Chapter 11
Efficient Noise Removal in Palmprint Images Using Various Filters in a Machine-Learning Approach

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ABSTRACT

A biological identification technique, palm print identification, takes advantage of the distinctive patterns on a person's palm for authentication. It falls under the broader category of biometrics, which deals with evaluating and statistically assessing each individual's distinctive personality characteristics. The efficiency of three well-known noise-removal methods the non-local mean (NLM) filter, Wiener filter, and median filter when utilized on palmprint images are examined in the present research. Peak signal-to-noise ratio (PSNR), mean squared error (MSE), and structural similarity index measure (SSIM) were used to evaluate the performance. The objective is to identify the best technique for reducing noise in palmprint photos without compromising important details. NLM filter beat the Wiener and Median filters by producing an MSE of 0.000143, PSNR of 41.79, and SSIM of 0.998, respectively and also the tool used for executing Jupyter Notebook and the language used is Python. Regarding the various types of noises frequently present in palmprint photos, the NLM filter demonstrated superior noise reduction abilities. The NLM filter successfully improved image quality while maintaining the images' structure.

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INTRODUCTION

Palm recognition, also known as palm print recognition or palmar biometrics, is a cutting-edge technology that leverages the unique features of an individual's palm to authenticate their identity. Unlike other biometric methods, such as fingerprints or iris scans, palm recognition focuses on the distinctive patterns and characteristics of the palm (Angeline et al., 2023). The human palm is an intricate canvas of ridges, lines, and creases, forming a pattern that is highly unique to each individual (Rajest et al., 2023a). This uniqueness makes palm recognition a reliable and secure biometric authentication method. The technology employs advanced image processing techniques to capture and analyze the palm's features, creating a distinct digital representation known as a palm print. One key advantage of palm recognition is its non-intrusive nature (Bose et al., 2023). Unlike fingerprinting, which may involve physical contact with a sensor, palm recognition can be accomplished without direct contact (Marar et al., 2023). This touchless feature enhances user convenience and reduces hygiene concerns, making it an appealing choice for various applications (Irfan & Sugirtha Rajini, 2014).

Palm recognition systems typically consist of a high-resolution camera or sensor that captures an image of the user's palm (Nallathambi et al., 2022). The captured image is then processed using sophisticated algorithms to extract key features and generate a unique template. This template is securely stored in a database for future comparison during authentication (Obaid et al., 2023). Palm recognition technology deployment spans various sectors, including security, finance, healthcare, and access control (Ogunmola et al., 2022). In security applications, palm recognition can be integrated into physical access control systems, ensuring that only authorized individuals gain entry to secured areas (Rajest et al., 2023b). Financial institutions can use palm recognition to enhance the security of transactions and protect sensitive information (Saleh et al., 2022).

Healthcare facilities can also benefit from palm recognition for patient identification, ensuring accurate and secure access to medical records. Additionally, the touchless nature of palm recognition makes it an ideal choice in environments where hygiene is a priority, such as hospitals (Regin et al., 2023a). The technology's potential extends beyond traditional applications, finding use in innovative areas like smart homes and mobile devices. Palm recognition can be integrated into smart home systems to enhance user authentication for unlocking doors, controlling smart devices, and ensuring the security of personal spaces (Regin et al., 2023b).

Despite its many advantages, challenges exist in the widespread adoption of palm recognition technology. Privacy concerns, data security, and the potential for false positives or negatives are among the considerations that must be addressed to ensure public acceptance and regulatory compliance. Palm recognition stands at the forefront of biometric technologies, offering a secure and convenient method for authenticating individuals based on the unique features of their palms (Sengupta et al., 2023). As advancements continue, the application of palm recognition will expand further, contributing to a future where secure and touchless authentication becomes an integral part of our daily lives (Regin et al., 2023c).

Image processing is pivotal in palm recognition, a sophisticated biometric technology that relies on capturing, analyzing, and interpreting the distinctive features of an individual's palm (Yuvarasu et al., 2023). As a subset of computer vision, image processing in palm recognition involves manipulating and enhancing palm images to extract valuable information for authentication purposes (Sharma & Tripathi, 2020). At the core of palm recognition is the acquisition of high-resolution palm images. These images are typically captured using specialized cameras or sensors capable of capturing detailed information about the unique patterns, ridges, and creases on the surface of the palm (Sharma et al., 2021a). Once