Drum2Drum – a Tangible Device to Encourage Social Interactions

Agnieszka Szymaszek
Chalmers University of Technology
Gothenburg, Sweden
agnszy@student.chalmers.se

David Eriksson
Chalmers University of Technology
Gothenburg, Sweden
daverik@student.chalmers.se

ABSTRACT
In this paper, the Drum2Drum project is presented, which is a set of two devices in the form of drums that perform bilateral communication. The project is an experiment aimed to explore alternative ways of social interaction by means of auditory, non-verbal messages. Our devices look like regular drums, but behave in an unusual way: they can transfer and play sounds by themselves. The rhythm played on one of the devices can be transmitted to the other drum and automatically recreated. We use sensors and actuators to detect and produce sounds as well as an Arduino board to control the transmitting. The drum devices employ wireless connection, thus allowing the players to reach a distant audience. The design is aimed to equip people who stay within close area, but have limited possibility to communicate, with a tool that encourages social interaction.

Keywords
Tangible User Interface, Social Interaction, Experimental Instruments, Arduino Controller, Actuation, Wireless Communication.

1. BACKGROUND
Today we experience a burst of communication possibilities that has no analogy in the past. At the same time, the question of providing design solutions that encourage communication between people remains an urgent issue. This can be seen on the level of societies, that become more and more diverse, as well as on the level of individuals, who often become affected by different forms of social isolation. Even within groups of people staying in a relatively close distance it may not be easy to have daily contact with each other or establish a sense of community. This situation is common in many modern cities, which are designed in a way that ignores the human dimension and does not sufficiently support social interaction in public spaces [1].

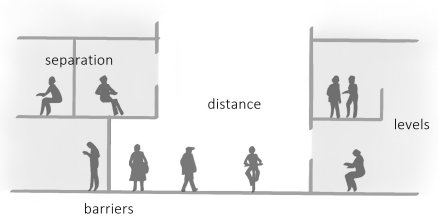

Figure 1. Some factors limiting possibility of contact in small scale environments, e.g. university campus.

Similar characteristic can be observed also in environments of smaller scale, such as a university campus, where students spend time in many separate buildings, following their different schedules. Although they pass lots of their time in the same area, they have a little chance to meet, observe and learn about others. The common obstacles for social interaction in spaces of that characteristic are both architectural barriers, such as distances, walls and other closings, floors and different levels, as well as organizational issues, such as daily schedules or access restrictions (see Figure 1).

Various modes of separation are necessary in terms of functionality, but often they have negative consequences for contacts between humans, who are inhabiting such segmented environments. That state could have been avoided by providing various meeting areas. However, it is not always possible to create such a place in physical space. Therefore, we believe that the technology can offer solutions that may help to some extend mitigate that state.

Furthermore, we have been inspired by drum communication found in several cultures around the world, where the instruments called "talking drums" were used over the centuries. Historical records suggest, that until the invention of the telegraph in mid 19th century, there was no other comparably efficient method of transmitting information from one place to another [2]. The use of drums for communication had a significant influence to the development of our concept.

2. THE CONCEPT AND DESIGN
The Drum2Drum project is an attempt to encourage, in a playful way, interactions between people staying in a close distance, but having limited possibility of contact. The concept for the devices is based on the human need to communicate and is inspired by the tradition of using drums to send messages over distance. With the Drum2Drum project we hoped to provide an alternative form of communication, which may promote interactions between people scattered in urban environments. In our system, players' response to such an invitation is free, voluntary and strongly relies on the interest of the audience on the opposite side.

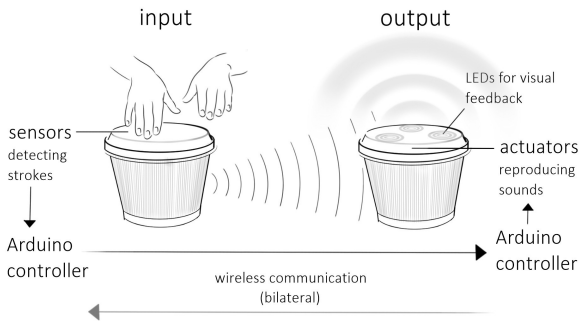

Figure 2. Schematic representation of the Drum2Drum project.

