ILLINOIS INTITUTE OF TECHNOLOGY

RESEARCH IN ARCHITECTURAL ROBOTICS

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Chicago, June 2016

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Abstract

This project was developed for a Research in Architectural Robotics at the Illinois Institute of Technology. The intention of it was to highlight the virtuality that surround us and explore how it can actively change our environment. To achieve that a small artistic intervention was done, with the goal of giving virtuality a physical, visible form. To be measured and analyzed the virtuality was summarized to Wi-Fi signals (probe requests), emitted by mobile devices. A sensor that can capture this signals was built and connected to a fan in a way that, as more signal were sensed, faster would be the speed of the fan. This fan was put in a room filled with balloons, that would fly as the fan would speed up. The balloons are a metaphor, they serve as physical representation of these signal that we can't notice, because basically, as more signals were in the air, faster would be the fan and therefore more balloons would be flying. It is a simple project, but it can instigate further investigations on how virtuality can be a mediator between environments and users, and how it can improve the relationship between architecture and its inhabitants.

1. Interactive Architecture:

> "While artists work from the real to the abstract, architects must work from the abstract to the real." – Steven Holl

Architecture is art, how ever, with some some singularities, such as this one Steven Holl points out. Architecture has to be real and tangible, so it can be habitable. That is how it always was. At least before the concept of virtual. We now live with two different worlds, a real and a virtual world, with no barriers separating them. We never

know where one ends and another begins. They are always communicating with each other, and we often mediate this communication.

The architecture will always have a part in the real universe, a physical, tangible, part. But each day, architecture has become more virtual. A clear example of this is its creational process, that each time more often, makes use of softwares to create forms previously unimaginable. In this example, architecture communicate with the virtual word with mediation of the architect, but users, or inhabitants, can also be brought to this process. Interactive Architecture, or Responsive Architecture, has been exploring how technology can connect users and buildings, how it can allow building to physically answer to environmental inputs. To illustrate that, an interesting example is the The Dream Cube, designed by ESI Design for the 2010 World Expo. The building facade is covered with LED, that change colors according to people's movement inside its 360˚ theater. Another example, Evoke, created by Haque Design + Research, also use lights, but in this case, they are a result of a projection at the facade of the York Minster, that changes in accordance with sound, mainly with people's voices.

Dream cube


Evoke

Interactive Architecture can be realized by a large diversity of inputs, normally dependents of human actions. It can use a big variety of sensors, to capture people's presence, touch, movement, or voices. For this project, considering that virtuality is a very important aspect, the sensor to induce the interactivity should be as much virtual as possible.

2. Mobile Phones as tracking devices:

People are connected to virtual world all the time, and mostly, they use their mobile devices to do so. Our mobile devices have an interesting characteristic that we usually don't realize: from the moment they are powered on, they are sharing information all the time, and because of that, it is possible to know someone location and even where the person has been. In other words, people's mobile devices could be used as people's sensors.

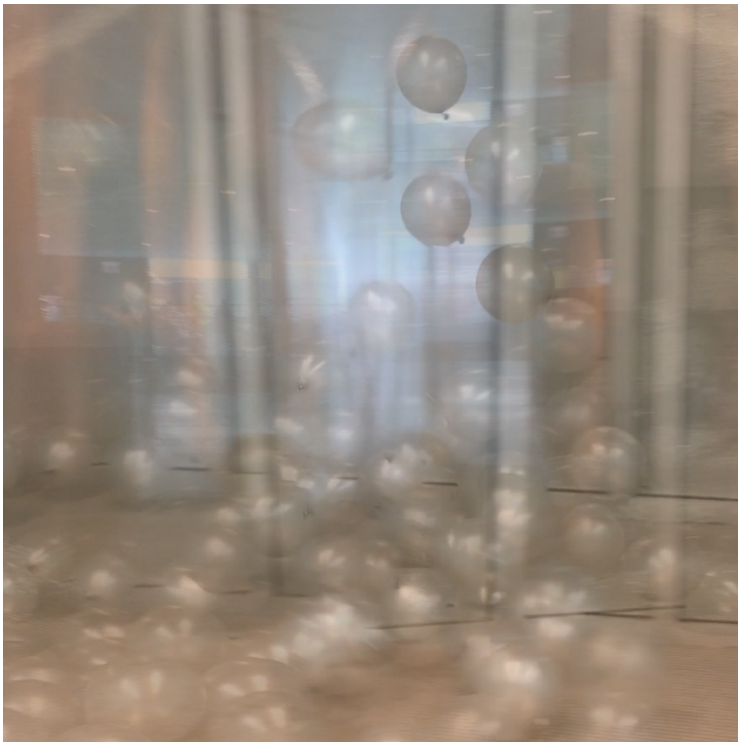
What happens is that mobile phones are communicating with network towers all the time. Observing the signal strength that one device has with different towers, by triangulation, it's possible to determine where the device is located, very often with an accuracy of one block in a city. This information can only be accessed by the mobile operator, but a "mobile fake tower", called IMSI catcher can be used by technically sophisticated organization to track a mobile device. Another way to tack a device, only possible for short range distances, like within a building, would be by using Wi-Fi signal. Every device has a unique serial number, called MAC address, which can be observed in wireless signals even if a device is not connected to a network. The device periodically broadcast packets called Probe Request, which include the MAC address. With a Wi-Fi

