Novel Simulation Framework of Three-Dimensional Skull Bio-Metric Measurement

Shihab A. Hameed, B.B.Zaidan, A.A.Zaidan, A.W. Naji and Omar Faroq

Abstract-Previously, most of the researcher was suffering from simulate any three dimension applications for biometrics application, likewise, various applications of forensics and cosmetology has not been easy to be simulated. Three dimensional figures have approved the fact that, it has been more reliable than two dimensional figures in most of the applications used to be implemented for the purposes above. The reason behind this reliability was the features that extract from the three dimensional applications more close to the reality. The goal of this paper is to study and evaluate how far three-dimensional skull biometric is reliable in term of the accurate measurements, capability and applicability. As it mentions above, it was hard to evaluate or simulate an application use three-dimensional skull in biometric, however, Canfield Imaging Systems provide a new suitable environment to simulate a new three-dimensional skull biometric. The second goal of this paper is to assess how good the new three-dimensional image system is. This paper will also go through the recognition and verification based on a different biometric application. Subsequently this paper will study the reliability and dependability of using skull biometric. The simulation based on the three-dimensional Skull recognition using three-dimensional matching technique. The feature of the simulate system shows the capability of using three-dimensional matching system as an efficient way to identify the person through his or her skull by match it with database, this technique grantee fast processing with optimizing the false positive and negative as well .

Keywords- 3D Imaging, Biometric, Skull Detection, Security, Recognition, Identification and Authentication

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I. INTRODUCTION

Biometrics verification is any means by which a person can be uniquely identified by evaluating one or more unique biological traits. Unique identifiers include fingerprints, retina and iris patterns, voice waves, DNA, hand geometry, earlobe geometry and signatures, it has been widely used in the security applications such as Electronic access control, Inmate booking & release/parole ID, safe & vault security, elimination of welfare fraud, information security, ATM. Fingerprint, Iris-pattern and retina-pattern authentication methods are already engaged in some bank automatic teller machines. Voice waveform recognition, a method of verification that has been used for many years with tape recordings in telephone wiretaps, is now being used for access to proprietary databanks in research facilities. Hand geometry is being used in industry to provide physical access to buildings. Facial-recognition technology has been used by law enforcement to pick out individuals in large crowds with considerable reliability. Currently, biometric technology is most identified with border control and transport agencies with both fingerprint and iris scanning being deployed in airports such as Schipol in the Netherlands.

However it is also starting to gain prominence in commercial sectors such as financial services, a move being further driven by regulatory compliance across Europe. In the last two years, numerous financial organizations have deployed non-Automated Fingerprint Identification System (AFIS) fingerprint recognition and voice verification to meet FFIEC (Federal Financial Institutions Examination Council) guidelines. Recent analysis from Frost & Sullivan of the world financial biometrics market found that it earned revenues of $117.3 million in 2006, with estimates to reach $2.07 billion in 2013[1]. Biometric systems are now becoming widely used by many organizations to provide greatest level of security because it more reliable than then password and it represent the user. Many biometric research publications are already done especially related to pattern recognition and digital signal processing issues.

In the literature, three-dimensional analysis of facial biometric has been involved, such as [3] perform three-dimensional face recognition using a sparse depth map constructed from stereo images. Iso-luminance contours are used for the stereo matching. Both two dimensional edges and is also luminance contours are used in finding the irises. In this specific limited sense, this approach is multi-modal. However, there is no separate recognition result from two-dimensional face recognition. Using the iris locations, other feature points are found so that poses standardization can be

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done. Recognition rates of 87% to 96% are reported using a dataset of ten persons, with four images taken at each of nine poses for each person. In [4] extend eigenface and hidden Markov model approaches used for two-dimensional face recognition to work with range images. They present results for a dataset of 24 persons, with 10 images per person, and report 100% recognition using an adaptation of the two-dimensional face recognition algorithms. In [6] Report on multi-modal faces recognition using three-dimensional and color images. The use of color rather than simply gray-scale intensity appears to be unique among the multi-modal work surveyed here. Results of experiments using images of 40 persons from the XM2VTS dataset [5] are reported for color images alone, three-dimensional alone, and three-dimensional + color. The recognition algorithm is PCA style matching, plus a combination of the PCA results for the individual color planes and range image. Recognition rates as high as 99% are achieved for the multi-modal algorithm, and multi-modal performance is found to be higher than for either three-dimensional or two-dimensional alone.

