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RESEARCH ARTICLE

FUSION OF KNUCKLE PRINT AND IRIS FOR MULTIMODAL BIOMETRIC RECOGNITION AND CRYPTOGRAPHIC KEY GENERATION

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ABSTRACT

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It is very difficult to remember long cryptographic keys by a human being since they are formed by the combinations of alphanumeric with special characters. Hence the researcher have been trying to find some alternate way for authentication in the client server application that is from human being biometric traits instead of remembering longer complex password or passphrase. It is an attempt to generate cryptographic keys from user's biometric features which are tough to cryptanalysis and unpredictable for a hacker to crack any information from the compromised biometric. This work proposes an efficient approach based on Multi-Model Biometric system (Fusion of Knuckle and Iris) for the Client Server Authentication processes. Features are selected from both Knuckle and Iris, the extracted features are encrypted by RSA algorithm and stored as a template in the database. The query input (both Knuckle and Iris) is processed by the same way and matched with the template stored in the data base. The experimental results have proved that Multi-Model Biometric system is having the capability of providing better user

1. Introduction

Biometrics is the science and technology of measuring and analyzing biological data of human body, extracting a feature set from the acquired data, and comparing this set against to the template set in the database [1]. Biometric-based techniques have emerged as the most promising option for recognizing individuals in recent years. Basically we identify the people using passwords, PINs, smart cards, tokens, keys etc. but these are sometimes misplaced, forgotten, purloined or duplicate and hard to remember. However an individual's biological traits cannot be misplaced, forgotten, stolen or forged. Biometric-based technologies include identification based on physiological characteristics (such as face, fingerprints, finger geometry, hand geometry, hand veins, palm, iris, retina, ear and voice) and behavioral traits (such as gait, signature and keystroke dynamics) [2].Human physiological and/or behavioral characteristic can be used as a biometric trait when it satisfies the requirements like ubiquity, peculiarity, stability and collectability. In practice, no single biometric can satisfy all the desirable characteristics mentioned above for it to be used for person authentication. This is due to the problems associated with noisy data, intra-class variation, non-universality, spoof attacks and high error rates [4]. To overcome this limitation, multiple biometric features can be used for person authentication. This resulted in the development of multimodal biometric person authentication system [4]. Thus biometric system can be classified as uni-modal system and multimodal system based on whether single or multiple biometric features are used for person authentication. Biometric security system becomes a powerful tool compared to electronics based security systems [3].

Multimodal biometric authentication techniques attract much attention of many researches recently as the fusion between many different modalities can increase the recognition rate. The fusion can be achieved in different levels such as sensor, feature, or classification level. The literature reported that the multimodal biometric methods achieve better recognition rates than uni-modal biometric methods. From the uni-modal biometrics data, two traits of iris [5] and finger knuckle [6] are recently best authentication biometrics.The finger knuckle biometrics is emerging as the full proof method of automated personal identification. Similar to fingerprint, these dermal patterns are formed at birth and they will not change throughout the life of a person. These line features are reliable and they can serve as unique personal identifier. Moreover, these line textures are clearly visible on the hand's upper surface and they can be captured using relatively inexpensive low resolution device [7]. Moreover, iris recognition system (IRS) is most efficient and reliable system [8] for authentication check. Generally, Feature selection strategies often are applied to explore the effect of irrelevant features on the performance of classifier systems [9-11]. In this phase, an optimal subset of features which are necessary and sufficient for solving a problem is selected. Feature selection improves the accuracy of algorithms by reducing the dimensionality and removing irrelevant features [12] [13]. Feature level fusion, signals coming the iris and finger knuckle biometric traits is first processed and feature vectors are extracted separately from the each biometric trait [14].

The multimodal-based authentication can help the system in increasing the security and efficiency in contrast to uni-modal biometric authentication, and it would be very difficult for an adversary to spoof the system because of two distinct biometrics traits [26]. Recently, multimodal biometrics fusion techniques have attracted much attention as the supplementary information between different modalities could improve the recognition performance [27].Information from different biometrics traits can be integrated at the feature level (integrating the features of different biometrics), score level (combining the genuine and imposter scores), or decision level (combining the decisions). Although feature sets are the rich source of information, features from these modalities may not be compatible. Moreover large dimensionality of a feature space may lead to irrelevant and the redundant information [15]. In addition, the scores are combined from two face recognition experts and one speaker recognition expert using three classifiers: k-NN classifier using vector quantization, decision-tree based classifier and a classifier based on a logistic regression model [16]. Fuzzy k-means and fuzzy vector quantization, along with a median radial basis function neural network classifier is implemented for the fusion of scores obtained from biometric systems based on visual (facial) and acoustic (vocal) features[17]. Score level fusion of iris and fingerprint biometrics is carried out via Support Vector Machine (SVM) [18].Score level fusion for iris recognition is achieved by using HD (Hamming distance) produced by a Gabor filter [19]. Cryptographic key generation is a method recognizes the human very secure. One effective solution with added security is the incorporation of multimodal biometrics into cryptographic key generation; so as to achieve incredible security against cryptographic attacks.

