A Tactile Friend Sense for Keeping Groups Together

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Abstract
Visiting crowded places at night in a group of friends is a common leisure activity in many parts of the world. However, the chaotic nature of such place makes it difficult to keep the group together. Constantly watching out for the others or frequent use of technology (e.g. phone calls or Google Latitude) may be contradictory to the idea of having a jolly night out. We therefore designed FriendSense, a mobile application that acts as a pervasive anchor to one of the friends. Beyond existing solutions it allows to continuously sense the anchored friend's location through vibro-tactile feedback. In a preliminary field study we investigated how this added sense affects a night out at an Oktoberfest-like festival. We found evidence that FriendSense users were more confident and less stressed with keeping the group together.

Keywords
Handheld Devices and Mobile Computing, Multimodal Interfaces, Tactile & Haptic UIs

ACM Classification Keywords
H.5.2 User Interfaces: Haptic I/O; I.3.6 Methodology and Techniques: Interaction techniques

General Terms
Human Factors

Motivation and Background

When visiting festivals with a large number of friends, one of the challenges is keeping the group together. Having to look out for the others is challenging given the crowded and noisy nature of such events. The bigger the group is the more stress is induced in meeting up [2]. In our previous work [5] studying groups visiting festivals, we even encountered the events that people get lost for the rest of the evening. We found that the common approach to locate the group or lost individuals is to use the mobile phone. However, as found in our previous studies, the noise at typical festivals makes it difficult to talk on the phone.

Commercial services, such as Google Latitude or Yahoo Fireeagle, address this challenge by allowing users to publish their own location through their mobile phone so others can see it on a map. However, many leisure events take place at night and often the venue is quite crowded. Thus, interacting with tiny screens will force the user to shift attention between the screen and the environment to avoid walking into obstacles [1].

The sense of touch is largely unaffected by such environmental interferences. It has been shown that tactile feedback is sufficient to support rendezvousing of groups [7] and can act as act as a sixth sense [4]. We therefore investigated the feasibility of using tactile feedback as a sense of a friend's location to support groups in staying together during at a festival.

Extending our previous work [5] we designed and implemented a vibro-tactile user interface that cues the geospatial locations in vibration patterns. We integrated it into FriendSense, a mobile application that allows sharing one's location. The application was tested with groups visiting one of the biggest festivals in Germany with about 1.5 Million visitors each year (see Figure 1).

Figure 1. The festival where the field studies took place.

Design Space of a Nightly Companion

We aim at creating a connection between friends, but at the same time do not spoil the experience of the nightly event. Thus, we had to address the questions of how to describe the location of a friend and which sensory modalities should transport that description so that the result is suited for a nightly companion?

Describing Locations

A common approach for describing one's location is relating it to a landmark, e.g. "I am next to the ferris wheel". Such information can be described easily on the phone. The disadvantage is that both sides must have a shared knowledge about the landmarks. This can be difficult, since people visit festivals infrequently and their layout probably change over time.

Another approach is conveying locations geocentrically by a map. The advantage is that it is not necessary to

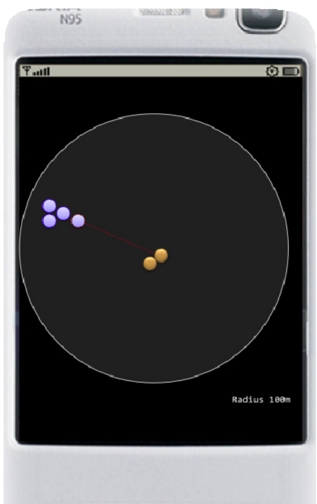

Figure 2. Screenshot of the visual component of FriendSense: direction and distance of all friends are shown in a radar-like UI. In the illustrated situation, two friends have strayed aware from the group, which is to the left-hand side. The red dashed line indicates which friend the user has selected to be displayed via the tactile feedback.

have shared knowledge about the landmarks. However, reading a map is not trivial for everyone, as it requires mapping its 2D content to the real world. This becomes even more difficult if the map does not show the layout of the festival environment.

Another option is describing locations from an egocentric perspective, e.g. by using its relative direction and distance (e.g. 2 o'clock in 200m). The advantage with such descriptions is that they neither require mapping them to existing geographic features nor require shared knowledge about the environment. In the ever-changing environment of a festival such descriptions are the most robust form of communicated geospatial locations.