device in monitoring mode is possible to have an idea about how many phones are trying to connect to Wi-Fi, and therefore have an idea about how many people are in a building. Yet, this process will not give the exactly amount of people because not necessary every single person will be caring a mobile phone, and neither every single device will be with the Wi-Fi on.

3. A representation of the virtual world:

This project is an attempt to make people more aware of the virtuality that surround us. The idea is to create an environment that can changes according to the amount of people (actually, their mobile devices) that it can senses. These changes would consist of a physical representation of the changes that are actually happening in the virtual world, related to the amount of mobile phones that are in the area and the signals that they are emitting.

A sensor that can monitor how many mobile phones have Wi-Fi on, in a short range distance, was built and connect to a fan, in a way that the speed of the fan is related to the amount of devices tracked. So, if there are no devices with Wi-Fi on, the fan will be off, and it will turn on, and start to speed up according to the amount of devices that get to the range area. The fan and the sensor were put in a room filled with some balloons. The balloons are a metaphor for the signals the devices are emitting in the air. So when the fan started to blow, the balloons, started to move and to go up in the air, and the more the fan speeded up, more balloons were in the air. So basically, as more signals were in the air, more balloons were flying.



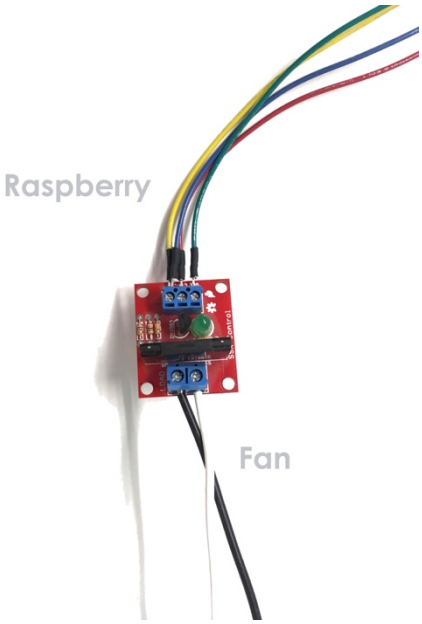
Balloons flying in the room.

4. Materials and Methods:

Overall, the only materials used for this project were the balloons, the fan and the Wi-Fi sensor. The balloons were regular latex balloons, filled with air, not helium. The fan was also regular, able to be set to four different speeds. Therefore, the sensor was the more laborious part. To create it was necessary one Raspberry Pi, a Wi-Fi adapter and a Solid State Relay (SSR).

The Raspberry Pi was connected to the Wi-Fi adaptor, and it was set to monitor mode, to sense all the probe requests that were broadcast around. The SSR was connected between the Raspberry Pi and the fan power font. The Raspberry Pi translates the rate of probe requests into a pulse-width modulation signal that controls the fan speed via the SSR. The speed of the fan increases along with the amount of probe requests, and when the rate of probe request is bigger then 10, the fan works on full speed, of whatever of the four speed it is manual set to work at.

Raspberry Pi



SSR

5. Outcomes

As well as the great majority of one trial projects, this project had both successful and unsuccessful aspects. The system of sensor and fan worked really well, in spite of the fact that if the maximum speed was set for a bigger number then ten probe request, it would be better. The environment where the project was executed had a big traffic of people outside, so the fan would rarely speed down, and even when it did, it was for a short time of period. Another problem found was related to the conduct of the balloons. Instead of going up, as expected, they tended to go to the sides, to escape from the wind. The room, was quite big for just one fan, so they would go the sides and stay there. A possible solution to that problem would be to execute the project in a corridor, that way the balloons wouldn’t be able to scape to the sides and would go up.

Balloons concentrated out of the wind range.

6. Conclusion

This project started with the curiosity about Interactive Architecture, and the virtual aspects of the word we are living in. The plan was to investigate, how could virtuality in some how improve the relationship between users and buildings. In midstream appeared an interest for the capacity of communication that mobile devices have, specially the communication that goes beyond the users will. Then an idea surged, to use these mobile devices to be the virtual mediators between users and buildings. The problem was that would be not enough time to produce a project in a building scale, therefore the option for an artistic intervention would fit better. Although it is in a small scale, this intervention is capable to illustrate how virtuality is all around and can actually change the environment we inhabit. It is only a beginning that can lead to further investigation of the combination between architecture, virtuality and people.

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