Millipede: A Rollerblade Positioning System

Farid Benbadis, Jeremie Leguay, Vincent Borrel, Marcelo Amorim, Timur Friedman
Laboratoire LIP6/CNRS, UMR 7606
Université Pierre et Marie Curie – Paris VI
Paris, France
{benbadis, leguay, borrel, amorim, friedman}@rp.lip6.fr

ABSTRACT
Paris, Friday evening, 9:30 pm. Hundreds of skaters are hanging out at the bottom of the Montparnasse tower, waiting for the start of the Friday Roller Tour. A few minutes later, they will be up to 20,000 at the starting point. Together, for about three hours and over about thirty kilometres, they will glide up and down the streets of Paris on roller skates. Due to the crowd and to the participants’ mobility, finding a friend is challenging. The main problem for friends participating in the tour is to find each other during the pauses, if they were separated after the start. Currently, in order to locate a friend, a participant should: (1) call his friend, using a cellphone, (2) describe the environment (street name and number, shops name, monuments, etc), and (3) according to the environment description, try to discover if the friend is forward or behind. In order to make it easier to find a friend, we propose a Bluetooth application to be embedded in cellphones. This application’s ultimate goal is to provide users the ability to discover, not only their relative position in the tour, but also the positions of their participating friends. The application acts in two steps. First, it calculates the current relative position of the user (positioning), and then, through a communication protocol, sends this position to a user’s friends (locating). In this demonstration, we do not consider the communication between skaters, but focus only on positioning.

Keywords
Positioning; ad hoc networks; mobility.

1. CONTEXT
The Friday night Paris Roller Tour is a weekly skate through Paris’s streets, organized by the Pari-Roller association [1], with the help of the SAMU, the medical emergencies service [2], and police agents from the Préfecture de Police de Paris [3]. Policemen are placed at the front of the tour, in order to stop cars and other vehicles, while SAMU agents are placed at the back. The number of participants ranges from fifty, during the winter when it is rainy, to more than 20,000, during the summer.

Groups of friends that attend the tour always encounter the same problem: finding each other a few minutes after the tour has started. The only solution currently available for a participant A to find a friend B is to call B using a cellphone and try to discover B’s current location. A should ask B to describe his environment in order to know which one of them is behind the other. Our goal is to propose a cellphone application that allows A to continuously know B’s location in the tour. This application acts in two steps. First, B discovers its current location, and then sends it to A. We focus in this demo only on the first step, where each skater discovers only its current location.

The width of the tour, which is less than fifty meters because of the streets’ width, is negligible when compared to the length, which can reach up to four kilometers. Considering the current position as the relative distance from the tour head is sufficient for positioning. Thus, a unidimensional coordinate system is enough. While the policemen and SAMU agents are relatively static (they, respectively, lead and follow the tour), we consider them as landmarks. We attribute them, respectively, 100 and 0 as coordinates. A skater’s coordinate ranges from 0 to 100, depending on its relative distance from the head and the tail of the crowd. The closer the skater is to the tour head, the closer to 100 is his or her coordinate.

2. RESEARCH CONTRIBUTION
Current positioning solutions are not really feasible. Using a GPS receiver can help, but needs special costly equipment. The solution described above, where participant A calls participant B, can be efficient but is not easy and needs both participants’ intervention. Millipede, the solution we propose, is simple, easy to use, and overall, does not require any additional participant equipment. The only need
our application requires a cellphone with Bluetooth and Java capabilities. Most of the recent cellphones satisfy these requirements.

The application we propose, named Millipede because of the shape of the crowd, is formed of two distinct pieces of software. The first one, installed on ten Intel iMotes, is given to the policemen and SAMU agents, which are considered as landmarks. Its goal is to broadcast their positions, which are fixed during the tour. We recall that they, respectively, lead and follow the tour. In the following, we detail the algorithm run on the iMotes:

The second piece of software, which is designed to be installed on participants’ cellphones, runs a relaxation algorithm, similar to the one described by Rao et al. [4]. Every second, each non iMote node computes its relative position as the average of its direct neighbors’ (including the iMotes) positions, and then broadcasts it. The cellphones run the following algorithm:

Using this relaxation algorithm, the relative positions of the policemen and the SAMU agents are propagated to the participants. We believe that only a few minutes are sufficient for the bootstrap, which is the time needed for a participant placed in the middle of the tour to obtain accurate coordinates for the first time. Once the bootstrap is over, the participants’ positions are updated every second.

3. DEMONSTRATION

The objective of the demonstration is to show the ability, through Millipede, to compute coordinates in a mobile network. Thus, we will use up to 20 iMotes, linearly placed in the demonstration room. The border iMotes will be considered as landmarks. One will be assigned virtual coordinate 0, and the other 100. Both will run the first piece of software, broadcasting their fixed coordinates. The remaining iMotes will run the second piece of software, which computes a coordinate as the average of its neighbors coordinates. Except for the border iMotes, which are landmarks, all the others will be mobile.

While no screen is available on the iMotes, a mobile Bluetooth cellphone, running the second software, will display its location in this topology, depending on its position. A version of the phone software will be available [5], in order to allow visitors to perform tests with their own cellphones.

Acknowledgment

We would like to thank James Scott, from Intel Research laboratory in Cambridge, UK, who provided us the iMotes. Millipede is part of the RollerNet Project [6], which is funded in part by the E-Next Project. It started on January 2004 and will end on June 2006. For more information, visit the project web page [7].

4. REFERENCES


118