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A Hybrid Verification System using Speech and Video

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Abstract. We propose a personal verification method using both speech and video to improve the rate of a single biometric verification. It has been a fundamental bottleneck of real-time personal verification on False acceptance rate (FAR) and false rejection rate (FRR). The proposed multimodal biometric method is to improve both verification rate and reliability in real-time through overcoming technical limitations of single biometric verification methods. The proposed method uses the hidden markov model (HMM) for speech verification, and also the principal component analysis (PCA) for face recognition. It also uses fuzzy logic for the final decision of personal verification. Based on experimental results, the proposed system can reduce FAR down to 0.0001%, which provides that the proposed method overcomes the limitation of single biometric system and provides stable personal verification in real-time.

Keywords: HMI, Multimodal, Biometric, Verification, Speech, Video, HMM, PCA.

1 Introduction

Human biometric characteristics are unique, so it can hardly be duplicated[1]. Such information includes facial, speech, hands, body, fingerprints, and gesture to name a few. Face detection and recognition techniques are proven to be more popular than other biometric features based on efficiency and convenience [2]. Face verification differs from face authentication because the former has to determine the identity of an object, while the latter needs to verify the claimed identity of a user. Speech is one of the basic communications, which is better than other methods in the sense of efficiency and convenience. Each a single biometric information, however, has its own limitation. For this reason, we propose a multimodal biometric verification method to reduce false acceptance rate (FAR) and false rejection rate (FRR) in real-time.

2 Personal verification using multimodal biometric

We present a personal verification method as shown in Fig. 1. The proposed method first detects the face area in an input image. The face verification module compares the detected face with the pre-stored code book of personal information. The speech verification module extracts and recognizes the end-point of speech, and authenticates it after comparing with the code book. Decision processes of face and speech use the proposed fuzzy logic algorithm. If the face and speech verification results coincide, there is not in further processing. Otherwise, the fuzzy logic is used to solve the mismatch problem. Therefore, if the face and speech is same to the personal information of the code book, the verification is accepted. Otherwise, it is rejected. The entire verification process is shown in Fig. 1.

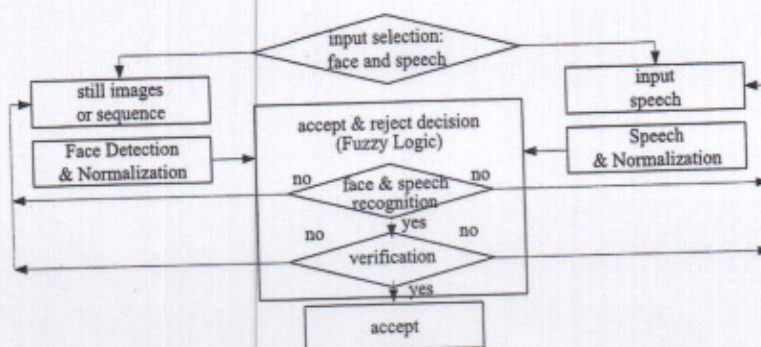


Fig. 1. The entire verification process

2.1 Code book of personal speech and video information

The proposed personal information code book is described as shown in Fig. 2. The face feature extraction block is trained by using the PCA algorithm with ten different images per single person. Each individual probability information projects the data to the original image. Fig. 2 shows a set of registered face images. The speech feature extraction block is trained by using the HMM algorithm with ten iterations per single person.

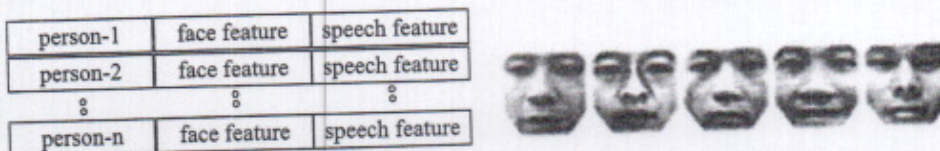


Fig. 2. Created personal code book and some images of registered person

The input fuzzy engine contains the recognized probability classified, where $P(R)$ represents the coefficient of recognized probability. The basic rule is given as follows:

$$\begin{cases} \text{FACE} & 1.0 \\ \text{If } P(R) \text{ is COMPLETE Then output } \theta \text{ is} & 0.5 \\ \text{SPEECH} & 0.0 \end{cases}$$

3 Results and discussions

The proposed multimodal, biometric human verification system is shown in Fig. 3.

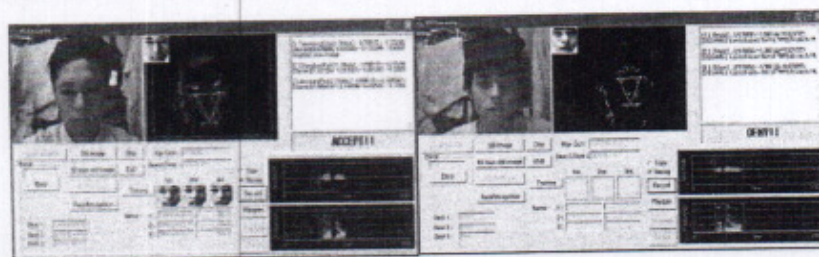


Fig. 3. Accepted and denied results

The proposed method can reduce FAR to 0.0001% and the impersonation to one person out of 10,000.

Table 1. Verification rate of the proposed method.

Test DB(100 person)	Verification ratio(%)	FAR(%)
Speaker and face	99.99	0.0001

3 Conclusions

We propose a human verification method using combined speech and video information in order to improve the problem of single biometric verification. Single biometric verification has the fundamental problems of high FAR and FRR. So we propose a multimodal, biometric human verification method to improve the verification rate and reliability in real-time. Based on the experimental results, we show that FRR can be reduced down to 0.0001% in the human multimodal interface method using both speech and video information.

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