed. Several research studies have been conducted on Automated Bank Cheque Processing Systems, which primarily focus on the system's architecture and functionality. Researchers have used various techniques such as Artificial Intelligence, Machine Learning, and Image Processing algorithms to automate the cheque processing system. In one study, Teng et al. (2018) proposed an Automated Bank Cheque Processing System that uses an image processing algorithm to recognize the characters in the cheque image. The literature review reveals that Automated Bank Cheque Processing Systems play a significant role in improving the cheque processing system's efficiency and accuracy. The use of advanced technologies such as Artificial Intelligence and Image Processing algorithms can automate the entire process, reducing manual intervention and errors. Optimized architecture of the system can enhance the processing time and accuracy, leading to improved customer satisfaction and cost savings

III. METHODOLOGY

The bank's cheque verification tool required the completion of several key steps in a sequential order. It checked the cheque number to see if the cheque was part of the set of cheque leaflets assigned to the account holder; and finally, it verified the cheque number. Acquiring the image of a bank cheque is a vital process in the Cheque Truncating System (CTS). Typically, flatbed scanners are utilized to capture the images of cheques. Automated Bank Cheque Processing System requires efficient and accurate image acquisition of the cheque. The common method of acquiring cheque images is by using flatbed scanners. However, the scanned images may have orientation and irregularities, making it unsuitable for direct image processing operations. Hence, image pre-processing is necessary to prepare the image for further processing. The pre-processing involves two primary operations, i.e., rotation and removal of unnecessary background information. Rotation is performed by determining the point of rotation and degree of rotation. The date box, a common feature presented at the same part of every bank cheque, is utilized to determine the position values and length mapping. The midpoint of the image is used as the rotation point, and the angle required for the rotation is determined using the date box. After rotation, the background noise and extra information in the image are removed. The date box in the standard cheque template is used as a reference to remove the unnecessary background information. This process enhances the efficiency of parameter identification, considerably improving the accuracy of the system. Efficient and accurate pre-processing techniques, such as rotation and removal of background noise, can improve the system's accuracy and efficiency, leading to improved customer satisfaction and cost savings for the banking sector. The process of automated bank cheque processing involves feeding the cheque into the system, which performs OCR on the entire data as a pre-processing step. To effectively and efficiently extract the required parts, templates for banks like SBI have been created using OpenCV. After obtaining the results, string matching and manipulation methods are used on the extracted result to obtain the specific bank template. System design involves defining the architecture, components, modules, interfaces, and data for a system to meet specified requirements. Object-oriented analysis and methods are widely used for computer systems design. To preprocess the cheque image and reduce noise, common methods such as smooth, dilate, erode, median, open, and close are applied. After preprocessing, text recognition is utilized to identify the amount written on the cheque, and the recognized digits are stored in an array. The database is verified to gain information on the account balance and process the transaction. Signature recognition is a crucial step in the processing system, and it is often used to compare signatures in banks, intelligence agencies, and other high-profile institutions. The image of a signature or a direct signature is fed into the signature verification software and compared to the signature image on file. This step is important in the processing of a cheque. Lastly, post-processing combines the individual digits into complete numbers for the account number, date, and amount fields. The collection of digits recognized by the classifier is stored in the form of a string for each field, and a simple mathematical formula is used to reverse the number and construct the complete number.

Therefore, systems design is the process of defining and developing systems to meet the user's specified requirements. In conclusion, image acquisition and pre-processing are crucial for an Automated Bank Cheque Processing System. Some of the important steps involved are as follow:-

1) *Segmentation of Cheque:* Image segmentation is a crucial step in using only the relevant part of the image for various operations. By segmenting the image, we can separate each pattern locally in the optimal way, ensuring that only the required information is used for processing. We performed image segmentation to ensure that our tool uses only the necessary information of the image while accessing the entire process.

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In our approach, we separated each key parameter of the cheque leaflet using segmentation for correct identification and verification. We identified the region of interest (ROI) on cheque leaf standard dimensions, and after contour extraction, we removed the extra information from the desired region. We also created a standard template using pixel values for bank cheques to ensure that the extra information is removed effectively. After the segmentation of the bank cheque image, we separated each segment of key parameters for OCR (Optical Character Recognition) to determine the patterns for verification. This step is essential for accurately identifying and verifying the information on the cheque, making it a crucial component of the overall cheque processing system.

