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Iris Recognition Using Multi-Algorithmic Approaches for Cognitive Internet of things (CIoT) Framework

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HIGHLIGHTS

- Iris recognition by multi-algorithmic approach for cognitive Internet of Things is introduced.
- A new segmentation scheme to localize iris is proposed.
- Two efficient feature extraction approaches to extract iris feature vectors are proposed.
- Parallelism concept applied over IoT authentication server in order to fuse features.
- The proposed iris verification is promising for real-time applications.

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ABSTRACT

The recent widespread development of connected sensors, cloud, big data analytics, and ubiquitous sensing technologies have facilitated cognitive Internet of things (CIoT) and its emerging applications. Although CIoT has a great potential to affect human life, scholars have not explored how biometric technologies (e.g., iris) can contribute toward the success of CIoT-oriented framework, where iris-based biometric recognition is used for verification or authentication. One of the trade-offs of biometric recognition designs is to choose a unimodal- or multimodal-based structure. In this study, an iris-based recognition technology was developed as a unimodal biometric with the aid of multi-biometric scenarios. In the segmentation phase, a new algorithm based on masking technique to localize iris was proposed. Two new algorithms, namely, delta-mean and multi-algorithm-mean, were developed to extract iris feature vectors. The proposed system was evaluated on CASIA v. 1, CASIA v. 4-Interval, UBIRIS v. 1, and SDUMLA-HMT. Results show the satisfactory performance of the proposed solution for authentication issues.

1. Introduction

In today's digital age, a huge number of devices and sensors have been connected in cognitive Internet of things (CIoT) [1,2]. Connected CIoT devices and sensors produce a considerable amount of data. However, the huge amount of data produced in connected IoT devices is vulnerable to security and authentication threats. Thus, security and authentication challenges need to be resolved by adopting a proactive approach in verification and detection processes. CIoT has the potential to analyze connected data to facilitate constant security without compromising connected devices or sensors [3]. However, traditional verification and authentication methods based on passwords may not be as effective as biometric-based authentication [4] because biometrics utilize user's cognitive characteristics based on iris, face, fingerprint, and voice to recognize an individual.

CIoT adds a "brain" to IoT. This useful practical paradigm gives the ability to deal with the social and physical worlds without input from anyone else. Objects or things are interconnected and carried

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on as agents with the least human intercession [5]. Cognitive systems gain information from their encounters and consequently improve their performance when performing repeated assignments. Through data mining and pattern recognition, cognitive computing is quickly advancing toward creating innovation to help answer complex inquiries. From a scientific and technological viewpoint, more imperative number is identified with the measure of information that the IoT creates and stores. IoT information has turned into the biggest kind of information on the Internet. This finding implies that information that is not broken down continuously or not long after it is produced is never taken a gander at. In this unique situation, scholars should focus on the need to advance along the data, information, knowledge, and wisdom (DIKW) way to promote a smart handling of IoT information [6]. Cooperation between cognitive systems and related smart sensors through the IoT leads to information sharing and real-time updates. This optimal communication strategy enhances decision making supported through data analytics [7,8].

Government organizations that need high security at critical access points search for a robust biometric system with high performance metrics. Unimodal recognition systems have to contend with various problems, such as those presented in [9]. The problems mentioned lead to high false rejection rate (FRR) and false acceptance rate (FAR). Noises in the iris (like reflections and occlusions) lead to FRR. Multi-biometrics have addressed some issues related to unimodal systems like those presented in [10]. Multi-biometrics facilitate the filtering or indexing of large-scale biometric databases. Moreover, it is limited for some majors in all scenarios and is expensive and complicated due to the requirement of additional hardware and classification algorithms.

The main research problem focuses on some points. Iris occlusion and localization considerations are some of the major factors that affect the quality of an iris image and iris template generation. In general, building an overall iris recognition system – as an authentication solution – is complex, computationally exhaustive and time consuming, and the system has moderate accuracy. To address such problems, this study presents and implements new algorithms to gain a robust and accurate system. In addition, to overcome some of the unimodal limitations, the multi-biometric scenarios were suggested as a principal of the solution. Multimodal fusion systems are expensive and complicated, especially in large population coverage. Therefore, this scheme is out of our architecture. The proposed method uses iris as unimodal biometrics with the aid of multi-biometric scenarios and not the multimodal scheme.

