The Voice Garden

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Abstract

In this project, we tried to explore the roles that urban gardening plays in community development, and how technology can contribute in building communities and bridging the local communication gap between gardeners.

For this purpose, we employed a participatory design strategy and involved real life urban gardeners in the process. As part of the project, we developed and evaluated an application concept which invites all gardeners on one versatile communication platform for community building. Our concept is broken down in two parts, an electronic billboard and a mobile application. A working prototype has been built and allows gardeners to send and receive audio messages privately or as public announcements within a given local community garden. This billboard design is meant for users who are unfamiliar with smartphones and computers. Evaluation and User testing results show that most of our eleven participants find it relatively easy to use the main features of the billboard.

Keywords:

Billboard, mobile app, urban gardening, community building, voice communication, physical interface, sharing interaction

Introduction

Community common from Latin word "communis," means common [2]. A community is a group of people who knew each other, sharing same interests and goals. In order to create community weather for rural or urban areas, it's often necessary to bring people together on one common platform so that they can learn from one another's experiences, behaviours and helping others. How do we build an interactive community that is effective, trusting and supportive? [3] Is one of the main focus area especially for large city communities where people often live very busy lives and do not have enough time to spend in public gatherings.

"In 1900, worldwide, there were 6.7 rural dwellers to each urban dweller; now there is less than one and projections suggest close to three urban dwellers to two rural dwellers by 2025. This has been underpinned by the rapid growth in the world economy and in the proportion of gross world product and of the economically active population working in industry and services (since most industrial and service enterprises are in urban areas)" [4].

Community gardens (urban gardens) are a very popular trend found in urban areas and today Sweden has about 26,000 allotments [1]. Urban gardening communities involve people with different backgrounds, lifestyles and belonging to different age groups. Leveraging the potential of community collaboration

and utilizing shared or shareable resources and human capital can only happen through effective communication. To support this, they need adequate tools which are built around their gardening activities. At present, despite their geographical co-location, the lack of such tools is hindering collaboration opportunities within communities of urban gardeners

With that in mind, we intend to bridge the communication gap between traditional Internet and smartphone users on one side, and non-smartphone users on the other side (who will be exclusively using the billboard as a physical interface). We would like to create a platform that helps strengthen community building amongst the gardeners by having them share products, services and expertise.

We would like for the app and billboard to be useful tools that fit into the gardening routines of the gardeners.

Background/ Related work

The purpose of this literature review is to evaluate how billboard and mobile app help user's to rise levels of communication. Billboard is a flat surface, usually used for outdoor advertisements or notices posts.

Billboard Poetry was a group of art students' project from Brigham Young University and their assignment was to experience how words can affect a community. They created essays that expressed their exploration experiences of a Provo (provisional) community. This resulted into "37 essays expressing Provo–the landscape, people, stories, relationships, community and these essays were published on a billboard" [5]. A billboard is an effective way of sharing thoughts and spread social messages in a community.

Post – it Notes for Neighbors is inspired by To Do: Illegal Art project [6] and created by Candy Chang, who covered a Brooklyn storefront window with post-it notes stamped with specific fill-in-the-blank forms to ask her neighbors how much they pay for their apartments. By the end of the week, the window was transformed into a collection of housing information created by and relevant to the community [7]. This project is helpful and provide an interactive platform to share local problem and information within a community.

Before I die, Artist Candy Chang painted the side of an abandoned house in her neighbourhood in New Orleans with chalkboard paint and stencilled the sentence, "Before I die I want to _____."Within a one day of the wall completion, it was covered in colourful chalk dreams as neighbors stopped and reflected on their lives. Photographs of the wall spread online, now more than five hundred Before I Die walls have been created in over 60 countries and over 30 languages by passionate people all over the world [8].

These projects are very famous and useful for community building and helping peoples to share their thoughts. In Billboard Poetry project this is a simple billboard and users/people have no interaction and they are only able to view and read it. Post-it notes and before I die projects were created for manual interaction using sticky notes and chalk as tools.

A mobile app is another important part of our project designed for smartphone users. There are currently

some applications that provide services in line with our objects.

The Plantifier[9] and Planticare [10] are crowdsourced mobile apps used as plant and bugs recognition tool. These apps allow users to upload pictures of unknown plants and bugs, and the MyGarden.org [11] (community behind the apps) tries to recognize the plants and bugs and gives answers to questions on the plants and bugs.