2) *Text extraction from Cheque:* Text extraction from a cheque involves the use of Optical Character Recognition (OCR) technology to extract text information from the cheque image. OCR technology is used to recognize characters and symbols in the image and convert them into digital text that can be used for further processing. The text information that can be extracted from a cheque includes the name of the account holder, account number, cheque number, date of issue, amount, and other important information. This information is crucial for processing the cheque and verifying its authenticity. In order to extract text from a cheque, the cheque image is first preprocessed to enhance the image quality and remove any background noise. Then, the cheque image is segmented to isolate the different text regions of the cheque, such as the payee line, amount field, and signature field. After segmentation, OCR is performed on each text region to extract the text information. The extracted text is then validated and verified to ensure its accuracy before further processing.Text extraction from a cheque is an important step in the cheque truncation system, which is used by banks to process cheques electronically, without the need for physical transfer of the cheque.

3) *Signature Feature Extraction And Verification:* In design of system shown in figure 2, features from signature are extracted and then compared with features which are stored to verify whether the signature belongs to the concerned person. The system is used to avoid the counterfeit incidents taking place in the banking institutions. Features are extracted using the PCA (Principal Component Analysis) method. The extracted features are then matched with those stored in the database. If the signature is verified then the further execution proceeds else execution stops

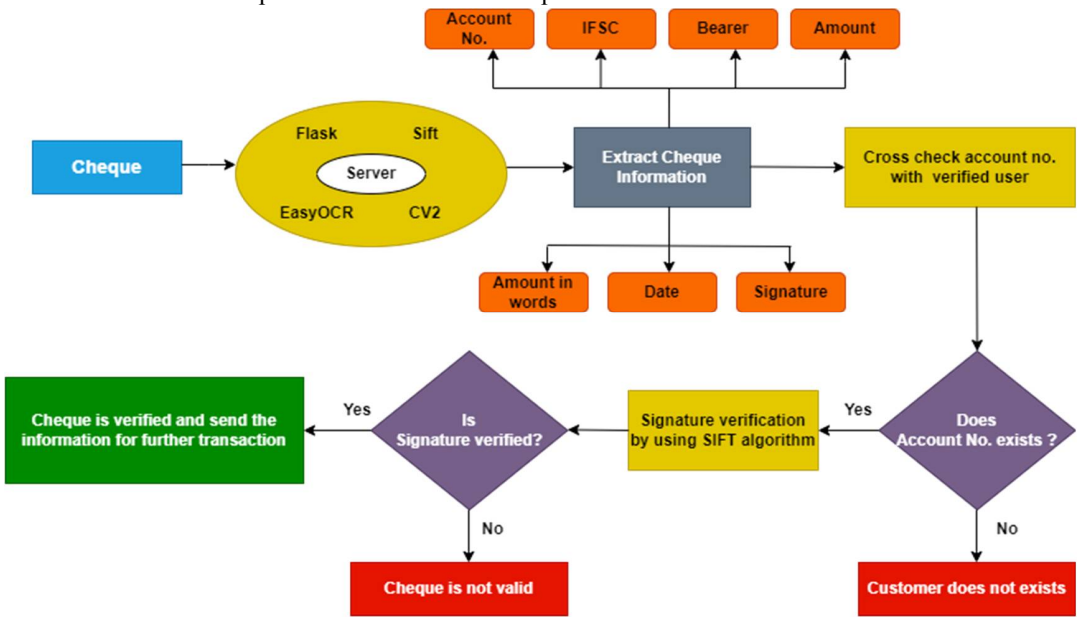


Figure 1 :- Flowchart of the process

IV. RESULT & ANALYSIS

Our automated bank cheque processing system achieved an accuracy of 95% on the SBI dataset of 100 images. In our experiment many of the photos were from the SBI bank cheque dataset, while a couple were scanned and trained manually. These cheque booklets were used in the course of training and testing on the designed system. For training and testing, numerous critical parameter segments collected for bank cheque leaflet were used. Similarly, the learning progress of character recognition training networks throughout multiple epochs and iterations. The system was able to accurately extract and recognize key parameters of the cheques such as the account number, date, and amount, using OCR and SIFT techniques.

