Investigating the Challenges Facing Behavioral Biometrics in Everyday Life

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ABSTRACT

The rapid progress of ubiquitous devices' usage is faced with equally rapid progress of user-centered attacks. Researchers considered adopting different user identification methods, with more attention towards the implicit and continuous ones, to maintain the balance between usability and privacy. In this statement, we first discuss biometric-based solutions used to assure devices' robustness against user-centered attacks, taking the inertial sensor-based gait identification for example. We finally discuss the challenges facing these solutions when integrated with everyday interactions.

KEYWORDS

behavioral biometrics, user identification, gait, inertial sensors

RESEARCH STATEMENT

Smart devices are ubiquitously used. In addition to phones, smart watches and glasses are gaining increasing popularity among users. These devices hold personal and potentially sensitive data that should be kept private. Despite this rapid growth of ubiquitous devices, the human factor remains the main source of privacy and security breaches. For instance, authentication is subject to observation attacks (e.g. shoulder surfing). Additionally, short PINs or passwords are inefficient, while long or complex passwords lack memorability and are prone to errors. Lately, more research is focused on studying behavioral biometrics as a solution to mitigate the human errors. Researchers are expanding beyond typical gait and typing behaviors [2]. Consequently, several novel solutions were presented as an implicit and continuous authentication methods. However, challenges arise for designers who want to integrate these solutions in everyday interactions. We mention in this statement some issues facing the inertial sensors based gait identification methods.

Behavioral Biometrics for Continuous Implicit Identification: Gait Example

According to Jain et al. [1], a typical biometric system first collects biometric data from an individual. Then a feature set is extracted from these data, later to be compared to a set existing in a database. This is basically denoted as a pattern recognition system, that includes both physiological or behavioral traits. There are several systems that rely on physiological traits such as a face and fingerprint. Despite their robustness, these systems are usually unable to seamlessly or continuously identify users.

On the other hand, behavior-based biometrics are capable of providing this continuous implicit identification. For example, inertial sensors-based gait identification. Continuously analyzing the walking patterns from users is proved to be *feasible*, *accurate*, and *usable*. Nowadays, the vast majority of smartphones are embedded with motion sensors such as accelerometers and gyroscopes. Several studies succeeded to identify people through analyzing their distinctive patterns collected from walking, with an identification accuracy rate of 93.7% [4]. Additionally, smartphone-based gait recognition systems are easier to investigate, as they do not require a dedicated setup or location.

Challenges Facing Gait-based Continuous Implicit Identification

There are several elements that affect the gait consistency, and consequently, the recognition. First is the *context understanding*, i.e., an understanding of a context that goes beyond the typical time and location. In a recent study, we conducted a focus group with experts from the biometrics field, and asked them about what external factors affect walking patterns [3]. Based on a level of control of the user upon these factors, we classified the factors as uncontrollable, semi-controllable, and controllable. Uncontrollable situations included different weather conditions, surface types or obstacles in the way. The other levels of control defined another issue facing the accuracy of gait-based identification, which is other *activity recognition*. Being accompanied by a person or a pet was considered a walk with a partial of control. Lastly, participants considered phone interactions (e.g. texting) and carrying objects as causes of change of a person's gait.

Conclusion

In conclusion, we considered gait, particularly inertial sensor-based, as an example for an accurate, feasible and usable continuous implicit identification solution. However, to maintain its accuracy when integrated in everyday interactions, there are crucial aspects to consider. We highlighted context awareness and activity recognition as two concerns to be profoundly studied. We foresee a more complex setup, where a system recognizes the surface the user is walking on, the footwear they are wearing, and the current activity performed to adapt the recognition system to a predicted walking pattern.

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