Effective design of multimodal biometric systems using intelligent agent technology

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Introduction:

Biometric technologies are emerging as important components in regulating online information access [1]. Significant application areas exist in electronic commerce, security monitoring, database access, forensic investigation and telemedicine. Many different technologies are available for person recognition and identity authentication and some examples include measures based on information from handwriting (especially signatures), fingerprint, face, voice, retina, iris, hand geometry and vein patterns. However, recognition based on any one of these modalities may not be sufficiently robust or else may not be acceptable to a particular user group or in a particular situation or instance.

Current approaches to the use of single biometrics in personal identity authentication are therefore limited, principally because no single biometric is generally considered both sufficiently accurate and user-acceptable for universal application. Multimodal biometrics can provide a more balanced solution to the security and convenience requirements of many applications. However, such an approach can also lead to additional complexity in the design and management of authentication systems. Additionally, complex hierarchies of security levels and interacting user/provider requirements demand that a system is adaptive and flexible in configuration.

This paper addresses explicitly a number of important issues currently being developed and evaluated in the context of a system designated IAMBIC (Intelligent Agents for Multimodal Biometric Identification and Control). The main aim of the IAMBIC system is to provide secure access to remotely stored data using a set of biometric devices to allow authentication of identity. The system will use multiple biometric modalities to check and verify identity, which can be combined using a series of novel data fusion techniques to find an optimum degree of reliability in authentication. The data fusion will be modified according to the characteristics of the person attempting to gain access to the system, adapting to such features as significance, confidentiality and cost of data, capture environment and recognition success rate histories of individual biometrics.

In considering the use of multi-modal biometrics in a realistic setting, such as a public system for regulated access to healthcare records, it is clear that there are several inter-related sources of variability which are likely to affect the required performance of the authentication system. These sources include, for example, environmental conditions, users' physiological/behavioural characteristics, users' preferences, variability of the communication channels, and so on. Thus, there is a clear requirement for the system to be able to adapt to user needs and conditions and, especially, to be able to determine and maintain an acceptable balance between confidence and convenience for its users through negotiations between information users and providers. The result of this facility is that the system becomes able subsequently to adapt quickly and efficiently to changing external conditions.

An implementation strategy:

A key novel aspect of the IAMBIC system is the use of intelligent agents to manage the complexity introduced by the use of multi-biometrics for remote access.

Intelligent autonomous *agents* [2]and *multi-agent systems* form a vibrant and rapidly expanding research field [12]. Agents can be defined as computer (sub-)systems that interact with some environment, and are capable of autonomous action. In addition they are flexible in responding to their environment, pro-active in exploiting opportunities and seeking goals, and "social" in their interactions with other agents where appropriate. In addition they may have other valuable properties such as adaptability or mobility.

The IAMBIC multi-agent system is implemented as a group of several interacting agents and is well suited to situations where multiple perspectives of a problem-solving situation exist. Types of interaction that may best be suited to biometric security involve co-operation, co-ordination and negotiation between agents. The needs of the information provider for establishing sufficient trust in the user may have to be balanced with the confidentiality of the user's biometric information and his ease of use of the system. A balance may need to be struck for each service, transaction or session and may even be dynamically modified during use. Tasks for the agent systems include handling of multiple authorisation levels, location of data across several repositories, and user interface and performance modification as required by the user or necessitated by the environment. The presentation will define an agent-based architecture which will address these diverse issues in an effective way.

Conclusion:

Multimodal biometrics provide a practically viable approach for overcoming the performance and acceptability barriers to the widespread adoption of biometric systems. However, it is essential that the resulting complexities are managed in a seamless and effective way. The paper introduces the basis of a system for the management of multimodal biometrics based on the use of intelligent agent technology within an overall security framework for trusted information exchange, which can embody exactly the requirements noted above.

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