.

In the technical aspect, we aimed to construct a prototype that will be able to produce sounds automatically out of the drum and test the possibility of bilateral transmission between the two devices placed in different locations (see Figure 2). Finally, our goal was to create a sensually rich interface that would offer users an enjoyable experience.

2.1 Methods

In order to envision possible applications of the Drum2Drum devices, we developed several scenarios based on the experience of studying at a university campus and informed by our intention for project to encourage social interaction. In preparing scenarios we took into account two factors that might influence interaction with the Drum2Drum devices: frequency of the user's presence in the given place (e.g. the time spent weekly at the university) and the level of acquaintance of the two users (if they already knew each other or had not meet before). Furthermore, we used scenarios to illustrate different possible outcomes of interaction with our devices (see Figure 3). We analyzed three situations, where in all cases one of the users is the same student who initiates interplay and the other user is:

Scenario 1 - Casual visitor, no link between two users. The drum attracts visitor's attention, but do not lead to direct contact between players.

Scenario 2 - Frequent occupant of the campus, potential link between two users. The use of device leads to the contact in person, but it is not the main motivation for interaction.

Scenario 3 - Everyday occupant of the campus, close link between two users. The device is used in order to arrange a spontaneous meeting.

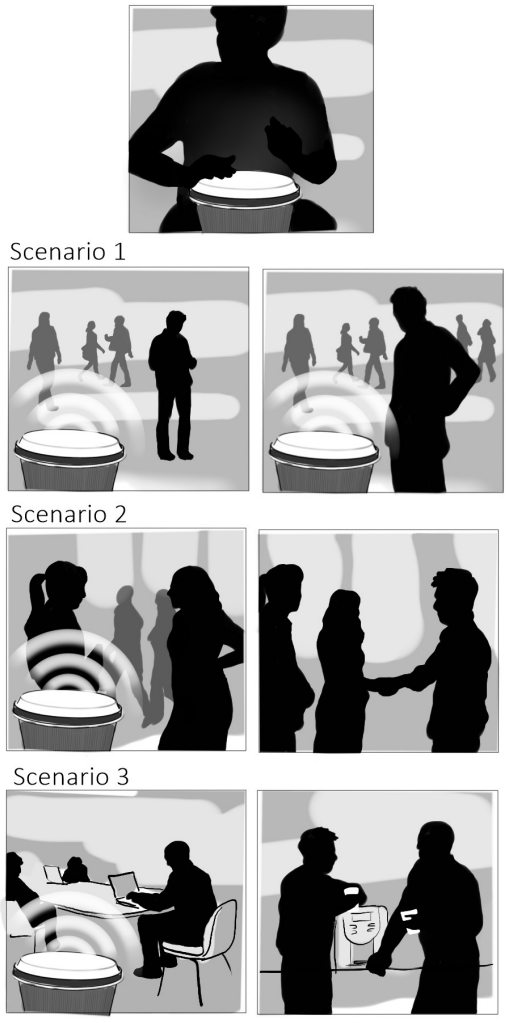

Figure 3. Scenarios illustrating different motivations and relations between users as well as possible outcomes of their interactions.

.

2.2 Design Decisions

2.2.1 Goals and intended aesthetics

The Drum2Drum project is meant to be an experiment exploring possibilities of social interaction within a channel alternative to conventional ways of communication. As the project relies on voluntary participation of the players, we believed that their involvement should be achieved in a subtle and unobtrusive manner. For that reason our design aims mainly for playfulness, addresses emotions and tangibility. The interaction was thought to create space for surprising, provoking or humorous situations between players to occur. We attempted to arouse attention or curiosity of potential players through intriguing and ambiguous character of the device. Furthermore, the design was intended to have a familiar, physical form, that would make it friendly to approach and would offer a sensually rich experience. All the above properties were aimed to initially attract an user and evoke

positive emotional states. However, the design leaves the player free to choose how much one wishes to engage into an emerging social interaction, as it was illustrated in the scenarios we worked with.