MojaZahradaApp is another crowdsourced mobile app by TrendsCo. Solutions bvba [12] that allows the users to "manage their gardens, send messages, searching for other gardeners, plants and information about them." [12].

Our project is different because we aim to have a billboard that provides features for users to interact and share services, products and knowledge. The mobile application is a tool that extends the billboard services and caters for smartphone users.

Methodologies

The research methodologies used in the project are Participatory Design and Rapid-Prototype Development. Rapid prototype is a methodology that allows for the early and quick designing, implementation and testing of a system model [13, 14].

Participatory design (PD) "is a set of theories, practices, and studies related to end-users as full participants in activities leading to software and hardware computer products and computer-based activities"[15].

The main end-users involved in our research process are urban gardeners in SloIsträdgården. The end-users participated in a number of phases of the project including: concept generation, prototyping, testing and evaluation. The methods used during the different phases are:

1- Task based testing (with observation)

Task based evaluation is a user centered form of evaluation that focuses on adequacy and user satisfaction [16]. Thomas, K [17] states "Task-based evaluations for spoken language systems focus on evaluating whether the speaker's task is achieved, rather than evaluating utterance translation accuracy or other aspects of system performance". We used this evaluation method in combination with observations of the users during the concept generation and prototyping phases.

2- Usability questionnaire (SUS)

The System Usability Scale (SUS) "Originally created by John Brooke in 1986, provides a "quick and dirty", reliable tool for measuring the usability. It consists of a 10 item questionnaire with five response options for respondents; from strongly agree to strongly disagree." [18, 19]

3- Semi structured interview.

A semi-structured interview is a form of qualitative method that combines "a set of pre-determined open questions (questions that prompt discussion) with the opportunity for the interviewer to explore particular themes or responses further." The responses are not

limited to pre-determined answers [20]. "Semi-structured interviews are used to understand how interventions work and how they could be improved" [20]. This form of evaluation helped us understand the stakeholders' responses to the concepts and prototypes. It also allowed for the stakeholders to raise unconsidered (missed) issues.

Stakeholders

The stakeholders of the research project include:

- Gardeners – these are urban gardeners in SloIsträdgården
- Living Archives Project members
- Chief Gardener of SloIsträdgården

Concept Generation

The concept generation phase was carried out during two workshops with the participation of the stakeholders (gardeners). The main stakeholders consisted of six gardeners ranging from 20 to 70 years old.

First Workshop: 2014-10-01

Aims of the workshop: learn about the gardeners' gardening practices. Identifying their challenges and potentials.

Data Collection: Mapping gardening practices using a seasonal circle, add posits of different colors (in the circle) depending on what category the input can be sorted into: Action, Tool, Information, Physical material (seeds, soil), People. Also use posits to write down questions and research gaps to be added to the challenges and potentials list.

Figure 1. Gardening Seasonal Circle

Challenges & Potentials

The ideas generated from the workshop were based on a selection of listed challenges and potentials. We decided to focus on the ideas of community-building and sharing.

Community

- Communication divide between gardeners of different age groups.
- Lack of knowledge transfer and resources between gardeners.
- Having no babysitter (helper) to an allotment when the owner isn't available/is away.

Harvest and Seed: Sharing of the harvest and seeds - a Facebook page currently exists where the gardeners share harvest and information, except not all gardeners are aware of the Facebook page.

Second Workshop: 2014-10-29

Generated Concept

We generated a community concept based on the selected challenges from the first workshop. Our concept consisted of an augmented reality app connected to an onsite billboard. The purpose of the app was to allow gardeners to see which gardeners are away, and if their allotments needed watering as shown in the figure below.

Figure 2. Mobile app showing closets allotment owners with availability and water level indications

The onsite billboard concept was to be used by the onsite gardeners who did not have/use smart phone. The billboard design had the gardeners names, allotment number, status (around/not), a map of the garden area, and a tag reader (to be used by the gardeners to gain access to the billboard services). It also had 3- level LED indicators against each gardener's details showing the water levels of each allotment.

The intended technologies included: mobile application (app), Global Positioning System (GPS), Augmented Reality (AR), Bluetooth low energy, 3- level Light-Emitting Diode (LED), humidity sensors, and RFID technology.

Proceedings of the workshop: Demonstrated our concepts, carried out task-based tests with observations, and semi-structured interviews. We then had an experience prototyping activity followed by a rapid prototyping session with the stakeholders.