2. Review of related works:

In the literature survey, several methods have been proposed for the biometric recognition in human authentication. Among the most recently published works are those presented as follows:

MadasuHanmandlu*et al.* [20] have explained the Score level fusion of multimodal biometrics using triangular norms. A multimodal biometric system that alleviates the limitations of the uni-modal biometric systems by fusing the information from the respective biometric sources was developed. A general approach was explained for the fusion at score level by combining the scores from multiple biometrics using triangular norms (t-norms) due to Hamacher, Yager, Frank, Schweizer and Sklar, and Einstein product. This study aims at tapping the potential of t-norms for multimodal biometrics. The approach renders very good performance as it was quite computationally fast and outperforms the score level fusion using the combination approach (min, mean, and sum) and classification approaches like SVM, logistic linear regression, MLP, etc. The experimental evaluation on three databases confirms the effectiveness of score level fusion using t-norms.

Moreover, Swathi*et al.* [21] have explained the DWT-based Feature Extraction and Radon Transform Based Contrast Enhancement for Improved Iris Recognition.In this paper, a method for recognition of iris patterns was explained by using a combination of pre-processing using Radon transform and Top hat filtering, feature extraction using Discrete Wavelet Transform (DWT) and Discrete Cosine

Transform (DCT), and feature selection using Binary Particle Swarm Optimization. Individual stages were examined and an attempt was made to improve each stage. Radon transform was used for detecting lines present in the iris textures and Top hat filtering was used for image enhancement. A combination of DWT and DCT was used to extract the salient iris features. A BPSO-based feature selection algorithm was used to search the feature vector space for the optimal feature subset.

In, Lan Lin*et al*. [22] get planned a geometric face model of human skull structure based on the Frankfurt horizontal plane of a human skull. As outlined by their particular face type, the compensating angle has been determined in the SCA for a face image used exactly the same lighting method. Using the compensating angle, the illumination compensation for a face image has been performed by simply an additive component procedure. Their own experimental outcomes confirmed their particular technique for the Yale B face database. In contrast to Choi's techniques, their technique has been increased the particular images along with significant lighting angle, and it has been better made to light change in both horizontal and vertical directions.

Similarly,Patricia Melin*et.al.*[23] have suggested genetic optimization of modular neural networks with fuzzy response integration for human recognition. They explained new method to genetic optimization of modular neural networks with fuzzy response integration. Here, they explained the technique was connected to the instance of human recognition based on three biometric measures, specifically iris, ear, and voice. The experimental results demonstrated that optimal modular neural networks could be designed with the utilization of genetic algorithms and as a consequence the recognition rates of such systems could be enhanced fundamentally. On account of optimization of the fuzzy framework for response integration, the genetic algorithm not just changes the quantity of membership functions and principles, additionally permitted the variety on the kind of logic (type-1 or type-2) and the changed in the derivation model. An alternate fascinating finding of their work was that when human recognition was performed under noisy conditions, the response integrators of the modular networks built by the genetic algorithm were discovered to be optimal when utilizing type-2 fuzzy logic. This could had been anticipated as there had been evidence from past works that type-2 fuzzy logic was more qualified to model larger amounts of instability.

Additionally, Shoichiro Aoyama*et al.* [24] have explained the finger-knuckle-print recognition algorithm using Band-Limited Phase-Only Correlation (BLPOC)-based local block matching. The phase information obtained from 2D Discrete Fourier Transform (DFT) of images contains important information of image representation. The phase-based image matching, especially BLPOC-based image matching was successfully applied to image recognition tasks for biometric recognition applications. To calculate the matching score, the algorithm corrects the global and local deformation between FKP images using phase-based correspondence matching and the BLPOC-based local block matching, respectively. Experimental evaluation using the PolyU FKP database demonstrates the efficient recognition performance of the algorithm compared with the state-of-the-art conventional algorithms.

