EMBODIED INTERACTION PROJECT

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1. Introduction

"Urban ecosystems are expanding around the world as people are migrating to the cities and the human population is growing rapidly" [4][p. 1]. This growing population and nuisance created by the human are affecting the degradation of the ecosystem. This is affecting the life of humans as well as flora and fauna in the earth [17]. Rivers as an important component of many urban ecosystems [7]. Taking Fyris river in Uppsala as an example, it is of much value for birds, animal and aquatic life [10]. According to the Water Authorities (Vattenmyndigheten), one-third of Uppsala County's surface was covered by Fyris' catchment. It also plays an important role in human activities, like the supply of irrigation and drinking water, hydropower, working as a shipping route [2] as well as serving places for relaxation in central cities.

In the project, we grasped a small reach of the Fyris river in Uppsala central city. There is a bank that was built as a garden, called Gotlandsparken, with garden plants, like tulips and grass, with artificial facilities, like paths, benches, and trash bins. In the Gotlandsparken, there is also wilder looking area where dry branches dip into the river and reeds grow in clumps. Therefore, this place not only attracts people for recreation but also provides a habitat for wild species. However, the river and wildlife in the river are confronted with many risks including the eutrophication of the water caused by farmland leaking and individual sewers, the artificial barriers which affect aquatic organisms to complete their life cycles, the industrial emission [2] as well as some urban trash, like plastic bags, floating on the water.

The aim of the project is raising environmental awareness and guide environmental-friendly activities toward people who relax in Gotlandsparken with embodied interaction. Ethnomethodological observation and interview were utilized for understanding what people do in this place and how they think about it. Several times of brainstorming were used for coming up with design opportunities and design ideas. Literature reviewing was adopted for verifying those opportunities and ideas. Through analyzing design ideas were narrow down and designed and evaluated for the final design ideas. The final design idea in the project is encouraging people to pick up trash floating on the surface of the river through remote controlling with embodied interaction so that not only will they enjoy the time stay in Gotlandsparken but also their activities will benefit the urban ecology.

2. Domain analysis

The project started with an ethnomethodological observation, this was conducted four times with each session being one hour long. In order to detect the different status of the place, the four observations were executed in 4 days in different time representatively, and all the observations were carried out in common weather (sunny/cloudy) to reduce the variable caused by weather. The observation was conducted in Gotlandsparken, an open ground in length of 200 meters, which is a part of the pavement alongside Fyris river and has entrance and exit. The reasons for choosing this place are that it is centrally located and easily accessible to people and it fits well into the theme of urban ecology. Since this place is easily accessible it means that there probably be more (frequency and quantity) flow of people meanwhile, the chosen place itself is an integrated ecological system, which offers the chances to explore the connection between the place and human's everyday life in the city and how people are embodied in the ecosystem. To summarize, this place provides potential opportunities to implement a design that help them to connect

better, physically and emotionally, to the city as an ecosystem. To study people's opinion and perspectives of the place, interviews were conducted through the whole observation process. As a result, This was done gaining a basic understanding of the place.

2.1 Surrounding

The landscape encompasses architecture, artifacts, animals, and plants. Being in front of the river, it is easy to see the symbolic architecture -- Uppsala Cathedral, and restaurants, houses on the opposite bank (Fig. 2.1) as well as a bridge across the river. Behind the bank, there are many shops, selling cafe, fast food, and the city center shopping mall is about 5-minute-walk away. In Gotlandsparken, there are many artifacts, including path, benches with different physical properties, trash bins, steps, hydrophilic platform, etc. (Fig. 2.2).