Data Collection: We collected the feedback using posits notes and two A0 paper sheets (one for the app, and the other for the billboard).

Stakeholder Participation

The stakeholders were split into two groups, to make the task-based testing much easier to follow and observe. We carried out both experienced and rapid prototyping with both groups to get feedback on the proposed concept. For the experienced prototyping, we created interactive mockups and sketches, and decided on the materials we were going to use for the rapid prototyping. The rapid prototyping involved augmenting the proposed concept together with the stakeholders.

Group 1: Preferred the billboard idea, suggested we incorporate a visitor counter feature, and suggested we include a dashboard/statistic reporting feature for the chief gardener.

Group 2: Suggested accessing information from home for: Real-time access to information, presence monitoring to encourage gardeners to go to their allotments. They also talked about community communication for services such as: Seed sharing, Harvest sharing, and Weeding. The group talked about

Figure 3. Mobile App

having access to information on what other gardeners are growing.

The ideas generated (solution) from the feedback include:

- Going with the billboard idea and adding features to meet group 2's requests
- Including audio and video messaging for information sharing.
- Creating a mobile app that receives/sends billboard notifications: Incoming message signal, Real-time info about presence counter, Button for adding to presence counter.
- Removing the AR and watering tag and instead have: 1 tag for checking messages, 1 tag for sending new message

Prototype Development (Cardboard)

Proposed solution

The first prototype of the billboard was designed and developed using cardboard and other materials to represent the different features as shown in figure 4. The board is in two parts: one piece with gardener details, and the other with the rest of the features (main piece). The idea behind this concept is to make it possible to add more gardeners to the board without having to replace the main piece.

The mobile app prototype (figure 3) was created using mockup design tools. It extends the billboard messaging features to make them accessible anywhere.

The app is to allow member gardeners to listen and send messages, and view the number of gardener's onsite.

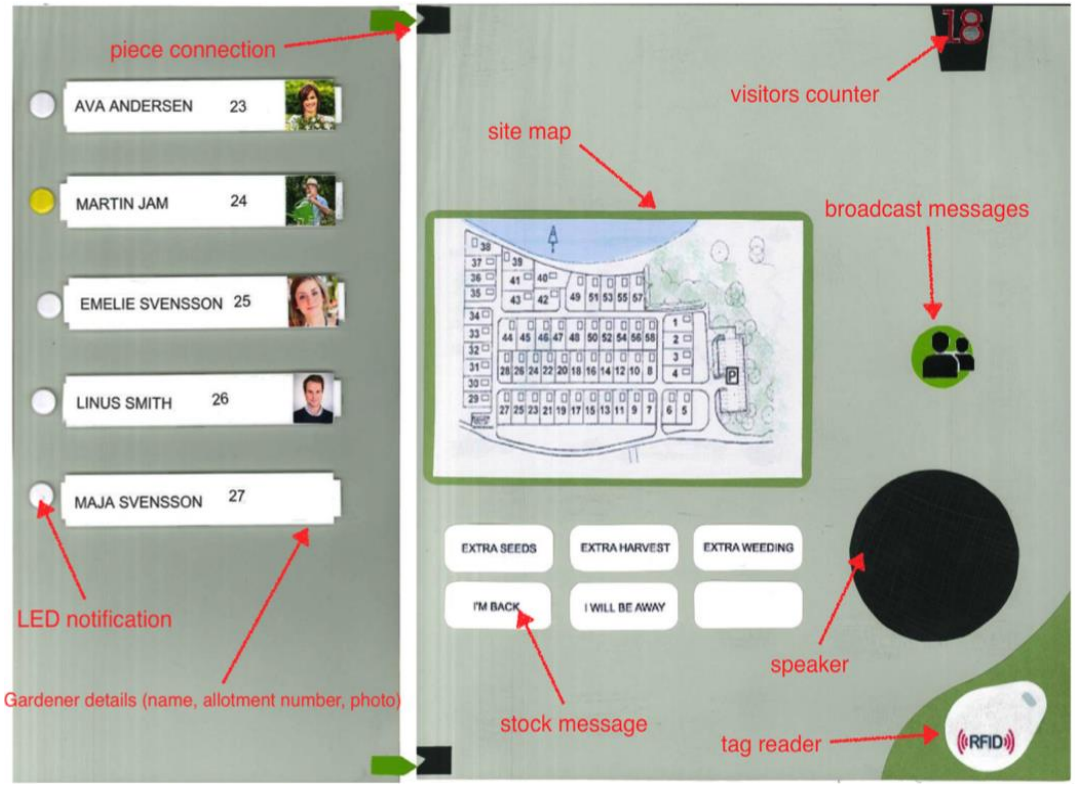

Figure 4. Two piece billboard

(Visitors counter). The chief gardener has extra features to view statistical reports of the gardeners' activities.

