Jogging over a Distance – Supporting a "Jogging Together" Experience Although Being Apart

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Abstract
Jogging is a healthy activity and many people enjoy jogging with others for social and motivational reasons. However, jogging partners might not always live in the same location, and it may be difficult to find a local jogger who runs at the same pace, we found through a survey. "Jogging over a Distance" allows geographically distant joggers to socialize and motivate one another by using spatialized audio to convey presence and pace cues, similar to the experience of running side by side. We hope our approach encourages active and prospective joggers to jog longer and more often, while simultaneously supporting friendships.

Keywords
Jogging, running, social support, mobile phones, Exertion Interface, physical, sports, active, exhausting, social interaction

ACM Classification Keywords
H5.2. Information Interfaces and presentation (e.g., HCI): User Interfaces.

Social Jogging

We have found through the use of an online survey and Internet forums that joggers often run with others [6]. Out of 77 responses from regular joggers, 57% replied that they run with at least one other person. The top four reasons for running with others were socializing (83%), motivation to run faster (78%), to have more fun (53%) and to be encouraged to show up (53%). We discovered that many social joggers value the ability to have conversations with their partners and use their exercise sessions as a way to stay in touch with their friends. For casual joggers, being able to hold a conversation can also be an indicator that they are running at a suitable pace: not too fast and not too slow for an optimal health benefit. This is often referred to as the "Talk Test" [8]. While social jogging can motivate people to run faster and farther than solo jogging, partners should have roughly the same physical capabilities in regard to both speed and distance, which was emphasized by our participants. In addition to the challenge of finding a jogging partner with a desirable pace, some runners commented that they run alone because they have yet to find a jogging partner. This challenge resulted from people moving away or, through training, becoming faster than their jogging partner.

Based on the feedback from our survey, there are two main challenges of social jogging, and those are finding a jogging partner who runs at the same pace and who lives nearby. With our current research, we are aiming to address these challenges, hence contributing towards greater opportunities for social jogging and thus leveraging its health benefits.

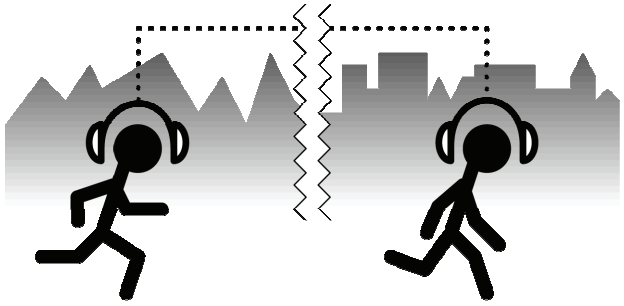

Figure 1. Jogging together although geographically apart

Jogging over a Distance

One possible solution that facilitates finding social jogging partners is to enable people to jog with remote friends and other remote joggers [Figure 1]. When jogging over a distance, jogging partners can live in opposite parts of the world, yet share the experience of jogging together. By meeting at the same time in separate locations, long distance friends could become, or stay, social jogging partners.

Mobile Audio Support

Our aim was to support the social communication between joggers which the participants found encouraging, and therefore opted for a solution featuring an audio connection between the joggers. An audio interface is suitable for a mobile, outdoor environment: it is simple, lightweight, and allows users to visually focus on their environment.

We understand not all joggers converse while running, but only 6% of our surveyed joggers who run with others replied that they do not talk while running. This finding encouraged us to believe that supporting audio

interactions could be very beneficial for a vast majority of social joggers.

Supporting a Sense of Presence

We were interested in the experience joggers would have if they would communicate with a remote partner through an audio channel only, and therefore asked 18 volunteers to go running at the same time, but in opposite directions, equipped with a mobile phone and a Bluetooth headset [6]. We were intrigued by the vivid sense of presence the audio conveyed to the participants: they not only mentioned hearing the other person's voice, but also the wind, the noise of the footsteps depending on the ground surface, and the breathing of the remote jogger. As a result, the combination created a social and enjoyable experience, the participants reported. Knowing how fast they and their partner were going was important for half of the participants. For one participant, this kept her running. She explained, "*There's some pride that you don't want to stop. I thought about stopping a bit today, and that would have been easier, because [my partner] wasn't there, but I didn't know if she could tell over the phone, so I didn't try*." One participant suggested each partner could carry some GPS-based tracking device and then verbally tell each other their speeds, which he felt would greatly improve his experience.