Moreover, JialiangPeng*et al.* [25] have explained the Multimodal biometric authentication based on score level fusion of finger biometrics. Here, finger multimodal biometric authentication that combines finger vein, fingerprint, finger shape and finger knuckle print features of a single human finger. The multimodal biometrics provides score-level fusion approach based on triangular norm with four finger biometric traits, instead of two or three ones combined in the previous approaches. The experimental evaluations and analysis were conducted on a merged multimodal biometrics database. The results were show that the score-level fusion approach using triangular norm obtains a larger distance between genuine and imposter score distribution as well as achieves lower error rates. Moreover, the comparison results suggest that the score level fusion of finger biometrics using triangular norm outperforms the state-of-the-art approaches.

3. Problem Definition and Proposed Methodology:

Most real-life biometric systems are still uni-modal. Uni-modal biometric systems perform person recognition based on a single source of biometric information. Such systems are often affected by some problems such as noisy sensor data, non-universality and spoof attacks. Multi-biometrics overcomes these problems. Multi-biometric systems represent the fusion of two or more uni-modal biometric systems. Such systems are expected to be more reliable due to the presence of multiple independent pieces of evidence. Keeping all these requirements in mind, biometric traits like fingerprints, hand veins, handwritten signatures, retinal patterns, ear patterns, electrocardiogram etc. are used extensively in areas which require security access. Among various kinds of biometric identifiers, hand-based biometrics has been attracting considerable attention over recent years due to its ease in accession. Biometric traits like fingerprint, palm print, hand geometry and hand vein and iris have been proposed and well investigated in the literature.

Additionally, human users have a tough time remembering long cryptographic keys. Hence, researchers, for so long, have been examining ways to utilize biometric features of the user instead of a memorable password or passphrase, in an effort to generate strong and repeatable cryptographic keys. The main objective of this research is to incorporate the volatility of the user's biometric features into the generated key to biometric identification and encryption. The goal of my research will be done in two phases in multi-model biometrics.

PHASE-1:

In this phase, the two set features will be extracted from iris and finger images. At first, the finger image will be preprocessed to get the finger ROI (Region of interest), and knuckle print features of index, middle, ring and little fingers will be extracted from the finger ROI. On other hand, localization process will be applied on the iris images; some useful features will be extracted. Subsequently, the extracted features will be fused together at the feature level to construct the multi-biometric template. After that, a 256-bit secure cryptographic key will be generated from the multi-biometric template. Finally, based on the 256-bit secure cryptographic key, the applications related to recognition and encryption will be done.

PHASE-2:

In this phase, some additional features will be selected based on iris and knuckle print of image presented in the database. The additional features provided based on iris and knuckle print image will provide the significant improvement as compared with existing algorithm. The implementation will be done in MATLAB and the performance of the algorithms will be analyzed using false alarm rate (FAR), False rejection rate (FRR) and accuracy.