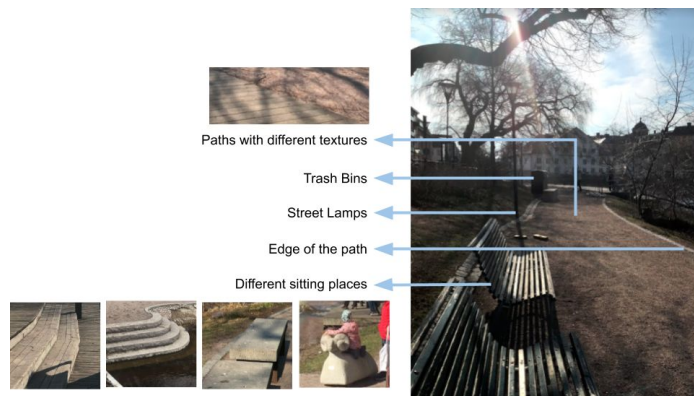

Figure 2.1 Architecture across the river

Figure 2.2 Artifacts in Gotlandsparken

In terms of animal and plants, at least 5 kinds of common birds and some insects are easy to be seen (Fig. 2.3). Birds often stay in the lawn or trees and waterfowls also swim on the river. Sometimes they will get close to people and artifacts. As for plants, the path divides the plants in Gotlandsparken into two sides. In the side far away from the river, plants were planted in order and all of them are garden plants (Fig. 2.4), while on the other side where near the river, the vegetation is wilder, as dry branches lay anywhere and reeds grow without organizing (Fig. 2.5).

Figure 2.3 Birds and insects

Figure 2.5 Garden plants

Figure 2.5 Wilder plants

Besides this visual sightseeing, many kinds of natural sound could be heard in the place, including the sound of flowing water, the chirping of the birds the sound of flapping wings the sound of falling leaves when they fall in the ground in the river or when insects crawl over. Human-made sound also surrounds, like the honking horns and motor sound.

In general, the landscape encompasses architecture like cathedral, house, bridge, etc., plants with different shapes and tactile impression such as tree, shrub, lawn, flower, river etc., artefacts including path, benches with different physical properties, trash bin, steps, hydrophilic platform etc.. Also, some fauna especially birds and insects live in the area. All the elements mentioned above compose a complete ecological system, in which people pass by or carry out activities, therefore, there's ongoing interaction between humans and the place.

2.2 People and activities

Through observation, we found that the place is utilized by people to conduct various activities. Four main activities were discovered. Firstly, some people just passed by (alone or in groups) through the pathway (Fig. 2.6), but an interesting phenomenon is that even though the pathway is adjacent to a wider main road, many people tend to walk on the pavement close to the river. Secondly, during the observation time, many people were seated on different benches or hydrophilic platforms (alone or in groups) while doing activities, like talking, picnics, reading, drawing, etc. Some of them try to interact with birds (Fig. 2.7). Furthermore, different kinds of sitting places led to different sitting postures. Thirdly, we observed that there is one person to go around the place and pick up trash, it should be noted that despite this, there was still some trash left (Fig. 2.8). The final activity is that some kids playing on the ground, chasing birds, throwing stones to them.

Figure 2.6 People pass by   Figure 2.7 Sitting   Figure 2.8 Picking up trash

The interviews gave an insight of people, to what extent people use the place for different activities and the motivation behind them. Some interviewees just want to walk there or sit there spontaneously while some visit the place in certain frequency to do some specific activities like reading, studying, drawing (monthly, weekly). Almost all interviewees mentioned that they are usually appealed by the landscape and the open view of the scenery around the river. A noteworthy phenomenon is that some interviewees are interested in the fauna there, but almost none of them would like to interact closely with them.

2.3 Problem and intervention

Through brainstorming based on the result of observation and interview, four problems were found in this place. For exploring the design opportunities, we searched the background of those problems and found out existed interventions or came up with potential solutions.

2.3.1 Protect asp fish

Across the river, under a white house, there is a hole which is easy to see by people. Water can get into it and flow through a stair-shaped facility for slowing the current of the stream so that migratory asp fish can go around the dam and swim back to the upriver for spawning. According to the result of the interview, 30 percent of the interviewees mentioned that they tried to watch fishes. In this case, one of the design opportunity is spreading awareness among people about the asp fish and help them to observe it.

Asp fish also called Leuciscus Aspius is "a widespread species with no known major widespread threats. However, locally threatened by river engineering projects" according to the statement of IUCN Red List [18][p.2]. For protecting Asp fish, in Fyris river in Uppsala, there is Aspen staircase which is installed in 2008 for supporting the fish's migration. In addition, Daniel Brelin, county fisheries consultant at the County Administrative Board, said that since the 2017 year, the counting work has begun. A camera is able to record when the fish passage work [8].

2.3.2 Clean up river water

For those interviewees who try to observe fish, they also think that the river water is too muddy to see anything. Thus, another design opportunity is to educate people about the water body in two aspects -- the level of cleanliness of the water in rivers and the practice methods of cleaning the water.

