

Gaze Prints: User Centered Design and Evaluation of an Eye Movement-based Biometric Authentication System

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Usable security technologies

Many current security technologies have serious usability problems. How often do you forget, write down, or reuse a password? How many times have you lost your keys?

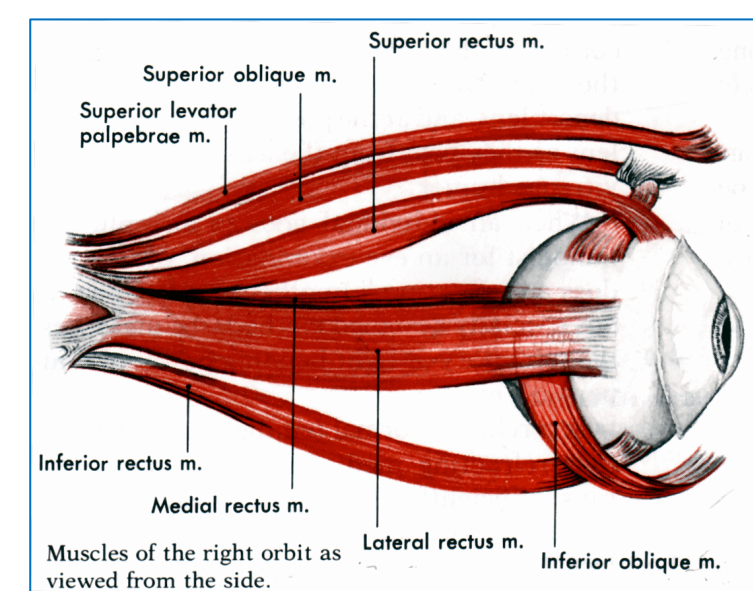
Biometric systems can solve some of these problems but are often still vulnerable to simple attacks. They are also sometimes seen as socially unacceptable. Security systems that are secure, easy to use, and acceptable are urgently needed.

What are gaze prints?

It is hard for someone else to forge your handwritten signature because your hand moves in a unique way as you sign your name. In the same way, your eyes have unique physical characteristics and move in a unique way giving you a *gaze print* that is yours alone.

The oculomotor plant

The *oculomotor plant* is made up of the eye globe and the surrounding muscles that controls the movements of the eye. We use a mathematical model of the oculomotor plant that takes into account parameters of these muscles.



The oculomotor plant.

How does it work?

Registering your gaze print

An enrollment process will register your gaze print with the system. An eye tracker records how you gaze at several items on a computer screen. The system extracts your gaze print from this data and saves it in a database.

Verifying your identity

When your identity later needs to be verified, you repeat this process. The system asks you to gaze at several items on the computer screen. It extracts a gaze print from the new recording and compares it to the gaze print stored in the database. If it matches closely, you are authenticated.

ACKNOWLEDGMENTS AND CONTACT INFORMATION

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Research Questions

1. How can we design usable interfaces for gaze print security?
2. What kinds of problems do users have with existing security systems and would gaze print security be an improvement?



ATMs are familiar and high security, making them a good testbed for gaze prints.

[Wikipedia.org]

Methods

We used a combination of questionnaires, prototype evaluations, and semi-structured interviews to begin to address the research questions.

Participants

We worked with nine participants from the University of Washington, including undergraduate students, graduate students, alumni, and staff.

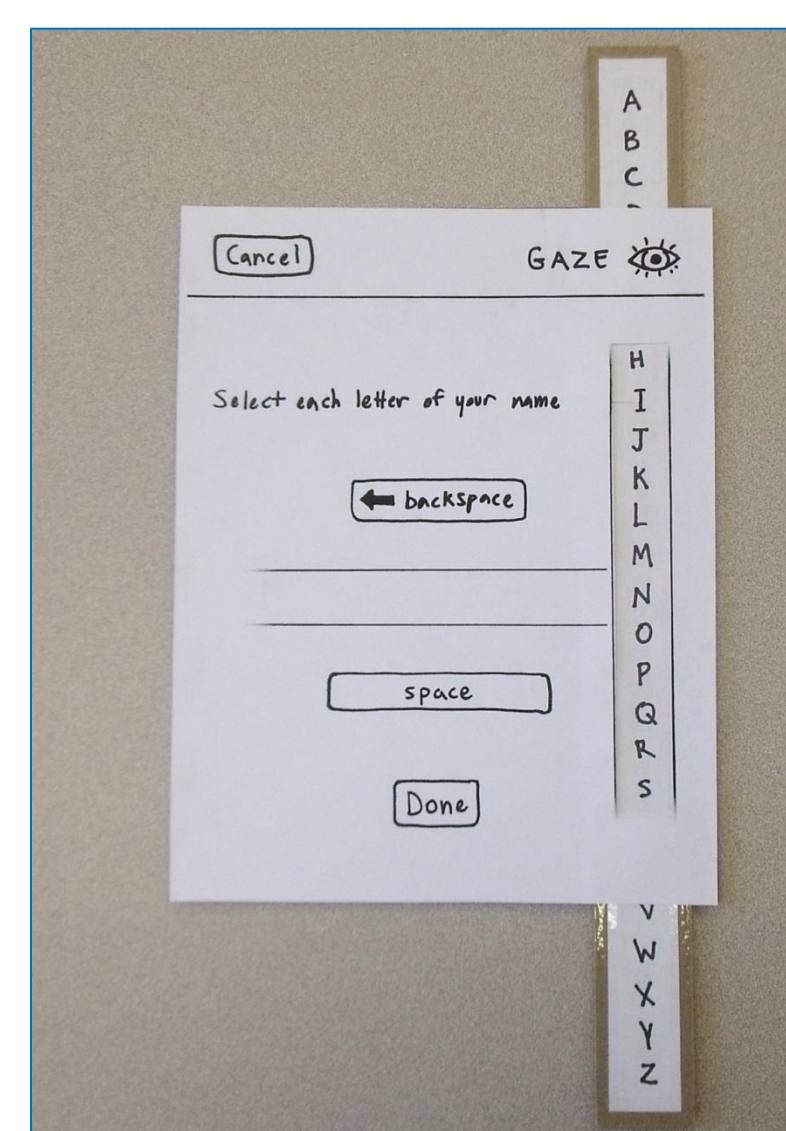
Procedure

We brought each of the participants into our lab for a 1-hour session including:

