Open Smart Eyewear: From Sensing to Human Amplification and Scaffolding Technologies

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***Abstract*—Human Attention is a finite resource and we need better tools to measure and manage it. We suggest an Open Eyewear Platform, a toolset to quantify social and cognitive functions of individuals and groups of people in real life settings using physiological sensing (e.g. eye movements, blink patterns, facial expressions etc.). This paper motivates smart sensing eyewear as an enabling technology for various application cases from behavior quantification to Human sensory amplification and scaffolding technologies.**

I. Introduction

In an increasingly interconnected world, and with a greater flow of information, more people are having problems with keeping attention and focus. Attention is a finite resource, and we need to use it smartly. We need new tools to better manage our attention, to improve our collective intelligence. There are patterns in human physiological signals (facial expressions, heart rate, nose temperature, eye movements, blinks etc.) that can reveal information about intentions and cognitive functions of an individuals and groups. So far, this data is only heavily exploited by advertisement and marketing companies. This proposal aims at exploring these patterns using an Open Eyewear Platform to better understand our behavior. So, people can optimize for their own personal and society goals. We see this as an integral first step to democratize Big Personal Data and giving the user more control over their lives, living with greater awareness and intention, and giving people more power to achieving their potential. We need better tools for personal and society introspection.

I suggest an Open Eyewear Platform, a toolset to quantify social and cognitive functions of individuals and groups of people in real life settings using physiological sensing (e.g. eye movements, blink patterns, facial expressions etc.) [1], [2]. For example, quantifying the attention level of students while listening to a lecture, can give a lecturer information about effective teaching methods and the individual student a way to introspect and assess his efforts (also compared to his fellow students). After we can quantify these social and cognitive functions, we want to design interactions/ interventions to improve behavior.

In a second step, I also believe that we can use Smart Eywear to amplify our senses. Given the

II. Approach

As humans receive most of their sensory input via the head, it is a particularly interesting body location for sensing and

Fig. 1. Smart eyewear to measure attention and concentration: J!NS MEME commercial sensing glasses.

interaction especially for tracking and enhancing social and cognitive functions [3], [4]. In contrast to Google Glass and early wearable system approaches that just attached devices to standard glasses, we envision exploiting smart eyeglasses for assistance applications through fully integrated sensing, processing, and interaction functions in the regular spectacles design, thus maximizing unobtrusiveness [5].

III. Application Areas

Smart Sensing Eyewear enables a couple of interesting application areas. From ”simple”, ubiquitous behavior quantification to human sensory amplification and scaffolding technologies.

a) Behavior Quantification: focuses on moving social and cognitive analysis from the lab to real life, as well as giving non-technical users a way to visualize the data to better understand their behavior (see Figures 2 1). This phase explores behavior patterns and physiological signals indicative of social and cognitive functions on an individual and group level [6]. There is a lot of related work in cognitive science and psychology, however most research focuses on controlled lab experiments with relative obtrusive equipment and simple tasks (e.g. remembering random wordlists, simple calculations).

b) Human Sensory Amplification: focuses on intuitive interfaces for digital sensing and can also benefit from smart eyewear as a baseline technology. Current sensing technologies complement and exceed the capabilities of the human. For

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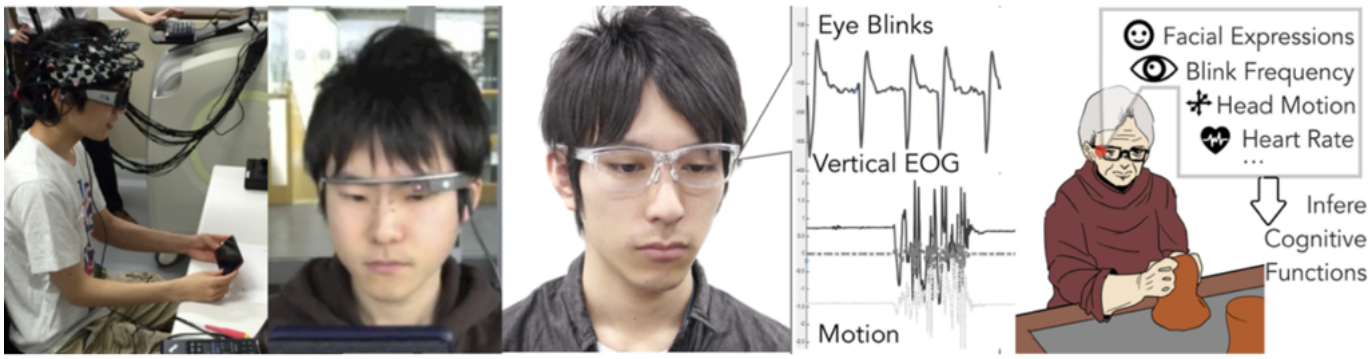

Fig. 2. From obtrusive lab experiments to unobtrusive multipurpose sensing glasses.

example, the visible spectrum of a hum is only a fraction of what a CMOS chip can recognize. Although we have these advances, there is very little research on how to use those sensors in everyday tools carried on our body. We have these set of analog wearable tools (e.g. binoculars) and we already carry digital tools with us (e.g. smart phone). However, their use is by far not intuitive. In this case, intuitive means that we could use additional sensory modalities as extensions of our body. Smart eyewear can help explore physiological signals and other clues about the intentions of a user to make these interactions as seamless as possible, creating superhuman senses.

c) Scaffolding Technologies: train a user to perform better at a specific task with technology. However, the skills the user train also increase when removing the technology. The digital assistants are used only for a training phase and boost the physical or cognitive baseline performance of the user [7], [8]. Especially for cognitive skill sets, eyewear might be a great scaffolding tech [9]. There are indications that we can recognize cognitive load and alertness using sensors embedded in unobtrusive eyewear, enabling novel interventions and interactions for scaffolding during learning and teaching.

Major challenges for these research directions can be summarized as follows. For behavior quantification, establishing clear links between cognitive states and social behavior in everyday life is difficult, especially targeting higher level cognitive functions. The most challenging aspects of Sense Amplificiation lei in interfacing digital technology with our senses. Whereas one of the most critical issues for scaffolding is how transferable knowledge and skill sets are between people and how much the learning experience is individualised.

IV. Conclusion

Overall, I believe that smart eyewear can be an impressive enabling technology from quantifying behavior in real life to creating superhuman senses, systems that extend human sensory capabilities in an intuitive way using digital technology. Such extension would be continuously available and transparent in use. A lot of digital sensor technology is superior to human senses and we employ them already in tools (e.g. heat cameras, radiation sensors, x-ray). However, their use is by far not straightforward. Affordances of using these tools in everyday life are still too high. We can use physiological signals and sensing integrated in the glassses to understand the intent of users and lower these affordances.

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