

IMP³ - Interactive Magic Places, People and Practices

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Figure 1: interactive multimedia installation; categorization system; black fiducial pieces

Abstract

The objective of this paper is to report on the ongoing research on project Interactive Magic Places, People and Practices - IMP³.

The project is based on an interactive multimedia installation with a tangible interface originally planned for adults and now adapted for a target audience of children (7-11 years of age) and includes game play.

The original IMP installation, designed for an adult audience, had a system of categorization of multimedia elements (sound, image and video) through the reading of labels on barcodes using a laser scanner that communicates with the computer via bluetooth. The IMP³ system represents a specific contextual application of the first system. It's still based on a multimedia installation but adapted to a target audience of 7-11 year olds, with a different labeling system composed of fiducial tags read with a web camera and appropriate computer vision software. Within the current installation it is possible to play games, among which the "five-in-line 3D". This paper reports part of the project related with the development of a global system for a network with more than two partners (Aveiro, Portugal; Montreal, Canada, and Dallas, USA) supported by a website that also incorporates a game and the preparation of the preliminary testing of this IMP³ system. This phase also prepared a prototype version for installation at a public museum Live Science Museum at Aveiro.

The project is being developed in three different countries that represent three different cultural contexts. The basic idea is to link the system of categorization of multimedia elements (sound, image and video) with the "5-in-line 3D" game so that a child (7-11) at Aveiro can interact with another child in another partner country, and vice-versa, exchanging their cross-cultural view of physical places based on multimedia narratives. The player can then revisit the website (using their game profile) and see/hear the moves he made while experiencing the multimedia

interactive tangible interface in the IMP³ Cartesian cube.

Keywords: tangible game, multimedia installation, children, cultural exchange, computer mediated communication

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1. Introduction and objectives

The project **Interactive Magic Places, People and Practices – IMP³** (reads "IMP cubed") has the purpose of creating, in the Department of Communication and Art (DeCA) of the University of Aveiro (UA), a new and innovative version of a project originally developed at Concordia University, Montreal, Canada. The original project, the Interactive Multimedia Playroom (IMP) designed by Rosemary and Harry Mountain [2005; 2006; 2007; 2007a], has as its main objective the possibility to subjectively categorize and trace the relationships that are felt to exist between sound, image, and video, in an immersive and tangible environment - a multimedia installation designed to be explored and visited in various different public spaces and/or museums (both science and generalist). The project reported in this paper was implemented as a functional prototype and consists of an interactive multimedia installation with a tangible interface adapted for a target audience of children (7-11 years of age); it is designed to include ubiquitous interactive technological solutions [Preece et al, 1996], with proposals for categorization of multimedia elements (sound image, video) and with proposals of games to be played in the installation environment. The project is being developed to work online interactively in a network with 3 partners, corresponding to the implementation of 3 different cultural contexts in 3 distinct countries - Aveiro, Portugal; Montreal, Canada; and Dallas, USA. These 3 nodes of the network will have a physical multimedia installation in

an immersive environment with a tangible interface, all with the same characteristics. The installations will be linked together by a website being developed at the DeCA at the UA. This Internet communication link is designed to promote a real-time transcultural exchange among the three installations situated in the 3 different and geographically and culturally “distant” cities. Each user who enters into the physical installation will be assigned a user profile on the project’s website. This allows the user to access his/her profile in the IMP³ website even after leaving the installation. In other words, the users can save the experience of their enjoyment in the installation into a profile of the IMP.cubed website which can later be shared with their network of contacts. The users can form their own group or narrative of multimedia elements and lists of associations, as well as draw on the suggestions of previous and concurrent users. This sharing of data and experiments is possible through the community network website which stores all the content experienced by the users and can be shared with other users in the matching installations of the partner institutions. The idea underlying the concept of this sharing is that a child in Aveiro can show his/her cultural context to another child, in Dallas or Montreal, and vice-versa, thus describing the style of life / environments of each-other, and contributing to the structuring of personal experience and knowledge of life [Veloso 2006]. The project IMP³ foresees the implementation of Aveiro’s prototype installation and network connection through a common website with the other installations (Montreal and Dallas). The user enters in the physical installation and finds a stimulating environment to explore the sound and its relationship with the still images and dynamic images. Each user inhabits the installation with a permanent background objective to construct a multimedia representation with semantic value directly related to a local cultural context. All the sounds, images and videos included at a certain time in the installation’s multimedia data base come from diverse contexts (places, cultures, ...) of the 3 partners, from 3 different countries. IMP³ thus aims to encourage the exploration of different modes by which individuals or communities may interpret and describe sounds in a transcultural attitude, as the project title highlights, situating “places”, including “people” and sharing “practices” to subjectively represent cultural contexts. The description can be made using sounds and/or images, colors, movements, places, states of humor and mood. Variations of light, decoration, and acoustic variations, among other elements, permit the creation of different atmospheres to simulate how the physical space itself has impact on the perception of the information and understanding. As the result of a first development phase, since September 2008, a multimedia prototype installation has been built at the DeCA at the UA, adapted for a target public of children between the ages of 7 and 11 [Rocha 2009]. It is accompanied by various game proposals and a tangible technological solution for multimedia element manipulation based on fiducial marks and a webcam recognition system [Rocha et al,