The water is very dirty due to various reason, a lot of waste floating in the river was human waste for example- people trying to feed the ducks by throwing food into the river and dropping plastic bags etc.. An intervention here could be showing real-time updates on level of cleanliness of water so that people are aware of their surroundings this along with some methods in which people can participate to clean the water body. One such method is adding coagulants (Moringa oleifera) to the water body by the people this shows them a difference that is visible since this clears turbidity of the water and also reduces ph levels [1]. Turbidity of the water can be measured with a unit called Nephelometric turbidity unit (NTU).

2.3.3 Handle trash

As we move along the river, trash which cannot be handled is plastic bags, packaging materials for taking away food, cups, straws, other kinds of microplastics as well as organic food, like melon seed shells. This trash is deposited into places where the cleaning staff can't reach or keeps blowing with wind or flows with water into different places making it difficult to keep it clean always. It is not only that the trash is generated at Gotlanparken but also from other places. This litter might be transported into the Fyris river and can have a negative impact on the environment. For example, organic trash like food remainings, package paper, etc. might further not only add to the nutrient load in waterways but also keep cultivated and provide ideal breeding conditions for disease-carrying insects such as mosquitoes [11]. The Fyris river flows long way meeting the Baltic sea, where it can carry more pollution to the end into the ocean [9].

The invention of this problem could be education about trash and also illustrations that can show the future of the place. Some previous studies tested littering norm activation by design, where both explicit activation through a verbal prompt and implicit activation through design had significant, the multiple garbage effects, reducing the amount of litter to a great extent [5]. From other perspectives, some researches have proved the advantages of conversion of organic matters in multiple garbages into biogas or compositing municipal into organic fertilizer or soil conditioner, which can be a possible direction of future work [14].

2.3.4 get close to natural

From the interview, we also found that most adults do not want to get close to fauna though, in this spot, there are many birds, ducks or insects. However, according to research, human-animal interaction (HAI) can benefit to human's health and welfare from psychological and physiological perspectives [3]. Thus, making people get closer to nature especially the species there could be a design opportunity.

Research shows how people find dangerous to get closer to animals because of three reasons they might get infected by some diseases, damage human property or can attack humans [15], so interacting with wild animals directly has potential risks. In this case, the potential invention could be using technology to observe animals or interacting with virtual animals.

3. Background & Theory

3.1 Embodied interaction

In this place, people talk or picnic with friends, walk along the path feeling the texture of the sand ground, sit in benches while reading a physical book or eat bread. All the activities appended there are tangible and most of them are social. People gain experience by utilizing their body, their senses. In order to design for these people who stay there, embodied interaction is appropriate to match the human movement in the place, because as what Durish defined "embodied interaction is interaction with computer systems that occupy our world, a world of physical and social reality" [6][p. 3].

Embodied interaction inherited theory of body from Merleau Ponty's philosophy in which a sense of body works for the perception of external reality [6]. Thus, in the project, embodied interaction design helps to understand how people perceive the place with their bodies and helps to make people be aware of the familiar place from a new perspective through changing their body movements so that the environmental awareness could be strengthened or the environmental-friendly activities could be completed.

3.2 Design in a "place"

According to Montgomery, the sense place is formed by the mix of the physical form, activity, and meaning (Fig. 3.1) [13]. Embodied interaction design conduct in a place and might install new physical devices, change activities there or even change the meaning of the place, so embodied interaction design in a place is a process of remarking place to some extent. In the process, if people develop an affective bond or link with specific places, the place attachment will be generated, which are good for increasing the sense of belonging, degree of attraction, frequency of visits and level of familiarity [16]. In turn, these factors are also indicators of place attachment.
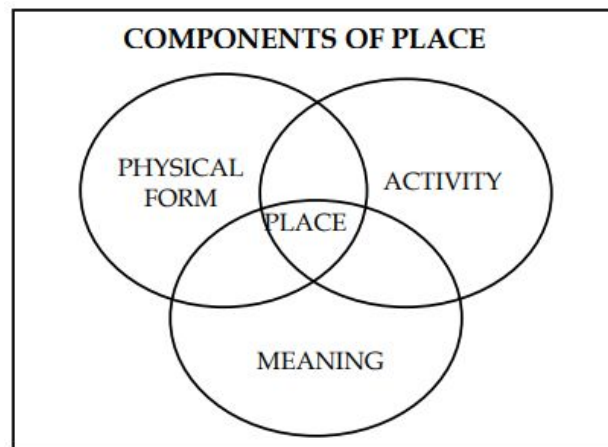

Figure 3.1 The components of place [13]

In the project, if the design in Gotlandsparken can increase the degree of attraction by the natural environment and species, the level of familiarity of this urban ecosystem and the frequency of visits, it will help to raise people's environmental awareness and guide environmental-friendly activities which are the aim of the project. Thus, when design in the place, raising people's place attachment through considering users' feelings and reactions towards the attributes and characteristics of the place [16] and measuring those indicators of place attachment will support to reach the aim.

