Poster: Usability Evaluation of Gesture-Based Authentication Using a Mobile Phone

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1. INTRODUCTION

Today, mobile devices are widespread and commonly used. Furthermore, they hold more and more sensitive personal and business data, e.g. photos, calendars, address books, emails, videos and credentials.

Normally, a mobile device is (in the best case) secured by a PIN or password which has to be entered on waking up the device. However, PINs cause a certain memory load, especially, if users are asked to change them regularly. This reduces the usability of the device.

In this paper we evaluate the usability of a biometric method which is expected to reduce memory load, and which is based on three-dimensional gestures performed with the mobile device. The method was presented in [1] and [2]. The difference of the presented work is that we developed a working demonstrator and tested the usability with two different error rates. Furthermore, we evaluate how the recognition error rate influences the usability. This paper is based on an unpublished bachelor thesis [3].

There is already some work published using movement either just to recognize a gesture and use it as PIN entry method [4], or to use natural movements as biometric features ([5], [6]). Closer to the presented work are Guerra Casanova [7] and Farella et al. [8] who use movement characteristics to identify people.

2. DEMONSTRATOR

The demonstrator is an iPhone 4 application build in Objectiv C. It uses the dynamic time warping algorithm and its variations as presented in [2] and [3].

As the recognition rates are not yet sufficient for real world usage and to be able to control the error rates, a simulation mode was added. It allows the recognition rate to be adjusted to a pre-set value, and uses a random number generator to decide whether a trial should be successful or not.

At first startup the demonstrator is in training mode. The user has to train his self-chosen gesture three times by pressing and holding a finger on any position at the screen and performing the gesture. Afterwards, the gesture's model is calculated or (if the three gestures were too different) the user has to train again.

After the training mode, the user can try to authenticate by pressing and holding a finger on any position at the screen and performing the gesture. After he releases the screen the algorithm compares the stored model with the sampled gesture using dynamic time warping and decides whether the user is the correct one or not based on the similarity. The simulation mode bypasses the recognition and returns a result reflecting the pre-set recognition rate. Figure 1 shows two screenshots of the demonstrator.

The demonstrator will be available in addition to the poster.

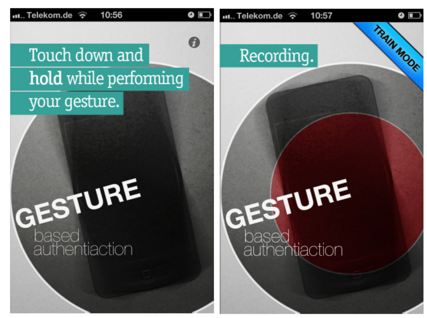

Figure 1: Screenshots of the demonstrator. Left: start screen to authenticate, right: train mode with pressed screen.

3. USABILITY TESTS

A usability test evaluating the demonstrator was performed in the rooms of the Technische Universität Berlin. 18 students (14 male and 4 female) aged between 17 and 31 participated. Except of one candidate all had a dominating right hand.

The test was conducted with two participants in pairs. With this arrangement one demonstrator could be set to simulation mode for one person and another one to realistic mode for the other person. Therefore, two conditions could be tested. In the simulation mode, the success rate was set to 100% (or 0% in the attacking case) to simulate a perfect system behavior while a false rejection rate of around 21% and a false acceptance rate of around 12% were achieved in the realistic mode.

The test was arranged in 5 phases:

1. Explanation of the test arrangement.
2. Getting familiar with the demonstrator.
3. Training and trying to authenticate themselves.
4. One user trains a gesture, while the other is watching and then tries to forge the observed gesture and vice versa.
5. Filling out a questionnaire including questions about the demographics, usability of the interaction, questions regarding the security experience and the SUS [9] (a standard usability questionnaire).

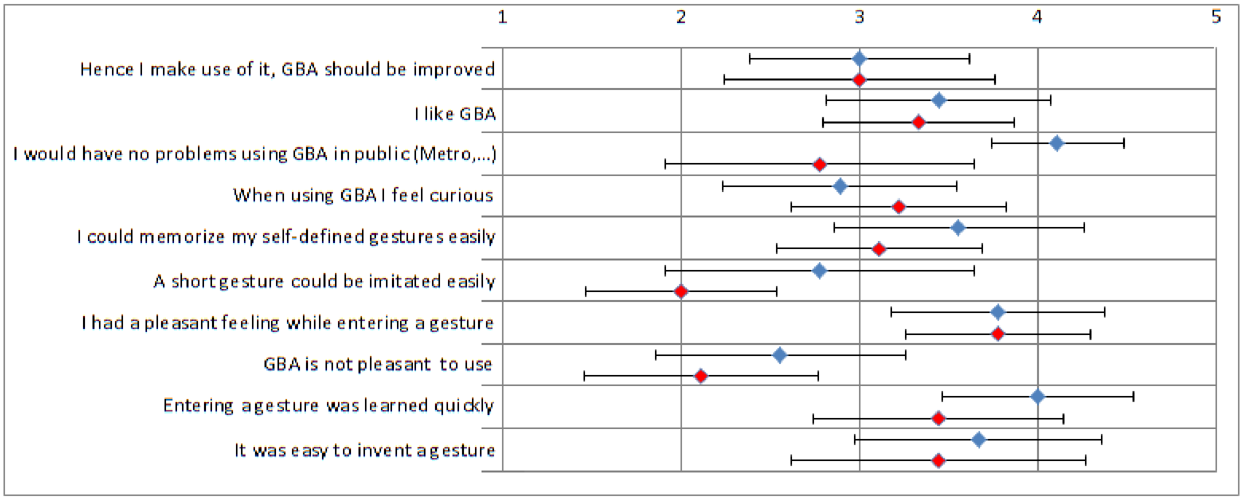

Figure 2: Usability ratings of user group 1 (simulation mode) in blue and user group 2 (realistic mode) in red (1 = strongly disagree, 5= strongly agree).

4. RESULTS

Figure 2 and 3 depict the results of the usability questions related to the gesture-based authentication (GBA). The results are more positive than negative. The users think that creating and remembering a gesture is easy. Furthermore, they find it pleasant to enter gestures. A small rejection can be seen in group 2 if the gesture has to be entered in public, meanwhile group 1 would have no problem with it. Interestingly, the results of the two user groups (simulation mode and realistic mode) do not differ although the error rates differ by around 21%.

The questionnaire included the SUS [9] and even the SUS scores do not differ between the two user groups. Both groups rated the demonstrator with a SUS score of 80 which is between god and excellent according to [10]. Therefore, the actual error rate in the realistic mode seems to not have any influence on the usability. Of course, this should be proven and also tested with even higher (simulated) error rates, because there might be a recognition rate threshold below which the system is no longer usable.

5. CONCLUSION/FUTURE WORK

The usability evaluation with a real demonstrator proved the results of earlier experiments with mockups or even only sensor packages. Even the most critical point of performing a gesture in public is not rated as significantly upsetting as thought.

Furthermore, it was found that an error rate of 20% does not influence the usability; it seems as if this value it is not too high for users, which has to be tested and analyzed in more detail.

Future work will include more usability evaluations, design guidelines for secure and usable gestures, an enhanced recognition algorithm to lower the error rates and to perform experiments to analyze the influence of the error rate on the usability.

6. REFERENCES

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