2009]. The fundamental and original research and development issue in this project is directly related with the target audience. Veloso [2006] in her work proposes a research hypothesis considering the relevance of the target audience: “the multimedia contents captured and created by the children does in fact transmit a better sense and feeling of a place to other children than some data collected by adults (professional multimedia designers) taking into account their best solutions for a same child audience”. The findings of this study are fundamental to reason on the direct engagement of children in strategies for the multimedia and game content construction. In doing so it is shown that the final project’s impact makes much more sense to its child audience. This is a particularly relevant strategy for informal educational settings (museums, exhibitions, workshops, etc.) and even formal (school).

2. Related Work

The IMP³ project brings together many influences from different areas of knowledge which together form a whole, such as, communication sciences and technologies; audience studies; games; cultural studies; music; performance; stage arts; psychology and engineering.

The original IMP is an interactive multimedia installation in human scale, with a tangible interface, which aims to contribute for the study of human perception, interaction and categorization of sound, image, and video, and to stimulate the exchange of ideas and terminology, with recourse to a rich environment which invites play [Mountain, 2005, 2006, 2007, 2007a]. The IMP, initially focused on artistic contexts and multimedia, has contributed to innumerable areas due to its versatility as a research tool as well as for its affordance for collaborative research [Mountain, 2005, 2006, 2007]. Its development already incorporates research in audio and multimedia perception [Bregman 1990; Chion 1994; Juslin and Sloboda 2001] and its team members and collaborators include several researchers working in these and cognate areas (McAdams, Manning, Godøy, Cohen).

The IMP³ project proposes a different approach, applied to children, which includes the multimedia content with the correlation of cultural and game context.

Taking the cue from Piaget [1967; 1975; 1977; 1978; 1979] and Erikson [1976], the reactions of the children for whom this installation is being developed, can be observed. According to Piaget’s theory of development [1967; 1975; 1977; 1978; 1979] children from 7 to 11 years old (5th stage) already have a notion of: i) the existence of objects, even if they are not present; ii) precise motor capacities and their adaptation to the dimensions of the real world; iii) the capacity for symbolic representation (2nd stage) which allows for the representation of reality through mental schemas; space and numerical operations; iv) and notably, and

very important for interaction with the installation being developed in this project - capacity for logical thought and concrete intellectual operations. According to Erickson's development theory [1976], children in the 4th stage (6-12 years old) already have the autonomy (2nd stage) to participate in the IMP³ and already have the sense of responsibility and guilt (2nd stage). The 4th stage is the stage of success, where the children learn this notion through the incentive to do and conclude something with success [Erikson 1976]. This phase also includes social aptitude and refined intelligence.

According to previous research in the area of communication sciences and technologies, specifically concerning the development of digital games for children with children's direct involvement [Veloso 2006; Veloso 2008], the active participation of children in the design process is a matter of major importance. This kind of involvement in the computer mediated communication conceptualization helps the production process, improves the efficiency and quality of the products, and above all, improves the satisfaction and fulfillment registered with the use of the product [Veloso 2006; Veloso 2008; Druin 2002; Druin 1999]. According to Weiser, the ubicomp concept imagines the digital world mixed with the physical environment. The digital world had become almost "invisible" and the users use the technology so naturally, that they become unaware of using it [Weiser et al. 1999].