4. Methodology and Method

Embodied interaction was used as an approach to interacting with computers in the project [6]. Embodied interaction inherits parts of phenomenological theories from Merleau Ponty who "reconciled Husserl's 'philosophy of essences' with Heidegger's 'philosophy of being'" [6][p. 114] to form the ontology and epistemology of it. Therefore, the ontology of the project is phenomenology that supports systematic

reflection for understanding the essential properties and structures of experience [12]. The epistemology is "a theory of the body" based on Merleau Ponty's phenomenological theories, which means that bodies play a role to perceive the world and form bodily perception for understanding the world.

As for the method, in the study, we used naturalistic observation and interviews for most qualitative data for data gathering. Brainstorming and bodystorming were carried out after the observations and interviews for ideation. Prototyping and evaluation also will be adopted for achieving and testing the final design idea.

4.1 Data gathering

Naturalistic observations: This method was chosen because it was reliable for qualitative research since we observe the testes in their natural habitat and it also helps out in the process of ideation [19].

Interviews: Interviews were carried out after the naturalistic observations on a different day. This method was used as it gave in-depth insights into our testes. A total of 7 interviews were taken and 7 questions were asked (Appendix 1) most people were of age 20-50. Interviews were taken on the location during the daytime.

4.2 Ideation

Brainstorming: The Brainstorming activity was conducted with following steps from figure 1. After the the process a total of 4 ideas were generated which had attributes like value, problem,solution representing the whole idea. One more session was conducted but this time only amongst the team members and 4 of the above ideas(figure 3) were narrowed down to two, and one more idea was added from the latest session.
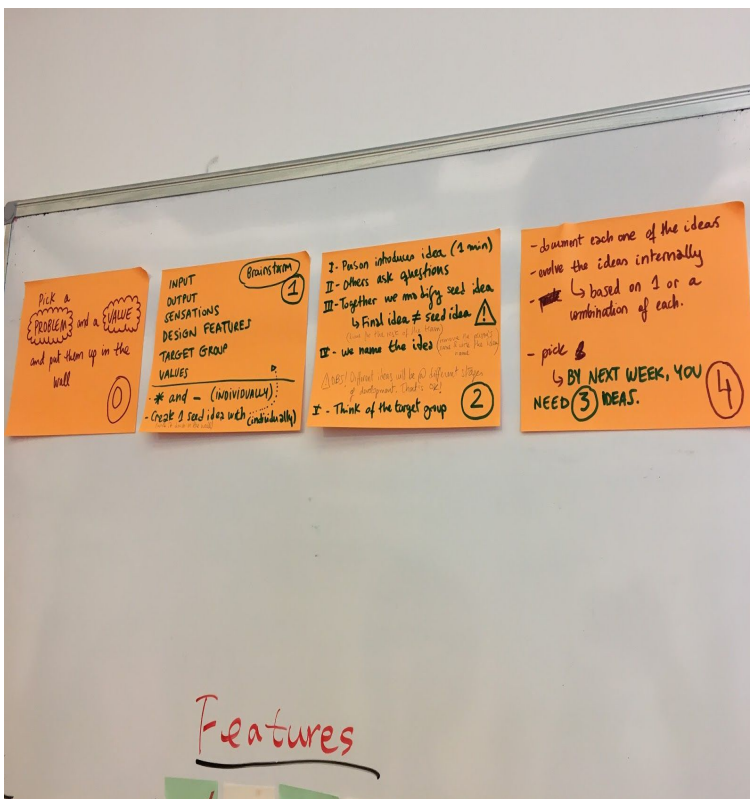
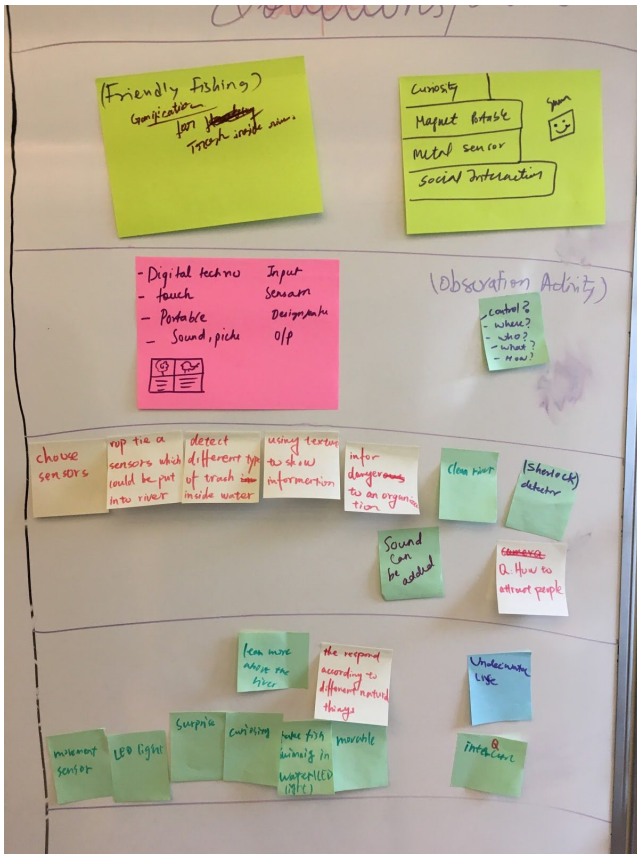Figure 1   Figure 2

