D4.3.1

RESULTS AND FEEDBACK ANALYSIS -DRAFT

End user feedbacks after 1st iteration

March 2014

ABSTRACT

This deliverable presents the results and end user feedbacks delivered by Zurich, and Barcelona Experimentation Sites after 1st iteration in the context of the Pervasive Game Platform of the FI-CONTENT 2 project.

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DISCLAIMER

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EXECUTIVE SUMMARY

This deliverable presents the results and end user feedbacks delivered by Zurich, and Barcelona Experimentation Sites after 1st iteration in the context of the Pervasive Game Platform of the FI-CONTENT 2 project.

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ABBREVIATIONS

AR	Augmented Reality
CG	Computer Graphics
FI	Future Internet
FI-PPP	Future Internet – Public Private Partnership
GPS	Global Positioning System
GPU	Graphics Processing Unit
HCI	Human Computer Interaction
iOS	Apple iDevice Operating System
LED	Light Emitting Diode
POI	Point of Interest
SE	Specific Enabler
SLAM	Simultaneous Localization and Mapping
GE	Generic Enabler

1 - INTRODUCTION: FIRST EXPERIMENTATION CYCLE OF THE PERVASIVE GAMING PLATFORM

1.1 - Purpose of this document

The objective of this document is to provide an intermediate report on experimentation results and user feedback on the technology released as part of the Pervasive Game Platform, as part of Work Package 4 of the FI-CONTENT project. The document is a “draft”, in the sense that it gathers data and feedback from only the first experimentation cycle. A second – complete – document including the second experimentation cycle will be delivered at M24.

1.2 - Reading this document

This document is labelled D4.3.1, and is part of a number of similar documents all released at M12 of the project. Two groups of deliverables are relevant when reading this document:

The first group includes D2.3.1, D3.3.1 and D4.3.1. These documents are the summary of the first experimentation cycle with respect to the three content platforms of the FI-CONTENT project. A common structure was created to present content in a unified way. The reader will find that *Section 3* of this document reflects such structure, presenting how and where the different scenarios were tested during the experimentation cycle. *Section 4* is specific to this document and the Pervasive Games Platform, and presents a discussion of the technical infrastructure to collect user data as part of the development tools of the platform. We added this section to better reflect Task T4.5 of WP4, as described in the DOW of the project, which addresses – among other things - the problem of providing technology tools for monitoring user activity.

The second group of relevant deliverables includes D7.1.2, D7.5.1 and D7.6.1, which collect the outcome of the user experimentation sites, and in particular the ones in Barcelona and Zurich. In the first experimentation cycle, all experiments in relation to the Pervasive Game Platform have been conducted on these two sites. To avoid duplicating the content, this document will include only a summary of the experiments performed plus information that is general to the Pervasive Gaming Platform. The reader is invited to inspect these other deliverables where more details are presented.

2 - FIRST EXPERIMENTATION CYCLE

2.1 - Overview of the scenarios for experimentation

In the context of the Pervasive Game Platform, we have conducted a number of experiments involving users, asking them to test and evaluate applications and technology components, in order to gather feedback to steer further development and extension of the platform.

Table 1 includes the list of experiments in chronological order as they were run in the Zurich Experimentation Site.

Table 1 Pervasive Game Platform Scenarios tested to this date

Scenarios	Tier	Barcelona	Zurich
1. Attraction Driving Content Sharing	2		April 2013
2. Augmented Reality in the Wild	1		July 2013
3. Seamless Augmented Reality in the Web	1		November 2013
4. Virtual Character Synchronization on the Web	1	February 2014	November 2013
5. Tabletop Augmented Reality Games	1	February 2014	December 2013
6. Immersive Control Systems	2		February 2014

As mentioned in D4.1, the Pervasive Game Platform targets three tiers of complexity, namely:

1. Augmented Reality Toys
2. Installation Based Applications
3. City-Wide Games

As indicated in the table, this first experimentation cycle touched the first two, with city-wide games planned for the next experimentation cycle. This choice was purely pragmatic, as the three tiers are increasingly more complex, both in terms of the technology required and the logistic for deploying and testing them. We have focused the initial months of the project on Tier 1 and 2 technologies and prototype, while conceptualizing and planning for Tier 3. Experimentations of Tier3 scenarios will be presented in the final deliverable at M24.