Suitable Sensory Modalities

The nature of a festival (noisy, crowded, and nighttime) also raises the question of the actual sensory modalities used for the information presentation. The information presentation should be robust against noise. The need to look at a display should be reduced as much as possible, since looking at a display while navigating through a crowd is highly demanding and it may increase the likeliness to bump into another person [1]. Finally, as nightly events are often used to maintain social contacts, the information presentation should be unobtrusive and not hamper the user's visual appearance (e.g. by requiring to wear head-mounted displays).

These requirements exclude most modalities and traditional interaction techniques. Auditory feedback is impracticable due to the expected noise level. The use of visual feedback is possible, but only if it is sufficient to consume it in short and infrequent glances. There must be no need to look at the display when e.g. moving through the crowd or chatting with another person. This leaves us with the sense of touch, as it is hardly affected by darkness and noise. It can be used to convey information in an unobtrusive way that remains invisible to others and may interfere less with social interactions.

FriendSense

In our previous we therefore proposed an application called FriendSense [5]. However, the previous design was based on tactile waist belts, which are difficult to provide in sufficient numbers to actually deploy the system. Thus, we created a version of the application that only requires common smart phones. Via 3G networks the user's GPS location is regularly shared with a server. Once retrieved, the location is relayed to the other connected FriendSense clients. Thus, every FriendSense client is aware of each friend's location all the time. Each FriendSense user is able to consume a friend's shared location through visual or vibro-tactile feedback.

Visual Feedback

The visual component of the FriendSense consists of a radar-like user interface (see Figure 2). It shows the direction and the distance of all online friends via small dots. The UI is kept as simple as possible to reduce the time needed to read its state. It aligns itself with the user's heading, so the directions can be read directly from the screen without rotating them mentally. The user can use this UI to select the friend that shall be presented through the sense of touch.

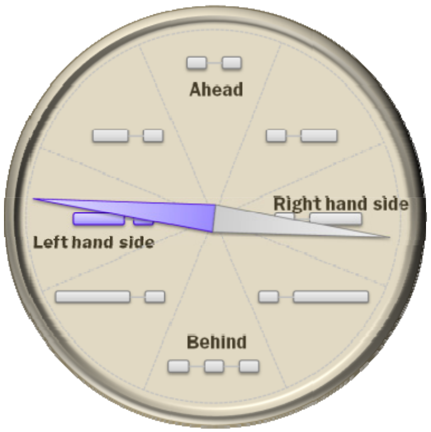

Figure 3. The vibro-tactile friend sense: the grey bars visualize the vibration pattern that would be played to indicate the respective directions. In this picture, the violet pattern (long-short) is played indicating that the friend is to the left-hand side.

Vibro-tactile Feedback
To present the location of the selected friend via the sense of touch we encoded her/his location in vibro-tactile patterns generated by the mobile device's vibration motor. We re-used a technique that has been designed in our previous work [6] and proved its effectiveness as navigation aid. The patterns are used to encode the general direction and the distance of a person.

Figure 3 shows the patterns used to encode the general direction. For example, two short pulses indicate that the friend is straight ahead. A long pulse followed by a shorter pulse, as shown in Figure 3, indicates that the friend is to the left-hand side. In a lab study with 21 participants the recognition rate was 78%. That result is sufficient for the intended use. First, more errors were off by one sector to the left or right, so the general tendency was mostly recognized correctly. Second, the patterns are played repeatedly as long as a friend is selected, so it is not fatal if the user is temporarily a bit of the mark. The distance is encoded in the pause between the patterns. The closer the friend is the faster the patterns are repeated.

To avoid annoying the user we muted the tactile feedback when not moving. First, groups often stay in one place for a while. In these situations, constant vibration feedback would be only disturbing. Second, users who are searching for the group or lost individuals are either on the move or they can stop to take a glance at the visual radar interface.

Field Evaluation

To get first feedback on FriendSense we deployed the application in groups of friends visiting a nightly festival. We wanted to investigate whether the tactile location cueing technique is suitable to be used in a nightly festival and if the system as a whole has positive effects on the nightly experience.

Participants
On two different nights a total of 12 participants took part in the study. The two groups consisted of friends that were visiting the festival as a leisure activity. The participation in the study was secondary to them.

Design
To study the effect of the location cueing techniques we used a between groups design with two conditions: participants in the *experimental group* were equipped with the fully functional FriendSense. The participants in the *control group* received stripped down version which only shared its location but did not display the others' locations in any form. The location was shared to ensure that the participants from the experimental group could sense all members of the group.

