Demo: iBlink: Smart Glasses for Facial Paralysis Patients

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Extended Abstract

Facial paralysis is a disease caused by nerve damage, which can make patients lose facial movements. Facial paralysis patients usually have muscles on one side of the face noticeably droop, which seriously impacts the person's quality of life as shown in Fig. 1. Worse still, the eye on the affected side is unable to blink and will become dry and infected by debries, which can incur eye damage even blindness. To the best of scientists' knowledge, the paralysis is due to the pressure incurred by infection in the tunnel containing main trunk of facial nerves, where the tunnel is inside of the people's head termed as the Facial canal.

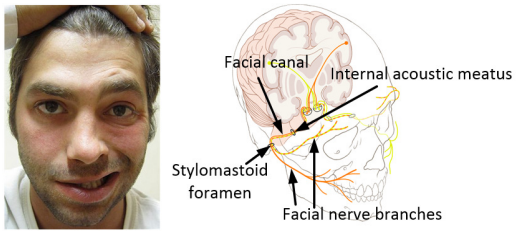

Figure 1: Anatomy of facial nerves.

In this demo, we present *iBlink* [1], a novel system to help paralysis patients to blink. Paralysis usually occurs in just one side of the face, and clinical trials show that electrical stimulation could trigger blink. Based on such observations, the basic idea of *iBlink* is to monitor the normal side of the face with a camera and stimulate the paralysed side, so that eye-movements of the both sides become symmetric.

Several challenges need to be overcome in the design of *iBlink*. First, since different patients require different configurations of the stimulation impulse to enable blinking according to our precedent Medtronic Keypoint electromyography(EMG) clinical trials, the system has to accommodate individual diversity. Second, because the accuracy of blink detection is significantly influenced by illumination conditions, the system has to adapt to varied environment. Third, the system has to be power efficient, which is common challenge for all mobile devices.

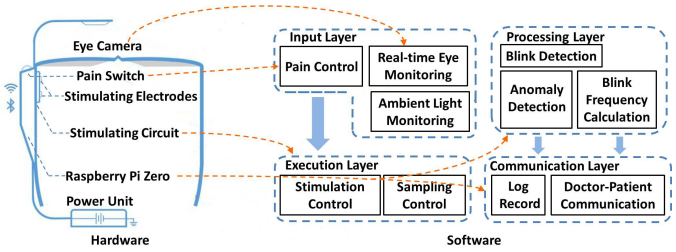

Figure 2: Design of the iBlink system

The architecture design of *iBlink* is shown in Fig. 2. The camera installed in front of the eyes monitors eye-movements in real time. The Raspberry Pi Zero platform processes the images captured by the eye camera, which also monitors the ambient lighting condition. The Raspberry PI Zero and stimulation circuits are located on the patient's paralyzed side of the face, where Raspberry PI Zero and stimulation circuits are in the outer side of the glass frame, and two stimulating electrodes are in the inner side of the frame pressing on the patient's face skin. The Wi-Fi and Bluetooth interfaces in Raspberry PI Zero can be utilized for communication with smartphones.

The software consists of four layers: input layer, processing layer, execution layer and communication layer. The input layer captures the input images and ambient illumination data from the camera and pain control action from the pain switch. The processing layer deals with the data captured by input layer to select day-and-night model, detect anomalous blink, and calculate blink frequency. The execution layer includes stimulation control and sampling control. The stimulation control adjusts the electric stimulation parameters for the patients automatically based on detection results from the processing layer. The sampling control adjusts the sampling frequency of the camera based on the blink frequency calculated in the processing layer. The communication layer collects patients' pathology data and transmits the data to doctors.

1. REFERENCES

[1] S. Xiong, S. Zhu, Y. Ji, B. Jiang, X. Tian, X. Zheng, X. Wang, to appear "iBlink: Smart Glasses for Facial Paralysis Patients," in *Proc of ACM Mobisys'17*.

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