The proposed solution aims to localize the iris region free of artifacts (Fig. 1-a) without changing its structure. The solution modifies the masking technique (MT) proposed in [11]. In feature extractor, multi-algorithm encoder – with less features as possible – depends on the fusion between statistical and texture features. The overall system was tested in verification mode by using four famous benchmark datasets for most capturing conditions and different resolutions, namely, CASIA v.1, CASIA v.4-Interval, SDUMLA-HMT, and UBIRIS v.1. The samples of the systems are shown in Fig. 1(b–e). This \research aims to investigate the new algorithms in image pre-processing and feature extraction stages.

The rest of this paper is organized as follows: previous published works related to iris recognition are described in Section 2. The proposed method is explained and discussed in Section 3. The performance evaluation, results with related comparisons, and discussion are discussed in Section 4. Finally, the conclusions of the research work presented in this study are concluded in Section 5.

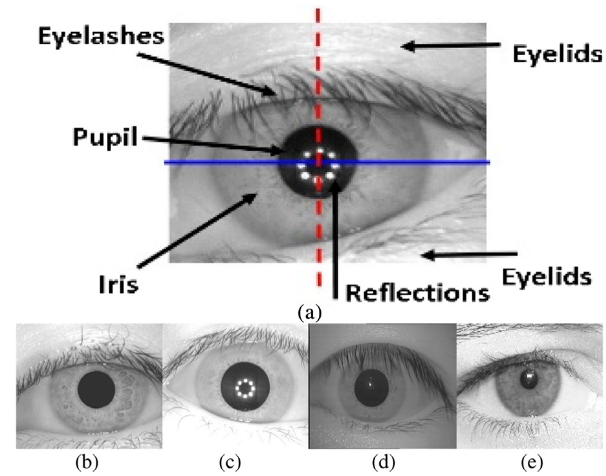

Fig. 1. Eye structure and samples from used datasets. (a) Iris image artifacts. (b) CASIA v.1 (c) CASIA v.4 -Interval subset (d) SDUMLA-HMT (e) UBIRIS v.1.

2. Related work

Current advances in 5G empower high system limit and are capable of access capacity, giving customized, human-driven, canny emotion-aware administrations [12]. The application of edge computing over connected sensors and devices of the IoT enhances healthcare quality. In addition, data analytics and IoT mechanisms have authorized the connected services for a healthful life. The big data-oriented framework empowered by 5G enhances the quality of healthcare on-demand services. However, the challenges of emotional cares are still not considered [13]. Nonetheless, numerous troubles and difficulties can beat the expansive scale arrangement of 5G cognitive system (5G-Csys) for social and healthcare; such difficulties include security of delicate information of clients and protection issues. These extensive plan insufficiencies are caused by the imbalanced dissemination of medical resources [6]. The authentication and authorization processes of any image are broken when the components of the images are collected to deliver either a splicing forgery or a copy-move forgery. The integration of CIoT and cyberphysical system (CPS) may greatly refine the quality of life of individuals [14].

The cognitive healthcare IoT (CHIoT) is a developing application field identified with people's health. The healthcare IoT has turned into an exploration hotspot, and the hypotheses and innovations in this viewpoint are at the advanced stage but are still not completely developed [15]. The healthcare IoT conveys sensors inside the patient body, on the surface, or around it to understand the discovery on exercises of the human physiological signs. Moreover, it provides a detailed design for CHIoT assisted by 5G [16]. An example of new applications of consumer cognitive systems is Microsoft Kinect platform for smart CE-dependent cognitive systems. The Kinect sensors present a human-behavior cognition technology for gesture and activity recognition. Chen et al. [17] propose a speech emotion recognition subordinate model stage for human service framework in view of a 5G-Csys, which comprises an asset intellectual motor and an information psychological motor. In addition, the need to plan an integrated improvement API for the framework should consider the end goal to encourage the foundation of uses and enhance calculation precision with decreased time unpredictability for the intelligent algorithm that the information intellectual motor presently uses.

The healthcare system proposed in [3] used a robust emotion detection module. The input to this module was captured by different IoT devices, such as speech and/or image signals. A patient