As means of data-collection we used the experience sampling method (ESM) [3] and post-hoc interviews. In our ESM implementation the application triggered an alarm every 20 minutes. Then, a short questionnaire consisting of five-point Likert scales appeared on the device's screen. The participants had to rate how relaxed they felt [*Relaxation*], how much attention they spent to keep the group together [*Attention*], and how difficult they perceived it to keep the group together [*Difficulty*]. Further, we asked whether the participant was with the main group. If the answer was "no" we also asked if the participant had left the group on purpose or not. The results were stored on the device together with a timestamp.

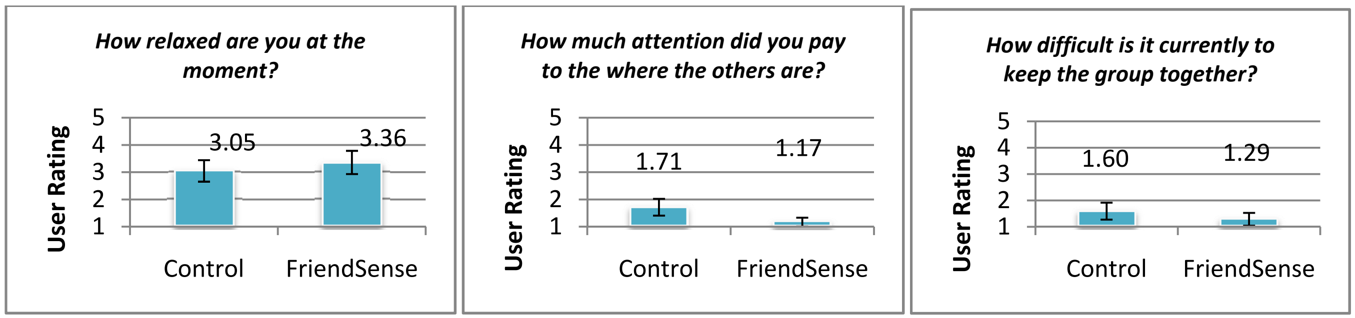

Figure 4. The diagrams show the average scores obtained via the experience sampling method. The error bars show the 95% confidence interval. All differences are significant at $p < .05$.

Procedure

All participants were introduced to the application some days before the actual study, so they already knew how to operate and use it. On the night of the study, the experimenter met the group of friends at the beginning of their visit outside the festival area. The group then visited the festival as they normally would. The post-hoc interview was conducted the day after. We asked open questions on how FriendSense had been used, how possible separations from the group were experienced, and how FriendSense affected the general experience of the event.

Results & Discussion

On the first evening, one person came late. Later on, two people split up from the group for about an hour. On the beginning of the second evening some people split up from the group in the beginning to join it again 20 minutes later. Later that evening, a single person left the group two times. Thus, most of the time the group stayed together, or was split into two parts.

Figure 4 shows the results of the Experience Sampling. FriendSense had significant positive effects on all three aspects. The participants felt more relaxed, subjectively devoted less attention to where the other group members are, and found it less difficult to keep the group together (all $p < .05$, independent t-test).

The participants from the experimental group reported six occasions of not being with the group, but always intentionally. The participants from the control group reported ten occasions of not being with the group. In three cases this was intentional, in seven it was by accident. The difference was not statistically significant.

Interview Results

From the post-hoc interview we learned that the participants subjectively did not “use” the system much. The most important feature of FriendSense was considered the ability to be located by the group if necessary. Thus, being separated from the group was not considered as fatal as it would have been without the system. This was even true for the participants in the control group. Since they shared their location as well the participants from the experimental group could still locate them. Some participants even felt encouraged to leave the group, knowing that the others could find them.

The tactile feedback was appreciated when moving through the very crowded areas of the festival area. The participants acknowledged that in contrast to the visual display it was suited well for being used on the move and in the crowd.

Limitations

One of the study's limitations is that the participants from the experimental group could track those from the control group. This had the effect that the control group participants were more confident as they could be found if they got lost. Thus, the difference between using FriendSense and using no technical device at all might be even more significant.

Conclusions and Future Work

In conclusion, the study showed evidence that FriendSense can improve the experience of the night out. In particular it made the participants more confident not to get lost and thus had a positive effect on the user experience. The work shows that continuous tactile cueing of coarse information accompanied by a visual overview that can easily be read is suited to such chaotic environments. In particular the tactile feedback – although comprising a rather non-intuitive set of patterns – could effectively be put to use in this casual scenario. The future work needs to focus more closely on the information presentation itself. Remaining questions are how the tactile feedback can be extended to communicate a wider range of information, e.g. several friends' location at the same time.

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