2.2 - User Centric Approach

Our experiments follow a user centric design, which has been applied as guiding principle during all phases of the creation of Pervasive Game Platform. As a brief summary, we have considered the end users' needs and interests in domains where FI-PPP technology would meet our use case, i.e. media content related to gaming, augmented reality, and pervasive experience, and have designed a number of scenarios, described in D4.1, which we believe are interesting for the public and can generate new business avenues. These scenarios have then driven the creation of a number of technology components, also called enablers, released in September 2013 as part of the Pervasive Game Platform, described in D4.2. Finally, the components have been combined to create applications that reflect the original scenarios, and they have been presented to the users.

In practice, these three steps were intertwined, as we have progressively designed scenarios, built technology and started experiments with users from early on in the project until now. What matters though is that the question of whether or not we are going in the right direction is answered at the experimentation step, which acts as check point for the quality of the work done so far. So, in the first experimentation cycle, we have gathered user feedback, with the main purpose of validating the scenarios as well as the technical components and applications we have built. The main line of questioning is whether or not the scenarios are

interesting for the users, and whether the technology provided actually support the scenarios in a satisfactory manner.

2.3 - Cooperation between different sites

Cooperation between different sites has three main purposes. First, each site has unique access to local communities, infrastructures, and cultural heritage. Different culture may react differently to technology and applications; hence, feedback may present interesting differences. Second, validation across multiple sites strengthens the value of the result. Third, experiments may actually involve interaction of services and users at different locations.

In this first experimentation cycle, the main collaboration happened between Barcelona and Zurich experimentation sites. For a detailed description of these two sites, refer to D7.1.2, Section 5 and 6 respectively. As mentioned before, the experiments touched Tier 1 and 2, and were executed individually on the different sites.

All experiments were conceptualized and developed as team effort with contributions from all partners. For practical reasons, the actual deployment and testing was done in Zurich first. The presence of both DRZ and ETHZ technical staff facilitated the execution of the earlier prototypes, which required some expertise to be run. Prototypes have been refined afterwards to allow portability to dissemination events, allowing testing in other sites. Two experimentations were replicated in Barcelona, with i2CAT in charge of the operations.

For the second round of experiments we plan to follow the same strategy, starting with controlled experiments in Zurich, and then involve both Barcelona and Cologne.

3 - EXPERIMENTATIONS

In this Section, we present details about the experimentation of the scenarios listed in Table 1. Notice that, more detailed information is presented in deliverables D7.5.1 and D7.6.1. Here, we summarize the experiments and put them in context of the platform.

3.1 - Scenario "Attraction Driving Content Sharing"

3.1.1 - Description of tested application

In this scenario, we explore a case of installation-based application (tier 2) aiming at increasing the entertainment value of a venue.

The ARPix application uses a billboard as marker and allows the users to take augmented reality pictures together with a virtual character. For a movie theatre, characters from the movie posters or cut-out cardboard can be added into the user picture.

3.1.2 - Test objectives and expected outcomes

The main goal of this experiment is to evaluate the robustness of the Reflection Mapping SE and Camera Artefact Rendering SE. We were also very interested in gathering feedback from the users about the application concept, and see their reactions to the pictures created.

3.1.3 - Applied methods and tools for evaluation

We briefly interviewed parents and their children attending a Zurich movie theatre. We also analysed transient video footage of the guests enjoying the apps and their interactions with the handheld AR devices.

3.1.4 - Summary of Experimentation in Zurich

3.1.4.1 - Dates (Start/end) of the experiment

A first internal experiment took place at Disney Science-Fair, March 2013. It was followed by an official public playtest at the Arena Cinema in Silh-City Zurich on April 5th 2013.

3.1.4.2 - Role (involvement) of partners

The Reflection Mapping SE has been created as collaboration between BLRK and DFKI. The Camera Artefacts Rendering SE has been created by ETHZ. The tested application was developed by BLRK and DRZ, and both partners participated in the field testing in Zurich.

3.1.4.3 - Short Report

This experiment was run in a movie theatre in Zurich. A particularly crafted poster has been placed in an area with enough space for people to stand and take pictures. Local visitors of the theatre were invited to participate to the experiment as volunteers. Participants would pose in front of the poster and a family member or a team member of DRZ or BLRK would take the camera shot.

3.1.5 - Summary of outcomes and Conclusion

The overall assessed engagement and enjoyment was very high and guests asked when the app would be publicly available. The Augmented Reality - Image Marker Tracking SE and the Social Network SE are planned to be used in the next release.

