CHAPTER 4

ENHANCING IRIS RECOGNITION IN LESS COOPERATIVE ENVIRONMENTS

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4.1 INTRODUCTION

An emerging technique that has recently gained significant attention is biometric identification. It identifies individuals by utilising behavioural or physiological traits. The iris, fingerprint, face, and hand geometries are examples of physiological traits, whereas behavioural traits include voice, signature, and keystroke dynamics. The iris provides separate phase information that covers around 249 degrees of freedom among these features. Biometric technologies differ in terms of complexity, capabilities, usability, and performance. Iris detection is among the most widely used biometrics for verifying individual identity.

Three phases of an iris recognition system are image pre-processing, feature extraction, and template matching. It is necessary to first process the iris image to acquire a functional iris area. In iris image processing, there are three steps: Iris localisation, iris normalisation, and picture enhancement. Iris localisation identifies the inner and outer margins of the iris. Detected eyelids or eyelashes might cover the iris region.

After normalisation, the iris image is a rectangular image with angular and radial resolution. The light source's placement is partly to

blame for the iris image's weak contrast and uneven illumination. All these problems can be addressed by the algorithms for image enhancement. Utilising texture analysis, characteristics are extracted from the normalised iris image. Key properties of the iris are retrieved for accurate identification reasons. Template matching compares the user template to templates from the database using a matching measure. The similarity between two iris templates will be determined by the matching measure. It offers a range of values when contrasting templates from the same iris to one another, and it offers a range of values when contrasting templates from another iris.

Among the various limitations of conventional iris recognition regarding user involvement and imaging conditions, degraded iris images pose a significant challenge. It includes issues like off angle, lighting, pupil dilation, half-open eyes, or specular reflection, gaze reflection, and gaze direction that led to incorrect localisation of the iris's inner and outer boundaries. These limitations also increase the likelihood of losing key features from the iris image, resulting in models failing to extract discriminative features from the data.

Furthermore, degraded image quality can make it difficult to distinguish between identical iris images, thereby maximising intra-class variation. To address this vulnerability, we propose a new and effective method of deep learning using the U-Net model.

The main goal of iris recognition in a less cooperative environment using the CASIA-Iris-Degradation-Database. Currently there are not many research papers using this dataset. This dataset is new, especially containing the usual degraded images. This chapter provides a solution to a biometric security system by using iris recognition in a less cooperative environment. To get the exact result, U-Net, a popular architecture used for image segmentation tasks, is used.

4.2 UNDERSTANDING THE BASICS

Iris recognition is a biometric method that uses the unique, stable patterns in the iris for reliable identification. While cooperative systems

require subjects to align with the sensor, modern approaches can also operate in non-cooperative and at-a-distance scenarios, enabling greater flexibility under less cooperative environments.

4.2.1 Overview

Non-cooperative iris recognition has gained a lot of attention recently since it considerably expands the use cases for iris recognition. The user takes a very passive role in the image capture procedure in non-cooperative iris recognition. We discovered during the research process that effective and efficient segmentation to reduce noise in images is one of the major obstacles to a functioning non-cooperative iris recognition system. Iris segmentation is a crucial component of iris recognition because it establishes the acceptable area for feature extraction, which is connected to recognition accuracy.

The model consists of four key modules: coarse iris localisation based on clustering, localisation of the pupillary and limbic boundaries, eyelid localisation, and eyelash or shadow detection. Figure 4.1 illustrates the process of iris segmentation.

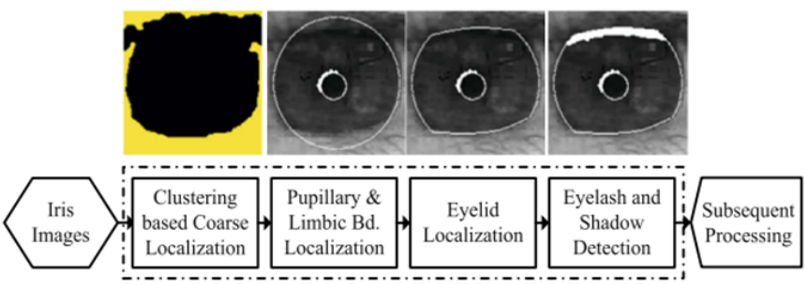

Figure 4.1 The flowchart for the proposed iris segmentation method

Iris identification from a distance is significant biometrics topic with substantial potential for a variety of practical applications. Iris acquisition at a distance (IAAD) systems have made notable advancements, including extending the operational distance from a few metres to tens of metres, expending the depth of field (DoF) through methods such as wavefront