StandOuter: Interactive outerwear for improving posture using self-conscious feelings

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Abstract
People adopt various habits in their lives. They sometimes got into negative habits that adversely affect their health. To cure the negative habits, people need to recognize the habits in real-time, and keep motivation of improvement in long term. In this study, we focus on negative habits of postures (e.g., standing/sitting postures). We propose a wearable system, "StandOuter", which helps people improve negative habits of postures in consideration of the eyes of others.

Author Keywords
Negative habit; posture improvement; wearable device; third person.

ACM Classification Keywords
H.5.m [Information interfaces and presentation (e.g., HCI)]: Miscellaneous

Introduction
People adopt various habits in their lives. There are both positive and negative habits. As a positive example, Breslow[1] reported seven health habits, which improve life duration and health condition. Meanwhile, there are also negative habits, which possibly damage health condition. People often have difficulty to improve negative habits, since these habits occur unconsciously. To solve the problem, we focus

on the eyes of third person; that is, by presenting negative habits of a user to a third person, the user might obtain opportunity to improve habits in two aspects: (1) advice by the third person and (2) notice by the self-conscious feeling.

As a specific habit, we focus on habits of postures, since poor posture often damage health condition (e.g., stiff shoulder and low back pain) in daily lives. In this study, we propose an interactive outerwear, StandOuter, to improve posture using self-conscious feeling. The system detects poor posture using an inertial sensor, and presenting it to a user and a third person. We consider four feedback methods for behavior improvement as shown in Figure 1. There are two axes of "timing" (real-time or later) and "target" (self or third person). For example, most of commercial services (e.g., Nike+*) visualize amount of exercise using graphs, which mainly focus on later timing and self target. In this study, we mainly focus on real-time timing and third person target, which have not attracted much attention. We also explore to integrate four feedback methods and verify suitable feedback methods for improving negative habits.

Related Work

Recently, many research projects on posture improvement have been proposed. Shin[2] developed system to improve postures through third persons; that is, when the system detects poor posture of a user, the system locks a smartphone of a third person. The person needs to contact the user to unlock the smartphone. Harrison[3] developed system called "Lean and Zoom", which aims to prevent poor posture of a user while using a computer. Specifically, when a user leans forward, the system changes the size of the contents(e.g., web browser) larger. Our system focuses on improving postures in daily lives using real-time feedback for both a user and a third person.

*http//www.nike.com/jp/ja_jp/c/nike-plus

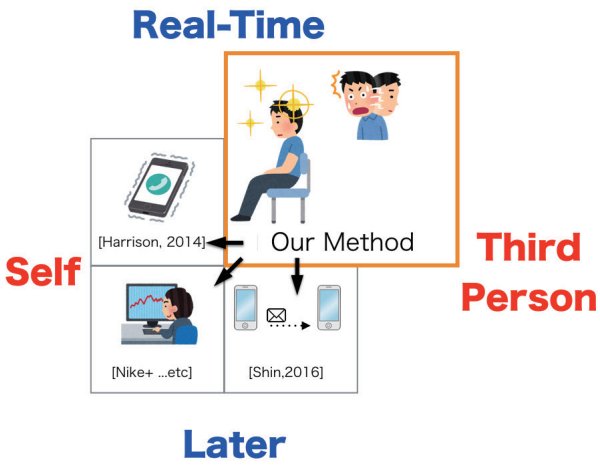

Figure 1: Classification of feedback methods for behavior improvement.

Judging Policy of Posture

In this section, we explain our judging policy of posture. Nakamura[4] reported that the boarder of "good posture" and "poor posture" is ambiguous, and there are no clear judging policy of good/poor postures. Therefore, we performed a preliminary survey to define judging policy of postures. First, we prepare 7 pictures of a same person shown in Figure 3, in which his back come to lean forward gradually (by 10 degree). We show these pictures to subjects and ask them to (1) select the border of poor/good postures and (2) answer impression of each posture. We recruited 9 subjects (6 male, age 19-23).

