XPlaces: an Open Framework for Shared Activity Spaces

Gavino Paddeu
and Massimo Deriu
and Alessandro Soro

CRS4 - Center for Advanced Studies, Research and Development in Sardinia
{gavino, mderiu, asoro}@crs4.it

Daniele Ardu
and Simone Kalb
and Gian Maria Simbula
and Selene Uras

Sardegna Ricerche

{ardu, kalb, simbula, uras}@sardegnaricerche.it

***Abstract*—In this paper we present XPlaces, an Open Framework for Shared Activity Spaces. Prototypes of Home Automation, Tangible Interaction, Collaborative Surface Computing, and so on, have been available for quite a while. However, in order to realize such kind of scenarios, it is necessary to master tools and techniques ranging from artificial vision (such as sensing and tracking of different kind of fiducials), gestures recognition, and embedded systems etc.. Such skills may be common in research labs, but deploying these solutions in the real world is a different matter. XPlaces is a software framework (C++ libraries and applications) designed to help developers in the creation, from design to testing, of collaborative applications for technology enriched places. The idiosyncrasies of sensors and devices are hidden by software abstractions, and a simple but functional distributed event system allows the creation of complex interactive applications.**

I. Home automation

A person comes back home at evening, she opens the door and, as soon as she puts her keyring on the table, the place gives her a warm welcome. The light is switched on and the TV set plays her favorite music...

This is one of the simplest scenarios of Home Automation, and yet its implementation is not trivial at all. In order to implement such basic functionalities a developer should master technologies such as presence sensors (e.g. Radio Frequency Identificators, RFID), programmable switches (e.g. X10 actuators), and, probably, microcontrollers boards and ZIGBEE transmitters. Using such devices all together involves to know how to program and debug them, the protocols involved, and how to develop and debug distributed applications. XPlaces is created to support developers in this kind of scenario, providing software abstractions to control sensors and actuators, a distributed event system, and a simple but powerful Application Programming Interface.

II. Multi-user surface computing

Father and son are playing on a multi-touch table. They contend with each otherin composing words with the given letters, however, it is clear that they are in a quite different mood: stressed versus enjoyable. The mum comes and plays the same game suggesting the right solution for all the family.

Again, an example of interaction that has been under the spotlight in recent years. Surface computing is an exciting research topic, since it enables collaborative or competitive multi-user applications. However, trying to translate the profusion of human expression and interaction into an computer program bursts the complexity of the design and the applications debugging. Moreover, different devices have specific constraints and potentialities.
In our video, for instance, is shown as the MERL DiamondTouch [6] is able to distinguish the users. On the other hand, *FTIR* [2] based multi-touch sensors allow to better identify the gestures.
XPlaces can manage such peculiarities, giving an abstract interpretation of users gesturs and their effects on the graphic interface, and thus supports the creation of portable interactive applications.

III. Tangible user interface

The family is involved in looking for the best holiday. They utilize two different tools: a particular holiday catalogue and an interactive video wall; the mum browses the catalogue and all the family enjoy together the exploration of the different destinations.
The holiday catologue works as a sort of remote control linked with the interactive wall. In fact, turning the of the pages of the booklet causes related pictures and videos to appear on the video wall. The video wall in turn can be operated by means of hand gestures. Again, Lab prototypes of such technologies have been available for quite a while, inspired by seminar works of Ishii on tangible interaction [4]

In order to realize such kind of scenario, it is necessary to master tools and techniques of artificial vision, such as sensing and tracking of different kind of fiducials and gestures recognition. Such skills may be common in research labs, but deploying these solutions in the real world is a different matter.

IV. XPlaces

XPlaces is a software framework (C++ libraries and applications) designed to help developers in the creation, from

design to testing, of collaborative applications for technology enriched places. The idiosyncrasies of sensors and devices are hidden by software abstractions, and a simple but functional distributed event system allows the creation of complex interactive applications.