Adding Pace Awareness

We believe by increasing the sense of presence of the other person we can enhance the experience of jogging together for geographically distant jogging partners beyond our previous audio-only approach. We believe limiting the interaction channel to audio is preferable in a jogging scenario, and hence refrain from requiring users to look at displays. However, we think adding pace awareness could be beneficial for an increased sense of presence between the jogging partners, which in turn could contribute to the motivational and social effects of jogging together. We have therefore designed a mobile audio system that connects two joggers over a distance, supporting their conversations while using spatialized sound to communicate pace awareness.

Jogging over a Distance Experience

With our latest prototype, *Jogging over a Distance*, each jogging partner puts on a pair of headphones and wears the remaining equipment in a small backpack. While each partner jogs, speed data is collected and used to position the audio of the conversation in a 2D sound plane, oriented horizontally around the jogger's head. As one jogger speaks, their partner hears the localized audio and is able to detect whether the audio is coming from the front, the side, or from behind, and thus the other person is jogging faster, at the same pace, or slower. Similar to a collocated setting, the audio cues runners when to speed up or slow down in order to "stay" with their partner. The joggers can discuss running routes, motivate each other to keep pace, or simply listen to the environment noises of the other location. For joggers with differing athletic abilities who would like to have the experience of running together, a baseline pace variable can be adjusted that allows each runner to push their own personal pace rather than try to run at their partner's speed. Thus, the system allows joggers to do something that is not possible when running side by side - challenge their individual pace while running with friends who run at different speeds.

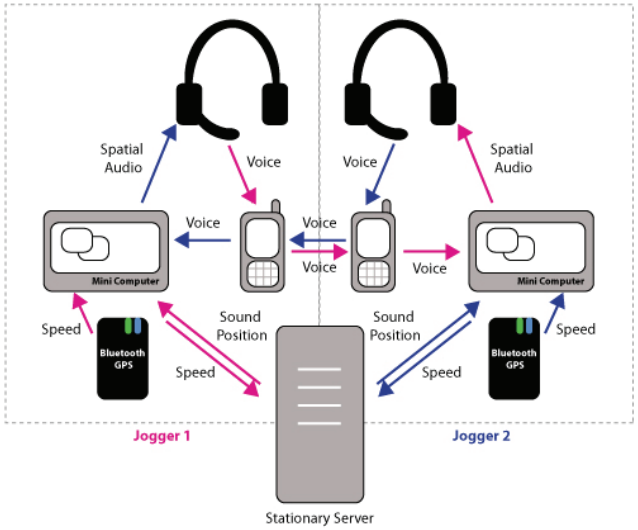

Figure 2. Technical implementation.

Technical Implementation

Jogging over a Distance consists of two identical systems, each with a miniature computer, a Bluetooth GPS device, a wireless modem, a mobile phone and a headset [Figure 2]. Each system is carried in a small, close fitting backpack while the user jogs. (Although the prototype currently requires weighty equipment to be worn by the jogger, we envision a final product to be only slightly bigger than an iPod, a device often worn by joggers.) Each mini computer is connected to a commercial wireless broadband service, which covers the major urban parks in which our joggers run. Speed and time data is collected via the GPS device and sent to the mini computer via Bluetooth. The computer then transmits this data wirelessly over the 3G network to a server, which calculates the speed difference and adjusts for GPS inconsistencies. The server determines how fast each jogger is running in relation to his or her partner. As a result of this, an algorithm calculates a sound position value for each jogger. As each jogger talks, their voice is picked up by a microphone and the audio is transmitted via a conventional mobile phone. (We initially used VoIP technology, but found the lag and reliability insufficient for our purposes.) Before routing the incoming audio from the remote jogger's mobile phone to the headphones, the mini computer applies a spatialization algorithm to the sound source. The mini computer uses the sound position value received from the server to transform the audio data into spatial 2D audio by placing the sound source onto an imaginary plane around the joggers head. The result is that the jogger hears their partner's voice coming from a certain direction.