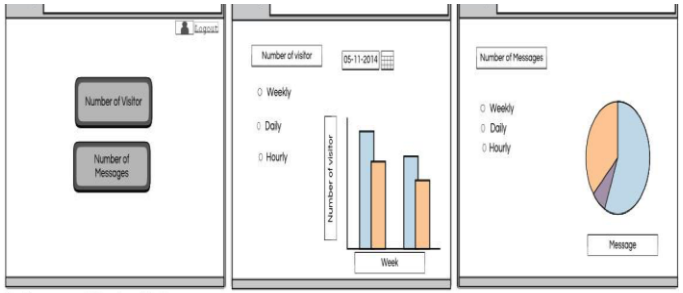

Figure 5. Statistical reports of gardeners' activities

Third Workshop: 2014-12-04

The aim of the workshop was to find out how the stakeholders relate to the layout, features and functionalities of the billboard and mobile app.

Proceedings of the workshop: using similar procedures as the second workshop, the stakeholders were divided into two groups. Task-based tests and semi-structured interviews were also included.

Data collection: The data collection methods involved dividing the feedback into four parts on an A0 paper: structure, features, functionalities and others. We used 2 A0 papers (one for the app and the other for the billboard), and different colored posits for the feedback in the different parts of the A0.

Discussion with the stakeholders

Group 1: suggested we changed the tag colors to red for sending messages and green for receiving messages, and we increase the size of the map. We talked about using 1 instead of 2 tags, this would mean lengthening the actions of the services on the board. A suggestion about adding LEDs behind the map to work with the LEDs behind the gardener details was made.

The group found the stock messages too general (could be more detailed), and wanted to have a little more of the billboard feel. The group had no issues with the size of the board and the placement of the features. The group also preferred the billboard to the app.

Group 2: was worried about the privacy of the user (gardener) details on the billboard. A suggestion was made about getting rid of the age and adding allotment numbers on the user details in the app. The group preferred the app to the board, and suggested the board for apartment buildings instead.

Modification of Proposed Solution

With the information from workshop 3, we made some modifications to the proposed solution.

With the app: we removed the age and included the allotment numbers.

With the billboard: we decided to make the allotment numbers (which are already openly displayed on the allotments) standard and the names and photos could be optional. We kept the two tags due to limited development time. To give the billboard feel: we thought of switching the stock messages to billboard activity categories (e.g. Harvest, watering, weeding, and seeding), and this will be displayed on a 'forum LCD screen' as shown in figure 6.

This is an extra piece to be added to the billboard and it can help create a more clear community feel for the gardeners. The forum screen will also be an added statistical feature. The size of the bubbles will depend on the level of activity in the different categories. The screen will also include a 'public announcement' feature.

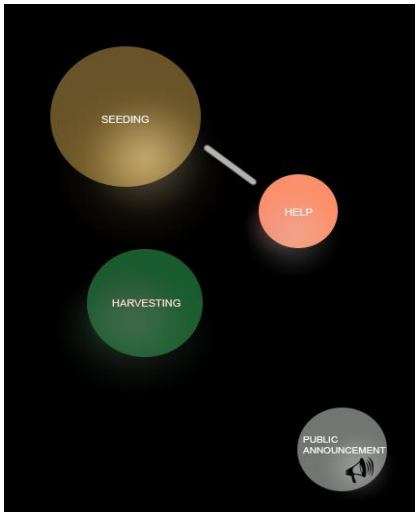

Figure 6. Rough design of the forum screen

Working Prototype

We prioritize the functionalities for the working prototype by deciding on the most important functions based on the allocated development time, and the functionalities that would help us get the best out of the evaluation process. The implemented functionalities include: tag reading and audio messaging (sending and receiving broadcast and individual messages). The technology and material used to construct the billboard and mobile app include:

Software: Android Studio, Arduino IDE

Hardware: LED lights, Arduino Mega ADK, Android phone (Android 3.1 and up) with NFC support, Micro switch on flat lever, Set of RFID Tags, Push button, digital display plexiglass, Wood material.