The interaction between people and virtual space is mainly done through graphical user interfaces (GUI), traditional interfaces of personal computers and laptops, which have some limitations. A tangible user interface (TUI) - would be adequate for the coupling of the digital world with the physical world and the corresponding interaction context would be a tangible interface targeted for the user [Ishii and Ulmer 1997].

According to Fishkin [2004] the tangible interfaces have a paradigm of functioning based on 3 events: input event – user manipulates the physical object; computer detects that movement; output event – system answers to the user.

According to Zuckerman's research [Zuckerman et al. 2005] there are 4 functioning paradigms for the tangibles interfaces according to their implementation model: i) TUI for input and GUI for output; ii) the output is projected from a standard computer on top of the TUI input device; iii) TUI as a front-end to a ubiquitous computing system, creating an interactive space or immersive environment; iv) the computation is embedded inside the physical object, creating a TUI that serves both as input and output, with no standard computers involved.

Our prototype belongs to this last paradigm.

Apart from the IMP installation, there are other games and installations with tangible interfaces and technologies, which stand out, including some developed for children. In the game CoGame [ITL, 2007], each player holds a slide, which projects an image onto a table that represents part of a street. Collaboration of the players allows a tortoise to follow the projections of the street from one end to the other.

Mü [Mü Project 2008] is a multimedia installation with a multi-tactile interface surface (based on fairy tales) designed for children from 5-7 who react to the touch and the tangible object of the game, and can thereby reproduce animated images and sounds. The CarettaKids project [CarettaKids 2004] is an educational system, which offers a face-to-face collaborative learning environment for children. It has two interactive components: a tray with RFID links for collaborative activities and PDAs for individual activities. CUBID [Hughes 2007] is a human-scale game environment where the players' move around the physical space manipulating objects in order to overcome projected virtual challenges. This game involves collaboration between players to advance to other levels. In interactive multimedia installations, the following are notable: Volume [UVA 2006], an installation composed by a group of luminous columns which react to human movement and respond with changes in light, colour, and sound, giving the participant an interactive audiovisual experience; and the interactive mural "Brand New School for Goodby" [BNS 2007] where an infrared room monitors the movement of people, records them and reproduces them on an animated mixed-media mural with a complex horizontal axis. In the area of music are tangible interface music sequencers such as "BeatBearing" [Bennet 2007], a sequencer made up of a group of spheres affixed on a totally tangible interface. The spheres placed on a tray can be moved and reorganized to produce different rhythms (horizontal position) and sounds (vertical position). "Bubblegum Sequencer" [Hesse et al. 2007] works very much like "BeatBearing" but with a variation: the sounds are altered with the color of the balls. Other contributions are tangible objects and technological components. "MindSpheres" [Philips 2008] provides relaxation and tranquility through motor exercises. The user interacts with wooden spheres in the palm of the hand, and LEDs react to the fluidity of the movement, revealing various patterns of illumination. "Cube World" [Cube World 2005] is constituted by a cube (screen), which shows an animated character on its interior. There are different cubes; by joining them, the characters initiate an interaction between them, playing, fighting, dancing, and even "entering" into the various cubes. The interactive video installation "Saissement" (in its aesthetic meaning) [Bonnes 2004], invites participants to touch and hold objects covered with silicone integrating a LCD screen, which reproduces video. This handling evokes changes (such as tempo and sequence) in the reproduced video.

3. Empirical research

The interaction between the participants and the original IMP is of an intellectual nature, and was originally intended for professionals and researchers from various fields associated with the research linked to the tool - i.e. the installation [Mountain 2003; 2006].

According to the author, the IMP evolved out of the research context of the “Multimedia Thesaurus” [Mountain 2005; 2006; 2007; 2007a] which sought to create a lexicon, though interaction / conversation, in accordance with its fundamental premise that a development of art involving new technologies would be facilitated by an increase of critical language and analytical tools [Mountain 2003].

