HABits Necklace: A Neck-worn Sensor that Captures Eating Related Behavior and More

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Introduction

➤ We present the design of the HABits necklace, a neck-worn device that estimates behavior.

➤ This neck-worn device is continuously evolving to provide researchers with the ability to use it in multiple applications including eating, gesture, and activity recognition.
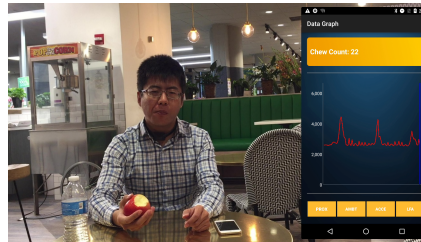
System

Sensor Design

➤ Proximity Sensor (VCNL4010)
a) points towards the user's chin,
b) captures the changes of the distance between the chin and the necklace when the user chews.
➤ Ambient Light Sensor (VCNL4010)
a) Placed around each subjects neck.
➤ Inertial Measurement Unit (BNO055)
a) calculate the amount the user leans forward and back.
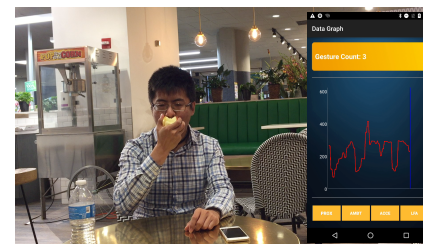➤ Real-time Clock
➤ Bluetooth Module
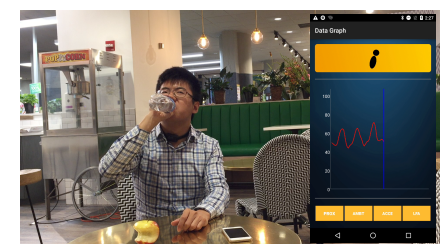
Eating Related Behavior

Chewing

The proximity sensor signal shows 3 bites and 2 chewing sequences between the bites with a chew count of 22.
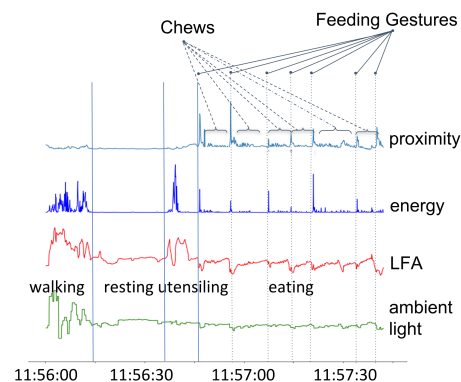
Gesture

The three dips in the ambient light sensor signal correspond to 3 feeding gestures as the participant places his/her hand close to the mouth.
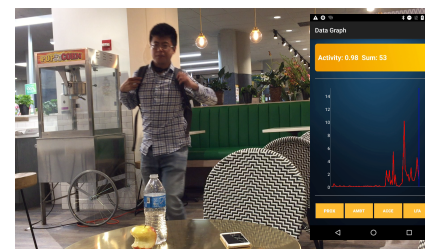
Lean Forward

The animation on top shows the posture estimated from the IMU. The lean-forward motion often corresponds with a feeding activity, while the lean-back motion corresponds with a drinking activity.

Example of signals

Activity Intensity

Activity intensity, calculated from IMU data, can inform us when users are moving and at what intensity level, to offset calorie need

Conclusion

➤ We present a demo of a necklace that is equipped with four sensing modalities (proximity, ambient, and inertial sensing).

➤ We show the feasibility of the necklace in characterizing chews, feeding gestures, posture, and activity during an eating episode.

➤ The necklace also streams data in real-time to an app for processing and visualization.