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SIGNATURE SCRUTINY BASED ON AI TECHNIQUES

Noor Fadel Hussain
Cyber Security,
College of Information Technology,
University of Babylon,
Iraq.
Email ID: noor.fadel@uobabylon.edu.iq

Bayadir Abbas Al-Himyari
Cyber Security,
College of Information Technology,
University of Babylon,
Iraq.
Email ID: sci.bayadir.abbas@uobabylon.edu.iq

Hiba Al-Khafaj
Software,
College of Information Technology,
University of Babylon,
Iraq.
Email ID: hibamj.alkhafaji@uobabylon.edu.iq

Safaa Sameer Mohammed
Software,
College of Information Technology,
University of Babylon,
Iraq.
Email: safaa.almarshidy@uobabylon.edu.iq

Abstract

The prevalence of fraudulent activities, especially in the banking sector, underscores the critical need for robust authentication mechanisms. In this project, we present a novel approach to signature scrutiny utilizing Image filters techniques. Leveraging the power of Python programming language, we have developed a graphical user interface (GUI) application that facilitates the uploading and comparison of signature images to detect forgeries. Our methodology begins with image preprocessing techniques such as filtering to enhance the clarity of signatures. Subsequently, we employ advanced algorithms to compare uploaded signatures with their authentic counterparts. Through feature extraction and comparison, the system effectively identifies discrepancies indicative of potential forgery attempts. The GUI provides a user-friendly platform for banking professionals to seamlessly upload signature images and receive prompt feedback regarding their authenticity. By integrating AI-driven scrutiny into banking applications, institutions can enhance their fraud detection capabilities and safeguard against unauthorized transactions. Overall, this project demonstrates the feasibility and effectiveness of employing image filters techniques for signature scrutiny in banking applications, contributing to the ongoing efforts to combat financial fraud and enhance security measures in the banking sector.

Keywords: Signature Security, AI Techniques, Image Processing, Image Filtering Techniques.

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I. INTRODUCTION

In today's world, where technology connects us in more ways than ever before, ensuring the security and integrity of financial transactions is paramount. Banks and financial institutions play a crucial role in safeguarding our money and assets, but they face constant threats from individuals seeking to exploit vulnerabilities for personal gain. One such threat is the forgery of signatures, a deceptive practice that can lead to unauthorized access to funds and fraudulent activities[1].

Signatures have long served as a primary means of authentication in banking transactions. They provide a unique identifier for individuals, confirming their consent and authorization for various financial activities such as withdrawals, deposits, and transfers. However, the traditional methods of verifying signatures, often reliant on manual inspection by banking professionals, are susceptible to human error and manipulation. As technology evolves, so too do the tactics of fraudsters, necessitating more robust and reliable mechanisms for signature scrutiny[2].

In response to these challenges, this project proposes an innovative approach to signature scrutiny in banking applications, harnessing the capabilities of histogram filter and Python programming language. The aim is to develop a sophisticated yet user-friendly system that can accurately detect forged signatures, thereby enhancing the security posture of banking institutions and mitigating the risks

The project revolves around the creation of a graphical user interface (GUI) image processing techniques , designed to streamline the process of uploading and analyzing signature images. Through a series of carefully crafted algorithms and image processing techniques, the system will be able to identify subtle discrepancies between authentic signatures and their forged counterparts. By automating this process, the application empowers banking professionals with a powerful tool for fraud detection, enabling them to quickly and efficiently identify suspicious transactions and take appropriate action[3].

This project is not merely an academic exercise; it addresses a real-world need for robust authentication mechanisms in the banking sector. By leveraging AI techniques, it seeks to enhance the efficiency and accuracy of signature scrutiny, thereby fortifying the defences against fraudulent activities. Image processing is a method to perform operations on an image to extract information from it or enhance it. Digital image processing has a broad range of applications such as image restoration, medical imaging, remote sensing, image segmentation, etc. Every process requires a different technique[4].

In the following sections, we will delve deeper into the methodologies employed in this project, exploring the various AI techniques utilized for signature analysis and the implementation details Image processing by using many filter. Additionally, we will discuss the potential implications of this technology for banking security and the

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broader landscape of financial fraud prevention. Through this project, we aim to contribute to the ongoing efforts to strengthen the resilience of banking systems and protect the interests of customers worldwide.

