LANTERN IN THE DARK – EXPLORING COLLOCATED INTERACTIONS

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ABSTRACT

Touch devices started to play a prominent role in in 2007 with the release of the first iPhone. The activities involving a smart device include long distance communications, individual work or game and collaborations on a single display. However, the area of collocated interactions between devices has been left almost unexplored. A board game, Lantern in the Dark, was created using mobile phones as physical building blocks in a collocated environment in order to explore a virtual area. The results show that people quickly overcame the difficulty of the new interaction and even built strategies around it.

INTRODUCTION

Mobile phones today are our go-to device when checking news, social-networks, taking photos and more (Lundgren et al. 2015). Collocated interaction, known as face-to-face interaction, is a rare feature in applications and the phones today have limited technologies that support it. Sharing a photo for example in a collocated environment usually ends with a user sending around the phone itself rather than sharing it to the group's phones.

This paper will discuss the concept of using mobile phones as physical building blocks in a collocated environment. The results will therefore not only utilize touch screens and sensors for the interactions. It can be seen as using the phones as pieces in a board game. To showcase the concept we developed a basic game, called Lantern in the Dark. The game features a lumberjack called Sven, who is trying to find his way home in the dark winter night. For each move, a phone is placed where the players want the lumberjack to move next. The whole process, from the theory through the implementation to the evaluation, is presented here.

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THEORETICAL BACKGROUND

During this project we used a framework that specializes in collocated interactions provided in the paper "Designing Mobile Experiences for Collocated Interaction" by Lundgren et al. (2015). The framework focuses on four different design perspectives that help designers to systematically create a concept.

The *social perspective* helps with social aspects of how users interact with each other and what social actions have to be made. The *technological perspective* concerns the user's devices and about the limitations with each of them. The *spatial perspective* involves the location of the users and what the distance between the users is. The *temporal perspective* encompasses the order of actions and how the intensity of the actions are, relative to time.

Each of the perspective then has several properties that go more in depth about the perspectives. The framework can be used for ideation to get initial ideas for the concept. It is advised to choose 4-6 properties and then go from there.

Lucero et al. (2011) proposed a set of principles they call the principles of Social and Spatial Interaction. These are: *Social*: Sharing devices to reach a common goal; *Spatial*: Using the phones relative position to each other for interaction, *Tangible*: Using phones as a tangible user interface to manipulate data and *Multimodal*: Giving the user multiple interaction and feedback possibilities. The premise of the principles is to extend the individual use of mobile phones to support shared collocated interaction.

CONCEPT CREATION

The framework by Lundgren et al. (2015) and the SSI principles by Lucero et al. (2011) helped us discover the area of using the phones as tangible pieces. The *Spatial*

and *Tangible* principles especially influenced us when working with our concept.

The first iteration of the concept was originally inspired by the "hacking" mini-game in the first person shooter BioShock (Bioshock Wiki, 2014). In order to hack safes, turrets etc. the player has to connect flowing water from one location to another in a grid system using pipes. These kinds of games date back to 1980s. Our first idea was to use phones as the pipe pieces in the grid, using the phones' sensors to detect their rotation and movement and use that to rotate and move the pipes. The problem is that to have a big enough grid system, we would require a lot of phones, a 5x5 grid would require 25 phones. However, we liked the basic concept of using phones as building blocks, and tried to further develop the idea.

Instead of using many phones as the whole game board, we use the phones to build the game board. Sort of like how the snake moves in the classic Snake game. One of the phones is randomly selected as the starting point. That phone is placed in the playing area (usually a table with players sitting around it), then the players have to decide which direction they want to go, in this first instance they can go forwards, backwards, left and right. They then place a phone in the direction they want to move. For example, if they want to go left, they place the second phone to the left of the starting phone. They can't move where a phone is already placed. The goal is to help the character (the lumberjack, Sven), find his way home. Placing phones makes Sven move from the previous phone to the newly placed one. This creates a snake-like structure made up of phones. To help the players, we thought of having Sven get warmer or colder depending on if he gets closer or further away from his home each time a phone is placed. To show this warm/cold relation, we would have a slider shown on the all of the phones. When a move was made, the slider would change, to let the players know whether they are moving in the right direction.

EVALUATION OF CONCEPT

The idea behind our concept is to allow a group of collocated people to explore an area in order to reach a goal by placing phones on a table. What we needed to do was to find out which interaction would be best for the concept, i.e. how to move from one phone to another and how to get proper feedback about the position. We realized a pre-study divided into two parts in order to find out what would be the most intuitive solution without making the game too easy.

The first part focused on the navigation by using paper prototypes to realize a user test. Looking at the technology smartphones have today, there is not really one that can make the concept fully realized. We thought about using accelerometers, or some other sensor to detect the movement and position of the phones, but for the purposes of this study and exploring the concept, we wanted a simpler solution to determine movement and position.

The solution we came up with was to use navigational arrows on the screen to fake the phone placing interaction. The phones themselves don't sense each other but they share their own theoretical position data with the others. It is therefore crucial that the users place their phones in a correct order. In order to find the most intuitive interaction of how the navigational arrows would be placed and how they would work we conducted a user test. The user test consisted of three paper prototypes that had different layout for the arrows. To make the participants sure of how the different prototypes works, we gave an explanation for all three of them.