4. Implementation Results:

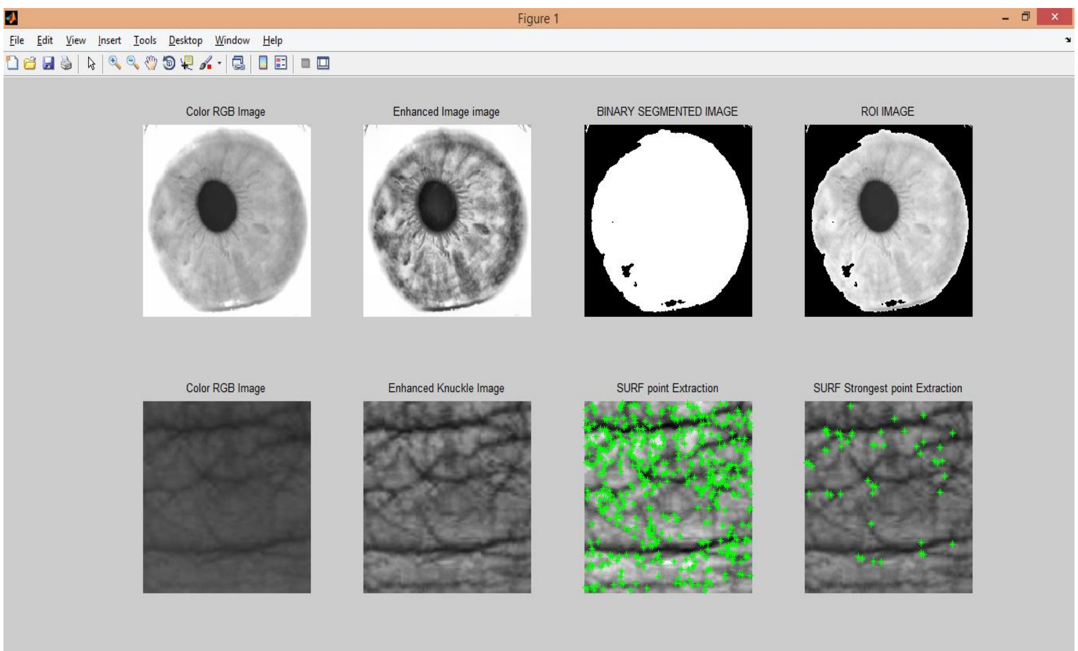

Figure 1: Image processing stepsat Client Side

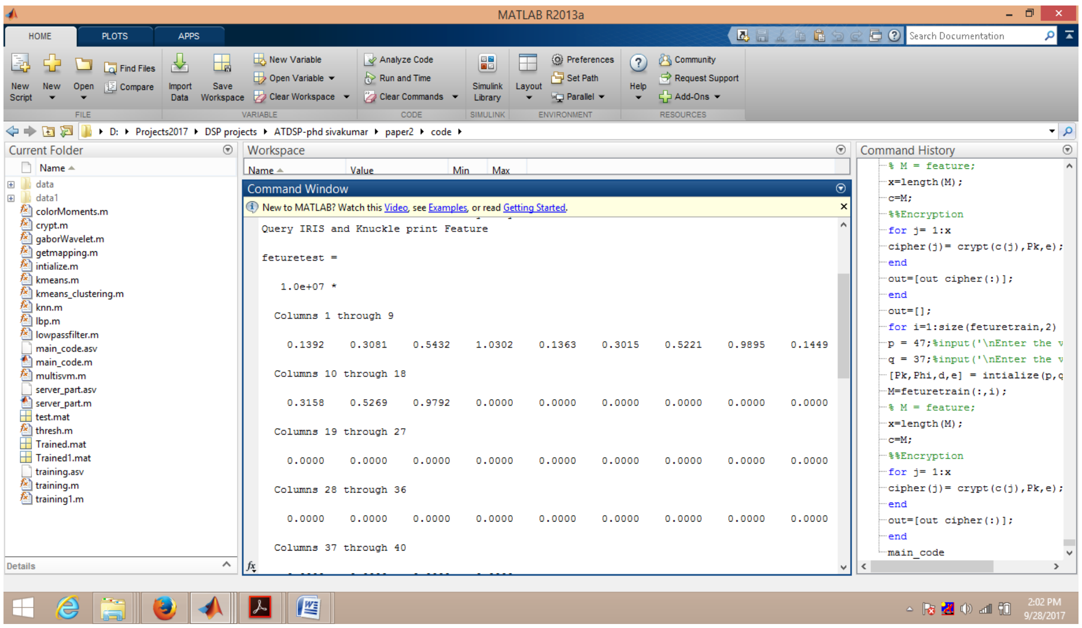

Figure 2: Feature of query input.