In [2] present a new method of measurement using 3D color speckle stereophotogrammetry and its application in the assessment of NLFV. The VECTRA-3D system was validated to determine its minimum resolution and accuracy.

II. System Overview

A. Canfield Imaging Systems Accuracy

In the literature, Canfield Imaging Systems Accuracy has been tested as it has been shown in [2] they did a case experiment for sixteen spheres were formed from the deformable material, and the weight of these spheres ranged from 0.0137 to 26.804 g. Through calculation from the above equation, a volume reference scale is generated, ranging from 0.0076 to 14.8913 ml. Volumes measured using VAM® software ranged between 0.0025 and 14.0167 ml. Excellent correlation was observed between the true volumes and volumes measured by both observers. For Observer 1, the correlation coefficient, r=0.9997 (confidence interval 0.9990 to 0.9999, p value < 0.0001). For Observer 2, the correlation coefficient, r =0.9992 (confidence interval 0.9975 to 0.9997, p<0.0001). The intra-rater variability, as measured by the coefficient of variation is 0.6748%. The inter-rater agreement kappa (k) value between both observers was 0.906, which indicates a very good strength of agreement.

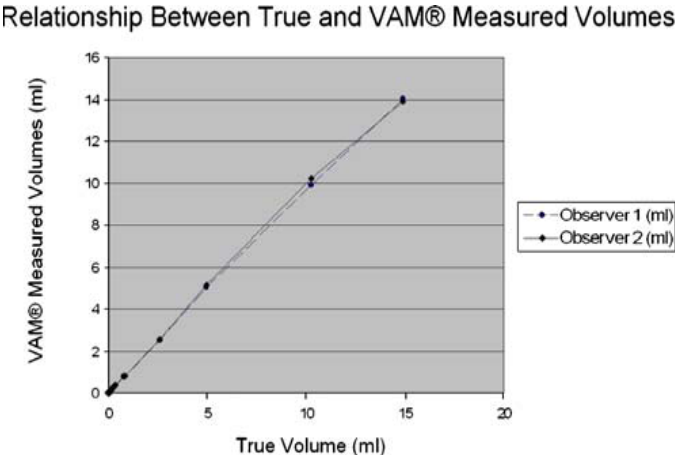

Figure 1 the relationship between the true volumes and volumes measured by both observers [2].

B. System Setup

Canfield Imaging Systems include two parts, hardware and software, below the descriptions of the system.

(i) Hardware

The device engaged in this paper is the VECTRA-3D dual module system for full face imaging (Canfield Scientific, Fairfield, NJ, USA).

The VECTRA-3D features two pods held together by a central bracket that mounts onto a tripod or stand (Fig. 2). Each camera pod contains three high-resolution digital cameras and a speckle texture flash projector. The camera positions, orientations, and imaging characteristics, such as the lens distortions, are predetermined by the calibration system.

Figure 2 the VECTRA-3D camera

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(ii) Software

The 3D model that is generated can be analyzed using VAM® (visualization, analysis, measurement) application software. As it is a digital facial model, one is able to rotate, pan, or zoom into the images as well as view multiple surfaces simultaneously to facilitate analysis, see figure 3.

