

BioCyberUrban parQ: An Ubiquitous and Pervasive Computing System for Environmental Integration

Suzete Venturelli, Francisco de Paula Barretto, and André Bassani de Freitas

Computer Art Research Lab,
University of Brasilia, Brasilia, Federal District, Brazil
{suzeteventurelli,kikobarretto,dedebf}@gmail.com
<http://midialab.unb.br>

Abstract. The goal of BioCyberUrban parQ project is to connect the living things, objects and environment in order to enable their cybernetic communication/coexistence in Sarah Kubitschek Park (Brasilia's city park). Art and society context aim the processes of physical, intellectual and moral users consciousness development, along with all living beings in the City Park. Therefore we seek for a better ecosystem coexistence, integration and communication through the crowd-collected data as the foundation of this cyber community.

Keywords: cyber objects, computer art, art and technology, pervasive computing.

1 Theoretical Framework

The BioCyberUrban parQ project was developed at the Computer Art Research Laboratory (Midialab) in collaboration with laboratories from the Faculty of Technology and the Scientific Technology Development Center (CDTC), both from the University of Brasilia. It started in 2011 and was designed to be developed in stages, as raising funds for its development. Undergraduate, graduate and post-graduate students from the University of Brasilia and the Community College of Brasilia (IESB) are involved¹.

This proposal has been inspired particularly by science and biology - especially the autopoietic mechanisms of life and the reflection of how living things are organized, developed, evolved and adapted to the environment. The concept of autopoiesis, as the organization of the living, originated in the Chilean biologists Humberto Maturana and Francisco Varela work in 1970s [1]. This idea was developed in the theoretical biology context and was early associated with artificial life simulation long before the term artificial life was introduced in the

¹ The main students involved are Guilherme Shimabuko, Marcelo Rios, Juliana Hilário, Ana Lemos, Bruno Braga, Sidney Medeiros, Camille Venturelli Pic, Claudia Loch, Roni Ribeiro, Fábio Fonseca, Hudson Bomfim and Eber Felipe Oliveira.

late 1980s in [2]. Pier Luisi presents a good concept review in [3]. Besides we are influenced by the work of Garnet Hertz[4] and Stocker and Schöpf [5].

BioCyberUrban parQ fits into the computer art and technology context. Therefore is based on its post-human philosophical perspectives, which provides new concepts and contemporary challenges to the art and technology traditions with innovative programs that challenge the technologies use for military purposes and others exploitation, proposing alternative human-machine interaction.

Post-human manifesto was first published by Steve Nichols [6] and is a concept discussed in contemporary art, science fiction, futurology and philosophy fields, about the possibility of non-humans forms responding like human thought [7].

This project demonstrates a possible technology application to stimulate sensitivity and sensuousness. We've seen the rise, in past decades, imaginary and nonconformists creations, whose aesthetic results criticizes the major enterprises, which seek only financial resources, giving a minimum return to community development. BioCyberUrban parQ brings the possibility of users participation in this digital ecosystem formation, currently feasible in terms of computational and cybernetic technologies of communication.

In parQ's theoretical context Art, Computer Science and Engineering fields are involved in order to develop objects whose characteristics are derived from ubiquitous and pervasive computing. Giving continuous communication and computer technical progresses, it seems that we're riding in complete computing activities integration into human everyday.

Ubiquitous computing will let the user visit the park without paying too much attention to the fact that there is a computer system allowing a more natural and transparent human-computer interaction. On the other hand, pervasive computing enables this natural interaction since the gathering and interaction data been made through everyday objects, embedded with computing devices. This mix of ubiquity and pervasiveness enable a cybernetic communication fluid among living beings, environment and cyber objects [8]. Mark Weiser in 1988 proposed this new idea with the phrase ubiquitous computing, when he was Xerox Palo Alto Research Center (PARC) Chief Technologist.

In a few words, the main idea is the ubiquitous and pervasive information system implementation that connects living beings, objects and environment at Sara Kubitschek Park. The main goal is to build a new collaborative cyber ecosystem, self-sustained by the appropriation of these elements by the public of the park, like modified benches and mobile phones. In this sense, parQ is also a pacific-activist action that suggests solutions to social problems, like access and appropriation of public spaces by the local population in order to valorize and take good care of the environment as a whole.

