Motion Log Skateboard: Visualizing Pressure Distribution of Skateboarding

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Abstract
Skateboarding is an extreme sport that is consists of various trick performances. You can control your board with various foot movements, and slip over the obstacle with the board. In this research, we provided a Motion Log Skateboard system that visualizes the pressure distribution of the foot on the board. A customizable pressure sensor sheet was attached to the top of the skateboard deck, and the distribution of pressure was imaged and reproduced along with the recorded video in smartphone App. We have focused on visualizing non-visible information of body movement, which is not easily observed but acts as important elements in sports activity. We expect that the providing these kinds of information through the interactive technology will encourage discussion on the body movement and induce people to share their boy movement with others.

Author Keywords
Sports interaction; representation; movement; body; perception; skateboarding; sports learning;

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

Introduction
In sports training or learning, proper logging and analysis of body movement are considered useful.

Because understanding one's own body movement can affect performance, safety, and even motivations [6]. Recently, the popularization of smartphones has enabled people to review their sport activities with various sensors high-quality video cameras. Smartphone cameras are used to record and analyze movement in sports, not only by professional athletes but also ordinary people who enjoy sports in their everyday lives. By playing back the recorded video at various speeds, people can carefully review how they moved. They can also upload logs of their movement to the Internet to discuss their body movement with others and consequently improve their performance. Despite these advantages, however, existing video recording has clear limitations in terms of obtaining information. Information from video recording is limited to observation of the external appearance of the body. However, the information the user actually desires is non-visible in nature and difficult to perceive through external observations, such as video recording. In this research, we focused non-visible information on body movement during skateboarding, which is hard to collect with existing video recording. By developing the Motion Log Skateboard system, pressure distribution on a skateboard deck, the primary element in skateboarding, was logged and provided along with recorded video. Based on this additional information, we expected skateboarders to be able to enhance understanding of their body movements in their skateboarding trials.

Related Works

Various studies on human–computer interaction (HCI) have focused on providing body movement information through modality transfer. Pijnappel proposed four design themes for skateboarding trick training by projecting traces of skateboarding on the wall. They explored various approaches for providing feedback on skateboarding [4]. Park developed a snowboard deck that can provide real-time visual feedback on weight distribution. It has the limitation of being a visual distraction; however, this feedback may be a hint for exploring body movement while snowboarding [1]. By sonifying a golf swing and visualizing the balance of each foot during jogging, Nylander presented advantages in mirrored feedback for sports [5]. Eventually, providing information on body movement through interactive technology can be beneficial in a way of enhancing performance, hedonic experience, and learning sport.

Skateboard

Skateboarding is a typical extreme sport where a person rides a wooden deck with four wheels. A skateboarder performs various tricks by controlling the feet and weight balance in short time intervals. Thus, the movement of the feet is an essential element in skateboarding. However, even if the skateboarder knows the mechanism of controlling the feet, a long time and many attempts are needed to learn a desired trick. In addition, the time of performance is relatively short at around 1 or 2 s, and the movement should be very precise, so it is hard to gain information from ordinary observation method.

Motion Log Skateboard

For Motion Log Skateboard, we chose to provide the pressure distributions on the skateboard deck synced with smartphone video recording. With this, the user can get information on the positions, pressure, and timing of the movement for the feet.

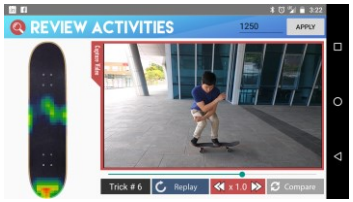

Figure 2. Single review mode of Motion Log Skateboard app

Figure 3. Comparative review mode of Motion Log Skateboard app

Hardware

Figure 1 shows the hardware of Motion Log Skateboard, which consists of customizable sensing and Bluetooth communication parts. A snowboard (Arduino kit from Kytronix) that had been optimized for a sensing pressure matrix was used to calculate the sensor data [3]. An RN42 Bluetooth module was selected to send the data to a mobile device. Two sheets of Velostat and 5 mm copper tape were used to make the pressure sensor matrix [2]. In the current prototype, 10 horizontal nodes in 15mm intervals and 16 vertical nodes in 50 mm intervals were used to collect pressure data from 160 points. This pressure sensor matrix has the advantages of thinness (less than 1.5 mm), ease of installation on an existing skateboard deck, and no effect on the safety or performance of the board.

