Poster: Auracle – A Wearable Device for Detecting and Monitoring Eating Behavior

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1. INTRODUCTION

Chronic disease is one of the most pressing health challenges facing the United States (and an increasing set of other countries). The onset or progression of diseases like obesity, diabetes, and metabolic disorder are strongly related to eating behavior, and scientists are still trying to fully understand the complex mixture of diet, exercise, genetics, sociocultural context, and physical environment that lead to these diseases. Health science, however, has no effective means for automatically measuring eating behavior in free-living conditions.

The **Auracle** aims to be a wearable earpiece that detects eating behavior, to be fielded by health-science researchers in their efforts to study eating behavior and ultimately to develop interventions useful to individuals striving to address chronic disease related to eating.

2. APPROACH

In the Auracle project we are developing an electronic earpiece (worn unobtrusively behind the ear) that senses sound (microphone) and muscle activity (EMG) to detect eating activities. While other work has used similar sensors (e.g., [2, 3]), the Auracle aims to monitor eating throughout a waking day, unobtrusively, in free-living conditions. We anticipate the earpiece will have the capability to communicate privately to its wearer through sound; the wearer can respond through intuitive input mechanisms. Finally, the earpiece will offload eating records to the wearer's smartphone for longer-term storage and for richer interactions.

Computational jewelry is beginning to appear in several form factors: bracelets, pendants, rings, and eyewear. Indeed, each location provides distinct opportunities and challenges. We see great promise in an earpiece form factor. First, the ear has long served as a culturally acceptable location for wearable objects, both ornamental (jewelry) and practical (glasses, headphones, hearing aids). Second, the ear is an ideal location for detecting and measuring behaviors relevant to health and wellness, such as eating, drinking, smoking, and speaking. Third, it could offer strong security (biometrically identifying its wearer with vocal resonance [1]). Finally, it provides rich opportunities for unobtrusive communication with the wearer via sound, speech, and touch.

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3. RESULTS

Our initial experiments evaluated several sensors and algorithms to determine their suitability for recognizing eating activities, with a focus on two popular sensors for eating recognition (based on acoustic and electromyography (EMG) sensors, individually and combined). We built a data-acquisition system using two off-the-shelf sensors and conducted a study with 20 participants. In controlled laboratory experiments, our preliminary results show that this system can detect eating with an accuracy exceeding 90.9% while the crunchiness level of food varies.

Our initial wearable prototype embeds an Arduino platform in a comfortable elastic headband (Figure 1); this prototype will allow us to conduct experiments in a broader variety of settings and with a broader variety of food types. The poster includes preliminary results of these experiments.

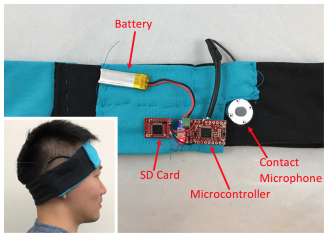

Figure 1: Wearable prototype

With the Auracle device unobtrusively mounted behind the participant's ear, we can enable extended experimentation in free-living conditions in support of health science. Please follow us at auracle-project.org.

4. REFERENCES

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