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BIOMETRIC SCANNER USING COMPRESSED SENSING

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Abstract

In today's world which is dominated and prevailed by millions of embedded systems lot of data is produced. Back in 2007 we reached a saturation point where the amount of data produced by these devices and sensors is more than the total available storage in this planet. This leads to the question about the necessity of these data. Also it was observed that the total number of embedded devices was more than the total human population. Hence a necessity to scrutinize the total volume of data produced without actually losing them. In order to overcome this issue of excess data, compressed sensing was proposed. In this method, the concept of compressed sensing in biometric scanners is used in order to reduce the amount of data extracted by the biometric scanner without losing the essential information. The compressed sensing is used to minimize the number of samples that the biometric scanner takes in order to do its work. By reducing the number of samples we can reduce the amount of processing required, time, space required for storage. The compressed sensing initially store less amount of the data in the corresponding data base, thereby reducing the resources required. In order to retrieve the compressed signal, standard L1 algorithm in a slightly modified manner in order to use it to suit the need of image processing.

Keywords: Biometric scanner, Compressed sensing, Samples, L1 algorithm

1.0 INTRODUCTION

A Biometric device is a security identification and authentication device. These devices use automated methods recognizing the identity of an individual based on a physiological or behavioral trait of the individual. These characteristics include fingerprints, facial images, Iris prints and voice recognition. Biometric devices can be broadly classified as non-automated biometric device and automated biometric device. Biometric devices have been used by man over a long period of time. Non-automated biometric devices have been used since 500 BC. Automation in Biometric devices was first seen in the 1960s. The FBI in the 1960s, introduced the Indent mat, which started checking for fingerprints to maintain criminal records. The first systems measured the shape of the hand and the length of the fingers. Although discontinued in the 1980s, this system set a precedent for future Biometric Devices. These biometric devices use the physical characteristics of the individuals to provide the individuals access to resources and information. These commonly used characteristics can be sub divided into various groups as follows:
Chemical biometric devices: Analyses the segments of the DNA to grant access to the users.

Visual biometric devices: Analyses the visual features of the humans to grant access which includes IRIS recognition, Face recognition, Finger recognition and Retina Recognition.
Behavioral biometric devices: Analyses the Walking Ability and Signatures (velocity of sign, width of sign, pressure of sign) distinct to every human.
Olfactory biometric devices: Analyses the odour to distinguish between varied users.
Auditory biometric devices: Analyses the voice to determine the identity of a speaker for accessing control.

Some previous work were investigated which were not much connected in the sense all papers explained about compressed sensing and recovery algorithms separately. For example, reference [1] this paper was about the use of L1 norm minimization and its utilization in obtaining the sparsest signal or vector that turns out to be the solution of the given system of underdetermined linear equations. Reference [2] discussed about the idea of using compressed sensing in biometric scanners in order to reduce the data that the scanner acquires from the finger prints in order to do the further processing. Reference [3] discussed the basics of compressed sensing and the basic mathematics involved in compressed sensing. Also, Reference [4] discusses about the approximation of L1 norm as equal to L0 norm of a given n-dimensional vector.

The existing systems consist of three main blocks namely the analog to digital converter block, the compressor block and the de-compressor block, which process the image from the server and gives the output. Because of the nature of sampling in the current devices in use it is inherently difficult to sample some of the naturally occurring signals. For example the acoustic signal produced by bats has very high frequency components that they need to be sampled at extremely high frequencies, in accordance with the sampling theorem. Also in conventional digitalization process we sample the signal at a higher rate, quantize it and then compress the signal to remove the unnecessary components of the sampled sequence. This is a big disadvantage to first sample, quantize and then to compress since we are unnecessarily processing unnecessary data. This is one of the major flaws of the conventional system of quantizing

2.0 PROPOSED METHOD

This system gives the general flow of operation of the biometric scanner based on compressed sensing and the interconnection of major components and their placement. There are two modes of operations of this system, initially the fingers of the employees are scanned once for storing the information in the server or a database. The second operation involves the process of authenticating the finger print whenever an individual uses the scanner.

The scanner module is designed in such a way that each new user is given a unique code that can be used to change the data that is already stored in the server. This makes the scanner based on compressed sensing an extra edge over the existing ones and it also makes the process of altering the existing data simpler. This system initially compares the data stored in the CS database or the server with the scanned data to get see if there is a match. Then after the successful completion of this the unique id is checked to get all the necessary details about the user.

Block diagram

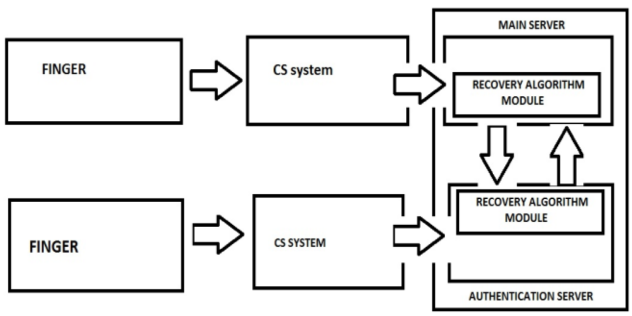

Fig.1 Block Diagram

3.0 Simulation Results

Fig.2 Sample input finger print

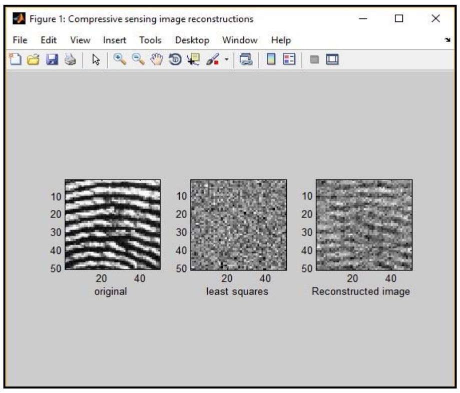

Fig.3 Output with 250 samples

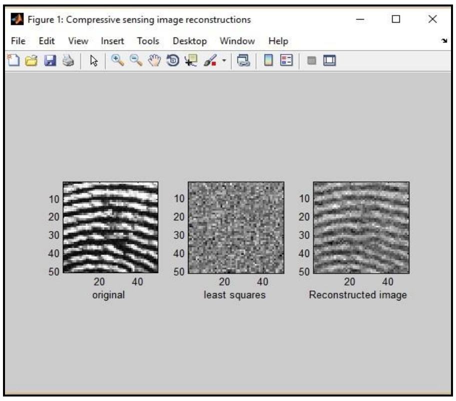

Fig. 4 Output with 750 samples

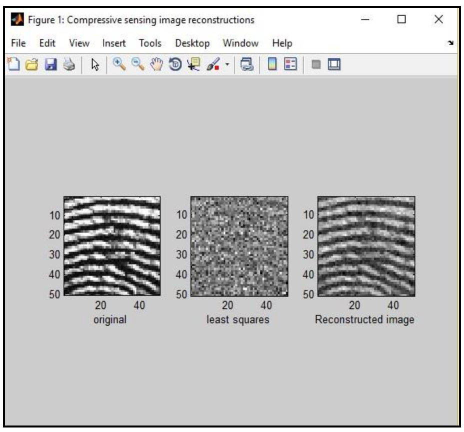

Fig. 5 Output with 1500 samples

4.0 Conclusion

From the above sample outputs we can clearly see that the compressed sensing technique is highly efficient compared to other compressing techniques as it has exactly reconstructed the image with just 750 and 1500 samples where in other techniques uses all the 10,000 samples available in the sample image. Thus this technique can be implemented in all biometric devices so as to save the computation time, storage space in the database.

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