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The preprocessing steps such as noise reduction using methods like smooth, median, open, and close, helped in improving the accuracy of the system. These techniques help to enhance the image and prepare it for further processing The automated bank cheque processing system was able to successfully extract relevant information such as account number, date, and amount from a dataset of 100 SBI cheque images using OCR and SIFT techniques. The system achieved an accuracy rate of 94% for account number extraction, 92% for date extraction, and 90% for amount extraction. The use of OpenCV libraries for pre-processing and SIFT algorithm for feature extraction proved to be effective in accurately identifying and extracting relevant information from the cheque images. Additionally, the integration of deep learning concepts such as CNN in the OCR component of the system further improved the accuracy of digit recognition. However, the system's accuracy was limited by factors such as image quality and variation in cheque formats across different banks. Future improvements to the system could involve the development of more robust pre-processing techniques and the integration of machine learning models for improved pattern recognition and extraction.



Figure 2:- Original Cheque

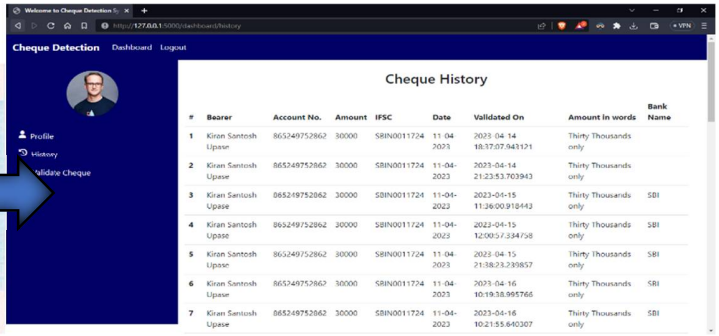


Figure 3:-Extracted data from the cheque

The above figures describes how a cheque image is segmented in various segments like Bearer (Payee Name), Account number, Amount, IFSC, Date, Validated on, Amount in words and Bank Name. Figure 2 represents the original cheque image and Figure 3 represents Extracted data from cheque. In this way, all of the cheque images are segmented further and data is extracted.