As part of our background research, we delve into the various image processing filters utilized in digital image manipulation. These filters play a crucial role in enhancing, transforming, and extracting relevant information from images. Here's an overview of the filters investigated:

- ✓ Blur: This filter is employed to reduce noise and smooth out details in an image, resulting in a softened appearance. It is particularly useful for removing imperfections and refining the overall quality of the image.
- ✓ Contour: The contour filter emphasizes the edges and boundaries of objects within an image, highlighting their distinct shapes and outlines. It is instrumental in edge detection and object recognition tasks.
- ✓ Detail: The detail filter enhances the fine details and textures present in an image, thereby increasing its sharpness and clarity. It is commonly used in image sharpening and texture enhancement applications.
- ✓ Edge Enhance: This filter accentuates the edges and contours of objects, making them more prominent and defined. It helps in delineating objects from their backgrounds and improving visual perception.
- ✓ Emboss: The emboss filter creates a three-dimensional effect by enhancing the perceived depth and texture of an image. It simulates the appearance of raised or sunken surfaces, adding a sense of realism to the image.
- ✓ Sharpen: As the name suggests, the sharpen filter enhances the sharpness and crispness of edges and details in an image. It effectively increases the visual clarity and definition of the image.
- ✓ Histogram: The histogram filter analyzes the distribution of pixel intensities in an image, providing valuable insights into its tonal range and contrast characteristics. It is widely used in image processing for histogram equalization and contrast enhancement.

The banking sector serves as the custodian of vast amounts of wealth and financial assets, making it an attractive target for fraudsters and cybercriminals. One of the persistent challenges faced by banks is the detection and prevention of fraudulent activities, including the forgery of signatures. Signatures, long considered a cornerstone of authentication in financial transactions, are vulnerable to exploitation due to their reliance on visual inspection and subjective judgment[5].

Traditional methods of signature scrutiny rely heavily on manual intervention, where banking professionals compare signatures on documents with those on file, looking for inconsistencies and irregularities. However, this approach is inherently flawed,

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as it is time-consuming, prone to human error, and often ineffective at detecting sophisticated forgeries. Moreover, the rise of digital banking and remote transactions has further complicated the process, requiring new strategies for remote signature verification[6].

1.1 Related Works

Image filtering techniques have the potential to significantly improve the process of signature scrutiny in banking applications [3] [4].

In the contemporary banking landscape, digital innovations have transitioned from being optional to imperative for financial institutions. This shift is driven by the need to remain competitive in a dynamic market and meet evolving customer expectations [5] [6]. Artificial intelligence (AI) stands out as a pivotal force behind these digital transformations in banking, fueling disruptive innovations across channels, services, and solutions [7].

AI's application in banking spans various domains, from front-office enhancements like voice assistants and biometrics to middle and back-office functions such as anti-fraud risk monitoring and credit underwriting with smart contracts infrastructure. The potential cost savings from AI adoption in banks are projected to reach $447 billion by 2023, with nearly 80% of US banks recognizing its benefits However, alongside opportunities, the integration of AI in banking presents multifaceted challenges. While historically, AI's focus was on automating credit processes, its capabilities have expanded to streamline internal operations and enhance customer relationship management [8].

The inception of AI traces back to 1956 when John McCarthy coined the term, describing systems that emulate human-like rationality. Over the years, AI's evolution has been marked by shifts in technological paradigms, from the aftermath of the dot com bubble to the emergence of Web 2.0 and, more recently, enterprise cognitive computing [9]. Despite the proven effectiveness of AI-based technologies, many corporate leaders lack strategic insights into its optimal utilization. Image processing has provided useful algorithms in this regard[10], and we will use a set of them mentioned in the next section.

II. PROPOSED SYSTEM

Traditional methods of signature scrutiny, reliant on manual inspection and subjective judgment, are increasingly inadequate in the face of evolving fraud tactics and the proliferation of digital banking channels. Recognizing the need for a more robust and efficient approach, our proposed system harnesses the power of artificial intelligence (AI) and image processing techniques to automate the process of signature analysis with unprecedented accuracy and reliability.

At the heart of our proposed system is a user-friendly Graphical User Interface (GUI) application, designed to streamline the process of uploading signature images and receiving prompt feedback regarding their authenticity. This intuitive interface allows

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banking professionals to interact seamlessly with the system, facilitating swift decision-making and proactive risk management.

