Micro City - Amusement Park Simulation
Intelligent Cyber Physical Systems

Alessandro Marcantoni
Simone Romagnoli

05/08/2022

Overview

Domain Context

The concept of **Micro City** was born observing contexts in which *self-awareness* and *situatedness* might help improve people's experience.

We believe that in these contexts wearable devices (and applications running on them) can have a great impact on how people interact with the environment.

What is a Micro City?

A *Micro City* is an area with:

- bounded temporal and spatial extension;
- various activities in the form of services or events;
- people (*guests*) that are interested in these activities and populate the *Micro City* itself because of them;

Thus, some examples of *Micro Cities* could be shopping centers, fairs, *amusement parks*, city centers, etc.

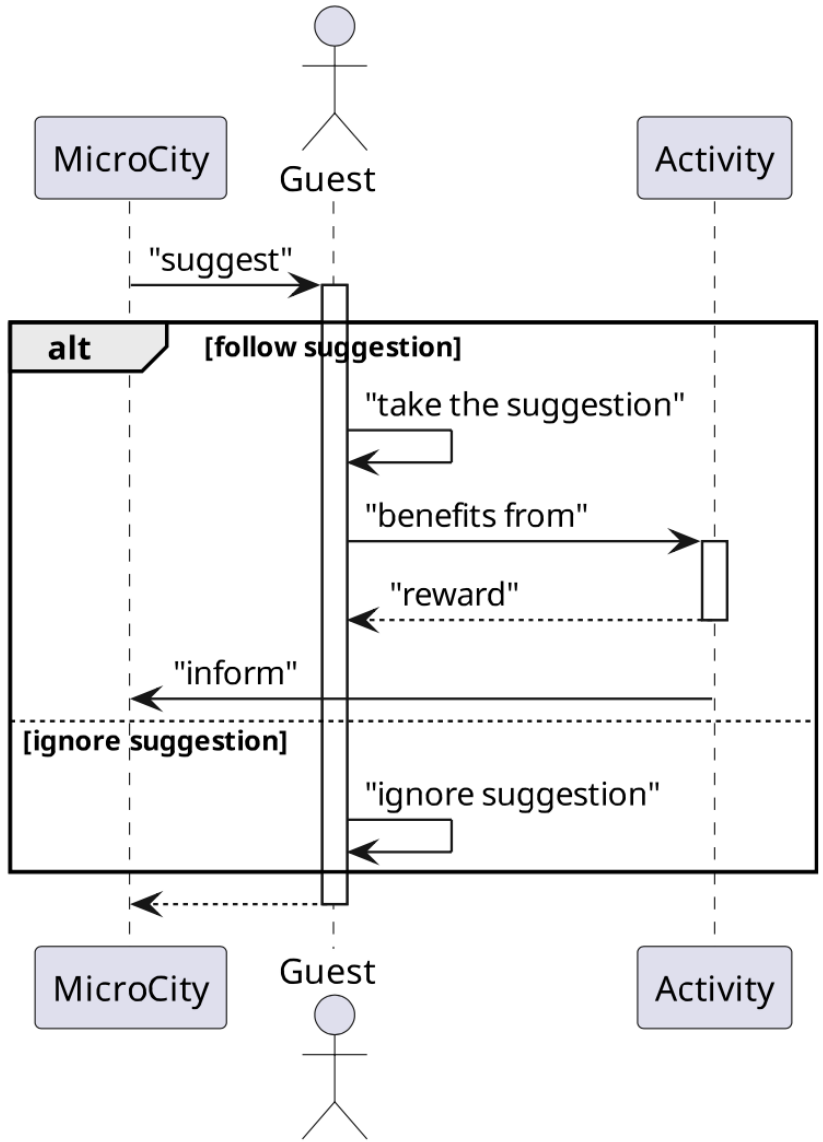
Recommendations

In this context, the introduction of a **situated recommendation system** could proactively provide recommendations to the guests that, if willing to follow them, would receive rewards.

