Interactive Surfaces

Vitor Gonçalves
University of Madeira
vitorgoncalves57@gmail.com

Tiago Tomás
University of Madeira
tiagotomas@netmadeira.com

ABSTRACT
The world that Weiser had in mind is where the objects interact to satisfy our needs in a clear view form could not exist without considering some interaction with those same objects. So, with this in mind, we decided to deepen into this subject that links the digital with the physical world.
The report shows some actual commercial solutions that are based on interactive surfaces and points out some real and possible scenarios for each of the solution.

Keywords
Interactive, Surfaces, Pervasive, Ubiquitous, Tangible.

INTRODUCTION
The surface are everywhere, they are the tables that support our draws they are walls that protect us from cold, the papers we use to write even the windows of the buildings; however those surfaces they are passives and limited in concern of the interactions we can have with them. In this project we will study the present solutions for creation of interactive surfaces and some visions about their future.

DESCRIPTION
The world that Weiser had in mind where the objects interact to satisfy our needs in a clear view form, could not exist without considering some interaction with those same objects. So, with this in mind, we decided to deepen into this subject that links the digital with the physical world.

Our project on interactive surfaces is in his core a research project about the state of the art of this subject, where we will see their applicability accordingly with Weiser's vision. We have also noticed that presently there is a big emphasis on combining these surfaces with other electronic devices, for example: the cell phones. Through a wireless connection it is possible to visualize information from the phone in a more appealing environment, making the information visualization more understandable and helpful. However there are some solutions that use physical objects that combined with surface allow new kinds on interacting da with the system.
But if we want to achieve the Weiser's vision it is not enough to make a physical shape interactive only with a particular surface. Instead, we can use the already existing surfaces, such as walls, and make them interactive in a transparent way for the user.
This bridge between the digital and the physical brings new and complex challenges that we will try to summarize by exposing some solutions that exist on market and some lesson to take in account based on articles.

METHODOLOGY
The adopted methodology for this project will be the research of the state of art, by seeing the company solutions that exist on the market, following through the reading and analysis of scientific articles about the usefulness of the solutions we did encounter. And for last we will summarize some lessons and thoughts relate to present solutions that should be taken into account in future development in interactive surfaces. [8]

STATE OF THE ART

Microsoft Surface
The Microsoft Surface experience brings people together to connect, learn and decide with a 360-degree interface that supports touch and real-world objects. With PixelSense™, Microsoft Surface sees and responds to touch and real world objects, supporting more than 50 simultaneous inputs.[1]
Make content more engaging. Give to customers immersive and collaborative ways to engage with photos, videos, documents, maps, custom applications, and more.
Plan and simulate. Bring to life real-time "if/then" modeling and visualization, simulations and calculations could be used for financial services, healthcare, and other consultative environments.
Make learning more fun. Allow new education process with rich visualizations that encourage teamwork and enhance learning.
Transform the shopping experience. Make shopping more immersive by connecting customers with more options, recommendations, product and service comparisons, and personalized service.
Connect with customers through games and pastimes. The surface could be used in restaurants, bars, hotel lobbies, and other venues, associating memorable experiences with company's brands.
Communicate and connect. Give people an efficient and intriguing new way to get the information they're looking for, like maps and tourist destinations in a hotel lobby. Or use it to help them exchange personal information so they can connect with each other.[1]

Applications

Microsoft Surface is featured at the Hard Rock Cafe

Hard Rock International collaborated with Duncan/Channon and Vertigo to create several custom applications for use on Microsoft Surface at the Hard Rock Cafe in Las Vegas, Seattle, Orlando, Los Angeles and Berlin. A key feature is the worldwide memorabilia application that allows the guest to locate Hard Rock properties from around the world, explore images of both the exterior and interior of the building, then deep-zoom into the iconic memorabilia items housed within those walls. This application also grants users the ability to pivot from one collection to another, using categories such as artist, year, genre, and type. Guests can also expect many other custom applications via Microsoft Surface designed to showcase Hard Rock's unique content. [2]

