Chapter 3
Indexing for Healthcare Biometric Databases

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ABSTRACT

The healthcare industry offers highly personalized services to its patients. It is necessary to correctly identify the patient and efficiently link his medical records as and when needed. It is important to note that the need of identification arises in many desperate scenarios when the patient may not be able to tell anything about himself. Biometrics can help in this scenario by using physiological or behavioral characteristics. Some of the biometrics traits could be acquired without direct participation of the person, and therefore, the patient need not provide any pin, password, or token for his identification. Biometrics can handle challenges of duplicate medical records and identity theft. However, there is an important issue that may arise when a large number of patients get registered to the system. Increase in the size of the biometric database gradually escalates the time required for identification. This calls for the need of an efficient indexing approach that can confine the search space and decrease the response time. This chapter highlights biometric indexing approaches suitable for the healthcare industry.

INTRODUCTION

With the availability of large volume of data originating from low-cost sensors, it is now possible to offer useful and personalized services to users. Healthcare can greatly be benefited by this as it offers highly personalized and specific services its patients. The healthcare industry comprises of the companies that offer medical services, develop pharmaceuticals, manufacture medical equipment, and offer medical insurance to its clients. There exist many challenges in healthcare industry that are in terms of existence of

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duplicate medical records and identity theft (Mogli, 2012). Also, with an accelerated growth in patients' data, this industry has been experiencing many faults due to mixing up of patients' data, confusion of medical charts among different patients and many more. This sometimes results in serious flaws such as giving medication to a wrong patient. In order to improve the quality of patient care, the healthcare industry has been migrating towards the digitization of health records, popularly known as Electronic Health Records (EHR) (Hoerbst & Ammenwerth, 2010). EHR comprises of a person's multiple electronic medical records which are generated by the physicians. It also contains personal health records generated by the patient himself (Ambinder, 2005). With this advancement, all the information related to a patient can easily be accessed at any place and at any point of time. It has also resulted in elimination of medical errors caused due to wrongly entered or redundant paperwork. With the presence of EHRs, physicians can easily trace a patient's complete medical history and the patient can enjoy higher quality of care. Patients also have an advantage in terms of less needed maintenance of medical charts and records.

An efficient healthcare system needs to deliver the right information to the right stack holder (such as patient or doctor) which in term depends on various factors such as accuracy of the records, their update state, data consistency *etc.* With everything going digital these days, security of a patient's information has become an important challenge in healthcare. Data privacy is a major concern. To address the issue, it is needed to restrict the access of patients' information only to the authorized persons. Authentication is the first step in access control, which is depends on accurately recognizing genuine users of the system. Traditional modes of authentication involve the use of the personal identification number (PIN), passwords, access cards, tokens *etc.* all these methods suffers with the loss or leakage of information. Biometrics offer better authentication mechanism by using physiological and/or biological characteristics of the user. Physiological characteristics involve the use of physical measurements of the body such as fingerprint, knuckle, ear, iris, palmprint, hand geometry *etc.* Behavioral characteristics refer to certain behavior associated with a person in performing specific task such as, voice pitch, signature, gait, keystroke, typing style *etc.* It has been established that biometrics should be preferred over the traditional methods for authentication as it overcomes various shortcomings of the later mode of authentication (Maltoni, Maio, Jain, & Prabhakar, 2009). Biometric is hard to spoof or forge and it is always available with the user. There is no need to explicitly carry/memorize it. Sometime biometrics could even be acquired covertly without the direct involvement of the user. Biometric authentication has widely been used in various areas such as financial sector, government sector, military establishments *etc.* for higher security.

A biometric system can operate in two modes *viz.*, enrollment and authentication. In enrollment mode, a new user is registered with the system and his/her biometric samples are stored in the database along with a unique identifier. The stored biometric sample is also known as a biometric template of the user. Biometric pertains highly binding information of the user. Since it is not possible for the user to change his biometric trait therefore the responsibility to protect template from malicious use and to maintain the privacy of user lies with the system itself. For authentication, a newly acquired biometric sample is presented to the system as input query. The system has to find another biometric template from the stored templates that matches the most with the query sample. The authentication can further be subdivided into verification and identification based on the type of applications biometric security is applied to. In verification, user provides his identity to the system along with the query sample and the system has to verify if the query sample matches the claimed identity. While, in case of identification, the system matches the query sample with all the templates stored in the database to establish its identity (Tiwari, & Gupta, 2015). Identification is the most needed application in the healthcare industry because the

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