The recommendations could be generated thanks to various policies and the rewards could vary depending on the context of the *Micro City* itself (discounts, cashback, simple reduction of waiting time, etc.)

Rewards

The following diagram shows the process of obtaining a reward when receiving a recommendation.



Amusement Park

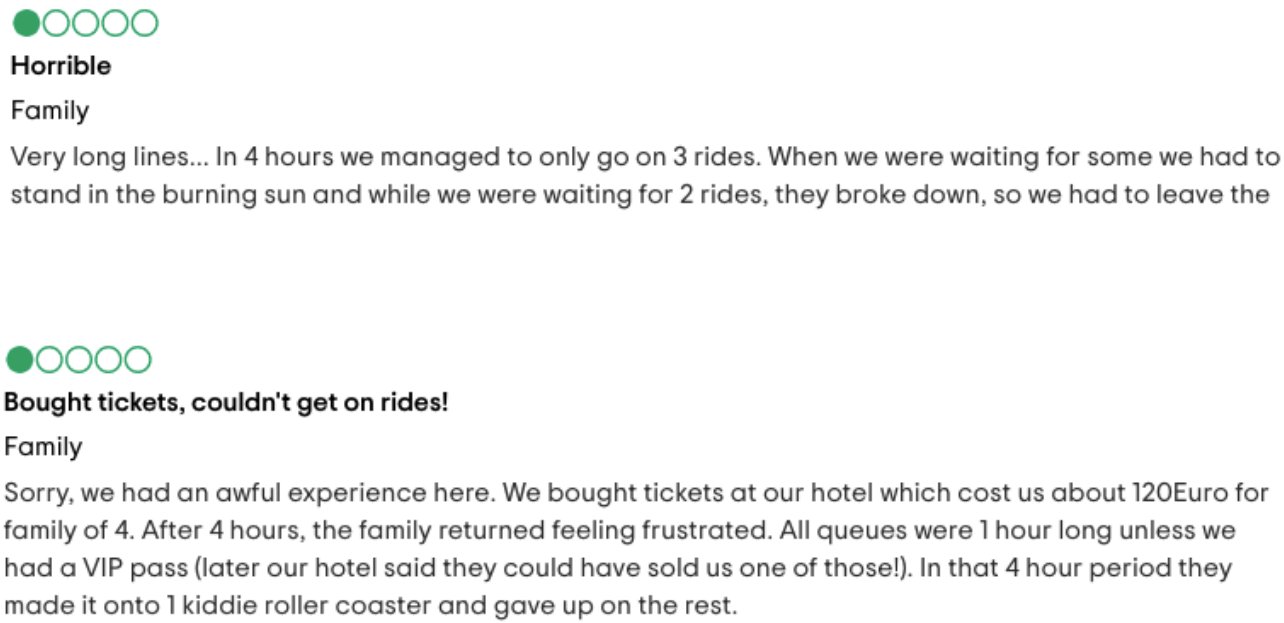
Amusement parks are considered to be a large business all around the world and attract people of every age and culture.

They can be considered *Micro Cities* because:

- they develop in a bounded spatial area and are open daily for a given amount of hours;
- they offer a large set of attractions (roller-coasters, carousels, water slides, restaurants, etc.);
- visitors populate the park because they are interested in the attractions.

Queues and Waiting Times

During holidays amusement parks can get extremely busy and visitors may need to wait in long queues in order to benefit from the attractions.



●○○○○

Horrible

Family

Very long lines... In 4 hours we managed to only go on 3 rides. When we were waiting for some we had to stand in the burning sun and while we were waiting for 2 rides, they broke down, so we had to leave the

●○○○○

Bought tickets, couldn't get on rides!

Family

Sorry, we had an awful experience here. We bought tickets at our hotel which cost us about 120Euro for family of 4. After 4 hours, the family returned feeling frustrated. All queues were 1 hour long unless we had a VIP pass (later our hotel said they could have sold us one of those!). In that 4 hour period they made it onto 1 kiddie roller coaster and gave up on the rest.

