Smart-Chairs: Ubiquitous Presentation Evaluation Based on Audience's Activity Recognition

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ABSTRACT

In this paper we use ubiquitous smart-chairs to evaluate live presentations. We validate the hypothesis that the audiences' activities can be recognized with pressure sensors under chairs' legs (74.6% accuracy rate from 8 typical activities in 8 live presentations, each with 6 chairs seated), and certain activities (e.g. talk, take notes) are linked to the audiences' subjective attitudes and evaluation of the presentation, moreover, the combinations of interactive activities like *Talk-Take Note*, *Nod-Laugh* and *Take Note-Laugh* are well linked to a positive rating of the presentation.

Categories and Subject Descriptors

I.2.1 [**Computer Methodologies**]: Artificial Intelligence—*applications and export systems*

General Terms

Design

Keywords

Smart Chair; Activity recognition; Presentation evaluation

1. INTRODUCTION

People usually spend much of their awake time on chairs: working in office, studying in library, having meals and entertainments; a lot of group and interactive activities take place on chairs: attending a lecture or conference, participating a meeting, watching a film and having dinners together. Much information can be extracted from a single chair, such as sitting postures and actions, but multiple chairs could tell more about group and interactive activities. There have been psychological evidences that particular actions of an individual could be driven by its emotions[2]. We developed a ubiquitous smart-chair system, with a group of chairs equipped with pressure sensors, to evaluate some typical group/interactive activities from live presentations, and studied the links between those activities and the audiences' attitudes towards the presentations (Fig. 1). Main contributions include:
1) High precision and dynamic range
2) We show that the system is able to recognize 8 interactive activities (e.g. *Talk*, *Nod*) from multiple people in parallel.
3) We validate the hypothesis that certain activities and the combination of multiple interactive activities are linked to the audiences' attitudes towards the presentation.

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2. STATE OF THE ART

The positive and negative ratings of a presentation are dependent on the audiences' attitudes and emotions. Cameras and microphones are commonly applied to recognize facial expressions and speech tones, but those usually raise privacy issues, and are not suitable in dark and noisy environments. Some biosensors are available for emotion detection[5], but they are neither practical nor convenient in a presentation which involves many audiences. Recognition of simple sitting postures and single daily activities based on smart chairs are studied in [1]. In [3] by using pressure sensors on a chair and accelerometers on the body, some emotions were studied from sitting postures. In [4] a system to recognize group emotion by synchrony of body sways is developed.

3. EXPERIMENT

The ubiquitous smart-chair system is composed of normal office chairs equipped with 4 pressure sensors under the legs, which is make of a commercial available force sensing resistor(model 402 FSR, Interlink Electronics) and a 3D-printed plastic container, fitting the film sensor under chair leg and expands the measuring range. The pressure is mapped to resistance then to voltage by a voltage divider and sampled by 24 bit ADC at 38 Hz. The overall noise level of the analog circuit is 0.56 mV(RMS).

We invite students to give talks ($\sim$ 20 minutes with 10-15 slides) in a meeting room, with 7 sensor-chairs placed around the table. After each presentation the printed-out slides with a questionnaire are distributed to the audiences to collect their ratings toward each slide. No restrictions are posed on either the presenter or the audiences as long as they remain seated during the presentation, and we tried to invite always the same audience. The talks are recorded with two fisheye micro-cameras for later manual labeling. In total, we carried out 8 presentations with altogether 11 subjects (4 females

Figure 1: the experiment setup

and 7 males, age between 22 and 34 years) attended, 7 of which attended at least 5 presentations. Combined length of all the presentations is 2.9 hours and 114 slides in total.

4. DATA EVALUATION

We divided the activities in talk into 8 classes, some of them involve interactions between audiences or presenter: Sit still, talk, laugh, take notes, shake leg, use laptop, and other small actions.The evaluated activities which involve body motions are detectable from the sensors, partly or combination of subtle body motions result in pressure change in pressure sensors. We apply a window of 4 *sec* moving in a step of 0.5 *sec* over the data stream, for each window we calculate 59 of features for each chair in time and frequency domain. The features used are simple, e.g. mean, RMS, mean crossing rate and etc. Random forest classifier is applied, with a half-half division on dataset as training and testing. The system is able to recognize the activities of the audiences in live presentations, with an average accuracy rate of 79.6% for knowing the subjects, and 74.6% for subject-independent case.

We then explore the relations between those activities and the slides ratings. We apply the activity labels and the slide changing time, to determine what typical activities occur during a particular slide, and combine with the feedbacks of slides ratings to evaluate the links between these activities and normalized slides ratings. It is discovered that when some interactive activities(*Nod*, *Laugh*) during the slides occur, the evaluation values are more positive than negative (viz. the audiences show higher tendency to give positive ratings to the slides). We further evaluate the combination of multiple activities with in each slide. The combinations of interactive activities such as *Talk-Take Note*, *Nod-Laugh* and *Take Note-Laugh* present positive evaluation values, and other combinations of interactive activities like *Talk-Nod* and *Talk-Laugh* present more positive than negative evaluation values, while *Take Note-Shake Leg* and *Shake Leg-Laptop/smartphone* show a negative trend. As the slide ratings represent how much the audiences are attracted in the presentation, those combinations can help evaluate presentations. The results are shown in Figure 2.

5. CONCLUSIONS

This paper investigates the possibility of using ubiquitous smart-chairs to evaluate live presentations. The exploration of slide ratings from 8 presentations and the labelled activities validates the hypothesis: occurrence of interactive activities such as *Talk*, *Nod* and *Laugh* are relevant to slide ratings and the activity combinations such as *Talk-Take Note*, *Nod-Laugh* and *Take Note-Laugh* are well linked to a positive

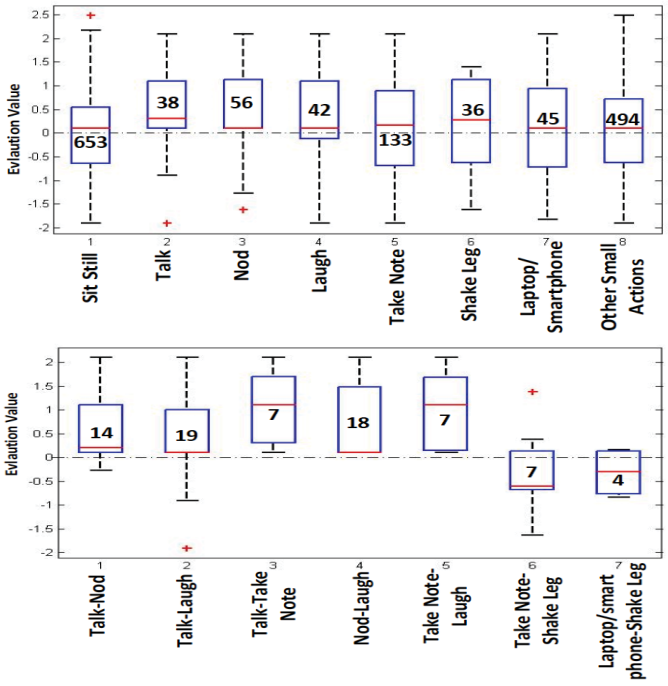

Figure 2: Evaluation values and activities: (top) single activity;(bottom) combinational activities, the value on each box is the times of occurrence)

rating of the slides. With the subject-independent accuracy rate of 74.6% in recognizing these activities, our system is able to help evaluate presentations.

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