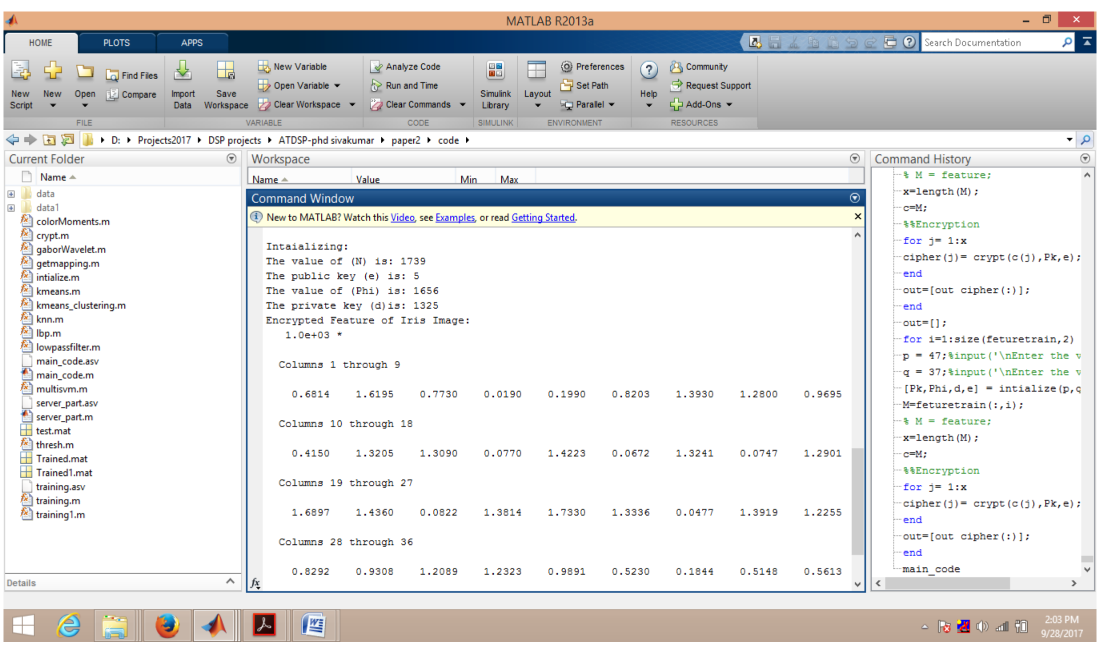

Figure 3: Encrypted Feature

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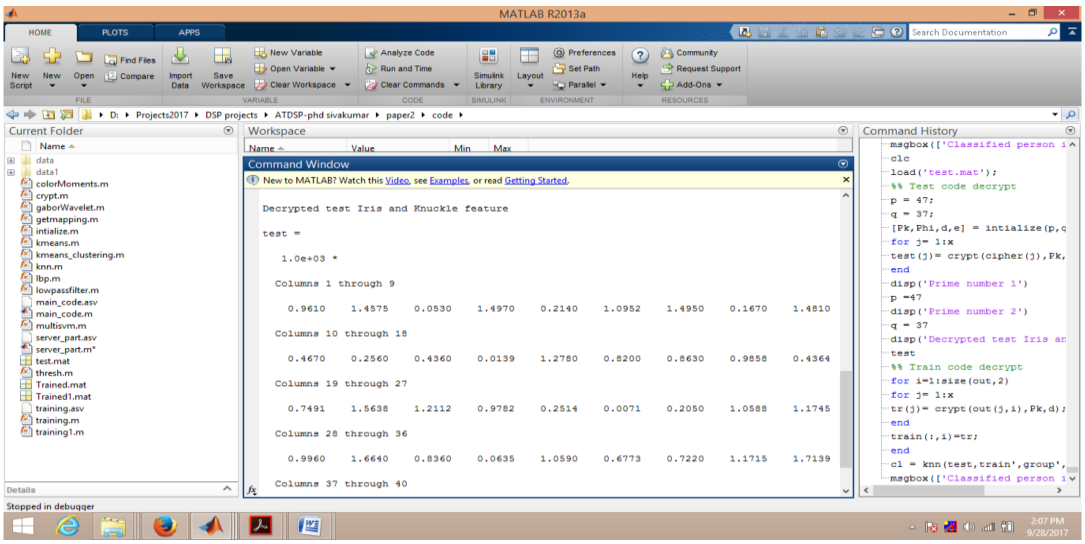