Figure 3 : Ideas from brainstorming

Bodystorming - A total of 14 people were involved in this session. The participants were divided group in two parts with 7 people in each. Our group also split up into 2 groups. Each of our group consisted of an observer,videographer and facilitator. All the participants were briefed about our problems of interest. Which are as follows

- Protecting Asp fish
- Handle trash: People do not throw Organic trash or trash properly
- Clean-up water : Quality of river water, there is lot of trash inside the water
- Getting close to nature: Lack of Human-Animal interaction

Figure1: Enacting a scenario of a family

Figure 2: Interacting with the river

Figure 3: Ideas generation for trash bin usage


Figure 4: Interaction with the nature

Feedback Session - This session was very crucial as this shaped our final design idea. This session involved 3 groups, where each group shared their ideas and got constructive criticism from the others.

# 5. Overview of design iterations

5.1 Initial ideas

In total 1 Body storming session and 2 brainstorming sessions were carried out. The body storming session gave us hints on what kind of designs and interactions would be desirable and the brain storming sessions helped us to build full fledged ideas which were then narrowed down to the current one. Four ideas were generated in the first brainstorming session among which two of them were deemed appropriate for further discussion, the second session of brainstorming only involved our team members where as the first one involved other groups as well. The final 3 ideas were as follows

1] Trash tracking - Detect waste flowing inside the river with the help of the sensors and map them real time on a screen. A mechanism to help pull out small things and ability to contact personnel from uppsala kommun if anything abnormal is detected. Here one of the issues was safety of the user when pulling out the trash from the river and what kind of mechanism or artifact would help in doing the picking.
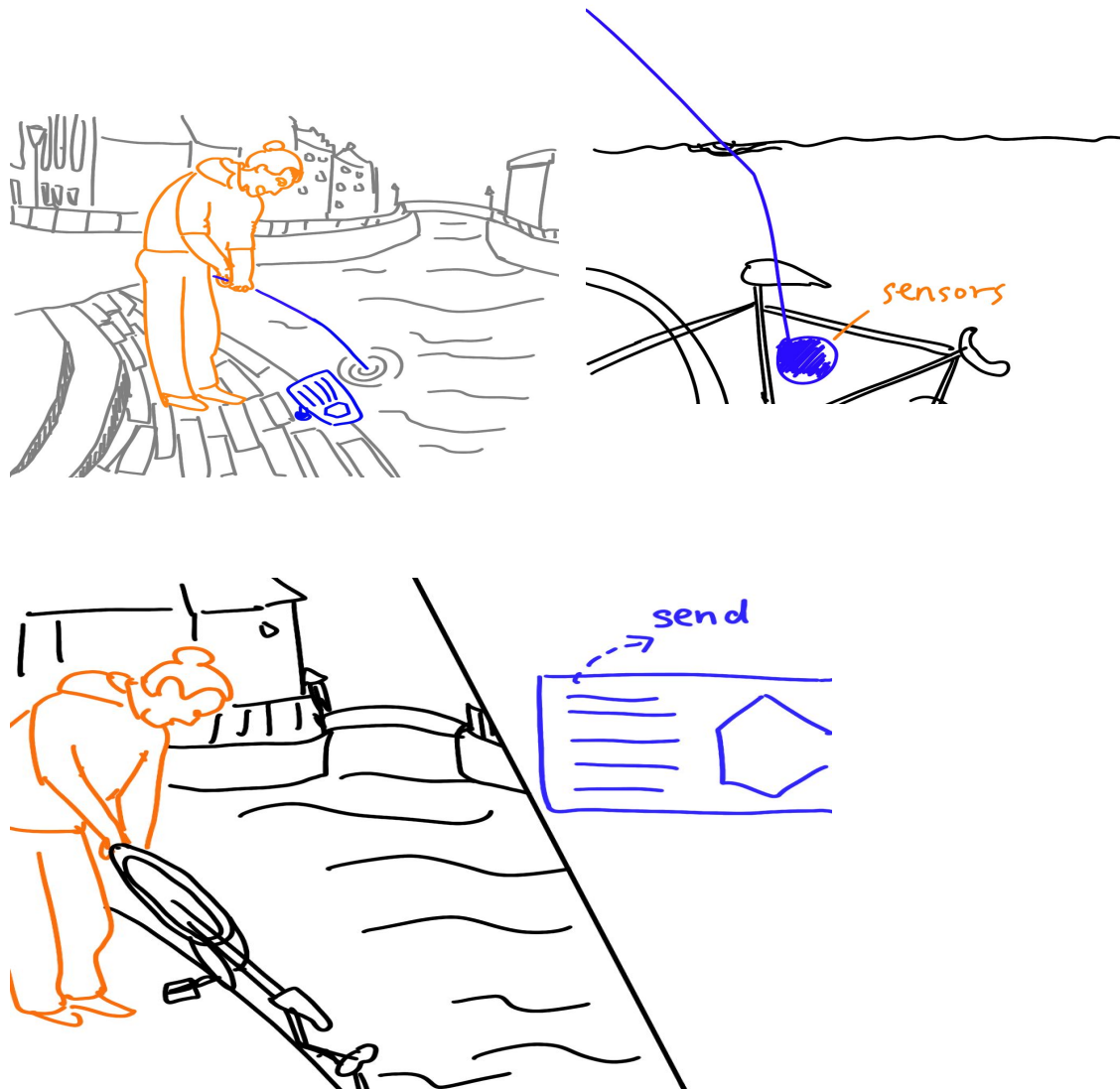
2] Awareness of Nature - Main intention here was to get people as close to the nature as possible and make them aware of their surroundings. To get people closer to the nature i.e in our case the river we planned for a artistic installation which comprised of array of sensors which detect presence in terms of and pressure applied, i.e a walking path which would sensitive to human presence, which could display lights and emit sounds. For awareness of user surroundings have some kind of fake flora and fauna which could be highlighted in users surroundings and give them information about the real presence of those species in the surroundings.
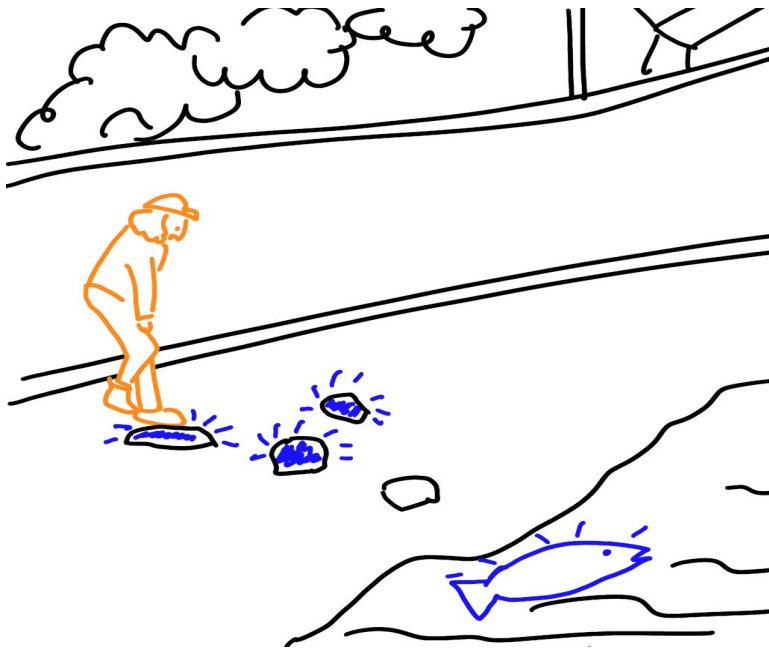
3]Night-time interaction - Our goal here was to encourage people to have night specific interaction in that space. This was supposed to use sensors and lights to help tracking trash and also for artistic installation which could be interacted with.