Retail Store experience

The first-ever Microsoft Stores are now open for business, and Surface is part of the customer retail experience. Surface is helping customers learn about various products in four distinct merchandise areas in the store — supporting Games, Mobility, Personalization and PCs with custom applications designed for Microsoft's retail experience.[2]

Sheraton Hotels partner with Microsoft Surface

Microsoft Surface and Sheraton Hotels & Resorts are transforming the hotel lobby! Create music playlists with your friends and family with the flick of a finger. Let your hands do the walking as you explore local attractions and services. Visit different Sheraton properties around the world without ever leaving the lobby. Available at select Sheraton locations.[2]

Reactable

The Reactable, is a novel multi-user electro-acoustic musical instrument with a tabletop tangible user interface. Several simultaneous performers share complete control over the instrument by moving physical artifacts on the table surface while constructing different audio topologies in a kind of tangible modular synthesizer or graspable flow-controlled programming language. [3]

The instrument hardware is based on a translucent round table. A video camera situated beneath, continuously analyzes the table surface, tracking the nature, position and orientation of the objects that are distributed on its surface. The tangible objects, which are physical representations of the components of a classic modular synthesizer, are passive, without any sensors or actuators; users interact by moving them, changing their position, their orientation or their faces. These actions directly control the topological structure and parameters of the sound synthesizer. A projector, also from underneath the table, draws dynamic animations on its surface, providing a visual feedback of the state, the activity and the main characteristics of the sounds produced by the audio synthesizer. The idea of creating and manipulating data flows is well acquainted in several fields, such as electronics, modular sound synthesis or visual programming, but the Reactable is probably the first system that deals with this connectivity paradigm automatically, by introducing Dynamic Patching **[7]** where connections depend on the type of objects involved and on the proximity between them. By moving these objects on the table surface and bringing them into proximity with each other, performers construct and play the instrument at the same time, while spinning them as rotary knobs allows controlling their internal parameters.

The Reactable was conceived and developed since 2003 by a research team at the Pompeu Fabra University in Barcelona. Sergi Jordà, Martin Kaltenbrunner, Günter Geiger and Marcos Alonso presented their creation for the first time in a public concert at the International Computer Music Conference 2005 in Barcelona.

Applications

Reactable Experience

The Reactable Experience is a version of the Reactable that is specially designed for public spaces and institutions such as museums, science centers, schools and universities. Conceived from the original Reactable, which was designed for professional musicians, the Reactable Experience is an intuitive and robust version for use by a casual player and is especially suited for children who are just starting to explore the world of music and sound generation.

Additionally, its collaborative and multi-user capabilities, which allow the instrument to be played by several simultaneous performers, open a whole new universe of entertaining and creative possibilities. [6]

Collaborative

Its circular multi-touch interface allows the instrument to be played by several people simultaneously, inviting the visitors to share the experience and naturally engage in collaborative compositions.

The Reactable already had been planned as a collaborative instrument from the very beginning. A table can be considered to be an already culturally defined collaborative space. Tables are places where various people can meet and discuss and where people together can develop their ideas and work on joint projects. Architects work over their plans and models, managers develop their project plans and generals used to move their troops on strategic table models. [3]

These concepts have been widely used and translated to the digital domain by the introduction of Tangible User Interfaces (TUI) **[4]**, where a large group of projects and interfaces as well have been implemented using table interfaces just because of their collaborative nature. Physical objects on a table surface, especially on a round table set-up, are equally accessible for direct manipulation for any participant at the same time.

Didactic

The years of research and the award winning technology behind the Reactable turn for the first time the complexity of music creation into something intuitive and easy to understand. [6]

Various reasons turn real-time computer music performance into an ideal field for the experimental exploration of novel forms of human-computer-interaction:
-It is an environment that combines outstandingly, expression and creativity with entertainment; freedom with precision, rigor and efficiency **[5]**
- Users are required to have an open but precise and rather complex control over multi-parametric processes in real-time.
-Playing and creating music with the help of digital tools can be a social and collective experience that integrates both collaboration and competition. Moreover, this experience can also be addressed to children.
- Music performance provides an ideal test bed for studying and comparing use and interaction by both dilettantes and experts, both children and adults.