This can have a very bad impact on visitors' experience...

Recommendation and Rewards

In this scenario the *situated recommendation system* could suggest the most suitable attraction for the visitors, taking into account information such as how busy the attractions are and which attractions the single visitor is interested in.

Requirements

In order to be appealing to amusement parks, the *situated recommendation system should*:

- **make recommendations** based on certain criteria. It should abstract from the particular strategy used to calculate the recommendations;
- **track the state of every attraction** inside the park in order to provide dynamic and *context-aware* recommendations;
- **track the state of every visitor** (or group of visitors) in order to provide them with *situated* and personalized recommendation;
- memorize the information collected during the park's lifetime in order to develop more and more effective recommendation strategies.

Simulation Elements

The aim of the simulation is to determine whether a situated recommendation system may help reduce the waiting time needed to benefit from an attraction.

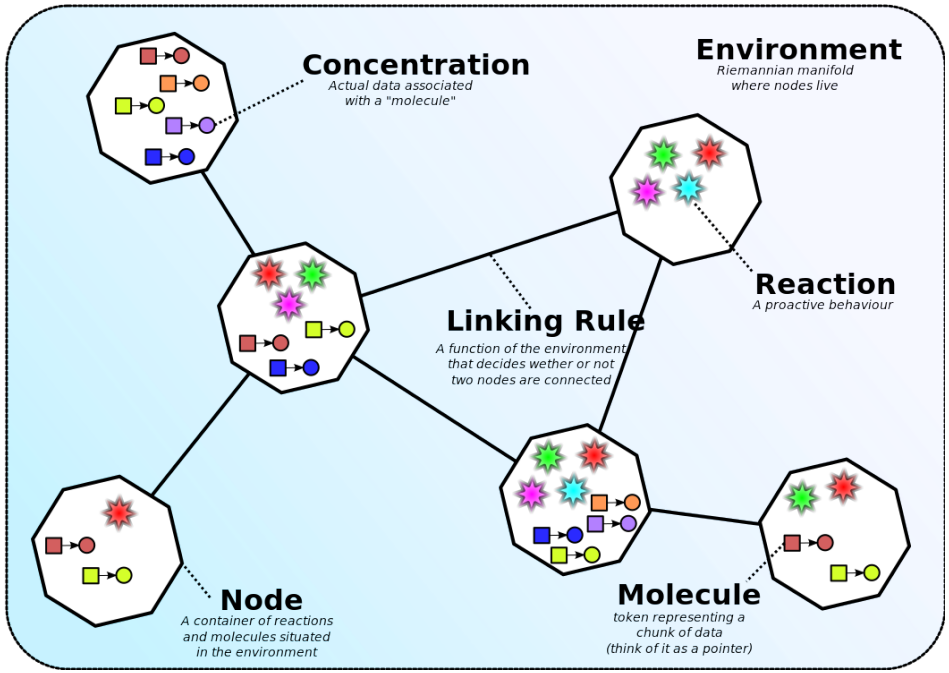
In order to achieve this, two simulations will be developed:

1. **Random Redirection** reflecting the current system.
2. **Recommended Redirection** reflecting the desired system.

The Simulator

As for the implementation of the simulation, the *Alchemist Simulator* was used for many reasons:

- It provides a *ready-to-use* simulation environment.
- It provides an intuitive graphic user interface.
- To contribute to the *research and development* area of the *UniBo DISI*.