Software

VISUALIZATION

The pressure distribution was visualized in heat-map style and overlaid on the skateboard image, as shown in Figure 2. Higher pressure appears as red, and lower pressure appears as blue, so the user can confirm the distribution intuitively. Based on the sensor data of 160 points, the pressure distribution image is visualized as 20 × 64 cells for better understandings of foot shapes.

SINGLE REVIEW MODE

Figure 2 shows the single review mode, in which logged data can be reviewed as recorded video and the pressure distribution. We decided that the orientation of pressure data should be aligned with boarder's first person's point of view. Sensor data and recorded video are synced and controlled by a timeline interface so that the user can analyze his or her body movement at various play speeds.

COMPARATIVE REVIEW MODE

Figure 3 shows the comparative review mode, in which two sets of logged data are played at the same time so that they can be compared. The user can play their logged data for the movement of a trick with another person's movement, such as a coach, colleague or even their past trials. Basically, the comparative review mode has a similar timeline interface with that of the single review mode. However, the two sets of logged data can be controlled simultaneously. In addition, the timeline of each set of logged data can be controlled individually to

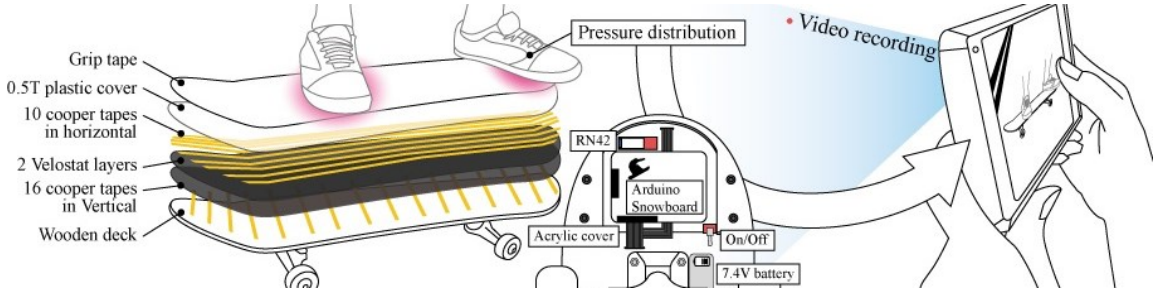

Figure 1. System structure and hardware settings

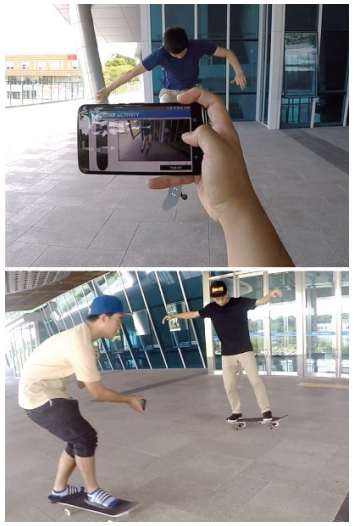

Figure 4. Interaction Scenario of Motion Log Skateboard.

help users compare their movements by matching the starting points of the performed trick.

Interaction Scenario

Interaction scenario of Motion Log Skateboard system can be predicting as follows. First, the skateboarder will want to see how his foot moves while performing his skills, and how this affects the movement of the board. After connect their skateboard with smartphone, they will record their skateboarding trials by using a smartphone camera (Figure 4). After the recording is completed, the user can study about their body movement with pressure distribution and video recordings of their trick. They can also discuss their trials with their instructor or friends. By using the comparative review mode, it is also possible to confirm the degree of growth of the user by comparing the trials in the past.

The second usage scenario is as follows. User can obtain know-how of trick performance by downloading the trials of others, not only just studying their own trials. For example, in case of kick flip, jumps and turns the board one turn and lands again, timing of foot position and snapping with ankle are important factors. Users will be able to download pressure distribution of an advanced skateboarders, and continue to study trick by comparing it with the information they have performed.

Conclusion

We developed a novel system that can record and share the movement of a skateboarder's feet on a deck. This non-visible information on the body movement, which was hard to be perceived by oneself, is visualized in an objective manner so that the performer and observer can easily share the performer's body movement.

ACKNOWLEDGEMENT

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