2 The parQ Project

ParQ will be implemented in Sarah Kubitschek Park, which is the largest urban park in the world, with 1.62 square miles, overcoming the Central Park in New York. This park allows on foot or cycling activities for both amateurs and professional athletes. There is a 2.5 miles route for beginners and two longer routes for

more experienced athletes, with 3.7 and 5 miles. Besides sport practices, there are several restaurants, a large woodland with picnic tables, an amphitheater, a kart track, playgrounds, an amusement park and an equestrian center. It is signed by three important people in the art, architecture and urbanism fields: the architectural design is by Oscar Niemeyer, the landscaping work was done by Roberto Burle Marx and urban area was developed by Lúcio Costa (all of them have participated on the concept and construction of Brasília).

The system parQ is composed by a social network (parQ.unb.br), an android app to explore the park (parQ), another android app for counting footsteps (pedParQ), a cyber-object bench with a scale for measuring weight (bench-scale) and an ambient sound for plants and humans composed by sensors (plantaParQ). All these components aim to encourage coexistence among living things, objects and environment, to enable the coexistence and cybernetic communication in the City Park of Brasília.

The main part of the system is composed by a social network/community, as seen in figure 1, which converges all the gathered information, including mobile devices data. Furthermore, it aims to develop cyber objects that are installed in the park, with a function to communicate and feed the social network and mobile devices by sending different types of information. That is, while being used by the public, these objects are build up according to their interests.

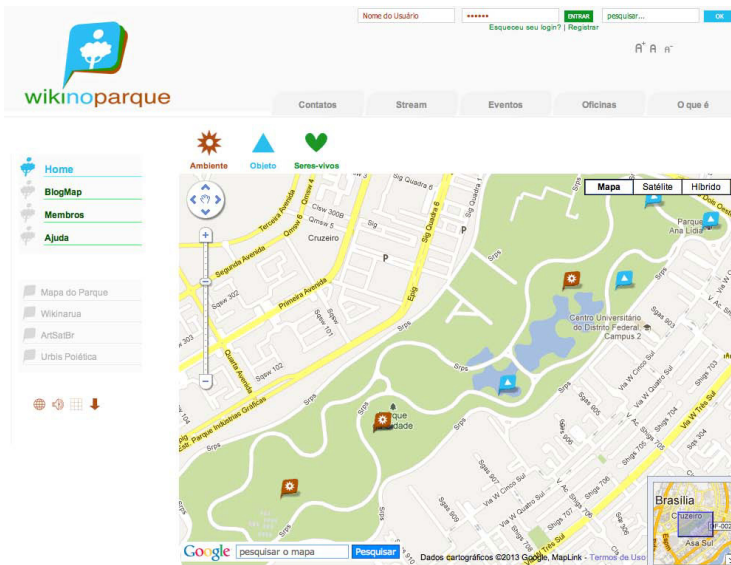


Fig. 1. ParQ social network interface (2013)

The social network, parQ.unb.br, can be considered itself a complex autopoietic living system since it is able to self regulate through human interaction, reflecting the changes in it's inside configuration and database, according to these interactions and data gathering.

This online social network, which is a subnet of Wikinarua , has all basic features of a regular social network but presents some innovations, since the information is presented in a collaborative cartography in which each user has it's own personal blogmap. Information is, then, presented as a collective web-cartography that is basically a confluence of all existing blog maps. Nevertheless, this autonomous community is connected with other social networks like Facebook and Twitter, sharing and disseminating the information.

The system consists of sub-systems set and these elements provide connection/communication and delivery real-time information between/to phones and databases. We consider Augmented Reality as the interval between the real and the virtual, a mixed reality that merges reality and virtuality.

The system has three main principles: the first one is knowledge about the operating environment, the second is reproduction quality and the third is presence metaphor. By definition, it is a social network as a social entities set, such as individuals or social organizations connected by relationships built from their social interactions. With the advent of Web2.0, new possibilities and paradigms have emerged. Between these newborn paradigms the most relevant for this social network is the content and modeling construction of its final shape been made through users interactions. With this new user provided content there might be the rise and formation of new social groups.