2.2.2 Drums as a tangible interface

The important factor, that determined the selection of a drum as a mean of tangible interaction for our project, was the easiness with which users can produce basic sounds or rhythms out of that instrument. Readily perceived affordances of a drum helped us to lower the threshold in understanding how to use the devices.

Moreover, a drum can be seen as an object with a common and well established mental model existing in collective imagination. Consequently, people instantly recognize an object as a drum, understand its function and a principle of its use, even if they have never played it for themselves. We also wanted to take advantage of its rich cultural associations on the semantic level. What in particular touched our imagination, was the use of drums in spreading the word through the network of locally operating facilitators involved as transmitters. Lastly, the form of that instrument offered a convenient space to hide all the electronic elements inside.

2.2.3 Dislocated Input and Output

The core of our concept required a design solution, that allows to transmit sound played on one device to the other piece. For that reason we have decided to place input and output of the instruments in two different locations. As the action of playing the Drum2Drum device offers experiences identical to those of playing on the regular drum, the output is still possible to track for a player in form of a tactile, auditory and visual feedback. What is essential for the project, displacing the augmented input and output in our device, significantly enhances the traditional instrument. The player is no longer limited by distance in engaging with other people in interaction through sounds or music. However, that design decision brought us the biggest challenge during development of the prototype.

2.2.4 Social Interaction

In terms of encouraging social interaction from design perspective, we see the function of the project as being mediated by individual players and situation. Our approach was demonstrated in trying to envision rather than define the use of our devices. We believe that they are able to engage people into social interaction on several levels, which is dynamic and fuzzy process [3].

In case of interactive systems based on auditory channel, the notion of awareness plays a crucial role for social interaction. The awareness of owns interactions within the system is thought to be a key factor contributing to the sense of presence, collaboration and supporting mutual engagement of users [4]. What that meant for our design in practical sense was more consideration given to the feedback offered by the Drum2Drum devices.

Lastly, the social interaction aspect builds on the physical dimension of the drum devices, as tangible interaction is inherently “embedded in real space”, which is in turn shaping user's behaviors [5].

3. REALIZATION OF A PROTOTYPE

The Drum2Drum prototype consists of two separate devices: two wirelessly connected drums (see Figure 4). For the purpose of the project, we decided to use regular bongo drums as they offered a feeling of a traditional instrument. Each device is an exact copy of the other, with the exception of their receiving and transmitting addresses being switched.

Piezo sensors attached to the bottom side of the membrane are used to register strokes of the player. In our prototype two different sounds are registered and replicated; a low pitch sound at the center of the membrane and a high pitch sound near its edges. For the better playing experience we worked on matching the physical sound patterns with the digital ones. Messages are sent wirelessly between drums using RF modules. Solenoid motors placed underneath the membrane are used to physically replicate sounds transmitted to the drum as low and high pitch notes. Finally, the set of LEDs corresponding to the two sounds are used to provide visual feedback on the receiving device.

Figure 4. The prototype of the Drum2Drum devices.

.

4. RELATED WORK

Our project can be placed at the intersection of fields such as interaction design, new musical interfaces and electronic systems based on sensors. Attempts of academics and inventors in these areas were focused on new ways to control music creation, what resulted in projects replacing the human player by the automated system or replacing a traditional instrument with its digital counterpart. The first approach is represented by constructors of musical robots, of which one group is percussion robots [6]. The second approach covers design of virtual instruments and computer driven devices for controlling another instrument [7]. Most of these works were focused on transforming musical properties of instruments for their performance values, or constructing new interfaces for creating music. Also, a reference can be made with actuated instruments, defined as physical instruments enhanced and controlled by a computer, but preserving tangible aspect [8].

Another related areas concentrate on collaboration, such as interactive systems for collaborative musical improvisation [9] or systems designed for networked music performance, where musicians situated in different locations perform together in real-time thanks to the network connection [10].