The IMP³ project has, as its principal goal, an evaluation of the pleasure and satisfaction level of user experience in a cultural based game that takes place in an interactive multimedia installation, developed and adapted from the IMP, in the context of a public exhibition in a museum. The project involves the creation of a prototype of a game that is played inside an interactive multimedia installation with a tangible interface adapted for a target audience of children (7-11 years of age). The play environment includes ubiquitous interactive technological solutions with proposals for categorization of multimedia elements (sound image, video) and with proposals of games to be played in the installation environment. It thus deals with a more accessible interaction strategy and a more ludic nature, and therefore can address a larger and more heterogonous public, than the original IMP, as already mentioned in the context of IMP³. The idea of exploring and conceptualizing game strategies, which incorporate the categorization system of the original interaction scheme of the installation, is a challenge, given the need to simplify these complex concepts for children. The project has been under development since September 2008 and the IMP³ research has already shown some preliminary evidence of its potential. The accomplished tasks were: i) a study of the structural dimension's adequacy, equipment, and materials of the installation; ii) development of two games to be played inside the prototype, “multimedia racecourse” and “5-in-a-line 3D”; iii) development of an alternative technology for the tangible I/O solution in order to guarantee viability of system use for children; iv) implementation of a prototype of the interactive multimedia installation and tangible interface adapted for the target children audience (7-11 year-olds), integrating the technological solution for interaction mentioned in iii) and with the game proposals mentioned in ii) which can be carried out in the environment of the installation; v) and carrying out of a preliminary evaluation with a reduced sample (non-probability, with 8-year-olds) [Rocha 2009; Rocha et al. 2009].

This research has an exploratory nature and is therefore adapted to the methodological procedure 'action-research' [Carmo and Ferreira 1998]. This method uses the collecting of information in research context to resolve problems, and adjust the research objectives. New research directions can then be followed which, in their turn, can lead to an iterative process as the results are seen as a better or worse fit.

3.1 Contextual design phases

The active participation of the children in the design process [Veloso 2006] is the cyclic process of involvement, play and assessment in several iterations based on User Centered Design methodology [Preece et al. 1996; Preece et al. 2002] and Participatory Design [Muller 2003] which is followed until one reaches the result that is the best fit to the initial objective.

To execute the research methodology an invitation was addressed to a class of 8-9 years old children of an Aveiro's elementary school to participate and integrate the research team in the development of the IMP³.

Five sessions were planned, with a weekly periodicity, to bring together researchers with children. The children already knew some of the researchers who facilitated the first contact.

The first session was held at the elementary school, a familiar environment for the children. The children didn't know the installation so the project was generally presented and the initial involvement of children was to carry out some drawings of Aveiro city.

The first session aim was to gather input from children about the city where they live through the construction of a graphical narrative. The specific objective was to collect a set of elements of Aveiro's cultural context to serve as support for the collection of sounds, images and videos of Aveiro to nurture the cultural context database library, in this case, Aveiro's cultural context. A similar procedure will be accomplished in Dallas (Texas-USA) and in Montreal (Canada) the other two cities connected to Aveiro in this project.

The children identified several typical places and objects of Aveiro's cultural context namely: “praça do peixe” (fish market); “moliceiro” (typical boat); “ovos moles” (soft eggs); “casas às riscas da Costa Nova” (UNESCO heritage old houses with color stripes); “salinas” (salt exploration facilities); “farol da Barra” (lighthouse); “estátua de Sta Joana” (Saint Joana statue); “festa S. Gonçálinho” (Saint Gonçálinho festivity); “parque da cidade” (city park); “teatro Aveirense” (city theatre); “baixinha” (downtown); “zona de restaurantes” (restaurant area); among others. Some of these drawings are exemplified in the following figures (Figure 2; Figure 3; Figure 4).

Considering the children didn't know the installation, between the second and fifth sessions, the children visited and explored the installation during approximately one hour, in small groups of 5 children each.



Figure 2: Example of a “moliceiro” (typical boat);



Figure 3: Example of a “praça do peixe” (fish market);



Figure 4: Example of a restaurant (typical downtown area);

The installation was setup in a room with restricted access. The children visited the facility sat on floor puffs to observe the installation while they were explained the categorization system and the game “5-in-a-line 3D”.