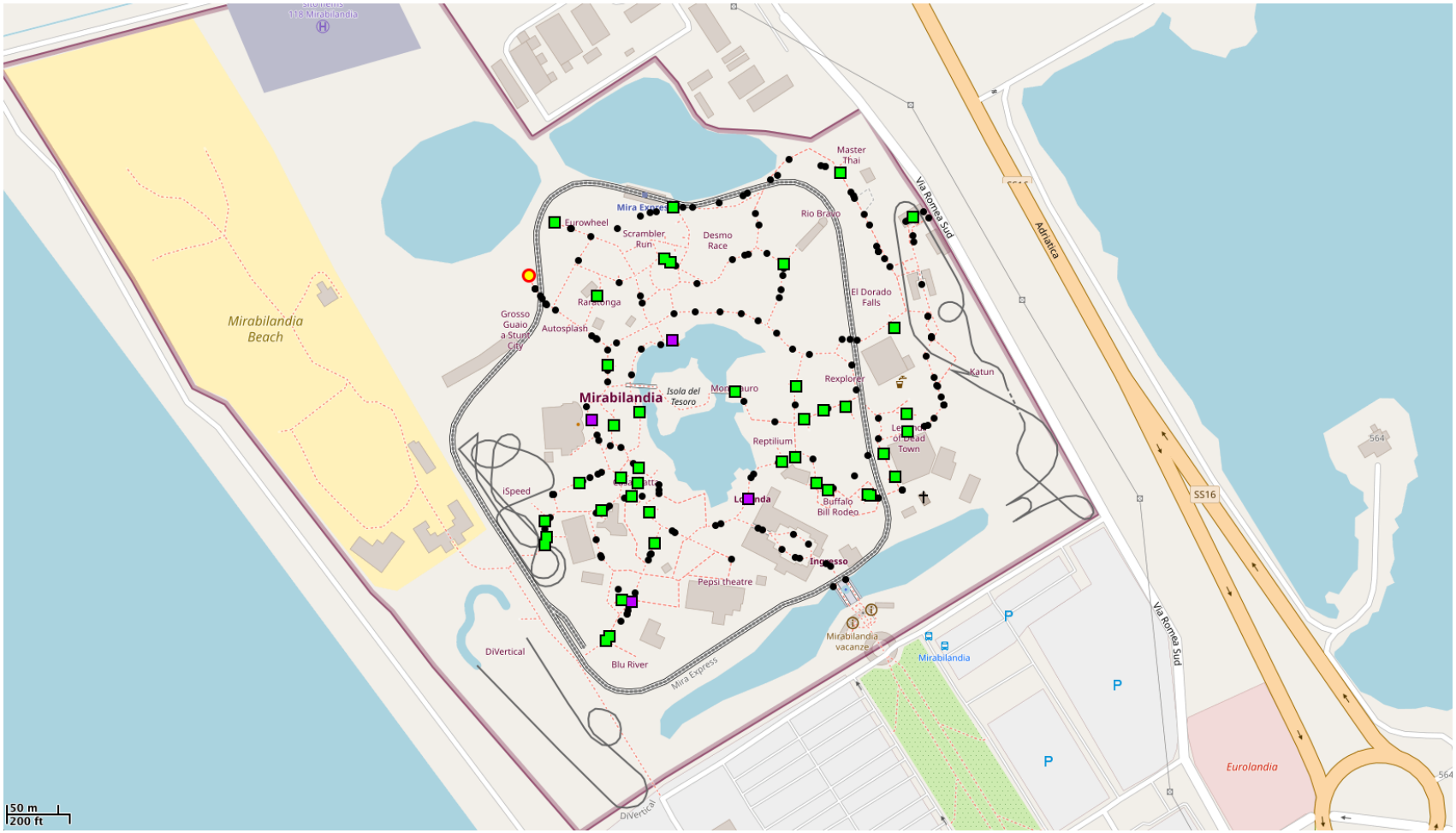
The Environment

The map of Mirabilandia, along with its streets, is provided by *OpenStreetMap*.

The deployed entities (Alchemist nodes) are **visitors** and **attractions**. Visitors are represented by black dots, while attractions are squares of different colors depending on their type (restaurant or ride).

Communication happens through attractions that are considered as **access points** that spread information to their neighbourhood.