Sound Spatialization

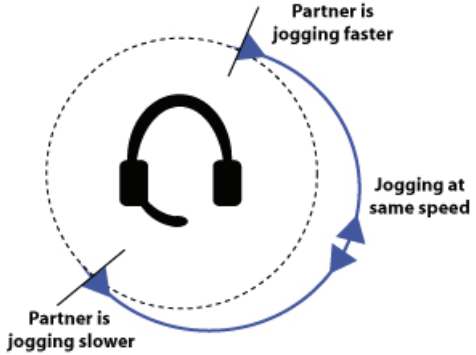

Figure 3. Bird's eye view of spatialized sound.

In order to develop *Jogging over a Distance*, it was important to find an audio setup in which users could clearly detect where the sound is coming from. Unfortunately, without the use of visual cues, it is difficult for people to differentiate between front and

back sound sources, in contrast to left and right [10]. In addition, mobility has been found to decrease audio target accuracy by twenty percent [11]. Fortunately, target accuracy for our application does not need to be very precise. However, the user needs to be able to clearly differentiate if the other person's voice is coming from the front or the back. To find a solution for communicating sound location while in a mobile environment, we evaluated different headphones and audio spatialization implementations.

In a small informal experiment, 5 participants were recruited to jog on a treadmill at a public gym while listening to spatially positioned audio cues with various headsets models. These headsets were off-the-shelf surround sound headphones, internally designed surround sound headphones and regular headphones. Some of the spatialization implementations use HRTFs (head related transfer functions), others relied solely on filtering frequency. We realized that jogging makes sound localization difficult due to the participant's exhaustion level, and we have therefore opted for an intensification approach for our prototype: instead of positioning the remote sound on an imaginary axis from 12 o'clock to 6 o'clock (from a birds-eye perspective, with the person being in the center of the clock, looking at 12 o'clock), we propose to position the sound on an axis from 1.30 to 7.30 [Figure 3]. This exploits a person's ability to easily distinguish between left and right audio sources, while simultaneously conveying an experience of hearing sound appearing from the front or back. Initial experiments confirmed that this design greatly improved the sound localization ability of participants, while still creating the impression that the other person is talking either "from behind or in front".

Related Work

Investigation of the social factors in motivating people to jog, or to exercise in general, has been described by McElroy in [5]. Various devices have been designed to use audio to motivate individual users when jogging: the *Nike+iPod Sport Kit* [1] is an MP3 player that tracks individual exercise performance and stops the music to verbally report on progress. *MPTrain* [7] is a mobile device that monitors heart rate and speed. The device selects music with a particular tempo to encourage the user to slow down, speed up, or keep pace. Although these devices can support motivating an individual user, they do not take advantage of the motivational benefits of jogging with other people. Shakra [2] supports physical activity awareness in a mobile setting, and the authors report on the beneficial aspect of competitive progress exchange as encouragement to exercise more. *Chick Clique* [9] and *Houston* [4] are other mobile phone applications that monitor step count and display it alongside the step count of friends. The primary focus of these devices is on everyday activity, not on a dedicated jogging session. A project combining social interaction with an audio interface to motivate physical activity is *Actively Mobile* [3]. However, the system does not communicate any pace data between the participants.

Limitations

In its current implementation our system does not take into account any elevation data and assumes that both joggers run on a flat surface in order to effectively compare pace data. Also, the joggers should ideally run for the same amount of time and start simultaneously.

Future Work

We are planning to conduct a comparative study to measure whether spatial audio delivery has an effect on the perceived vividness of the presence of the other person. Furthermore, we are interested in investigating if a greater sense of presence can serve as a motivational tool to encourage people to run faster, farther and more often. The results of this research can inform future designs that aim to support social interactions between geographically distant participants in a mobile setting. Participants also mentioned the desire to use music while jogging. We are therefore investigating the use of spatialized music to communicate pace, augmented with an audio communication channel.

Conclusion

Jogging with others is enjoyed by many, but finding the right jogging partner, as indicated by our participants, can be difficult. *Jogging over a Distanc*e is an advanced mobile prototype based on user feedback from an initial study. It uses spatialized sound to convey pace awareness in order to increase the sense of presence of the other person. With *Jogging over a Distance*, we are hoping to enable joggers to run with partners that are geographically distant, and hence support their desire for socializing and motivation to keep pace, resulting in an increased health benefit.

Acknowledgements

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