MEME – Eye Wear Computing to Explore Human Behavior

Kai Kunze
Graduate School of Media Design
Keio University
Yokohama, 223-8526 Japan
kai@kmd.keio.ac.jp

Yuji Uema
Graduate School of Media Design
Keio University
Yokohama, 223-8526 Japan
uema@kmd.keio.ac.jp

Katsuma Tanaka
Graduate School of Engineering
Osaka Prefecture University
Sakai, Osaka, Japan
ishimaru@m.cs.osakafu-u.ac.jp

Koichi Kise
Graduate School of Engineering
Osaka Prefecture University
Sakai, Osaka, Japan
kise@cs.osakafu-u.ac.jp

Shoya Ishimaru
Graduate School of Engineering
Osaka Prefecture University
Sakai, Osaka, Japan
katsuma@m.cs.osakafu-u.ac.jp

Masahiko Inami
Graduate School of Media Design
Keio University
Yokohama, 223-8526 Japan
inami@kmd.keio.ac.jp

Ubicomp/ISWC'15 Adjunct, September 7-11, 2015, Osaka, Japan.
ACM 978-1-4503-3575-1/15/09.
http://dx.doi.org/10.1145/2800835.2800900

Abstract
In this demonstration, we focus on eye wear to assist people, sensing their physical, social and mental activities. Detecting and quantifying our behavior can raise awareness towards unhealthy practices. We use J!NS MEME prototypes, smart glasses with integrated electrodes to detect eye movements, in application cases from reading detection over ergonomics to talking recognition for social interaction tracking.

Author Keywords
Smart Eye Wear; Eye Wear Computing; Glasses; Electrooculography

ACM Classification Keywords
H.5.2 [User Interfaces]: Input devices and strategies.

Introduction
Eye Wear Computing is a new paradigm that gains more and more traction [1]. Most of our senses are situated on the head near the eyes, making it a suitable location for sensing devices. Still head-worn electronic devices (maybe with the exception of hearing aids and mobile headsets) are not common place. We believe that smart devices in the form factor of eye glasses will fill this gap.

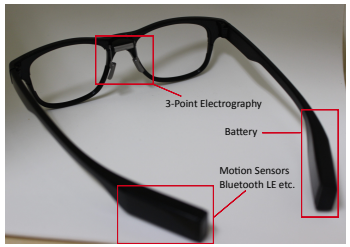

Figure 1: The MEME Prototype

Figure 2: User wearing MEME while reading

We show a couple of demonstrations on an early prototype of J!NS MEME, smart glasses with integrated electrodes to detect eye movements. First, we depict a simple eye movement visualization, detecting left/right eye motion and blink. Users can play a couple of games in which a they need navigate/interact using eye movements. We detect and recognize reading and talking behavior of the user using a combination of blink, eye movement and head motion. People can get a long term view of their reading, talking, and also walking activity over the day. We can also give now detailed word count for the reading behavior and designed a couple of interactions related to ergonomics.

This paper is an extension of our submission to SIGGRAPH Emerging Technologies and shows a demonstration of technology from our UbiComp submission focusing on detecting reading habits [4, 5].

MEME Prototype

The J!NS MEME prototype, sensing eye glasses able to detect head and eye movements we are using for our demonstrations is depicted in Figure 1 [3]. It is has 3 electrodes (electrooculography), 2 as nose pads and one on top of the nose, for eye movement analysis and motion sensors (accelerometer and gyroscope). It can connect over Bluetooth LE module to a PC, laptop, smartphone or tablet. The electrodes are sampled with over 100 Hz, the motion sensor with over 50 Hz. The prototype already has a battery runtime of over 8 hours while streaming sensor data (will be improved). The glasses weigh 32 grams. The glasses don't do any advanced processing of the sensor data, the application logic is implemented on laptop, tablets or smart phones.

Demonstrations

Reading Detection and Word Count

One of the new functionalities we show a word count algorithm based on line-break detection 2. We recognize reading and afterwards detect how many lines a person read to estimate the word count. We apply the algorithm presented in related work [5].

Interactions to Support Knowledge Work

Two of the biggest problems in relation to computer work are dry eyes (also computer vision syndrome) and a too steep head angle. Both can lead to chronic headaches and in severe cases to long term inquiries [6, 2].

To combat computer vision syndrome, we detect if a user is not blinking for a given period of time. If this is the case, the screen slowly blurs forcing the person to blink.

Similar we detect the too steep head angle using the motion sensors in the glasses. If the head angle falls under a given threshold for a longer period of time, we flip the screen contents away from the user. The user needs to adjust the head position to continue reading.

These interactions are by no means unobtrusive so far. They are to illustrate that detection of these states is possible and should spark discussions on how to improve posture with less invasive techniques.

Talking Recognition

In addition to reading and ergonomics support we can also recognize talking. Blinking frequency usually doubles and head motion increases if people talk. Therefore, MEME is equipped with the right type of sensors to detect talking.

Gaze Interactions
The user can try out simple gaze interactions: extreme left and right movements of the pupils as well as eye blinks are detected and can be used to interact with a couple of simple games (e.g. Fruit Ninja or Flappy Bird).

Application Scenarios

Ergonomics seems to be the first and most straight forward use case for smart eye wear. Especially problems with (head) posture, gait and eye fatigue should be easy to detect from sensors on a glasses position.

Education is the second scenario that comes to mind. We can already implement a word count algorithm for reading, giving quantified feedback to students/pupils about their reading habits. They can also easily compare their performance. To support this application scenario more, tracking concentration or attention on smart eye wear would be a killer feature.

Smart eye wear might also help in depression application cases. Severe episodes of depression are usually accompanied with a decline in social interactions. Talking recognition is a first step towards quantifying them.

Conclusion

We introduced an early prototype of Eye Wear Computing sensing glasses (MEME), showed a couple of demonstrations to underline the application cases we see for this new application class.

Acknowledgements

This work is supported in part by the CREST project from JST and JSPS Grant-in-Aid Young Researchers B No. 26730095.

References

[1] Amft, O., Wahl, F., Ishimaru, S., and Kunze, K. Making regular eyeglasses smart. *Pervasive Computing, IEEE 14*, 3 (July 2015), 32–43.

[2] Bonney, R., and Corlett, E. Head posture and loading of the cervical spine. *Applied Ergonomics 33*, 5 (2002), 415–417.

[3] Ishimaru, S., Kunze, K., Tanaka, K., Uema, Y., Kise, K., and Inami, M. Smart eyewear for interaction and activity recognition. In *CHI Interacitity*, ACM (2015), 307–310.

[4] Kunze, K., and al et. Meme smart glasses to promote healthy habits for knowledge workers. In *to be published at ACM SIGGRAPH ETECH*, ACM (2015), 11.

[5] Kunze, K., and al et. Quantifying reading habits - counting how many words you read. In *to be published at UbiComp*, ACM (2015), 11.

[6] Yan, Z., Hu, L., Chen, H., and Lu, F. Computer vision syndrome: A widely spreading but largely unknown epidemic among computer users. *Computers in Human Behavior 24*, 5 (2008), 2026–2042.