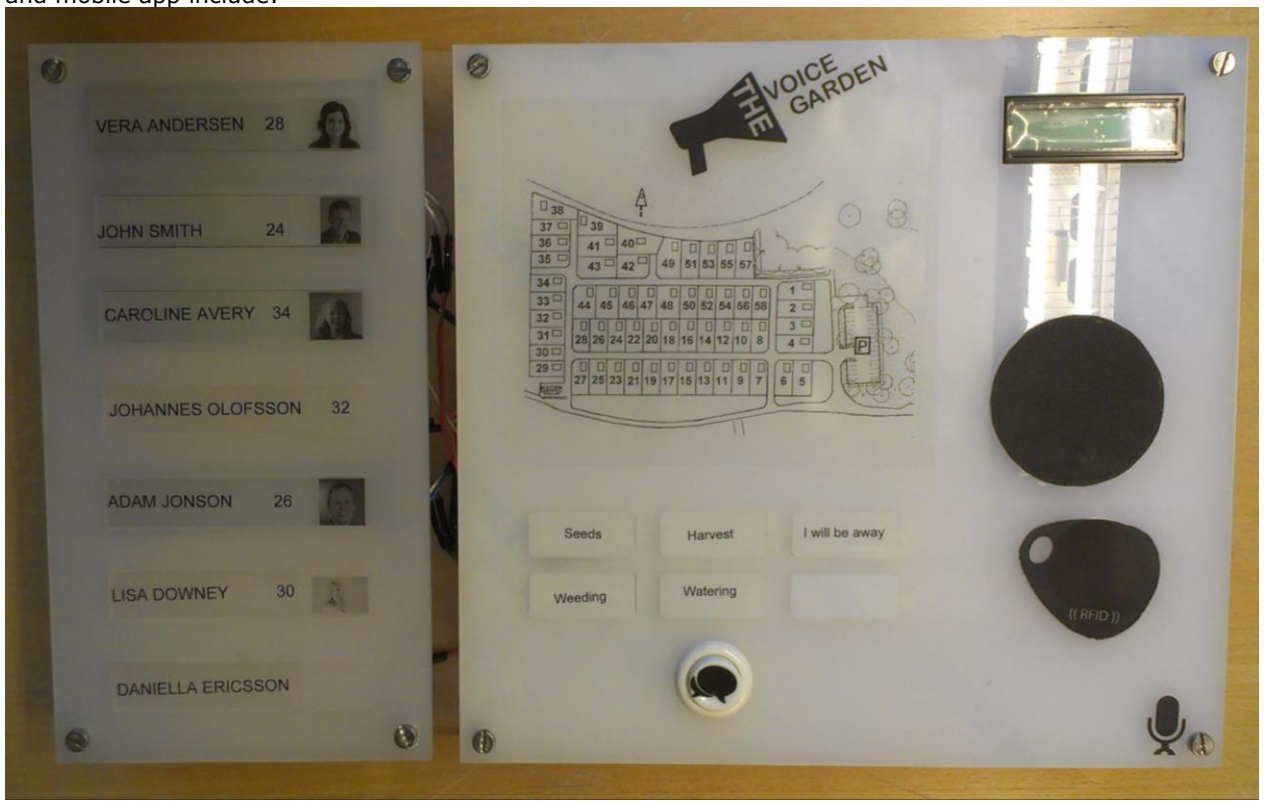

Figure 7. Working prototype

Evaluation

Fourth Workshop

In the present work, we have prioritized building and evaluating the physical prototype of our billboard concept, hence postponing the other components' evaluation to future work. For this purpose, we opted for a task based usability test – with one, two or three participants at a time - followed by a semi structured interview.

Split over two evaluation sessions, 11 participants were asked to complete the following tasks in the order:

Task number	Task type	Instructions
1	Login	Login as person A
2	Send to one person	Send a message to person B
3	Login	Login as user person B
4	Check inbox	Check inbox for messages and listen to them
5	Send to everyone	Send a message to everyone (broadcast)
6	Login	Login as person A or C or D.
7	Check inbox	Check inbox for messages and listen to them

Table 1**.** List of tasks performed by participants

Based on observations of participants executing these tasks while thinking loudly, in addition to analyzing their responses during the semi-structured interviews later, we tried to measure the perceived level of difficulty (by participant per task) and present it in the following table.

Remark: Difficulty level can only take one of the 3 discrete values {Easy, Medium, Hard}.