The main features of parQ are:

- Computational open platform;
- Collaborative Mapping/Data crowdsourcing;
- Interaction between members;
- Data Sharing;
- Construction of Identities;
- Augmented Reality Application (figure 2);
- Distribution and communication of applications, games, cyber objects and widgets;

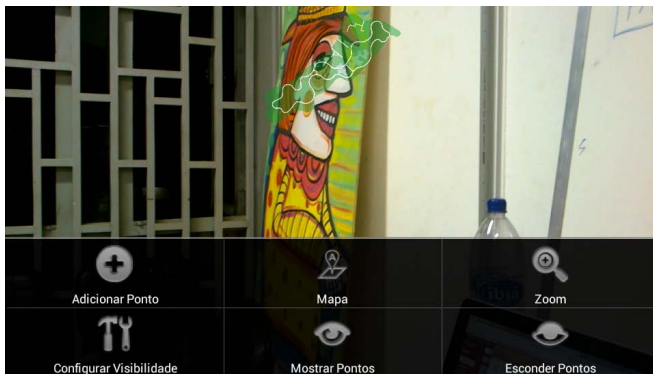
3 Cyber Objects: Expert Systems Embedded in the Cybernetics Field

At this point of the work we are designing some objects to be placed in the City Park. We call these objects cyber objects. They form a kind of expert system according to the classic definition derived from the cybernetic. Cybernetics is a science control systems, living or non-living, founded in 1948 by the north-American mathematician Norbert Wiener. Based on this definition, our world is full of overlaid systems that interact with each other. Therefore we can consider society, economy, computer network, machines, enterprises, cells, organisms, brains and everything else like a system.

All computers and intelligent machines as we know today are cybernetic applications. Cybernetics has also provided powerful methods to control two main systems: society and economy. A cybernetic system may be identified as an elements set, which interact with each other. These interactions set might be based



(a) Menu



(b) Augmented Reality

Fig. 2. ParQ augmented reality application running in an android phone (2013)

on substance information or energy exchanges. The elements of this compound system react and change according to these exchanges, changing itself or the possible interactions set with other compounds. Communication, signal, information and feedback are main concepts of the cybernetic field, fitting all criteria to also be an autopoietic system.

When items are organized in a system, the interactions between components cause a qualities set, which is not owned by any isolated component. For example, a given capacity of a living being, like running cannot be expressed by any of its isolated organs. In the same way a machine like a computer has higher qualities levels than the sum of its parts. Some the objects we're developing aim to use living being knowledge to solve problems. They represent knowledge, data gather or rules like any other computer. These rules and data might be triggered when necessary by digital devices. These objects possess a software layer that allows them to execute some tasks which might involve a decision making process. This knowledge is some times incorporated by some snippet code in order to reflect a knowledge change in the code itself.

We are working with knowledge based systems in order to manage different levels of interactivity between machines and other living beings without direct human interference as additional resource non-supported by orthodox programming technics. There has already been developed a street signpost cyber object, based on QR Codes, which leads the user to the social network uniform resource locator (URL) through his mobile device, figure 3. There is also a secondary cyber object which is a trash can, attached to the signposts and connected to the social network, whose function is to monitor the environmental education level of passersby and allow a remote visualization through a preinstalled web camera.

The ParQ project presents a systemic approach, since it's being developed in the context of pervasive and ubiquitous computing, which thus is required. We recur to Weiser and Brown's concept of calm technology in order to project information systems able to perform in the outskirts of our attention, based on cognitive psychology studies about attention mechanisms [8]. The second cyber object is a scale-bench, which verifies the health of sport practitioners and sends the collected data to the social network and mobile devices. This cyber object, figure 4, collaborates with relevant data related to the users average health. The creative process in this project involves clear notions of pervasive computing where computers are within the objects. Moreover, the project uses the ubiquitous computing in which computers are scattered and hidden in the environment of the Brasilia's City Park, an ubiquitous art inclusion into everyday



Fig. 3. 3D simulation of QRCode signpost and smart trash can final design (2013)

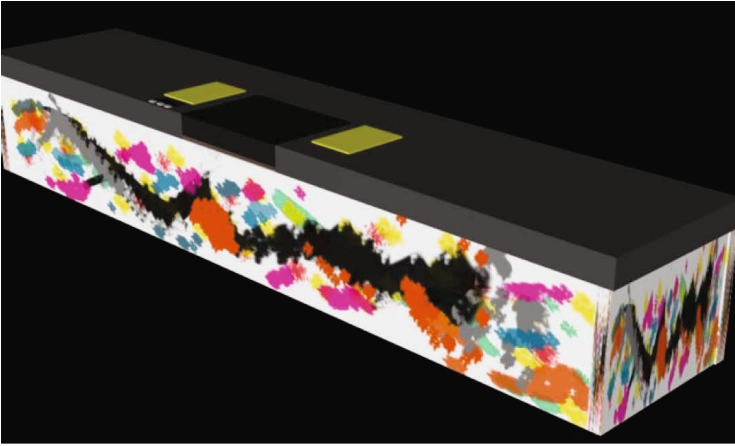


Fig. 4. Exact 3D model of the implemented bench-scale (2013)

life. According to Luigi Carro and Flávio Rech Wagner [9], there are currently great demand for mobile computing, ubiquitous and high computational power. They quote as classic examples the entertainment and telecommunication area where mobile devices and set-top-boxes increasingly demand more CPU operation per seconds and huge amounts of available memory. To 4G telecommunication equipment, they say, it is foreseen the computer processing need on the order of Teraflops and memory capacity on the order of Terabytes.