Figure 4 : Database key generated by RSA algorithm on server side

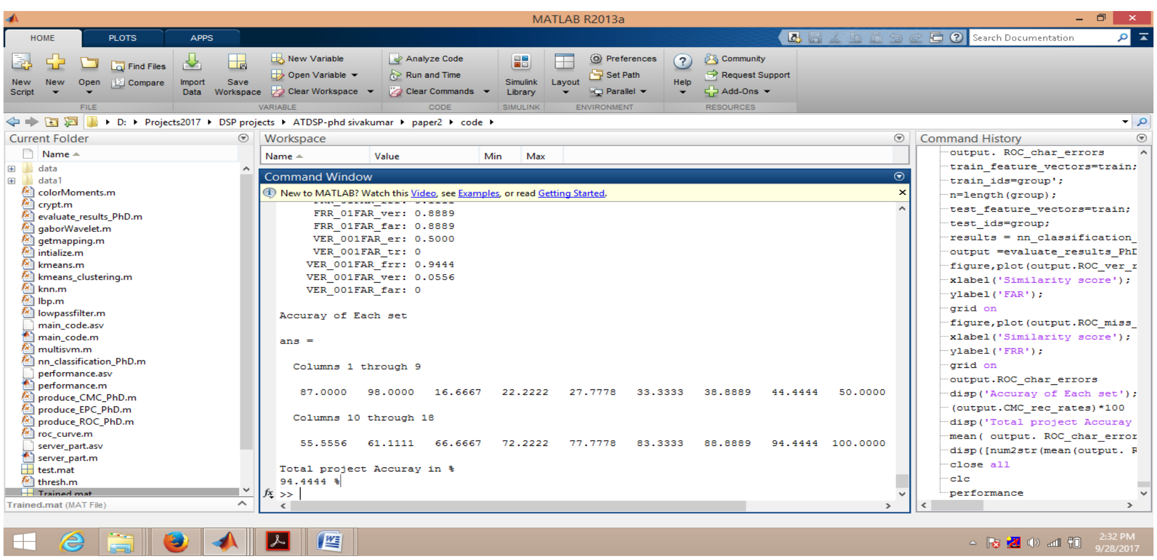

Figure 5 : Template Generation using by RSA algorithm on server side

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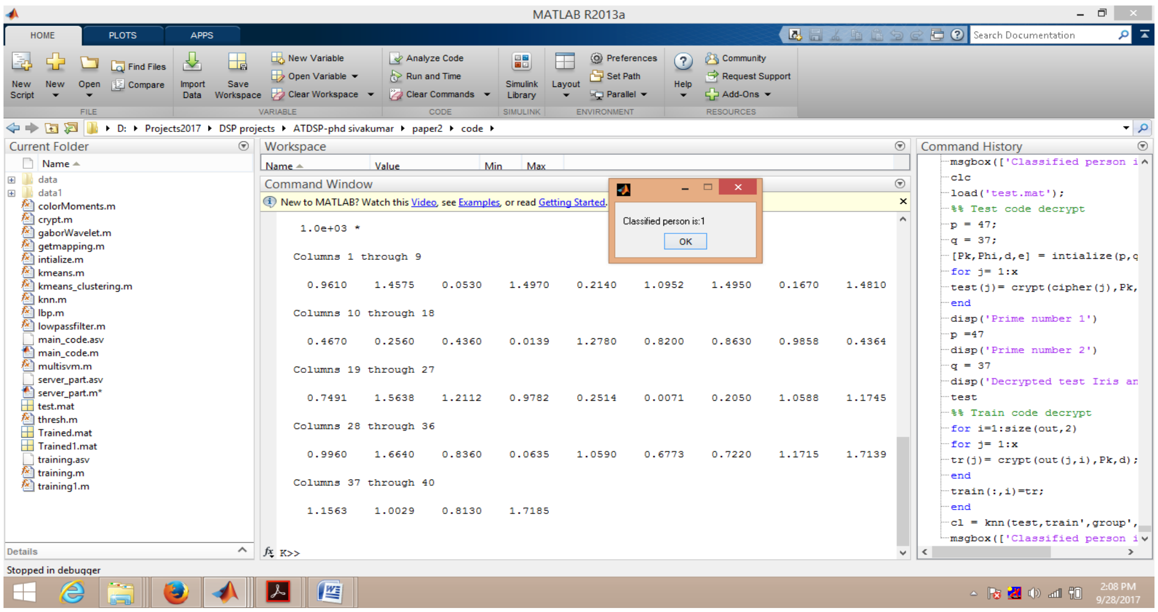