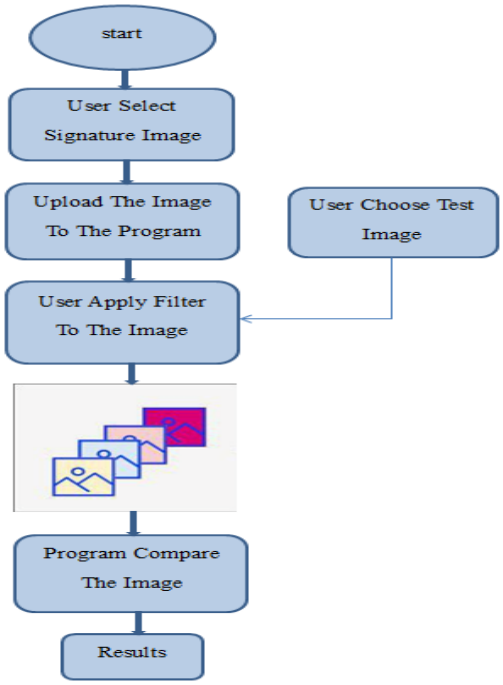

Fig 1. System Design

As shown in Fig. 1. The chart represents the flow of actions in the proposed system for signature scrutiny in banking applications. Here's an explanation of each step depicted in the chart:

1) **Start:** The process begins with the user initiating the signature scrutiny procedure.
2) **User Select Signature Image:** The user selects a signature image for analysis. This could be a scanned image of a signed document or a digital signature file.
3) **Upload the Image to the Program:** The selected signature image is uploaded to the program for further processing and analysis.
4) **User Apply Filter to the Image:** The user applies a filter to the uploaded signature image. Filters can enhance image quality, remove noise, or highlight specific features to aid in signature analysis, This include Histogram filtering.
5) **User Choose test Image:** The user selects a test image against which the uploaded signature image will be compared. This could be an authentic signature stored in the system's database or a reference signature provided by the user.
6) **Program Compare the images:** The program compares the uploaded signature image with the test image. This comparison involves extracting features from both images and analyzing similarities and differences to determine authenticity.
7) **Results:** The program generates results based on the comparison, indicating whether the uploaded signature is authentic or suspicious.
8) **End:** The process concludes, providing the user with the final assessment of the signature's authenticity.

This flowchart illustrates the sequential steps involved in the proposed system, from the initial selection of a signature image to the generation of results indicating its authenticity. By automating and streamlining the signature scrutiny process, the system aims to enhance fraud detection capabilities and improve security in banking applications.

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III. IMPLEMENTATION AND RESULT

The implementation of the image management and comparison tool has been realized using the Python programming language along with several libraries such as Tkinter for GUI development, PIL (Python Imaging Library) for image processing, and OpenCV for additional image manipulation capabilities. It is where the Graphical User Interface (GUI) is being created. Firstly, the main window is being initialized. It uses 'Tk()' which is Custom TKinter, a much more interactive extensive version of Tk(), Then the other elements are placed directly on the window created, such as labels and buttons. A label, with the text "Image Fillter" is created displayed, which also has other properties such as a background a colour, foreground colour, font and also padding.

- ✓ The load_image() function is triggered when the user clicks the "اختيار صورة" (Select Image) button. It opens a file dialog allowing the user to select an image file.
- ✓ Upon selecting an image, it is opened using PIL's Image.open() function and resized to fit within a designated area in the GUI using thumbnail().
- ✓ The loaded image is converted into a Tkinter-compatible format (ImageTk.PhotoImage) and displayed in the GUI using the configure() method of the label_image widget.

Additionally, the image undergoes various image processing filters, and the filtered versions are displayed alongside their filter names within the GUI.

Preprocessing steps applied to the original image to enhance its quality and prepare it for comparison. Various image processing techniques are utilized for this purpose, including filtering operations such as blur, contour, detail enhancement, edge enhancement, embossing, sharpening, and histogram equalization.

- ✓ The apply_filters() function is responsible for applying various image processing filters to the original image.
- ✓ A list of filter names is defined, and for each filter, the corresponding PIL ImageFilter method is applied to the original image.
- ✓ In the case of histogram equalization, the OpenCV library is utilized to perform histogram equalization on the image, and the result is converted back to a PIL Image object.

The filtered images are resized to a thumbnail size and displayed alongside their filter names in the GUI using Label widgets.

The customization of the graphical user interface (GUI) theme, offering users the flexibility to switch between different visual styles. The customization is facilitated through the ttkbootstrap library, which provides a range of pre-defined themes for styling Tkinter widgets.

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- ✓ The ttkbootstrap library is imported to enable theme customization for Tkinter widgets.
- ✓ Two theme names, DARK_THEME_NAME and LIGHT_THEME_NAME, are defined to represent dark and light themes, respectively.
- ✓ A Tkinter window (root) is created with the specified theme.
- ✓ Frames frame1 and frame2 are defined to organize the GUI elements within the window, each styled with a specific theme.
- ✓ The toggle_theme() function enables users to switch between dark and light themes. When the checkbox is selected, the dark theme is applied, and when it's deselected, the light theme is applied.