5.2 Final Design Decision

After the brainstorming sessions, a feedback session was conducted which involved other project groups as well. We were able to get a lot of valuable feedback on our ideas. Our main feedback was that our design ideas didn't completely balance the concepts of embodied interaction and urban ecology.

1] The first idea emphasised too much on trash cleaning in river but missed out on being a embodied interaction.

2]The second idea and the third idea had lot more interaction in them but missed out on the concept of urban ecology.

All in all, there was no proper balance of the two concepts.

A literature review was carried out to support selection of our ideas. According to some theories, the adverse impact of urbanisation on the 'health' of freshwater streams and rivers is just one consequence of the growing pressure that urban development has on the conservation of the natural environment and rivers and streams are among the most threatened habitats globally[20]. Thus we decided to narrow down our design topic at the pollution in the river. Furthermore, the litter on the river is the most obvious and accessible. Thus we decided to solve the problem of the litter in the river. On the other side, some theories inspired us that efforts to reduce the littering problem fall into encouraging people to pick up and properly dispose of litter left previously by other people, through design specific persuasive messages that were then evaluated for their impact on visitors' beliefs, attitude and behaviour[21].

From all the valuable feedback and literature review, we generated a new design idea that incorporated both the concepts.

Cleaning fish- A radio controlled boat would be stationed in the river along the edge of bank, this is where the interaction will take place . The RC Boat would follow the users movement in parallel and collect any floating trash and come back to the shore after its full. The user can now empty the boat and put that back into the river.

