School of Engineering and Computing Sciences

User Authentication Using a Haptic Stylus

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Project Overview

Haptic devices can provide tactile feedback to a user by recreating the sense of touch when interacting with objects in a virtual environment. These devices are able to record biometric information, which has proven useful in previous research in user authentication. Using behavioral characteristics can be an excellent form of security because individuals typically exhibit unique behaviors. This project attempts to determine which behavioral biometric features can achieve the best authentication results.

Approach

Our current experiment has the user interact with one of five virtual objects (Figure A). We continuously record information about the interaction, such as the instantaneous velocity of the pen and the pressure the pen exerts on the object. With this data, we create features for the user. For example, a feature could be the average pressure exerted on the object throughout the interaction. We can further classify features depending on different kinds of interactions, such as when the user pokes, or 'probes', the object and when the user 'strokes' the object. These features are then combined to create a template for a user, which are then compared with other users' templates. The goal is to have different users' templates be dissimilar, and to have same users' templates be similar. EER (Equal Error Rate) is a good metric for determining how well an authentication protocol achieves these goals.

Goals

- Determine which set of biometric features achieve the best EER for 'stroke' and 'probe' events.
- Create a reliable authentication system centered around using a haptic stylus.

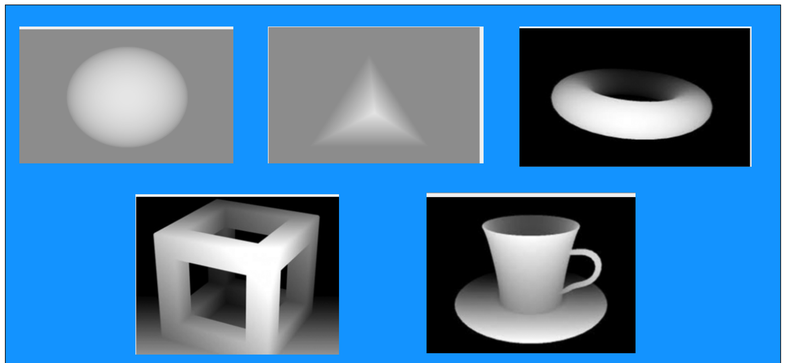


Figure A. Five Virtual Objects: sphere, pyramid, donut, cube, teacup

Figure B. Geomagic Touch haptic pen

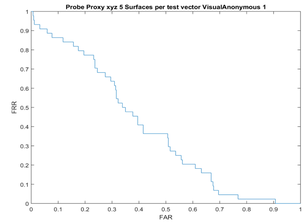
Experimental results

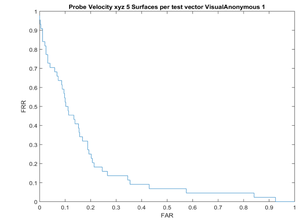
Probe Pressure (Proxy)

Scene type	EER	Genuine Comparisons	Impostor Comparisons
Sphere	0.41	44	440
Pyramid	0.39	79	1027
Donut	0.49	65	910
Cube	0.49	100	1384
Teacup	0.53	181	2714

Probe Velocity

Scene type	EER	Genuine Comparisons	Impostor Comparisons
Sphere	0.21	44	440
Pyramid	0.38	79	1027
Donut	0.42	65	910
Cube	0.33	100	1384
Teacup	0.40	181	2714





Discussion

The experimental results above show that, for 'probe' events, velocity is a consistently better feature to use for authentication than pressure. Similar results hold for 'stroke' events. However, EERs are too high to use for a reliable authentication protocol; an EER of less than 10% is more desirable. Clearly more work is left ahead of us, but this is a step in the right direction.

Future Work

In the current experiment, we either compare 'probe' features or we compare 'stroke' features. However, if we use both features in the same experiment, we will be able to create templates which hold more information about the user, and will thus make it easier to distinguish two users.

In addition, it would be interesting to see the effect of location by providing locational context to the features. For example, with the teacup, this means treating interactions on the handle separately from interaction inside of the cup, instead of mixing them together.

Acknowledgement

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Related Work

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