A checkbox (dark_theme_cb) is provided to allow users to toggle between dark and light themes.

The outlines the deployment process for running the project using Anaconda, ensuring that Python and the required libraries are installed and configured properly.

- ✓ Anaconda Installation: If Anaconda is not already installed on your system, download and install it from the official Anaconda website (https://www.anaconda.com/products/distribution). Follow the installation instructions provided for your operating system.
- ✓ Environment Setup: After installing Anaconda, create a new Python environment for the project. Open the Anaconda Navigator or Anaconda Prompt and create a new environment using the following command:
- ✓ conda create --name myenv python=3.10
- ✓ Activate Environment: Activate the newly created environment using the following command:

conda activate myenv

After applying filters to the signature image below are the results of the work and the proposed method to detect matching and non-matching signatures.

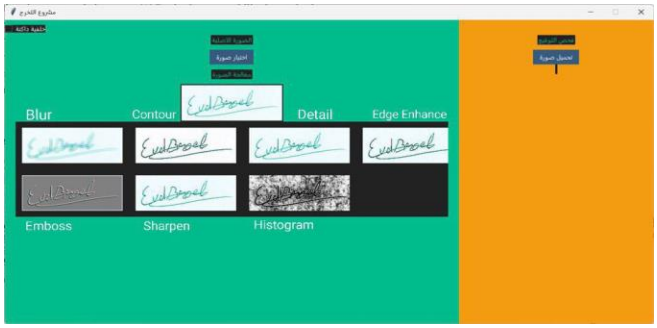

Fig 2. Upload Image to the Application

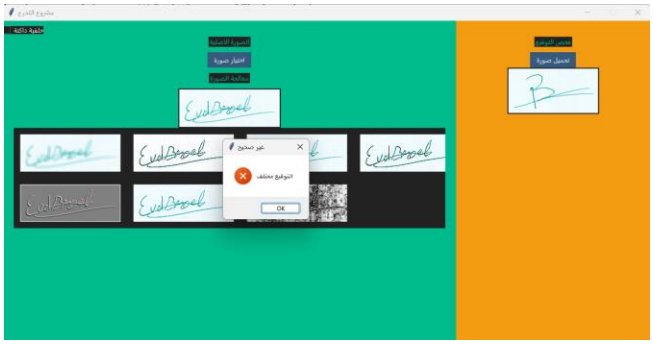

Fig 3. Check if an Image is Valid

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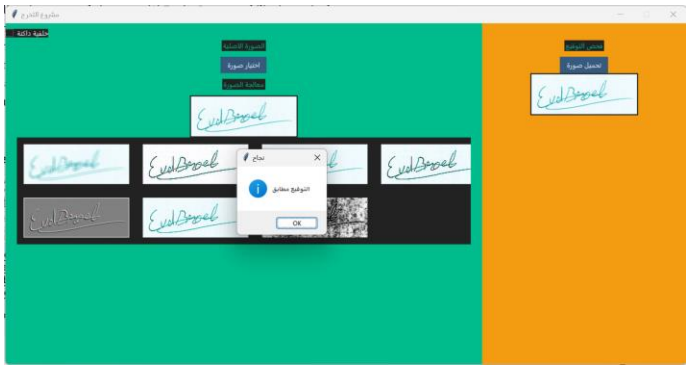

Fig 4. Another Test for Image Validity

From Figures 3 and 4 above, it is clear that the result can be given. In the case of a match, the signature will be printed as matched" **التوقيع مطابق** " , and in the case of a non-match, the non-match will be printed" **التوقيع مختلف**" .As shown in Fig. 3and 4

IV. CONCLUSIONS AND FUTURE WORK

In conclusion, the image management and comparison tool developed in this project provide a user-friendly interface for uploading, processing, and comparing images efficiently. The implementation demonstrates the successful integration of image processing algorithms with a graphical user interface using Tkinter and OpenCV libraries. histogram equalization, to enhance the quality of uploaded images and facilitate accurate comparison.

Through the course of this project, several key findings and outcomes have been observed:

- ✓ User-Friendly Interface: The GUI design prioritizes simplicity and ease of use, allowing users to intuitively navigate the application and perform image comparison tasks without unnecessary complexity.
- ✓ Image Processing Capabilities: The tool incorporates various image processing techniques, such as filtering and
- ✓ Theme Customization: The inclusion of theme customization options enhances user experience, allowing users to personalize the appearance of the application according to their preferences.
- ✓ In terms of future work, several avenues for improvement and expansion can be explored:
- ✓ Enhanced Image Analysis: Integrate advanced image analysis algorithms, such as deep learning-based approaches, to improve the accuracy and robustness of image comparison results.

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