1. a questionnaire about vision problems and experience with eye tracking and security technologies.
2. a think-aloud protocol eliciting feedback on the prototypes. The participants were asked to make a cash withdrawal using our low-fidelity prototype ATM interface. The prototypes were constructed from paper and heavy cardboard.
3. open-ended interview questions about current security practices and criteria for acceptable security systems.

Prototypes

We developed three paper prototypes as an initial exploration of the design space. Interfaces like these might be used at the ATM to record eye movement data for authentication.



Scrolling ribbon of letters used to enter your name. The ribbon scrolls as you look up and down.



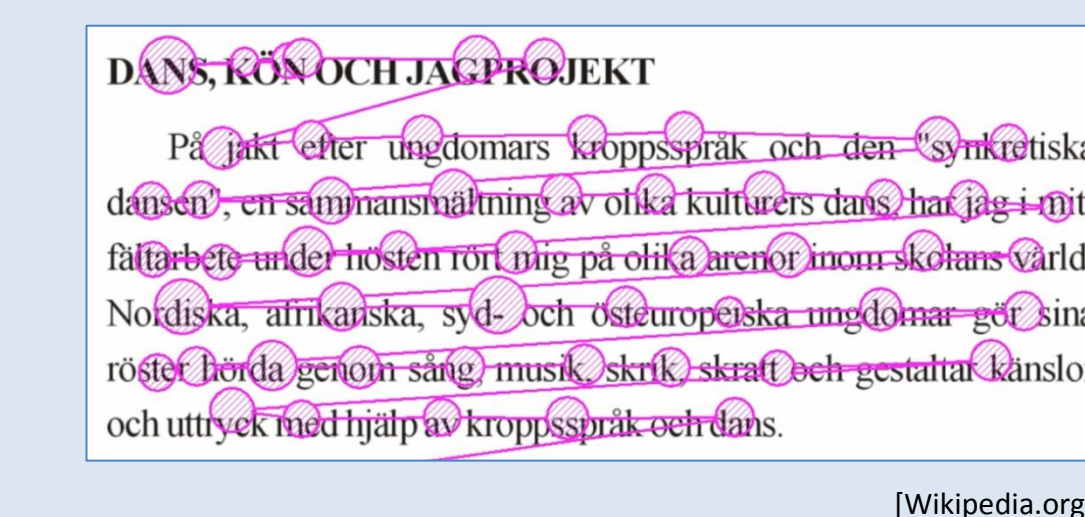
“Eye-type” your name using a standard keyboard.



Letters of your name appear on screen, and you gaze at each one to advance.

Background on Eye Tracking

Eye tracking is used in cognitive studies, human factors research, marketing research, and other disciplines. Most current eye tracking equipment relies on infrared cameras, but soon it may be possible using low-cost webcams.



Eyes move unevenly, in *fixations* and *saccades*.

[Wikipedia.org]

Results

Many of the participants were excited about the gaze print prototypes. From their input, we produced a set of design recommendations.

Design Recommendations

1. Speed is a priority. Make it as fast as possible.
2. The verification step should be clearly identifiable.
3. Gaze-based interaction should be tolerant of inexperienced users.
4. The transitions between touch and gaze-controlled interfaces should be clear and consistent.
5. Visual simplicity is very important for gaze-controlled interfaces.
6. Use predictable gaze patterns, such as from top to bottom and left to right.

Current Security Practices

The participants we spoke to:

1. are fed up with current security systems like passwords.
2. welcome something more convenient like biometrics.
3. but have very limited experience with biometrics

Additionally, many of the participants:

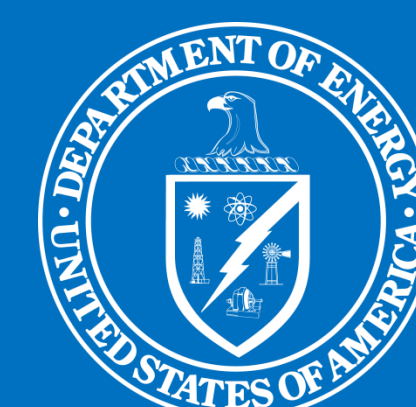
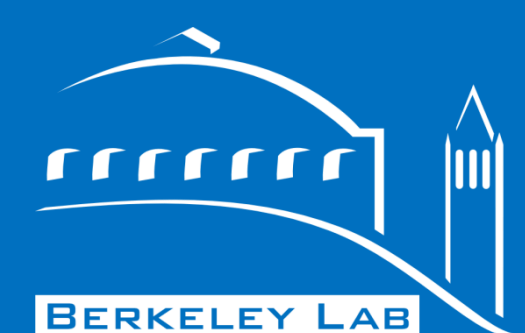
1. knowingly sacrifice security for convenience by writing down or reusing passwords.
2. feel safe from attacks primarily because of a sense that they are not likely targets.

Future Work

Using the results of this work, we will create and evaluate high fidelity prototypes to further refine our designs. We will also compare our system to existing authentication techniques and work to transfer the designs to other contexts besides ATM authentication.



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