Entertaining

Reactable's design is so intuitive that can be enjoyed from the very first minute by a casual player. But at the same time its richness allows never ending creative possibilities for experienced musicians, such as DJ's. [6]

EyeWall

The EyeWall is an interactive window projection system that displays graphics and can detect users touching the screen externally as well as people passing by from a distance. All applications can be run on this platform, from simple web pages to custom built 3D applications, making this a highly effective marketing tool reaching target audiences in retail environments, museums, lobbies, visitor centers, playgrounds, and other public spaces. EyeWall allows you to:

- Easily set up, assemble and control your interactive display
- Use a rich set of embedded templates and visual effects
- Easily customize the different visual effects
- Brand a template with your corporate logo
- Create a playlist of effects
- Remotely schedule campaigns and content
- Generate data reports on who interacts and for how long
- Define interactive zones[8]

Applications

This technology provides an extra tool much shop by providing the ability of possible customers to see the potential of the shop and their products in very dynamic fashion. We all seen those promotions catalogs on shops glass and doors, but unfortanely those products are static and most of times we can only see a small part of the product or the inventory, for example we cannot see how it fits me (clothes). In other hand there are sites of those shops that allow us to find the appropriate and precise information by the ease of use of the search option. But this sites lack the physical touch and feel of the real product which we are interest. So if a shop could the benefits of both world we would we would the benefit of searching digital peaking in the physical shop. So having the border of the shop with EyeWall we get the better of two worlds. Besides that because people can interact with this tool, in future will make advertising customized to the target on shop possible.[9][10]

Sixth Sense

And what about having the information that is intangible within our everyday tangible artifacts? Well Sixth Sense brings us that bridge, whiteout the need of having a physical table or surface to interact with the digital information, making every object a virtual surface that we can interact and bring up the information we want. The prototype of Sixth Sense is comprised of a pocket projector, a mirror and a camera. The hardware components are coupled in a pendant like mobile wearable device. Both the projector and the camera are connected to the mobile computing device in the user's pocket. The projector projects visual information enabling surfaces, walls and physical objects around us to be used as interfaces; while the camera recognizes and tracks user's hand gestures and physical objects using computer-vision based techniques. The software program processes the video stream data captured by the camera and tracks the locations of the colored markers at the tip of the user's fingers using simple computer-vision techniques. The movements and arrangements of these colored markers are interpreted into gestures that act as interaction instructions for the projected application interfaces. The maximum number of tracked fingers is only constrained by the number of unique colored markers, but even so Sixth Sense also supports multi-touch and multi-user interaction.

Applications

Map

The map application lets the user navigate a map displayed on a nearby surface using hand gestures, similar to gestures supported by Multi-Touch based systems, letting the user zoom in, zoom out or pan using intuitive hand movements.

Drawing

The drawing application lets the user draw on any surface by tracking the fingertip movements of the user's index finger.

Gestures

The Sixth Sense also recognizes user's freehand gestures and binding them to actions. For example, camera of the system takes photos of the scene that user is looking at by detecting the 'framing' gesture. Another example is by drawing an '@' symbol the system will allow the user to check his mail. And so on.[11]

Augmented reality

Also the system augments physical objects the user is interacting with by projecting more information about these objects projected on them. For example, a newspaper can

show live video news by streaming the video according to news topic that the user is currently reading /pointing.

FUTURE AND LESSONS

Based on some articles we read we have notice that the most promising systems are those that are hybrid surfaces. Which is an interactive system that combines techniques of direct-manipulation multi-touch surface interaction with elements of tangible user interfaces, example Reactable. Following through the reads we have taken some notes and lesson of present prototypes and solutions:

-The first important decision the choice of the object, but also it important to think if the physical objects will or not carry any semantic meaning to their function. Based on that we need to decide if either the objects will have to dynamically chance their semantics or create the illusion of containment.
-Another important issue has to with the degree to which system will require eyes-free control. By having a very high degree of eyes-free control we have a very good argument to use physical objects either for identifying and controlling data. Otherwise the digital control elements will have to provide to add non-visual feedback, for example sound or vibration.
-We need to consider if already exist physical artifact that have a unique affordance to some action, for example a pen for writing or drawing. If so, it's important to find ways for incorporating these artifacts in the design of the system.
-Another issue is the affordance of digital actions and physic objects when they don't exist. For example, on the following actions: generating, reproducing, replaying, merging and deleting data, there is no affordance within the physical world. So it's important to rely on established digital conventions.
- Building 3D encourages and suggests the user of gestures to manipulate the objects within it. But it's important to that it's almost impossible to represent all action that exists in our 3D world. Either because we it's difficult to have the real and full physics in the environment (3D virtual world) but also the lack of the third dimension (most of the surface are 2D). So the challenge is to come up with coherent gestural vocabulary and set of actions that user can use in other to interact with the systems.
-Another issue is activities. Imagine we have a folder and we are displaying it. Then the user touches on a physical object that represent the digital folder, for example a box, should the folder display the content or simple represent that we touching the folder? So reconciling the activities in the two disjointed worlds is the challenge. [12][13][14][15]

DISCUSSION

Through the elaboration of this project was possible to perceive that improvement of the techniques in interactive surfaces and TUI's allow that human computer interaction becomes more natural, transparent and ubiquitous by using the gestures which are intuitive and embodied to the user and the use of real object allow an improved affordance between the system actions and interactions.
Also we would like to point out that emerging of these improvements was made possible because of development of display technology and sensors.

REFERENCES

[1] Microsoft Suface, http://www.microsoft.com/surface/en/us/default.aspx, 24.06.11
[2] Microsoft Suface Case Studies, http://www.microsoft.com/surface/en/us/casestudies.aspx, 24.06.11
[3] M. Kaltenbrunner, S.Jordà, G. Geiger, M. Alonso. *The reacTable*: A Collaborative Musical Instrument*, IEEE, 2006.
[4] B. Ullmer and H. Ishii. *Emerging Frameworks for Tangible User Interfaces*. In J. M. Carroll, editor, Human-Computer Interaction in the New Millennium, pages pp. 579–601., 2001
[5] *S. Jord` a. Instruments and Players: Some thoughts on digital lutherie. Journal of New Music Research, 33, 2005*
[6] Reactable, http://www.reactable.com/, 24.06.11
[7] M. Kaltenbrunner, G. Geiger, and S. Jord` a. *Dynamic Patches for Live Musical Performance.* In Proceedings of the 4th Conference on New Interfaces for Musical Expression (NIME04), Hamamatsu, Japan, 2004.
[8] Klemmer, R.S., Thomsen, M., Phelps-Goodman, E., Lee, R. and Landay, J.A. Where do web sites come from? Capturing and interacting with design history. In *Proc. CHI 2002*, ACM Press (2002), 1-8.
[8] Eyeclick – Eyewall, http://www.eyeclick.com/products_505.html, 24.06.11
[9] Eyeclick Ltd, *Eyeclick Creates Interactive Wonders at the GE Imagination Center*, Poster, Jan 2009.
[10] Eyeclick Ltd, *Nike "Evolve" Interactive Storefronts with Eyeclick's Technology,* Poster, 2009.
[11] Pranav Mistry, Fluid Interfaces Group, MIT Media Lab, Sixthsense, http://www.pranavmistry.com/projects/sixthsense/, 24.06.11
[12] S.Hunter, J. Kalanithi, D. Merrill, *Make a Riddle and TeleStory: designing children's applications for the siftables platform*, ACM New York, NY, USA ©2010
[13] J. Yoon, J. Oishi, J. Nawyn, K. Kobayashi, N. Gupta, *FishPong: encouraging human-to-human interaction in informal social environments*, ACM New York, NY, USA ©2004
[14] D. Kirk, A. Sellen, S. Taylor, N. Villar, S. Izadi, *Putting the Physical into the Digital: Issues in Designing Hybrid Interactive Surfaces*, Microsoft Research Cambridge, HCI 2009 – People and Computers XXIII
[15] J. Luderschmidt, I. Bauer, N. Haubner, S. Lehmann, R. Dorner, U. Schwanecke, *TUIO AS3: A Multi-Touch and Tangible User Interface Rapid Prototyping Toolkit for Tabletop Interaction*, Sensyble Workshop 2010 manuscript.