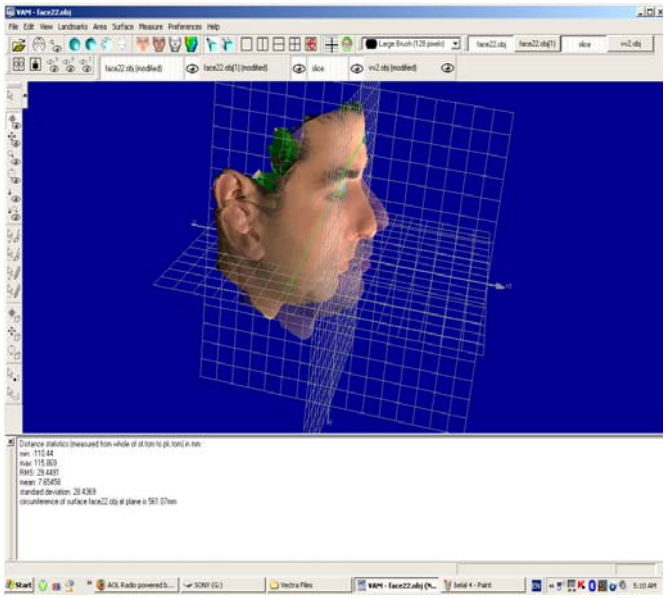

Figure 3 VAM software

C. Facial Image Experiment

Several applications might be applied using VAM system upon. The first experiment in this paper was for three dimensional faces. In this experiment the author has tried to show the flexibility of the new system, also the reliability of the measurement. The figures below shows many possible for the image view, and also experimentally two faces matched and other were not.

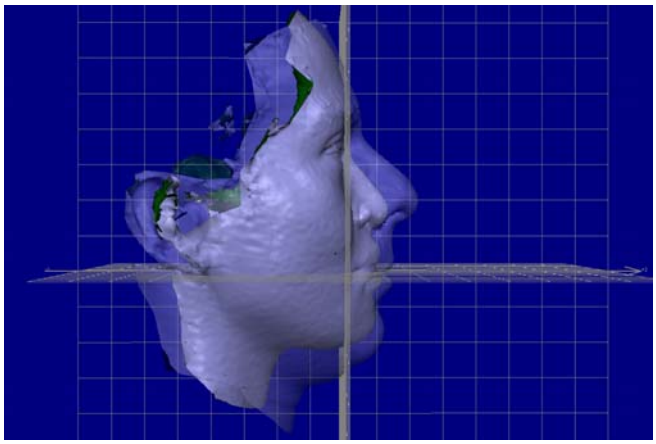

Figure 4 Unmatched Faces

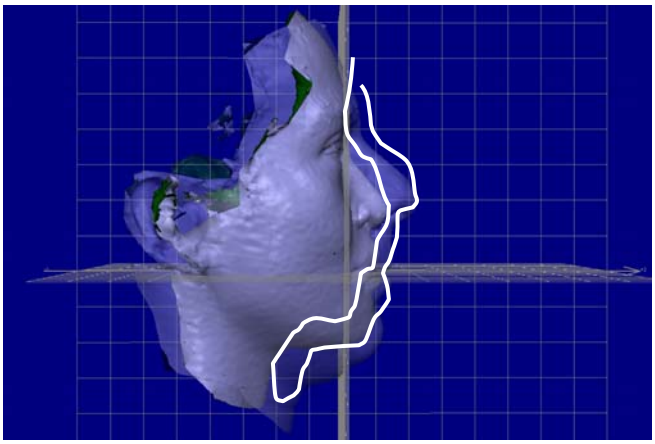

Figure 5 Unmatched Area Bounded by a White Color

Figure 6, 7, 8 shows two faced matched, where in figure 6 the same face need to be rotate. To be more clear, two pictures from different angles has been taking automatically