The movement of boat which mimics humans movement along the path is way of embodied interaction within the user space i.e the bank of river. Taking out of the trash helps in maintaining the ecosystem of that place.
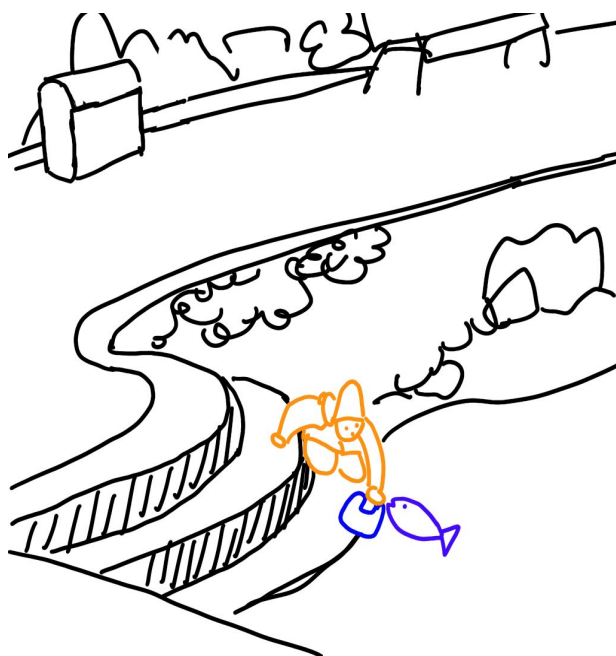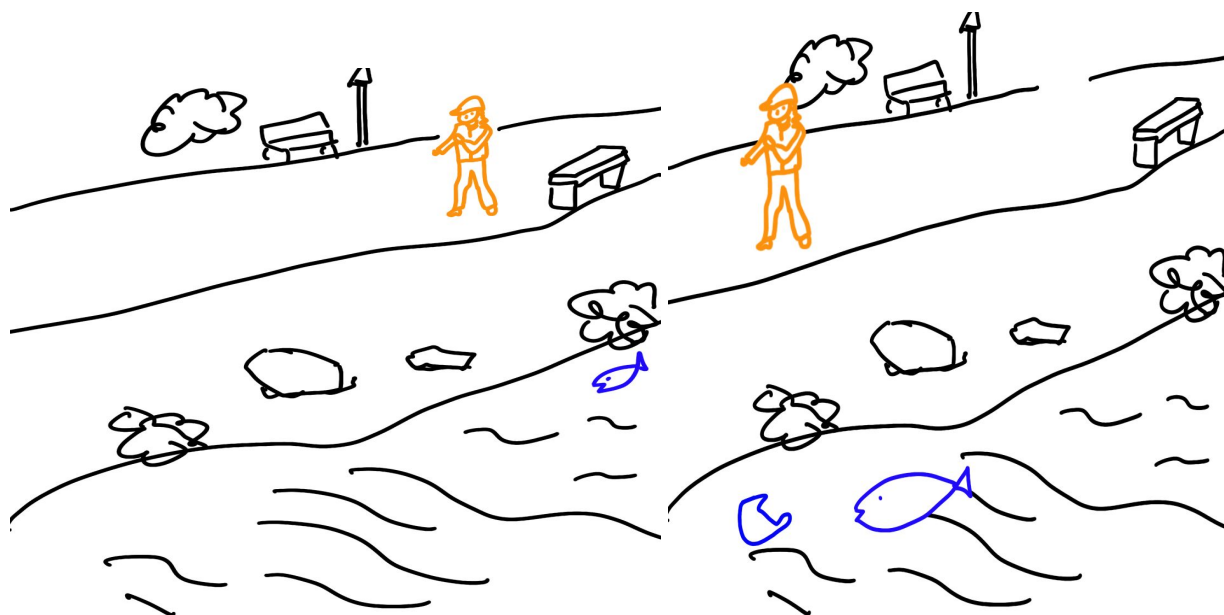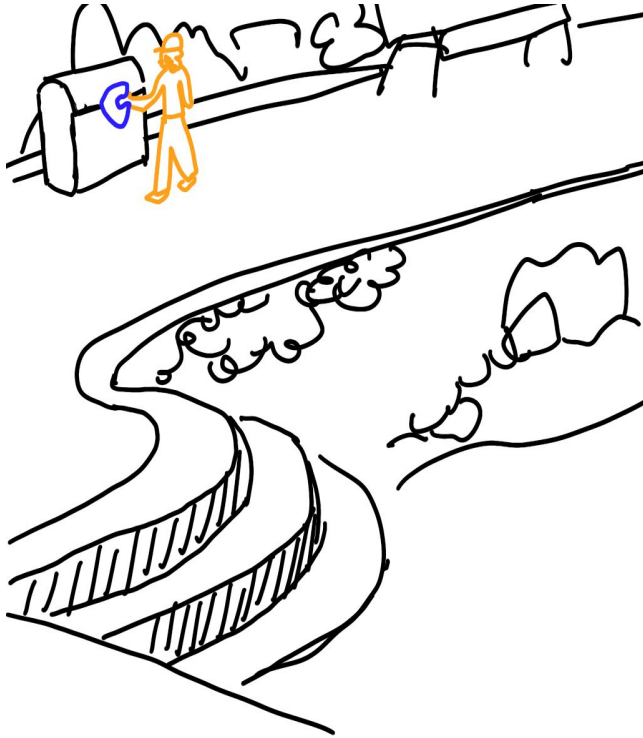
5.3. Evaluation

Initial Evaluation
A initial evaluation of the Final idea was carried out which involved role playing by the group members. One member assumed the role of the boat and two others portrayed the user and the remaining two were observers. We found some issues which are

1] Although mimicking was felt to be natural, number of people the boat can track may be an issue.

2]The issue of when the boat must return i.e either if its full with trash or every time the interaction ends.

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Appendix 1

Interview Questions

1. How often do you come here?

2. What do you do here mostly?

3. Any particular reason why you chose this spot? (any differences with other places)

4. What else do you do except this activity? Why?

5. What do you like about this place? And why?

6. Do you interact with the animals, birds or fishes? What are your thoughts on them?

7. Ask who people pass by, why they use the pathway near the river rather than going by the main road?