Furthermore, our project may be linked to the concept of Interactional Sound and Music (ISM), which is an area of study analyzing ways of interactions with systems centrally relying on audio [4]. Within interaction design, closely related are explorations of interplay between tangible interaction, spaciality and sound [11].

5. CONCLUSION

In relation to the above mentioned work, the Drum2Drum project appears to present a new and innovative approach by combining:

- Approach to the instrument: We aimed to employ a character of the instrument, so it keeps the look and feel of a traditional drum as far as possible. We made a conscious choice to keep a characteristic of the traditional drumming experience, but our focus was not on its musical properties.

- Technical solution: We wanted the drum to produce sound automatically, but without any external elements, so we created a unobtrusive, built-in actuation system that is not visible outside of the instrument.

- Social interaction: Every drum device works both as a sender and as a receiver of the transmitted signal. That allows a direct, real-time interaction between players based on taking turns, as it happen in the conversation.

Based on the initial testing of our Drum2Drum prototype, it is possible to state that the devices provide an enjoyable experience for the players. For the future work, the more robust prototype would be required in order to conduct a more comprehensive user test. Some improvements may include adding an augmented feedback to the device, to provide an indication that the drum is processing an input as the user plays on the drum. Also, more efforts could be dedicated to refine the mapping between traditional drumming and sounds produced by the solenoids.

6. REFERENCES

[1] Gehl, J. 2010. *Cities for people*. Island Press, Washington, DC.

[2] Gleick, J. 2011. *The information: A history, a theory, a flood*. Fourth Estate, London.

[3] Ludvigsen, M. 2006. *Designing for Social Interaction: Physical, Co-located and Social Computing*. PhD dissertation, Aarhus School of Architecture.

[4] Bryan-Kinns, N., Fencott, R., Metatla, O., Nabavian, S. and Sheridan, J.G. 2010. Interactional Sound and Music: Listening to CSCW, Sonification, and Sound Art. In *Proceedings of the 2010 Conference on New Interfaces for Musical Expression,* (NIME '10), Kirsty Beilharz, Andrew Johnston, Sam Ferguson, Amy Yi-Chun Chen (Eds.). Sydney, Australia, 403-406.

[5] Hornecker, E. and Buur, J. 2006. Getting a grip on tangible interaction: a framework on physical space and social interaction. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (CHI '06), Rebecca Grinter, Thomas Rodden, Paul Aoki, Ed Cutrell, Robin Jeffries, and Gary Olson (Eds.). ACM, New York, NY, USA, 437-446.

[6] Kapur, A. 2005. A history of robotic musical instruments. In *Proceedings of the International Computer Music Conference* (Barcelona, Spain, September 2005). MPublishing, University of Michigan Library, Ann Arbor, MI.

[7] Miranda, E.R. and Wanderley, M.M. 2006. *New digital musical instruments: control and interaction beyond the keyboard*, volume 21. AR Editions Inc., Middleton, WI.

[8] Overholt, D., Berdahl, E. and Hamilton, R. 2011. Advancements in actuated musical instruments. *Organised Sound*, 16(02), 154-165.

[9] Blaine, T. and Perkis, T. 2000. The Jam-O-Drum interactive music system: a study in interaction design. In *Proceedings of the 3rd conference on Designing interactive systems: processes, practices, methods, and techniques* (DIS '00), Daniel Boyarski and Wendy A. Kellogg (Eds.). ACM, New York, NY, USA, 165-173.

[10] Nicolas Bouillot. 2007. nJam user experiments: enabling remote musical interaction from milliseconds to seconds. In *Proceedings of the 7th international conference on New interfaces for musical expression*, (NIME '07), ACM, New York, NY, USA, 142-147.

[11] Williams, A., Kabisch,E. and Dourish, P. 2005. From interaction to participation: configuring space through embodied interaction. In *Proceedings of the 7th international conference on Ubiquitous Computing* (UbiComp'05), Michael Beigl, Stephen Intille, Jun Rekimoto, and Hideyuki Tokuda (Eds.). Springer-Verlag, Berlin, Heidelberg, 287-304.