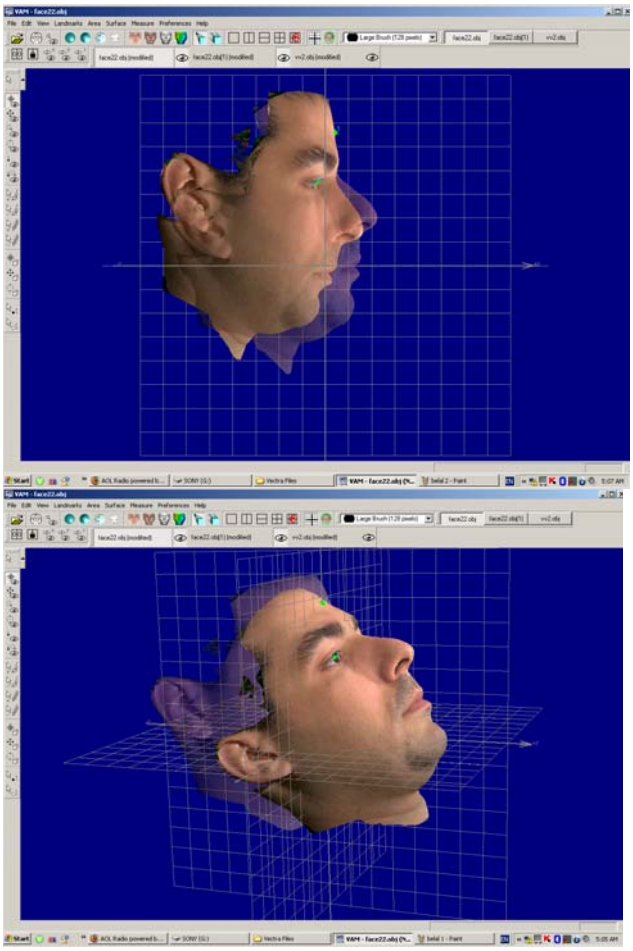

Figure 6 two faces from the same person has been started to match

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The final step both of the faces has been establish matching, the author has change the color of the second face to show the matching accuracy

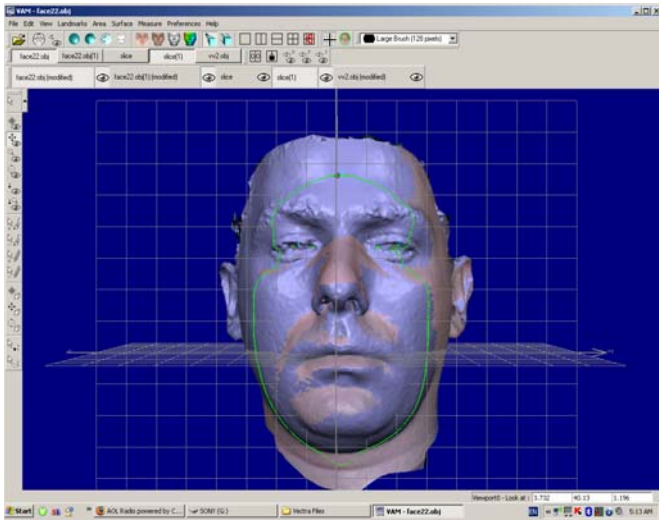

Figure 7 Two Faces Matched

The other possible application might also apply the new approach in the crime and forensic application; in fact, Canfield Imaging Systems with the new features give the green light to the researchers to apply those algorithms in a very fixable environment.

D. Three Dimensional Skull

This system has choice three-dimensional detection system for the skull and the reason of choosing this Correlation between skull recognition and three-dimensional matching technique is that in this algorithm is to make less process by use the number of sold matching pixel. Three-dimensional technology has improved in the last decade and may become increasingly mainstream in the future. Recently, authors have used three-dimensional reconstruction of the face biometric.

In this research the author has used the Three-dimensional technology to improve a new biometric using skull object; figure 8 is snapshot from the simulation shows two skull matching for the same person.

Using the software, we were able to superimpose each upright image onto the corresponding supine image and measure the distance between the two surfaces. This represents the movement that occurs in the soft tissues from upright to supine. Figure 8 shows the changes that occur to the soft tissues of the face from upright to supine by color[1].

