RunRight – Real-Time Visual and Audio Feedback on Running

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Abstract
RunRight is a system that gives two different kinds of feedback for runners. First, it creates a visualization of the running movement based on acceleration in vertical and horizontal direction. Second it gives audio feedback on the rhythm. These two types of feedback are valuable when exploring how to design technology that supports athletes in learning how a desired movement should feel.

Author Keywords
Running; rhythm; representation; feedback

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

Introduction
A key skill for athletes to develop is the perception and awareness of how they are moving and how that links to their performance. Coaching aims to support athletes to develop a 'feeling' of the desired movement. Many sports use training devices and methods such as golf clubs with whippy shafts, cross country skiing without ski poles, and tools such as mirrors & video capture, along with performance measures such as time, speed and distance. We explore how widely available sensor-based mobile technology can play a role in supporting

athletes in the process of developing awareness of their technique in sports.

To further study how we can create feedback on movement in sports we developed RunRight, a system that gives feedback on running technique. RunRight was implemented as an Android app that used a wearable sensor sending data to the phone, and generated and displayed graphical feedback on the phone. The sensor used was the Zephyr body harness 3 (see figure 1), a heart-rate monitor with built in accelerometer and breathing sensor, and Bluetooth capability for data transmission.

Figure 1: The Zephyr heart-rate monitor with built in accelerometer.

The exhibit

At the exhibit, we will allow visitors to wear the system and try it out. It is easy to outfit people with the heart rate monitor, clothes does not need to be taken off. We aim to display the visualization on a larger screen to allow the audience to see it, thus making it possible for people who are not wearing the sensor to understand how the system works. Sound feedback will be played through loud speakers. Since the heart rate monitor sends data to the phone, the person wearing the sensor does not have to hold the phone or be very close to the phone which is generating the visualization and the audio.

Furthermore, we intend to allow people to download the app to their own android devices and borrow heart rate monitors for their regular runs during the conference, thus allowing them to experience the system in natural settings. We intend to bring 8-10 heart rate monitors, and also use them on the proposed SIG Jogging with Technology.

Related work

There is little previous work on sports in the CHI community. Related work mostly concerns health applications aiming to promote physical activity [1, 2], or systems supporting the social aspects of sports [3]. Notable exceptions are Stienstra et al.'s system for speed skating [5] and Spelmezan's system for snowboard instructions [4].

RunRight design and implementation

We started with an idea generating workshop where we set endurance, speed, and running technique as the domains for ideas to open up the design process. From 13 concepts, one concept targeting movement analysis of the step and feeding it back to the runner was chosen. In particular, we choose to address the directions of the acceleration in the stride, and how to design interaction that allows for reflection on that.

As a follow up activity we ran a second workshop exploring different motives for running, with elite as well as recreation runners, researchers, and interaction designers as participants. Goals and motivations were surprisingly similar: have a good feeling when I run, improve my performance, feel good about myself. We did of course also see differences such as recreational runners who run to be able to eat good food without guilt, and elite runners having the goal of becoming world champion.

The conclusions from the workshops were:

1. The most interesting aspect to design for was how runners move their body and how "well" they run, i.e. try to support their running technique.

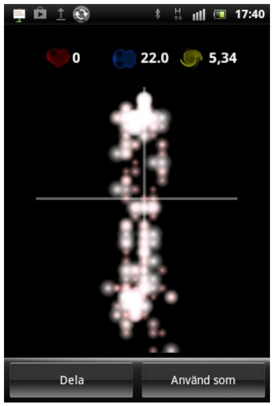

Figure 2: Example visualization of a person running slowly. The star cloud is narrow and collected.

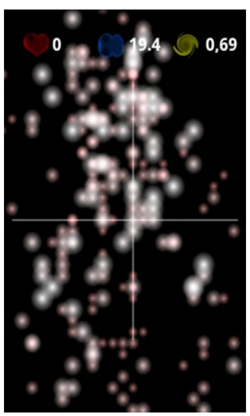

Figure 3: Example visualization of a person running fast, losing their technique. The shape disappears and stars are covering the screen.

2. Many goals and motivation factors were related to how it feels to run, or how the participants wanted it to feel. For these purposes, corrective feedback is not very productive.

These conclusions were fed into the system design and made us opt for two main functions, visual feedback on the movement and audio feedback on the rhythm.

