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Neural Network Approach to Iris Recognition in Noisy Environment

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Abstract

Iris recognition is a challenging problem in the noisy environment. Our primary focus is to develop the reliable iris recognition system that can work in a noisy imaging environment and to increase the iris recognition rate on CASIA and MMUiris datasets. This research paper proposes two algorithms, first, a novel method for removing noise from the iris image and second, a texture feature extraction method using a combined approach of Local Binary Pattern (LBP) and Gray Level Co-occurrence Matrix (GLCM). Our proposed approach give highest recognition rate of 96.5% and low error rate and requires less execution time.

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Keywords: Noisy environment, Noisy Artifacts, Occlusion, Local Binary Pattern, Iris Recognition, Neural Networks

1. Introduction

In the modern society, most advanced security system uses biometric all over the world[1] and are used in many places such as corporate offices, criminal investigation, identification, border control, security zones, airports, hospitals, banks, autonomous and non-autonomous institutions, etc. Nowadays biometric based systems are in widespread use and it plays a vital role in human identification. Among all different biometric traits iris is a most reliable and unique organ[2]. It is well protected from environmental and physical damage by the eyelid and the eyelashes[3]. In comparison with other biometric traits, iris features are more discriminating due to non-uniform texture available in iris[4] but at the same time iris recognition process is quite complex. Hence it is divided into four different steps, i.e. 1) Iris image acquisition 2) Preprocessing 3) Texture feature extraction and 4) Classification[3]. Efficiency of iris recognition system is fully determined by correct preprocessing and feature extraction technique[5]. Existing algorithms works

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well but still there is a scope of improvement in performance of existing preprocessing and feature extraction algorithms[6]. A Major issue arises due to the presence of various artifacts, while capturing iris images. These artifacts are present in existing public databases in literature [7, 8, 9] as shown in Fig 1. Due to these artifacts the most well-known challenges faced is the iris segmentation. For example, occlusions by eyelids are caused by biological characteristics of the eye. In such cases,the boundary of the eye is not circular in shape and boundaries around the pupil and iris region is difficult to identify as shown in Fig 1 (a). Similarly occlusion by eyelashes plays the important role to determine the quality of an iris image. This also affects the iris boundary detection process. The occlusion with eyelash presence in iris image is depicted in Fig 1 (b). Segmentation accuracy is also affected by the high-intensity pixels present in pupil region in iris images, characterized as specular reflections as shown in Fig 1(c). This occurs due to improper focus of light source. Iris images may have artifacts due to motion blurriness, such as shown in Fig 1(d). The off-angled iris images artifacts is caused, when angle of orientation of sensor used for acquiring iris is improper as depicted in Fig 1(e). In such non-ideal situation the length of iris is reduced and the boundary detection becomes tedious. The large standoff distance also affect quality of iris image. It refers to the distance between the camera and subject. The pixel resolution is depend upon the distance. The number of pixel is less in acquired image, if the distance is large. In such situations, the texture information is not captured accurately as shown Fig 1(f).The more noise may be added in the acquired iris images due to presence of contact lens on the pupil region as shown in Fig 1(g). Similarly, less information is captured due to poor illumination. In such situation texture features extraction process becomes difficult and due to which recognition rate is reduced. Fig 1(h) shows the image with poor illumination. The reflection component present due to eye glasses, while capturing an iris image is also considered as noise as shown in Fig 1(i).

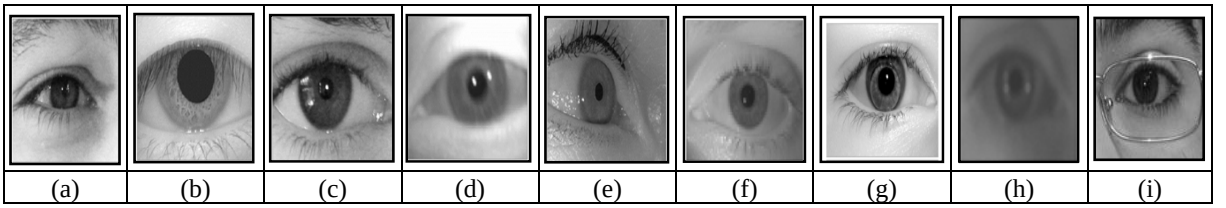

Fig. 1. (a) Occlusion by eyelids, (b) Occlusion by eyelashes (c) Specular reflections (d) Motion blur (e) Off-angle (f) large standoff distance captured iris images (g) Contact lenses (h) Poor illumination (i) Person with spec.

In such non-ideal situation the length of iris is reduced and the boundary detection becomes tedious. The large standoff distance also affect quality of iris image. It refers to the distance between the camera and subject. The pixel resolution is depend upon the distance. The number of pixel is less in acquired image, if the distance is large. In such situations, the texture information is not captured accurately as shown Fig 1(f).The more noise may be added in the acquired iris images due to presence of contact lens on the pupil region as shown in Fig 1(g). Similarly, less information is captured due to poor illumination. In such situation texture features extraction process becomes difficult and due to which recognition rate is reduced. Fig 1(h) shows the image with poor illumination. The reflection component present due to eye glasses, while capturing iris image is also considered as noise as shown in Fig 1(i).Apart from these artifacts, there are other factors like faked iris images, camera diffusion, head rotation, camera angle, reflection and contrast which may also cause improper segmentation of iris and ultimately degrades the performance of recognition[10]. Amongst all these challenges, we have addressed reflection issue in this paper, which is always present while capturing iris image. The preprocessing algorithm proposed in this work is having the capability to remove the reflection, which results in better recognition. The remainder of this research paper is described as follows: Section 2 describes proposed system architecture of iris recognition in noisy environment. Section 3 describes the noise detection and removal algorithm along with iris pre-processing. Section 4 describes texture feature extraction algorithm. Section 5 discuss about neural network classifiers. Simulation results are presented in section 6 along with the comparison of the proposed approach with existing iris recognition system available in literature. Finally, Section 7 concludes this research paper.