Task Participant	Login	Send to one person	Send to everyone	Check inbox
Participant 1	Easy	Medium	Medium	Easy
Participant 2	Easy	Easy	Easy	Easy
Participant 3	Easy	Hard	Medium	Easy
Participant 4	Easy	Medium	Medium	Medium
Participant 5	Easy	Medium	Easy	Easy
Participant 6	Easy	Easy	Medium	Easy
Participant 7	Easy	Easy	Medium	Medium
Participant 8	Easy	Easy	Easy	Medium
Participant 9	Easy	Medium	Easy	Easy
Participant 10	Easy	Easy	Medium	Easy
Participant 11	Easy	Easy	Medium	Medium

Table 2. Level of difficulty

Summary of the results

All participants found it easy to swipe an RFID tag for logging in, which confirms our assumptions about this interaction method when designing the billboard. However, most of them think that reducing the number of needed tags from two to only one, would further simplify the process and avoid them being confused in some circumstances.

Less intuitively, they have had mixed feelings when experiencing the two features of sending messages. For both private as well as public messages, most of participants were confused whether to push/release button then record the message, or to hold pushing button while recording the message then releasing once done.

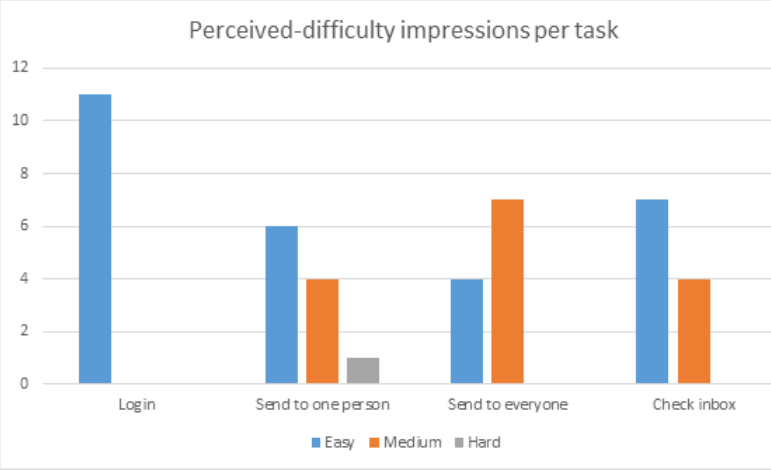

Figure 8. Quantitative view of results

Arriving at the last tested feature, which is checking a user's inbox, most participants found it easy to comprehend but so far accompanied with little friction. Although everyone agree that it makes sense to light-up the sender's button when the recipient (active user) is checking his inbox, they still expect to see the active user's button in a lit-up state as well (we assume it shall be in a different color).

Besides that, a non-tested functionality, that is message tagging, has provoked questions and remarks from most participants. One has seen it as unnecessary, others were curious yet neutral at the same time, but an active urban gardener found it as impactful in the sense it suggests what topics people shall be communicating about. Hence, serves to frame the communication's thematic.

Out of all recommendations we have received during the two evaluation sessions, we considered the following after their recurrence and or the background's relevance of its contributor:

Visual and physical aspects:

- Review the size of the full scale product based on body storming tryouts.
- Arrange names by alphabetical order for an easier reach.
- Integrate a mic in every sub-module for convenience.
- Optionally display a personalized garden name instead or in addition to the owner's name.

Interaction and user experience aspects:

- Limiting the voice message length to 20 or 30 seconds with animated progress display. This shall be further tested with users to decide on optimal max

duration. We should think more about how long an average user is willing to listen rather than to speak.
- Play a beep sound when starting to record.
- Change to: Push/release then record instead of holding the button pushed while recording a message.
- Use one tag only and access directly the inbox.
- Integrate interactive backlight at the level of the allotments' map, which indicates the sender's allotment when listening to his recorded messages.

Conclusion and Future Work

For future work, and based on feedback from the evaluation sessions we intend to simplify the interaction model, by using one tag per user and implementing audible feedback for the message recording feature. In addition, developing a working prototype of the mobile application will be necessary for carrying out further research, in the aim of investigating how using this platform will influence communication patterns inside a local urban gardening community.

We propose for that a longitudinal study based on three treatments experiment:

- Control or standard treatment.
- Introduction of a non-integrated system: billboard for non-smartphone users and mobile application for smartphone users.
- Updating the same system by integrating the two components to allow communication between physical billboard users and the mobile app users.

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