XPlaces supports or wraps a number of useful sensors, such as

- RFID, Thermometers, Accelerometers
- camera based motion detection
- MERL DiamondTouch multiuser/multitouch table
- FTIR based multitouch sensor

and actuators, such as:

- GUI style widgets, capable of handling multitouch interactions and displaying most common data sources (images, movies, web pages)
- X10 programmable switches

The programmer writes high level application logic, while the burden of sensor discovery, calibration, geometrical transformations, adaptation to environment conditions (a known issue of computer vision based sensors), etc... are hidden within the framework.

In order to help the developer in testing and debugging the application, XPlaces also provides simulators to trigger fake events, getting rid of the inherent unpredictability of such kind of applications.

Further details on implementation issues are beyond the scope of this paper, however, a complete description of the architecture is given in [1]; improvements on FTIR technology to allow pre-contact feedback and robustesness to changing lighting conditions are given in [3]; bevel-cameras interactive wall is described in [8]; multi-diplay video walls using commodity projectors are discussed in [5]; the tangible multimedia booklet is described in [9] and finally, design issues of the overall set up of the intercative space are presented in [10].

V. Conclusion

Home automation, natural interaction, internet of things, are new and challenging topics of research that promise to have strong impact and influence on our daily life. For these technologies to break out of research labs, though, a lot of engineering effort is still needed. The accompanying video shows some simple and quite usual scenarios of our daily life. We intentionally describe the simplest possible scenarios in order to underline, by contrast, the skills, the knowledge and the technical support behind the implementation of such usual behavioral patterns.

This paper describes XPlaces, an Open Framework for Shared Activity Spaces, that integrates several heterogeneous technologies and protocols in order to provide developers with a simple yet powerful application development environment.

References

[1] M.Deriu and G.Paddeu and A.Soro, XPlaces: An Open Framework to Support the Digital Living at Home. Internet of Things Symposium (IOTS), IEEE and ACM, Hangzhou, China, 18-20 December 2010 (accepted)

[2] Han, J. Y. 2005. Low-cost multi-touch sensing through frustrated total internal reflection. In Proceedings of the 18th Annual ACM Symposium on User interface Software and Technology (Seattle, WA, USA, October 23 - 26, 2005). UIST '05. ACM, New York, NY, 115-118

[3] S.A. Iacolina and A.Soro and R.Scateni, Improving FTIR Based Multitouch Sensors with IR Shadow Tracking. CRS4 Tech Report (submitted to TEI-2011)

[4] Ishii, H. and Ullmer, B. 1997. Tangible bits: towards seamless interfaces between people, bits and atoms. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (Atlanta, Georgia, United States, March 22 - 27, 1997). S. Pemberton, Ed. CHI '97. ACM, New York, NY, 234-241

[5] A.Lai and A.Soro and R.Scateni. Interactive Calibration of a Multiprojectors System in a Video-Wall Multi-Touch Environment. CRS4 Tech Report (accepted at UIST-2010)

[6] http://www.merl.com/projects/DiamondTouch/

[7] Want, R. 2006. An Introduction to RFID Technology. IEEE Pervasive Computing 5, 1 (Jan. 2006), 25

[8] A.Soro and G.Paddeu and M. Lobina. Multitouch Sensing for Collaborative Interactive Walls. In *Proc.of the 1st Human-Computer Interaction Symposium, (HCIS 2008)*, 2008

[9] A.Soro and Massimo Deriu and Gavino Paddeu. Natural exploration of multimedia contents. In Proc.of the 7th ACM International Conference on Advances in Mobile and Multimedia, Kuala Lumpur 15-16 December 2009

[10] S.Uras and A.Soro and G.Paddeu. The Lab is the Prototype: redesigning a setting to fit daily work and visitors. CRS4 Tech. Report (submitted to TEI-2011)

[11] http://en.wikipedia.org/wiki/X10_%28industry_standard%29

[12] http://www.zigbee.org/