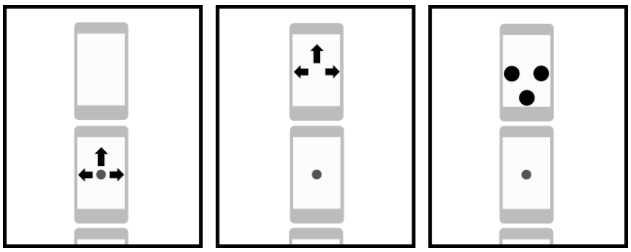

Figure 1: (a), (b), (c) Paper prototypes used during the evaluation of the concept

The first prototype (figure 1.a) had arrows pointing in all possible directions on the first phone, so if the user would press on an arrow, let's say the forwards arrow, the character would move forwards and enter the second phone from the bottom of its screen. The second prototype (figure 1.b) had arrows on the second phone, which meant that the phone was basically a remote control for the character on the first phone. Users would press the forwards arrow on the second phone which made the character go forwards and enter from the bottom on the second phone. The final prototype (figure 1.c) was similar to the second one but instead of using the phone as a remote, the second screen would have "come here" bubbles, which means that the phone would be placed at the desired placed and then a bubble would be selected to say "come here" to the character.

The study involved three participants, who took part in the same session since collaboration is key here. The result of the user test was that the first prototype felt the most natural. Having the navigational arrows on the first phone meant that the users didn't have to consider using both phones when doing one action. Having the second phone as a controller also resulted in that it was more important to put the phone on the right place before pressing an arrow.

The second part focused on the feedback that the users can get from the system. A discussion about that subject was conducted with the same participants. The idea of the warmer/colder slider was presented to them and they were asked to give their opinion on it. The general comments about this were that a slider would make the game too trivial as you could probably find the right

direction in just a couple of moves. One of the participants said that less precise feedback could help promote the discussion on where to go next and therefore the collaboration. While the game was never meant to be too complex since it was made to test the concept of using phones as building blocks, we could see their point. Instead of having the slider, they suggested we use sounds that could be played when Sven went further away and closer to home respectively. Moreover, based on the *Multimodal* SSI principle Lucero et al. (2011), multiple types of feedback are always better.

IMPLEMENTATION

Based on the previous study, a prototype was implemented. The system and the interactions with players rely on different levels of interpretations.

As mentioned before, the purpose of the game is to move from a starting point to the exit, both assigned by the system and unknown to the players. The order of the phones is randomized at the beginning but remains the same in the later steps. In the following section, "phone" and "device" will designate the physical object while "screen" and "interface" will designate what is displayed.

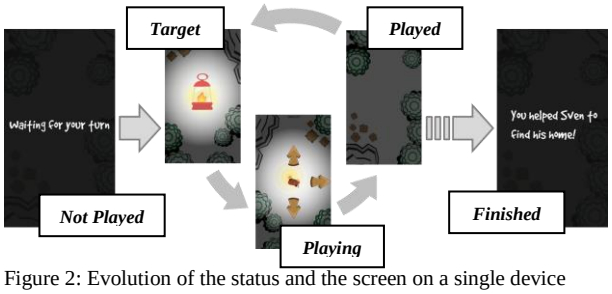

Figure 2: Evolution of the status and the screen on a single device

Each turn, a phone is assigned with a status and its corresponding screen (figure 2): *Not Played*, *Target*, *Playing* and *Played*. *Target* displays a lantern to draw the attention of players on the imminent move of the corresponding device. *Playing* shows Sven (viewed from above) and arrows to make a decision about the direction to take. Finally, a grey layout when it comes to already explored areas is displayed for the *Played* status. All three of them have a forest background, in contrast to the *Not Played* status, which simply shows a dark screen with the words "Waiting for your turn", making obvious that the phone has for now no impact on the game.

It starts when one phone is displaying the *Playing* interface. As shown in figure 3.a, all the other phones are not in play, with either the status *Target* or *Not Played*. All along the game, *Playing* is the screen where Sven currently is and where a decision about the next move will be made. Players provide their instructions to the system by pressing one of the displayed arrows, which disappears once this has been done. Sven then walks to the next phone in line, which is currently *Target* and will be placed on the board at the required position (figure 3.a). The turn is now over. In the next one, as explained in figure 3, the device displaying *Target* becomes *Playing*, which in turns becomes *Played*. One of the *Not Played* phones turns into the next *Target*. This scenario is repeated until there are no more phones. Then already *Played* phones (which are placed in the queue figure 3.b) can be reused, following the same order. From the second turn on, another interaction is added. Sven appears from the side where the previous phone is located. A popup message "you feel colder" or "warmer" is displayed depending on if the lumberjack is further away or closer to the exit, while a sound evoking a howling wind or a fire in a chimney is played, in order to give feedback about the current position. The only arrows that are displayed are the ones pointing to playable directions. The non-allowed positions are defined by the sides of the grid (players can't get out of it) and the places already occupied by *Played* phones. The loop *Target-Playing-Played* (figure 2) ends by winning the game.