Figure 6: Verification Process

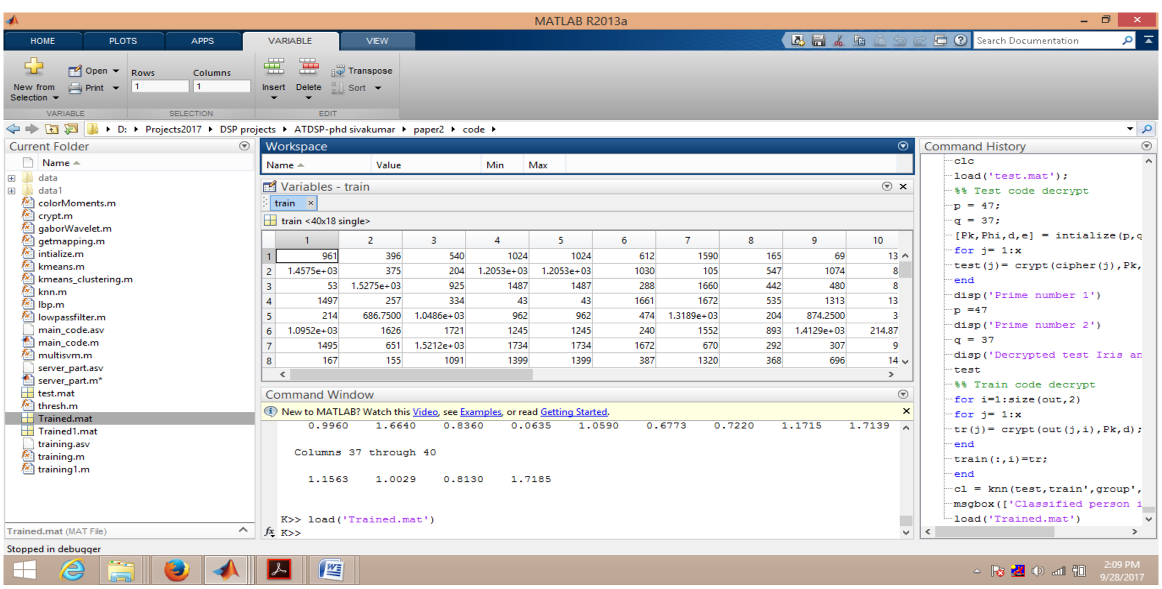

Figure 7 : Performance Analysis

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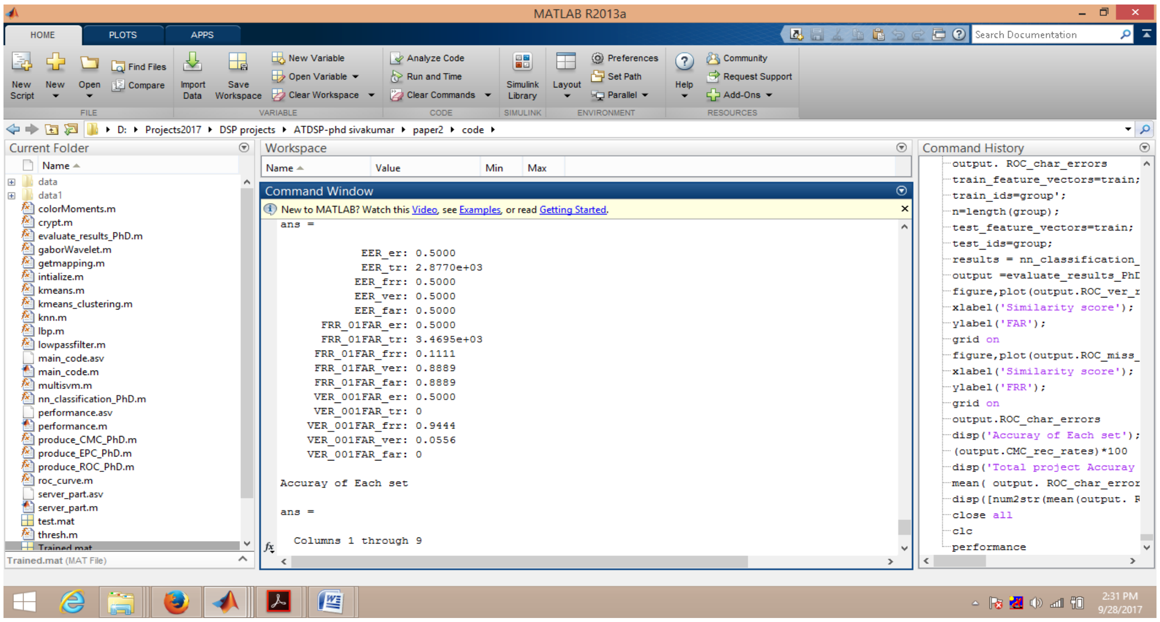

