Audio-Only Augmented Reality System for Social Interaction

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The System

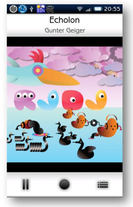
TARGETS

To propose and implement an audio-only augmented reality system for social interaction. Using the system, participants can interact with one another as well as with the system's components and affect the structure of the music in the virtual space.

FRAMEWORK

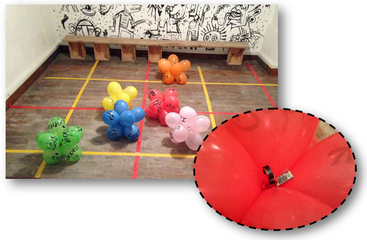
Numerous augmented reality applications can be found in the visual domain (Google Glass[1] , Layer[2], buildAR [3]).

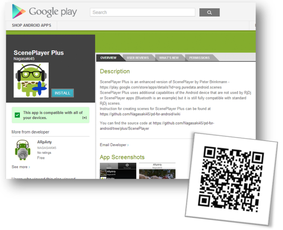
Our system is inspired by technologically-dependent social phenomena, like silent discos and flash mobs.

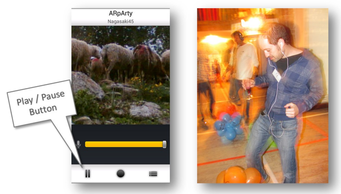


Our system is also part of the trend of creating interactive music applications for non-musicians (RjDj[4], Autorap[5], REWORK_[6]).

USER EXPERIENCE







There are six balloon bundles on the dance floor, each with a unique color and marked with distinct musical style.

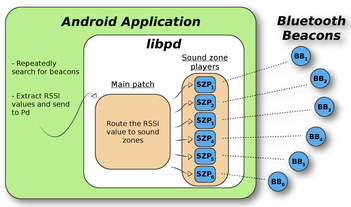
Every bundle contains standard $10 Bluetooth beacon that is used for indoor positioning.

In addition to these beacons, the only other system requirements are the Android devices and participant's headphones.

Every bundle creates a virtual sound zone around it, corresponding to a pre-defined musical style.

When a participant approaches a sound zone, he hears the musical style associated with the sound zone. If participants approach one or more sound zones together, they will hear a harmonious and synchronized mixture of the music of these sound zones. In addition, participants can move the bundles across the dance floor themselves, thereby changing the structure of the music in the virtual space.

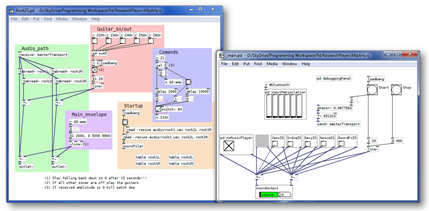
IMPLEMENTATION DETAILS



Bluetooth implementation of relative indoor positioning system (Bluetooth Discovery Routine)

The Android application repeatedly searches for nearby Bluetooth beacons, and then extracts received signal strength indicators (RSSI) from each device discovery, using it to estimate the distance between the user and the beacon.

The application then sends the device's address and RSSI value to a Pure Data patch using libpd API[7].



Pure Data patch — the audio part of the Android application

Each one of the six beacons corresponds to pre-defined sound zone player.

The patch receives RSSI values from the app, and routes them to a sound zone player according to its Bluetooth address.

Each sound zone player uses the RSSI value differently in order to manipulate the music in real time (E.g. volume, music filtration, granularity).

The Evaluation

TARGETS

We evaluated the system within the context of silent disco party, and showed that using the system enhances social interaction. Furthermore, we wanted to know if using the system caused participants to interact more with each other, and with the system components.

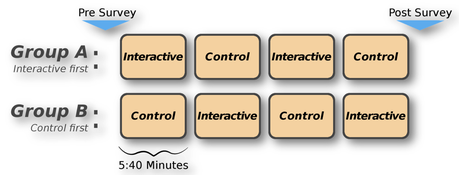
EXPERIMENT DESIGN

Participants were randomly assigned to two groups.

Both groups started the experiment together.

In the control blocks, participants heard pre-composed music based on the music of the interactive system.

They were informed that the experiment consists of interactive and control segments.



MEASUREMENTS

Surveys

Each participant filled a pre/post party survey that included questions regarding their musical background and preferences, as well as system evaluation feedback.

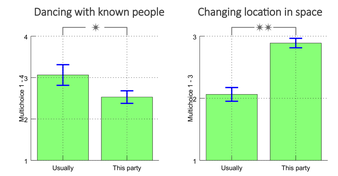
Analysis of Bluetooth discoveries

The same system used for indoor positioning was also used to count the number of Bluetooth device discoveries made by the participants' phones during the interactive and the control blocks. In order to eliminate edge effects, we analyzed only the two middle blocks of the experiment

Positioning tracking

We used video to capture the party from above the dance floor. Then we analyzed the data offline to find exact positioning of every participant on the dance floor during the experiment.

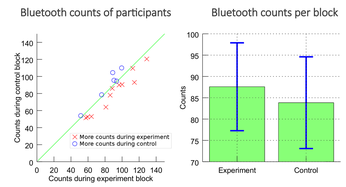
PRELIMINARY RESULTS



Surveys: Shows that participants self-reported enhanced social interaction.

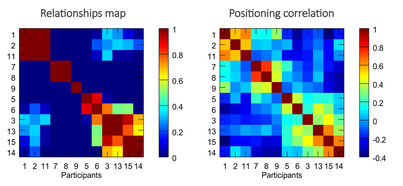
"Dancing with known people": paired t-test, t(14) = -2.5, p_value = 0.01

"Changing location in space": paired t-test, t(15) = 3.9, p_value < 0.01



Bluetooth discovery count: Indicates higher interaction with system components.

paired t-test, t(16) = 1.7, p_value = 0.06, marginally non-significant



Positioning tracking: We did not find significant difference between video-positioning in the control and in the experimental blocks. However, we found that position is indicative of the social relations between participants.

Monte-Carlo reshuffling, p_value < 0.01

FUTURE RESEARCH

We plan to use the devices accelerometers to assess entrainment as an implicit measure of engagement.

We plan to capture audio from the party and use the audio volume to measure spoken interactions between participants.

We plan to conduct more comprehensive experiments with a different group-based design.

Conclusions:

- Our system demonstrates a simple way to use Bluetooth technology for relative indoor positioning.
- Our preliminary results show the potential for audio-only augmented reality to significantly enrich the experience of music consumption and social interaction.
- We show that the social implications of the system can be validated in a controlled experiment.
- We show that positioning tracking can be used to reconstruct social relationships within large groups of people.

References:

[1]Google Glass, http://www.google.com/glass

[2]Layer, http://www.layar.com/

[3]buildAR, https://buildar.com/

[4]Sonic Experiences – RjDj, http://rjdj.me/

[5]AutoRap by Smule, http://www.smule.com/autorap

[6]REWORK_, http://www.snibbestudio.com/rework

[7]Brinkmann, P.: Making Musical Apps. O'Reilly Media, Sebastopol (2012)

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