There are also appearing significant examples for mobile computing new markets especially in healthcare. In this area, with computer technology, there is a possibility of remote population health monitoring, using large databases. It is interesting especially to populations with access difficulty to the necessary means in large centers such as Brazil.

At the same time one aim to dilute the devices medley that surrounds computer technologies, parQ seeks to make unnecessary too much cognitive effort from the users to perceive the motivation behind the artistic proposal, using ubiquitous computing. By adopting unexceptional objects and expanding some of their original functions with computing devices that can process information and communication with other systems, like our social network.

One example of artistic work that involves ubiquitous computing is the installation of Live Wire, projected by Natalie Jeremijenko. The installation presents an electric engine in a room's roof connected to the internal Xerox research center network. In this art work, the information flow interferes directly on the electric engine's rotation speed. The larger information flow, faster the motor turns, causing a loud noise.

Finally this proposal involves an environment information system, containing the data visualization gathered from animals and environment. In order to achieve it we will recur to biosensors which are sensorial devices used to determine the concentration of substances and other parameters that might be

interesting from the biological point of view. These biosensors might communicate wirelessly, like smart sensors to enable the digitalization of such environmental data. The correspondence between the system and the real world considers that the information is truly relevant also from an aesthetic point of view.

3.1 PedparQ: An Anti-sedentarism Gameart

The development of a gameart is part of this project and aims to connect the park users with our parQ network through the use of mobile devices in order to think about technology as an extension of your body. The proposal entitled PedparQ (ped stands for feet in Portuguese) seeks not to let the user become sedentary. Therefore, when activated, PedparQ counts the footsteps and if it doesn't reach a minimum, will consider the user as sedentary and in this case an alert sound is played on the mobile device. This game art will be connected to parQ social network and will send automatically this data.

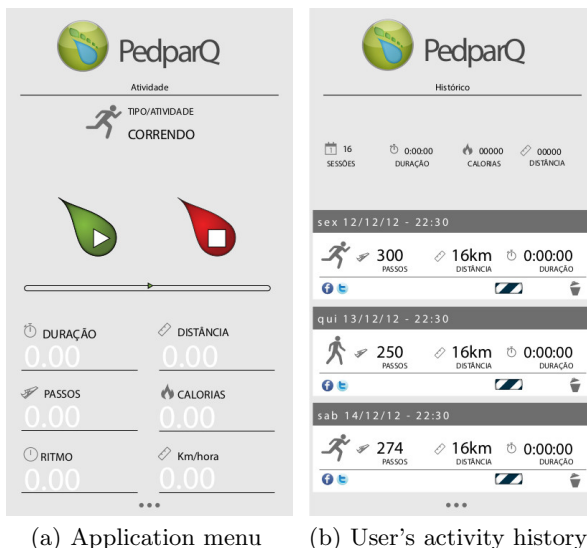


Fig. 5. ParQ augmented reality application running in an android phone (2013)

4 Conclusion

The social network parQ.unb.br was implemented in 2011, adapting functions such as the graphical user interface and the database server itself from Wikinarua, integrating the parks security cameras with the social network, a cyber-radio implementation, network communication implementation and data interaction visualization between living beings, objects and the environment.

Next we expanded the functions of database and software parQ for Android phones. The software parQ passes or streams information from the server database to mobile devices, as well as information from other social networks shared with parQ. We are now developing and implementing items like the interactive biocybernetic communication between the park and the parQ social network, the mobile augmented reality application that will be able to recognize nature, objects and environment shapes.

We emphasize that the concepts presented here, such as pervasive or ubiquitous computing or ubiquitous provoke from the methodological point of view, a strongly integrative work from many areas such as computer science, art and engineering. It is on this synergic development that we aim to bring on discussion about which are the impacts that the result of this research will provoke in the structures and competences of other research groups in Brazil.

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