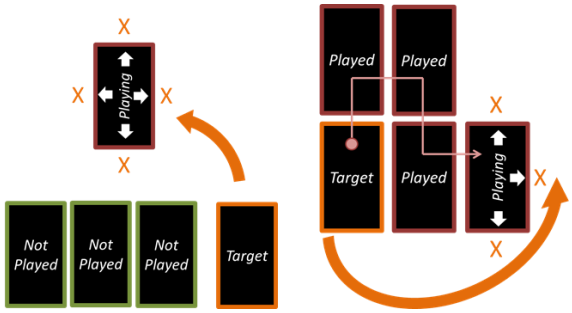

Figure 3: (a) first round, (b) later steps in the game. The green cards are not played yet, the orange one is about to be played (again in figure b) and the red ones have been already played. The playable positions are shown with the orange X. On figure b, the path followed is highlighted.

EVALUATION OF THE PROTOTYPE

In order to evaluate the interaction and concept of the finished prototype, a second user test was conducted. There were two different steps in the study: observation with as little intervention from the moderator as possible and discussion.

Firstly, the four participants of our study were handed a phone and then told to connect. Since the goal was to test the experience of someone playing the game for the first time, no explanation was provided about how to play. The participants got to play through a round of the game from start to finish while we observed. We paid extra attention to the following factors: if the game was easy to understand and if the participants collaborated and discussed decision-making. Afterwards a couple of questions were asked to get their feelings towards the game and concept.

Overall, the participants enjoyed playing the game and thought the concept was promising. The only significant problem encountered by the participants was at the very first turn. As they didn't know that the game is played with phones on the table, the first player clicked an arrow with the phone still in their hand. We intervened

at this point, telling the participants to put their phones on the table. Other than that, the game played out smoothly, with everyone discussing about where to go. The interactions - giving instructions and getting feedback - were easily understood and well used, which made the players quickly focus on the game itself. Since the game is not very complex, it did not take long for users to adopt the proper strategy and to win. This could be considered a downside due to the lack of challenge. The discussion provided some more in-depth perspectives and explanations. The comments were mostly about the issue encountered at the start of the game and how the gameplay could be improved. To make the game easier for the first time players, the participants recommended us to have a short tutorial in the start of the game. The queuing phones were also considered annoying if they have no other purpose in the game than preventing Sven from going back to that position. A gameplay mechanic should be invented to motivate this as well as to increase the difficulty. One idea to solve this issue was raised: something could chase the character and be seen on the previous phones. This would also introduce a time condition and make people take fast decisions.

Figure 4: Participants playing during the evaluation of the prototype

DISCUSSION

The results we have from the user tests and the general thoughts from people who were playing the game suggest that the concept is interesting and unexplored. The different points to discuss for further steps are the following ones: the use of sensors and output as well as a way to create a better coherency between the gameplay mechanics and the algorithm developed for the game.

We explained earlier the reasons why we chose not to use any kind of sensor. However, it would be good to compare our results with other kinds of navigation, like using the accelerometer in a clever way. It should also be taken into account that removing arrows also means removing feedback about the playable directions to take. On a more general scale, all feedback could be improved, for example, by using vibrations. It could either break the experience or enhance it, but in order to fully give an opinion about it, it has to be tested. It could make it easier for the users to know which phone that had to be placed next, but the sound could be irritating after a while, we all know how it sounds when a phone is vibrating on a hard surface.

Even more important is to work on the gameplay. As a basis, the prototype was interesting and participants liked using the physical aspect of the phone as well as the interactions with the system and among the devices. Everything was quite intuitive, even though some information at the beginning should be provided. However, as already mentioned, some more thoughts have to be done on the motivation for not allowing players to move to a position already occupied by a *Played* phone. Something chasing Sven, following the same path and displayed on those phones is a quite interesting idea. On the other hand, a solution could be to allow only one step backwards, but in this case, it would probably be better to re-use the previous phone and not have the players stack a second phone on top of the other. Also, the grid system has the downside of having a limit, preventing players from going out of it when they are at the edge. This means there is a pattern of moves that could lock the players in with nowhere to go. Ideally, it should be possible to explore the area without any constraint of this type, since it would fit better the forest environment used in the game.

Other focuses could also be taken into account, like the battery life. For now having the screens always on is not a big issue since a game only lasts a couple of minutes, but adding complexity to the gameplay would automatically increase the time spent to play. Also, the different screen sizes between the devices are a potential issue in later steps, even though we didn't encounter any difficulty in our study. A good balance between the game and technology requirements would have to be defined.

CONCLUSION

This paper has investigated the concept of using mobile phones as building blocks for a game, Lantern in the Dark. The game lets players use their phones to guide a lumberjack through the dark winter night, to find his way home. Through the development and evaluation of this game, we have found that the concept was easily understood and it has potential but requires more exploration to fully utilize collocated interaction possibilities between mobile phones.

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