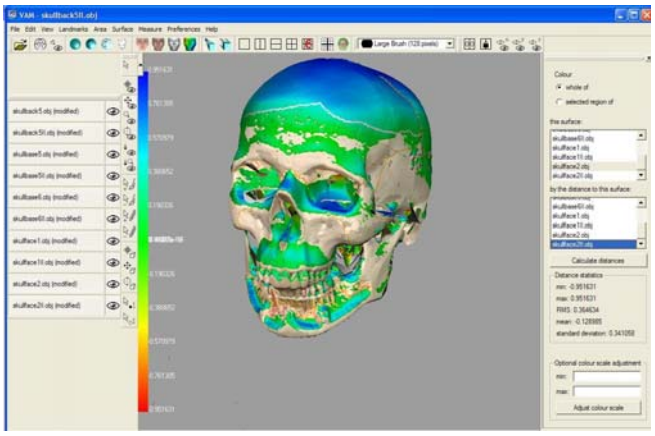

Figure 8 Snapshots From the Simulation

In the figures below there different skull some of them match and other is not, it shows clearly how accurate and reliable using three-dimensional skull recognition in the biometric, Moreover, the snapshots below recommended using the new Canfield Imaging Systems for the three dimensional applications.

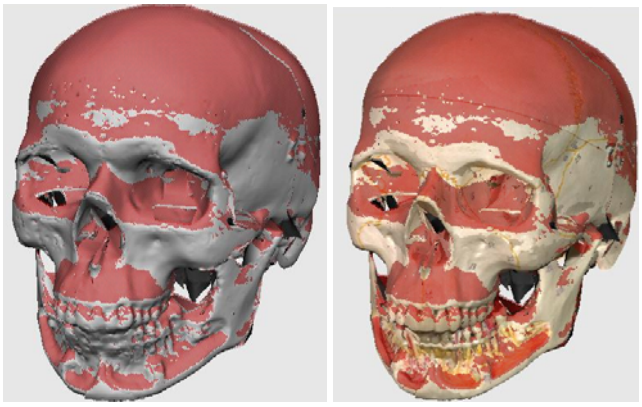

Figure 9 Match Skull

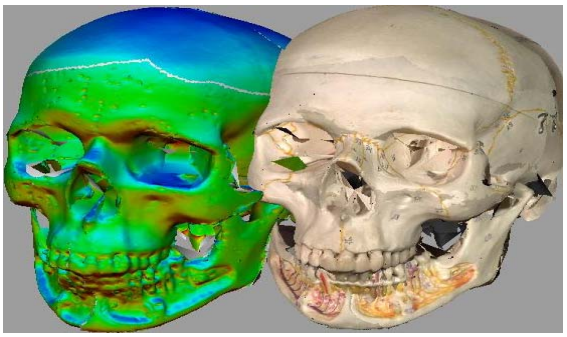

Figure 10 Different Skulls Unmatched

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Different skull used experimentally to test the reliability of the using the skull in the 3-D bio-metric, the conduct test measurement shows skull bio-metric is qualified and capable to be used in the bio metric, forensic, computer forensics, etc. as it shown above the red image is actually a matching .

III. CONCLUSION

Reliability in personal authentication is the key to the stringent security requirements in many application domains ranging from airport surveillance to electronic banking. In this paper the author has used the new Canfield Imaging Systems for processing the 3D images, there are two goals approved in this paper, the reliability of 3D skull biometric and evaluate the dependability of the simulator, different test on the 3D skull and 3D face has been used to insure both of the projects goals give the appreciated result. The new system has given a very good result in term of accuracy, time cost and optimizing the false positive and false negative. These entire features have been improved by using a very simple technique, three-dimensional matching with skull. Data captured used a very high image quality, in fact, more than 8 MB, .obj images. In additional, this paper highlights several biometric approaches to determine a wide review about the current bio-metric applications.

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