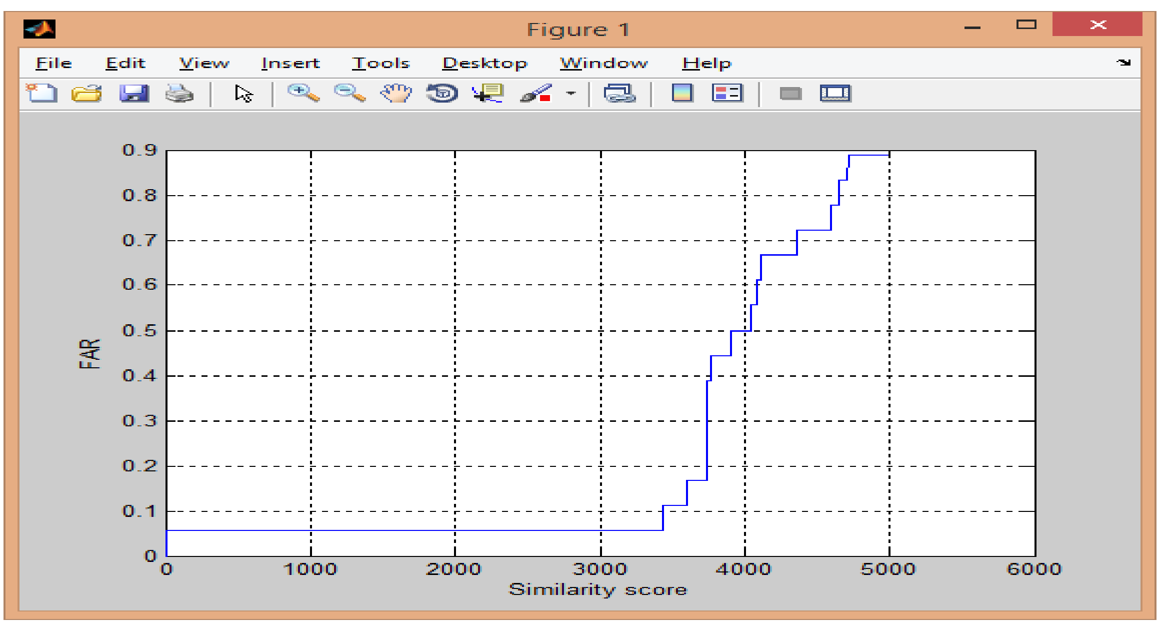

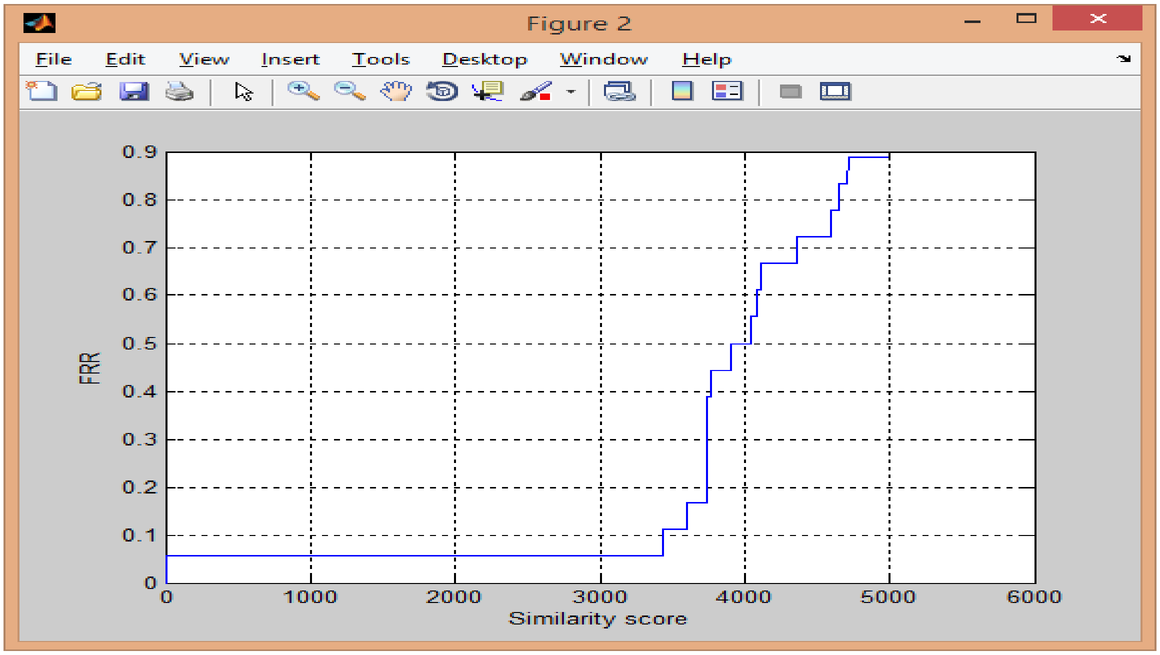

Figure 9**:** FRR (False Rejection Ratio)

5. CONCLUSION

This work proposed an efficient authentication mechanism from client and server by the use of fusion of biometric traits like Finger Knuckle Print and Iris. This method enhanced the security of the by the fusion of two biometric using Multi- model Biometric System. The proposed approach consists of three modules namely, 1) Feature extraction from Knuckle, 2) Feature extraction from iris 3) Then above two features are fused to generate features and 4) Finally features are encrypted by RSA algorithm and stored as a template in the database.

Any input query requires authentication, the above said steps are repeated and compared with the template in the database. The query input is matching with the template then the corresponding then the given input is authenticated and allowed to access service from the server. For experiment results, data base of finger Knuckle Print images and iris are used. The experimental results have demonstrated the security of the proposed approach to enhance when compared to the previous methods of Multi- Model Biometrics.

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