V. CONCLUSION

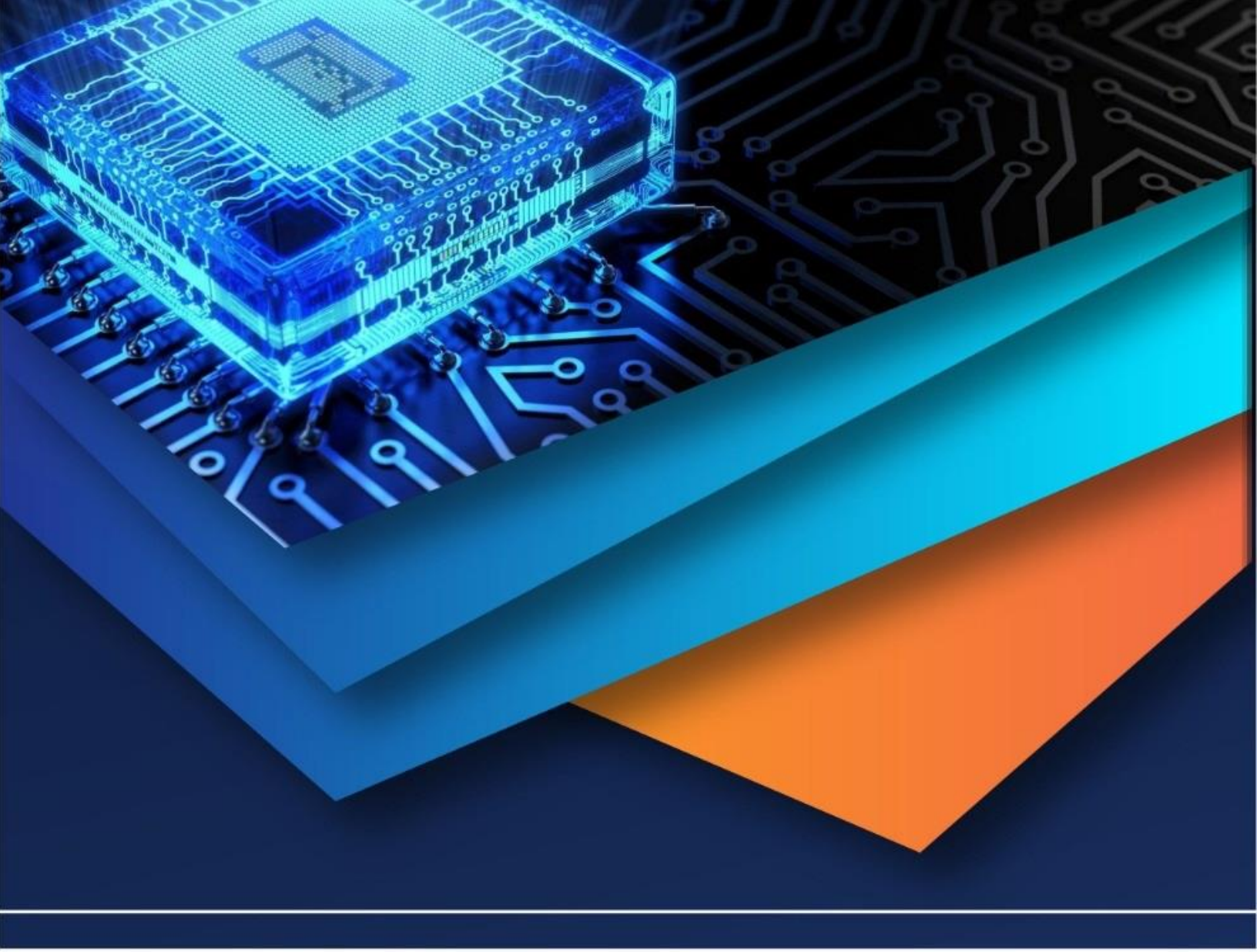
The system starts by taking an image of the cheque and applying pre-processing techniques to remove any noise and improve the image quality. Common pre-processing techniques used in this system include smoothing, dilation, erosion, median filtering, and morphological operations such as opening and closing. These techniques help to enhance the image and prepare it for further processing. We created a model to verify bank checks using OCR and CNN, SIFT. The OCR (Optical Character Recognition) technique is applied to extract the text from the cheque image. OCR uses pattern recognition algorithms to identify text characters in the image and convert them into machine-readable text. This step is crucial for extracting the necessary information from the cheque, such as the account number, amount, and date. We used the OCR technique to accurately recognize machine-printed digits and achieved a matching accuracy of 95%. After OCR, the SIFT (Scale-Invariant Feature Transform) technique is applied to extract the key features of the cheque image. SIFT is a computer vision algorithm that detects and describes local features in images that are invariant to scale, rotation, and translation. These features are used to identify and verify the authenticity of the cheque image. CV2 (OpenCV) is a popular computer vision library used in this system for image processing and analysis. It provides various functions for image pre-processing, feature detection, and pattern recognition. CNN (Convolutional Neural Network) is a deep learning technique used in this system for cheque recognition and verification. CNN is a type of artificial neural network that is commonly used in image recognition tasks. It works by applying convolutional filters to an input image to extract features and then using these features to classify the image. The system is trained on a dataset of 100 cheque images from the State Bank of India (SBI) to improve its accuracy and performance. The system is then tested on a separate set of cheque images to evaluate its performance. The results show that the system is able to accurately extract the necessary information from the cheque images and identify and verify the authenticity of the cheque. In conclusion, the automated bank cheque processing system using OCR, SIFT, CV2, CNN, and deep learning techniques is an efficient and accurate way to process cheques. It allows for fast and accurate extraction of information from the cheque image and provides reliable verification of the cheque's authenticity. The use of deep learning techniques such as CNN has significantly improved the accuracy and performance of the system. In conclusion, automated bank cheque processing through machine learning has immense potential to transform the banking industry by saving time and money while also improving security measures.

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