The Environment



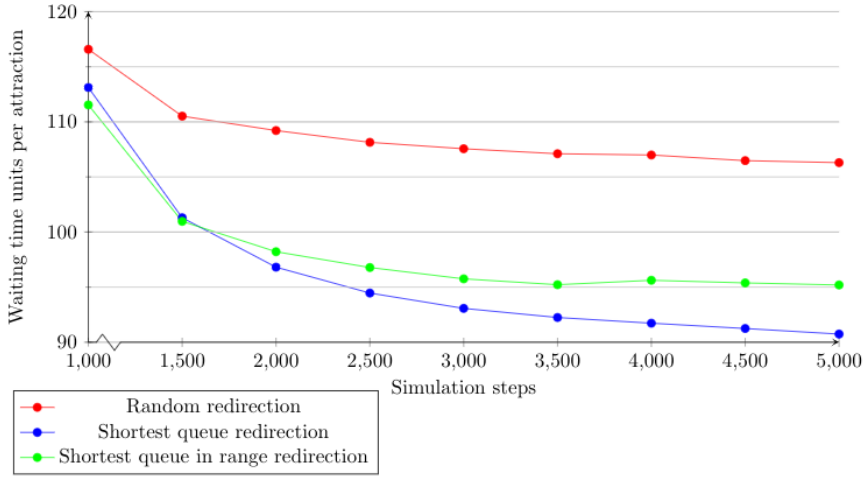
Redirection Policies

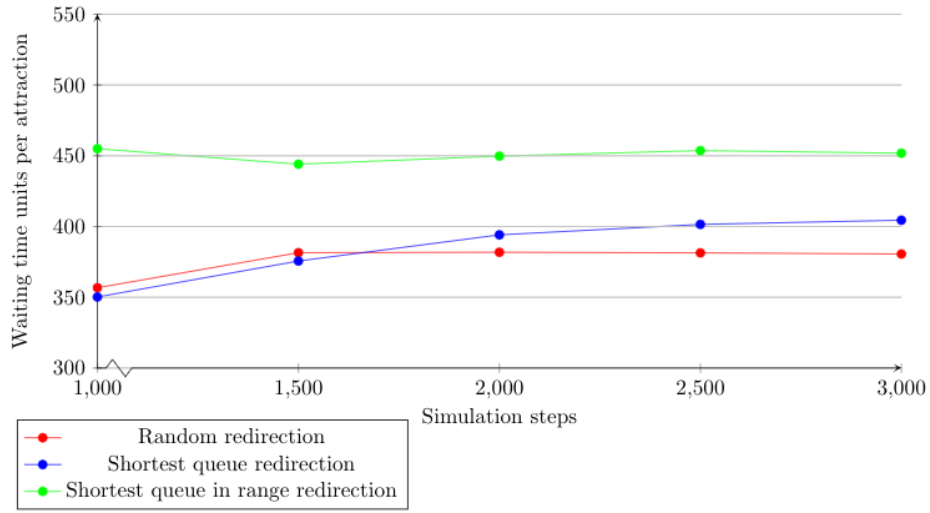
It is possible to define custom policies that allow determining the **next attraction** for a visitor. For the sake of the current simulations, the following policies were analyzed:

- `RandomPolicy`: performs a *random redirection* by choosing one of the attractions inside the park randomly.
- `ShortestQueuePolicy`: performs a *recommended redirection* by choosing the attraction with the shortest queue inside the whole park.
- `ShortestQueueInRangePolicy`: performs a *recommended redirection* by choosing the attraction with the shortest queue within a given range with regard to the visitor.

Redirection Policies

The two plots show the average waiting time per attraction with the described policies respectively with 500 and 3000 visitors.





Redirection Policies

Although the outcome of the simulation with 500 visitors went exactly as expected, it was not the case for the one with 3000 visitors. This could be caused by disparate reasons:

- The policies may be too simple. In fact, the attractions that in a given moment are less crowded end up being the most crowded a few moments later because a huge amount of visitors is redirected there.
- The simulation does not perfectly match the reality: not all the visitors in a real scenario will accept the recommendation received. Moreover, at the current state of the simulation visitors' interests and preferences are not taken into account.