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GESTURE DYNAMICS WITH SKIN CONDUCTIVITY - A MULTIMODAL APPROACH TO BIOMETRIC AUTHENTICATION

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Security, authentication, biometry, gesture dynamics, cognitive biometrics, skin conductivity, multimodal.

SUMMARY

There are three ways to recognize an individual, by what he knows, by what he has or by what he is or does. The latter method is known as biometric, which overcomes the problem of transmissibility that the other two ways have. But biometrics is not foolproof because it can be replicated. Today there are several fraudulent ways to replicate a biometric characteristic, and this raises new challenges. A potential solution lies in cognitive biometrics, which uses biological signals representative of the mental and emotional states for the authentication of users. We intend to prove that it is possible to implement, with comparative advantages, a multimodal biometric authentication solution using gesture dynamics in conjunction with skin conductivity.

MOTIVATION

In the perspective of security of information systems, the predominant area of the proposed research lies not in storage or transmission of information, but in the recognition of who can access it, given the way the interaction with the computer is performed. This induces a crossing of different areas, but not so divergent as might appear at first sight, such as human-computer interaction, electrophysiology and computer graphics.

In a networked knowledge society, in which we want access to information anywhere and anytime, the question of security/privacy is an issue of extreme relevance. The business processes, from government, from the citizen, or even those who seem to have no owner, belonging to all in the computing "cloud" that is the global network, require increasingly secure recognition procedures.

It is exponential the growth of confidential information that is managed digitally. On the one hand we want speed and efficiency, achieved by sharing information, on the other that has caused various types of threats to confidentiality. Thus, it becomes imperative to develop reliable methods to accurately determine the identity of those who want to access certain services/systems.

There are three ways to recognize an individual, by what he knows (e.g. a password or PIN), by what he has (e.g. a smartcard that stores an electronic key), or by what he is or he does (e.g. the fingerprint or the way he use the keyboard). The latter method is known as biometric recognition, which overcomes the problem of transmissibility that the other two ways have.

Biometrics is a multidisciplinary research field dedicated to the statistical study of the physical or behavioral characteristics of an individual, such as the fingerprint, the iris pattern, the voice pattern, the way a keyboard is used, the brain's response to certain stimuli, etc., for the purpose of authentication and/or identification.

But biometrics is not foolproof because it can be replicated. Today there are several fraudulent ways to replicate a biometric characteristic. This raises new challenges in this area. They are then required new effective and efficient authentication schemes. A potential solution lies in cognitive biometrics, which uses biological signals representative of the mental and emotional states for the authentication of users, using tools such as electrocardiograms, electroencephalograms and dermoelectric responses. These signals are generated by the heart, brain and nervous system respectively. The challenge lies in knowing how certain physiological processes associated with cognition can be adequately utilized to extract the individuality of a person in quantifiable terms.

PROBLEM

In the current solution we have identified the following problems: replicability is possible even with the common biometric technology; requirement of

continuous authentication; constant need to improve the accuracy of the systems (information systems with more users imply a need to lower error rates); constant need (inherent in the existence of a business) to lower the cost; need to keep the mobility of the systems, with restrictions on the type of hardware needed (dimension, energy, etc.) and on the use conditions (light, noise, etc.).

There is recent work in cognitive biometrics, particularly in the conductivity of the skin that seems to indicate that this technology has potential (with or without activation of the knowledge component). The current size of the conductivity sensors enables its integration into mobile devices. There is also work done and consolidated in gesture dynamics.

Thus, we intend to prove the following: *it is possible to implement, with comparative advantages, a multimodal biometric authentication solution using gesture dynamics with skin conductivity*.

METHODOLOGICAL APPROACH

Given the nature of this work the research methodology is based on a proof of concept with a study of acceptance. For that, it will be developed a prototype for graphical data collection and a prototype for dermoelectric data collection, for further definition of algorithms that determine authentication patterns.

The main challenges will be to find a good algorithm for each of the biometrics and find the thresholds that combine successfully these same algorithms. This does not correspond to the simple junction of the two since it will take advantage of the synergistic multimodal integration or even, in some situations, the alternate one.

Later we will proceed to the test of the defined algorithms, with half of the data to test and half of them to attack.

Developed the solution, the aim is also to evaluate the user acceptance of such a system. We plan to use the Technology Acceptance Model (TAM) for its wide dissemination and acceptance in this context.

For better exposure of the tasks involved, results, goals, resources and timing, the Research Plan was developed in a project management tool, with the corresponding set of deliverables, activities, effort, duration, dependencies and milestones.

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VÍTOR J. SÁ holds a five-year "licentiate" degree in Systems and Informatics Engineering and a Masters in Computer Science, both from the University of Minho. Its main activity has been teaching in higher education at the University of Minho, the Portuguese Catholic University and the Polytechnic Institute of Viana do Castelo, Portugal. In parallel, has worked in software development, having a multimedia product released in the Portuguese market by the largest national publisher (Porto Editora), and has done consulting / training in several national and international companies. He lived for four years in Germany as a Guest Researcher at the Institute for Computer Graphics (Fraunhofer IGD) in Darmstadt, linked to the Technical University of Darmstadt, where he participated in several projects, being the most prominent the EMBASSI project, in the area of Multimodal Interaction and Ambient Intelligence, a strategic project funded by the German government. He has provided consultancy and training to several companies, through the PMO Projects Group, a leading company in Europe in the field of Project Management, including: Autoeuropa, a German company from the Volkswagen Group, Millennium bcp, the largest Portuguese private bank, and CeNTI, a Nanotechnology company headquartered in Northern Portugal. Vítor Sá is a Chartered Member of the Portuguese Association of Engineering, a member of the Project Management Institute, member of the Portuguese Association of Information Systems, and holds a Certificate of Pedagogical Aptitude issued by the Portuguese Institute of Employment and Vocational Training. Vítor Sá has participated and published in several international scientific events, having also published several book chapters. The most significant international events in which he engaged as a member of the organizing committee were the Eurographics Symposium on Parallel Graphics and Visualization (2006) and the International Conference on Global Security, Safety and Sustainability (2010). He is currently doing his Ph.D. work under the supervision of Professor Henrique Santos (President of the Security Techical Committee of the Portuguese Quality Institute) and Professor Sérgio Tenreiro de Magalhães, and he is researching in Biometric Authentication. He is member of the Scientific Committe of the International Conference on Cyber Conflic, organized in 2011 by NATO Cooperative Cyber Defence Centre of Excellence, in Estonia, and the International Conference on Cybercrime, Security and Digital Forensics, organized in 2011 in the University of Strathclyde in Glasgow. His e-mail address is: vitor.sa@braga.ucp.pt and his Web-page can be found at https://sites.google.com /site/vitorjssa.