After the initial explanation of a few minutes the children experienced the system interaction within the interactive multimedia installation.

After this initial period of experience children performed two tasks:

- observation and categorization of multimedia elements (sounds, images and videos), individually;
- came together as 2 teams and played the game “5-in-a-line 3D” with black and white pieces.

Highlights of these sessions are the two ideas proposed by children during the experience - add multimedia elements (sounds, images and videos) from Aveiro’s cultural context and categorize them instead of the actual multimedia elements. Namely a combination of the two previous tasks into a single game.

The collection of multimedia elements that characterize Aveiro’s places and cultural context data were collected in several different media (video, audio and still image) and classified in the database after these presentational sessions with the children. Figure 5 and Figure 6 show some examples of these elements.



Figure 5: Example of a “farol da Barra” (lighthouse)



Figure 6: Example of the “casas às riscas da Costa Nova” (UNESCO heritage old houses with color stripes);

Summing up this design cycle, it is expected that after the children live the experience in the installation with the system of categorization and/or playing the game, the result is an identification of a place (a child’s representation of his/her cultural context) so that a child of Aveiro can share Aveiro’s cultural context with a child of Dallas (Texas-USA) or a child at Montreal (Canada) and vice-versa.

3.2 IMP³ website and game

The site was designed to cover information for three different types of users/audiences general public

(public access area), players and researchers (both areas with registration access) (Figure 7).



Figure 7: Layout of the homepage of the IMP³ website
URL: <http://linlabmm.ca.ua.pt/imp/index.html>

The blue area (Figure 7) is the area of free access to the general public. This area is composed with six different sections: History; Gallery; Video Tour; Wall; Help and Search. In “History” section the IMP³ is explained alongside a little of its history. “Gallery” section contains some pictures of past IMP exhibitions and an explanatory video in section “Video Tour”. This part of the site also includes a mural of public messages in the “Wall”, a navigation “Help” system and a “Search” function.

The green area (Figure 7) is the researcher’s area dedicated to people who are involved in research projects related with the IMP. Each researcher can create a profile, which can be viewed by other researchers. The idea is to provide researchers with a common platform of work, meeting and sharing the contacts and work outputs. There is also an area for IMP related publications.

The yellow area (Figure 7) is the player’s area that is probably the most important area of the site concerning the work reported in this paper. This area is divided in seven different sections: Profile; Game Area; Wall; Help; Search; Other Players; Other Games.

Each player can create an individual profile. Each game is associated with the profile developed in a game area. It can also access the profiles of other users and their games. The player can profiles exchange private messages with other users, and have access to a public mural of posted messages.

For security reasons each player is identified by an avatar represented as an image icon and only the place where he/she are playing from is shown.

The traditional “5-in-a-line” game is adapted to the multimedia installation that is a cube with a 3 axes grid divided in 5x5x5 Cartesian volume elements. The game context has the following elements:

- i) white and black fiducial tags in a basket
- ii) each fiducial tag represents an image, a sound or a dynamic image (short video)

- iii) a webcam is available to scan and detect media content code as one of the 3 possible media
- iv) IMP³ has a surround sound system, an image/video projection system and screen parallel to IMP³ Cartesian cube

Figure 8 has a symbolic representation of the IMP³ system as a whole, containing in each of its modules the game elements mentioned above.

The “5-in-a-line 3D” game is played following this procedure:

- i) a child can play alone or in a team and chooses colour white or black as team color;
- ii) a team element gets from a basket a fiducial tag with the corresponding team color;
- iii) a team element uses the webcam to scan the fiducial tag and read the media content;
- iv) if the team decides to “pin-up” the tag inside the installation they must choose a 3D coordinate of the 5x5x5 possible positions in order to build up the “in-line” strategy
- v) the first team to end the 5 “in-line” elements inside the multimedia installation wins;
- vi) the “coherence of the narrative” that the sequence of five elements translates is important but is not taken into account in this version of IMP³ to decide the winner.

Before visiting the IMP³ presential installation the game players can also upload media content into IMP³ website, content that can be used during game play inside IMP³.