Visualization of running

We chose a visual user interface since it is a modality that is easy for users to understand. Visual user interfaces might not be universally suitable for sports, but we collaborated with elite orienteerers who are extremely skilled in processing visual information while running.

Since the data we chose to represent, acceleration in horizontal and vertical direction, are data that is not traditionally used for feedback on running or other types of movement, we opted for a modality that would be easy for users to understand and interpret at the very beginning.

We implemented a non-interpretive visual representation where each accelerometer reading is mapped to a star in a two dimensional grid, see figures 2 and 3. The system does not interpret or value the data in any way, but lets users create their own interpretation.

The visualization is created during a ten second window and shows the acceleration in the horizontal and the vertical plane. Stars go paler and fade at the end of the ten second window. The system logs data on the phone to allow post-analysis if desired.

Axes were adjusted after initial testing since even moderate runners placed many data points outside the screen in the vertical direction. We still decided to keep the axes fixed instead of implementing dynamic axes since acceleration varies a lot according to speed, terrain, running style, and technique, and we wanted this difference to be visible in the user interface.

When users are running slowly, i.e. with ease, the system generated a narrow pillar-like shape, while running faster creates a wider shape. When runners lost their technique, stars were generated all over the screen in no particular pattern.

User Experiences

Six runners have tested the system in pairs, by having one person running and another watching the visualization. They all found it easy to understand the cloud and what it represented, and felt that it mapped well to their understanding of their running. However, there are many aspects of the running that is not visualized in the cloud, and participants were interested not only in the differences they saw in the cloud when someone was running with a lean to the side or waving their arms a lot, but indications on which changes in their movement actually produces a certain change in the shape of the cloud. For example, was the cloud leaning to the right because the torso was not straight or because the push with the right leg was too weak.

Modality and multi-modality

Participants also imagined the star cloud being difficult to interpret while on the run. They speculated in that turning it into a solid shape would make it easier to interpret at a glance, even though the representation of time would be lost if the effect of stars fading over time would be eliminated.

Combinations of modalities were also proposed. For example, adding audio or tactile feedback to the cloud alerting users when the cloud goes too wide or starts to lean to the side. With such alerts implemented, one would think that the visual cloud would be unnecessary. However, we believe that the visual representation still fulfills an important function in that it helps users understand what the audio or tactile feedback is based upon.

Audio feedback on the rhythm

The second part of the functionality was implemented as a 'metronome', a device used in music to give a steady tempo. Our application gives users a beep rhythm and runners should put one foot to the ground at each beep. The rhythm can be set to shuffle within an interval, thus guiding runners to a varied step frequency, or to a steady pace helping users to keep an even pace.

Our purpose with the audio feedback was to allow us to explore a different kind of feedback compared to the visualization described above. While the visualization lets users make their own interpretation without trying to guide runners to a certain movement, the purpose of the audio feedback is for users to follow the given rhythm. We believe these two types of feedback each provide different perspectives and different pieces of support for athletes that are aiming to build their feeling of the movement.

Conclusion

Our system will allow CHI visitors and participants to experience one of very few systems that give feedback on body movement in sports settings. They will also get the opportunity to experience two types of feedback, an open representation where users make their own interpretation and a guiding feedback they are supposed to follow. We believe this will encourage visitors to reflect on how feedback can be designed for sports activities and sports situations.

Acknowledgements

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References

[1] Ahtinen, A., Huuskonen, P., et al. Let's All Get Up and Walk to the North Pole: Design and Evaluation of a Mobile Wellness Application. In Proceedings of NordiCHI, Reykjavik, Iceland, (2010).

[2] Consolvo, S., McDonald, D.W., et al. Activity sensing in the wild: a field trial of ubifit garden. In Proceedings of CHI, (2008), 1797-1806

[3] Mueller, F., Vetere, F., et al. Jogging over a distance between Europe and Australia. In Proceedings of UIST, New York, NY, (2010), 189-198.

[4] Spelmezan, D. An Investigation into the Use of Tactile Instructions in Snowboarding. In Proceedings of MobileHCI, San Francisco, CA, (2012), ACM Press, 417-426.

[5] Stienstra, J., Overbeeke, K., et al. Embodying Complexity Through Movement Sonification: Case Study on Empowering the Speed-skater. In Proceedings of CHItaly, (2011), ACM Press, 39-44.