The results of the first question (boarder survey) are shown in Figure 2. The border of good/poor postures is dispersed between 10 degree and 40 degree, and most subjects put

the boarder on 30 degree and 40 degree. Next, we show the result of the second question (impression survey) in Table 1. The impression of posture (good/poor) is generally in proportion to social impressions (e.g., Insincere/Sincere, Unsociable/Sociable, Uncomfortable/Comfortable). The result shows that when the subjects look poor posture, they tend to think these postures are inappropriate in social meaning.In this paper, we focus on the posture in social meaning, and define the boarder of good/poor postures is about 30 degree.

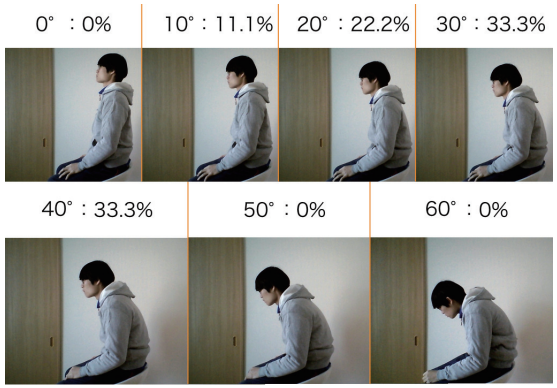

Figure 2: The pictures and results of the preliminary survey.

Table 1: The results of the impression survey.

Question	0°	40°	60°
Good Posture - Poor Posture	5.0	1.7	1.0
Insincere - Sincere	4.9	2.0	1.6
Unsociable - Sociable	4.2	1.9	1.2
Uncomfortable - Comfortable	4.7	1.6	1.2

StandOuter

We propose an interactive outerwear, StandOuter, to help a user improve posture using self-conscious feeling. The system detects posture state using an inertial sensor, and presenting it to both the user and a third person using multiple LEDs. The system also records posture state for future review. We designed the system as an outerwear in consideration of usability of daily environment. A user can control StandOuter using a smartphone application.

Implementation

In this section, we explain the StandOuter prototype. The prototype mainly consists of an outerwear-type device and a smartphone application.

The outerwear-type device includes a microcomputer (BlendMicro) , 6-axis inertial sensor (MPU-6050), two full-color LED tapes and a battery (Figure 3). The BlendMicro has built-in BLE (Bluetooth Low Energy) module.

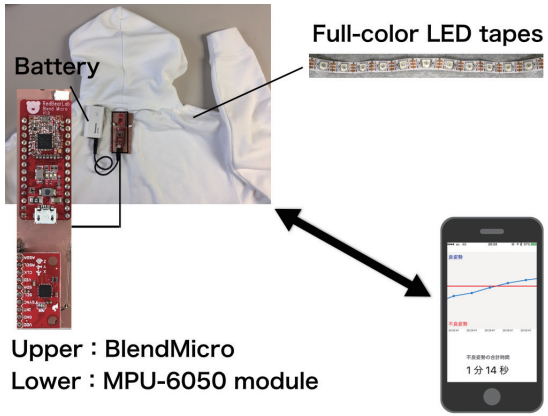

Figure 3: System Configuration.

We attached the inertial sensor on the upside of the back

to detect poor posture based on the angle of the back. We also attached the microcomputer and the battery around the sensor. These devices can be covered with the hood of the outerwear for clean appearance. We sewed two LED tapes inside the both sleeves in consideration of the visibility for both a user and a third person.

The BlendMicro receives the sensor data (3-axis acceleration and 3-axis angular velocity) from the inertial sensor. Then, the BlendMicro calculates the back angle based on the data and compare the back angle with the threshold. When the posture state is judged as "poor posture", the BlendMicro starts to flash LED tapes to present the state to the user and a third person (Figure 4). The back angle and posture state are also send to the smartphone.

The smartphone application has some functions to control the outerwear-type device, such as (1) start/stop the measurement, (2) change threshold of posture judgement, (3) record posture state and back angle, (4) draw graphs of past data for future review. A user can optionally check the time/duration of "poor posture" using the graphs.

Figure 4: Usage example of the system.

Conclusion and Future Work

In this paper, we propose an interactive outerwear, StandOuter, to improve posture using self-conscious feeling. The system detects poor posture using an inertial sensor, and presenting it to a user and a third person. Our feedback methods mainly focus on real-time timing and third person target. In the future, we will explore to integrate four feedback methods shown in Figure 1 and verify suitable methods for improving negative habits.

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