Its also important to mention that all the “pin-up” media used in the game is registered in the IMP³ cultural context data base associated to a player/team profile and can be consulted and/or downloaded afterwards from the website.

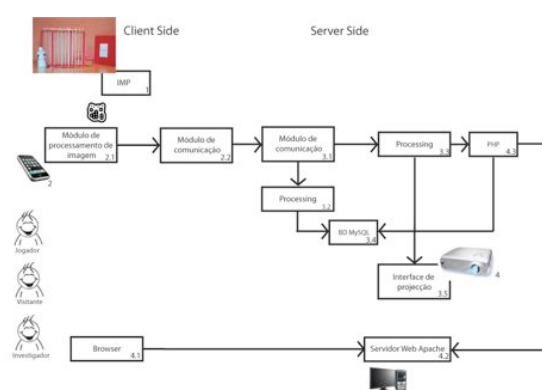


Figure 8: technical scheme of the interaction system between the player, installation and website

4. Results

For the collection of data, various techniques and tools are selected to be used: the participant's observation as an exploratory tool which allows a direct contact with the knowledge of the interaction between the target public and the installation; audiovisual recording; the qualitative evaluation of the interview; and the quantitative evaluation of the questionnaire, which allows for a better understanding of the children's experience interacting with the IMP³ by not interfering with the presence of the researcher during the questioning [Carmo and Ferreira 1998].

The internal evaluation is related two fundamental phases: the finalization of the installation and the qualitative research.

The first step was accomplished; the finalization and final improvements to assess the functional and technical requirements were made. A preliminary evaluation with a convenience sample of three 9-year-old children was also made.

Non-obstructive techniques and data collection methods, validated to be used with children [Veloso 2006; Druin 1999] were used. The data collection instruments such as questionnaires, interviews, and audio and video recording were also used.

The preliminary evaluation consisted in three different tests namely usability, compatibility and security.

The project's usability test was applied on different types of users (common, player, researcher), since each type of user has different features at their disposal. Each user had a different script containing the tasks that each should develop.

The tasks for the user "player" were: registration in the website; login in yellow area; edit profile; access to other players area; visualize other players profile; write a message in the wall; delete a message from the wall; logout.

The tasks for the user "researcher" were: registration in the website; login in green area; edit profile; access to publications area; access the partners area; write a message in the wall; delete a message from the wall; logout.

The tasks for the "common" user (blue area) were: watch the video tour; watch history area; watch gallery area; write a message in the wall; delete a message from the wall.

The usability test measured three different aspects of IMP³ system: satisfaction, effectiveness and efficiency. The measurement parameters used were, respectively, direct observation by the investigator; compliance or not with the tasks; time duration and number of clicks.

For the user "player" test two different tasks were planned: 1) to play the categorization game in the IMP³ installation; 2) evaluate posterior website's use.

The analysis of the results obtained showed: 1) all users were easily able to grasp the rules and related targets of the game developed on the platform, after a brief explanation made by the researchers. The

satisfaction in use was obvious, since all users have expressed an interest, arising from the fact that they felt the game and platform very innovative. 2) According with direct observation of the researcher the user – player expressed satisfaction during the use of the website.

To evaluate the effectiveness the user was asked to perform the tasks previously listed. The results were 100% positive, since all tasks were successfully completed.

Regarding the level of efficiency, the results are also positive. The numbers of clicks were always, except for a situation, the minimum necessary to perform the requested task, which apparently seems to indicate that the pathways necessary for these operations are properly marked.

Regarding the time spent in each task there is relatively significant increases to the minimum time expected.

Some improvements can be made: highlight the access links to some important task as for example the "registration" area; adequate terminology for user age; give precise indications of all tasks that user is obliged to perform; have elements marked, always visible, on every page.

The user "player" test presented the least problems. The users performed all the tasks in a short time without any difficulty. This could be related to the fact that the range of tasks to be developed was very simple, and required a very low interaction with the system.

The user "researcher" demonstrated relevant findings and questions. The effectiveness rate was 100%, because all tasks were completed. Most of the tasks were carried out using the minimum number of clicks possible, and in a reasonable time. The most relevant flaws mentioned were: need to keep the coherent form fields between the several areas of the website; make filling the forms more intuitive, if necessary, using different fields; have the relevant links to development tasks clearly visible; have the most important elements always visible on every page.

A peer reviewer that highlighted some topics for improvement made the security test. There isn't a correct verification of data in the forms because it is possible to fill the forms with any type of data. There isn't any feedback system during the login and logout process.

The website compatibility test was carried out in the following browsers: Opera (Mac), Safari (Mac and Windows), Firefox (Mac and windows), Chrome (Mac and Windows) and IE 8 (Windows). There were few technical errors found and almost all related to the improper alteration of the website margins.

5. Final comments and future work

The second step of internal evaluation, the qualitative research, will be conducted during the next year within the scientific areas influencing IMP³ project. These include aspects related to “system use” and user experience of IMP³, such as: games, play, playfulness; cultural context; communication (verbal, non-verbal, multimedia, cross-cultural issues); classification (semiotics, lexicology); musicology; music and multimedia analysis; auditory, temporal, and multimedia perception; emotion and multimedia; information retrieval; among others.

After the previous evaluation phase of the project, there will be an external evaluation with Live Science Museum focus groups. The prototype will be assembled in a public space, as an open activity for children (7-11 years), the “5-in-line 3D” game will be promoted and its context of use registered internally in system logfiles for future enhancements.

The visiting groups of the Live Science Museum will be the focus groups involved in this quantitative evaluation of satisfaction and enjoyment.

As in the previous phase, the data collection methods used will have non-obstructive techniques validated for use among children of the IMP³ target audience. Data collection instruments such as questionnaires, interviews, audio and video recording will also be used.

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References

- BENNET, P., 2007. BeatBearing. Available December 2008, de Peter Bennet-Projectos.
<http://www.sarc.qub.ac.uk/~pbennett/projects.htm>
- BNS - BRAND NEW SCHOOL, 2007. Adobe CS3 Mural installation. Available December 2008.
URL:http://www.brandnewschool.com/project.php?410/movies/bns_adobe_cs3.mov
- BONNES C., 2004. Saisissement. Available December 2008, URL:<http://www.er.uqam.ca/nobel/interstc/projets/encbSaisissement.html>
- BREGMAN A. S., 1990. Auditory scene analysis: the perceptual organization of sound. Cambridge, Mass. MIT Press.
- CARETTAKIDS, 2004. CarettaKids. Available November 2008 URL: <http://www.itl.k.u-tokyo.ac.jp/~sugi/CarettaKids/>
- CARMO, H. & FERREIRA, M. M., 1998. Metodologia da investigação: guia para a autoaprendizagem. Lisboa: Universidade Aberta.
- CHION M., 1994. Audio-vision: sound on screen. Edited and translated by Claudia Gorbman. New York: Columbia University Press.
- CUBE WORLD, 2005. Stick People Sticking together. Available December 2008.
- DRUIN A. (Eds), 1999. The design of Children's Technology. San Francisco, Morgan Kaufmann Publishers, Inc.
- DRUIN A., 2002. The role of children in the design of new technology. *Behavior and Information Technology*, (BIT), 21(1), 1-25.
- ERIKSON, E., 1976. Childhood and society. London: W. W. Norton & Company Ltd. (Org. 1950).
- HESSE, H., MCDIARMID, A. AND HAN, R., 2007. Making Music with candy. Available November 2008, de Bubblegum Sequencer.
URL: <http://backin.de/gumball/>
- HUGHES, L., 2007. CUBID. Available December 2008, de Hexagram-Projects.
URL:http://www.hexagram.org/spip.php?page=project_file&lang=en&sid=2&id_rubrique=3&id_article=76
- ILT - INTERACTION TECHNOLOGY LABORATORY, 2007. How to play. Available December 2008, de CoGAME.
URL:<http://www.itl.t.u-tokyo.ac.jp/cogame/about.html>
- JUSLIN AND SLOBODA, 2001. Music and emotion: Theory and research. Oxford: Oxford University Press.
- MOUNTAIN, R., 2003. Flexible frameworks: the Multimédia Thesaurus. In Kopiez, R., Lehmann A.C., Wolther, I., & Wolf, C. (Eds.). *Proceedings of the 5th Triennial ESCOM [European Society for Cognitive Studies in Music] Conference, Hannover, Germany, 2003*.
- MOUNTAIN, R., 2005. Tool/ game/ environment: the Interactive Multimedia Thesaurus & Playroom. In *Electroacoustic Music Studies Network (EMS-05)*.
- MOUNTAIN, R., 2006. Name that mood! Describe that tune! Invitation to the IMP. Poster and demo at ISMIR [International Society for Music Information Retrieval]. Victoria, BC, Canada
- MOUNTAIN, R., 2007. Interactive Multimedia Playroom – project overview. In *proceedings of the University of Prince Edward Island, Department of Psychology*.
- MOUNTAIN, R., 2007a. Playful tools, serious questions. In *proceedings of the Canadian Acoustical Association conference, Montreal, Canada*.

- MU PROJECT, 2008. Mu overall winner of the EUROPRIX Multimedia Awards 2008. Available December 2008, de Mu news. URL: <http://www.mu-project.com/>
- MULLER, M., 1991. PICTIVE—an exploration in participatory design. In proceedings of the SIGCHI conference on Human factors in computing systems, 225 – 231. ISBN:0-89791-383-3
<http://portal.acm.org/citation.cfm?id=108844.108896&type=series>
- PHILIPS: DESIGN, 2008. Three red dots for Philips Design. Available December 2008
URL:<http://www.design.philips.com/sites/philipsdesign/about/design/designnews/newvaluebydesign/december2008/threereddots.page>
- PIAGET J. E INHELDER B., 1979. A psicologia da criança – do nascimento à adolescência. Moraes Editores (1ªed.). Lisboa, Portugal.
- PIAGET J., 1967. O raciocínio na criança. Editora Record, Rio Janeiro, Brasil, 2nd edition.
- PIAGET J., 1975. A formação do símbolo na criança – imitação, jogo e sonho – imagem e representação. Zahar Editores. Rio de Janeiro.
- PIAGET J., 1977. A linguagem e o pensamento da criança. Moraes Editores (1st portuguese edition). Lisboa, Portugal.
- PIAGET J., 1978. Biologia e conhecimento, RÉ S Editora, Porto, Portugal.
- PREECE J., ROGERS Y., SHARP, H., BENYON D., HOLLAND S. AND CAREY, T., 1996. Human Computer Interaction, Addison-Wesley Publishers, Inc, USA.
- PREECE J., ROGERS, Y. AND SHARP, H., 2002. Interaction design – beyond human computer interaction, John Wiley & Sons, Inc, USA.
- ROCHA, I. N., 2009. *Estratégias de jogo para uma instalação multimédia de interface tangível concebida para crianças*. Master Dissertation, December 2009, University of Aveiro, Aveiro.
- ROCHA, I., VELOSO, A. AND MEALHA O., 2009. Estratégias de jogo para uma instalação multimédia de interface tangível concebida para crianças. In: *Proceedings of Videojogos2009 Conference, 26-27 November 2009, Aveiro, Portugal*. ISBN – 978-972-789-299-0 URL: http://www3.ca.ua.pt/videojogos2009/actas/artigos/S3-ID60_pag_139-148.pdf, 139-148.
- UVA - UNITED VISUAL ARTISTS, 2006. Volume at the V&A. Available November 2008.
URL: <http://www.uva.co.uk/archives/49>
- VELOSO, A., 2008. Conceção e Desenvolvimento de Jogos Digitais: Estudo Comparativo das preferências das crianças. In proceedings of 5th SOPCOM conference, Braga, Portugal, September, 2007, 2176-2190. ISBN: 978-989-95500-1-8
URL:<http://lasics.uminho.pt/ojs/index.php/5sopcom/article/viewFile/192/188>
- VELOSO, A., LOPES, C. AND MEALHA, O., 2005. Participação activa de crianças no design de artefactos lúdicos digitais. In proceedings 4th SOPCOM conference, Aveiro, Portugal, 21-22 October 2005, 488-500. ISBN:972-789-163-2.
- VELOSO, A.I., 2006. *As tecnologias da Comunicação e da Informação nas Brincadeiras das Crianças*. PhD Thesis, September 2006, University of Aveiro, Aveiro.