This experiment led to further ideas for enhancements to the experience, such as, better interactive photo button placement, bigger buttons for children, a mirror view to take self-portraits, higher resolution and more seamless integration of the photo with use of the Reality Mixer - Camera Artifact Rendering enabler concept. Some of these ideas are already implemented.

3.2 - Scenario "Augmented Reality in the Wild"

3.2.1 - Description of tested application

This experiment is labelled Tier 1, as in the end it is a simple application running on a device without connectivity. However, it is our first attempt to enable AR tracking in an unstructured environment, which is a necessary step to move toward Tier 3 and city-wide gaming.

The Skye Wars application was developed targeting the computer graphics conference *SIGGRAPH 2013*. During the conference the robot balloon Skye Blimp [5] was flying around in the hall before movie screenings. Participants could download the application and by following the blimp with the phone they were able to see an epic space battle happening around it.

3.2.2 - Test objectives and expected outcomes

The main objectives were to gather feedback and reactions from the users, to evaluate the robustness of the Fast Feature Tracking SE in a non-controlled environment, and in turn validate the concept of combining Fast Feature Tracking SE and gravity based AR (from the device gyros) for Tier 3 applications.

3.2.3 - Applied methods and tools for evaluation

Participants were informally interviewed during and after the event.

3.2.4 - Summary of Experimentation in Zurich

3.2.4.1 - Dates (Start/end) of the experiment

During the SIGGRAPH graphics conference that took place in Anaheim from 21th to 25th July 2013.

3.2.4.2 - Role (involvement) of partners

The Fast Feature Tracking SE has been created by BLRK. The tested application was developed by BLRK and DRZ, and both partners participated in the field testing, demo setup and support.

3.2.4.3 - Short Report

During the computer graphics conference participants were provided with a link to the apple app store to download the application and some simple instructions. Participants had to point their phones to the blimp balloon and hit the start button of the app.

Most of the targeted end users were researchers, software developers or artists; the number of users was around 1500.

During and after the event participants were informally interviewed by DRZ and BLKR experimenters. As the crowd at the presentation was quite big we had a lot of interesting feedback from the participants.

3.2.5 - Summary of outcomes and Conclusion

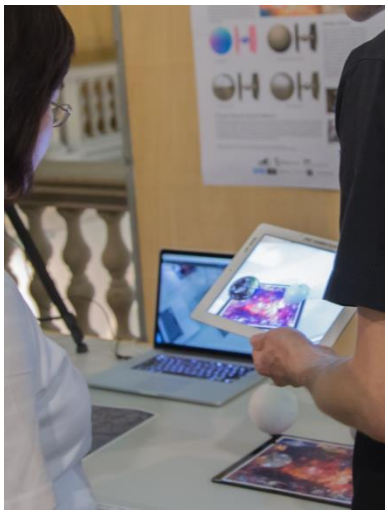
Feedback was very positive and complimentary given the technical knowledge of guests and there awareness of harsh lighting conditions for robust operation of the Fast Feature Tracking enabler, although it was not clear that participants understood the app could actually be played anywhere away from the robotic Skye Blimp, which provided the focus of the event, but was not critical to enjoyment of the game.

All the participants interviewed were able to run the application and track the blimp successfully.

This experiment was indeed a success. We were able to verify the robust functionality of the Fast Feature Tracking SE.

3.3 - Scenario "Seamless Augmented Reality in the Web"

3.3.1 - Description of tested application



The *Star Tours* application showcases the Reality Mixer - Reflection Mapping SE. Spheres placed at a certain position on top of the image marker are used to include as lighting probes to integrate realistic lighting effects for virtual objects in a very efficient way.

3.3.2 - Test objectives and expected outcomes

While testing the robustness and operation of the reflection mapping technique, we were also interested in the feedback from the users. Especially we were interested to see how much this technology improves the immersion and realism of the virtually rendered objects and if it justifies the additional necessary sphere(s).

3.3.3 - Applied methods and tools for evaluation

Informal feedback was acquired during and after the experimentation.

3.3.4 - Summary of Experimentation in Zurich

3.3.4.1 - Dates (Start/end) of the experiment

The Star tours demo was presented and tested by interested visitors at the Swiss Vision Day 2013, NEM 2013 and CeBIT 2014.

3.3.4.2 - Role (involvement) of partners

The Reflection Mapping SE has been created as collaboration between BLRK and DFKI. The Camera Artefacts Rendering SE has been created by ETHZ. The tested application was developed by BLRK and DRZ, and both partners participated in the field testing in Zurich.

3.3.4.3 - Short Report

The application was demonstrated to potential users who could then try on their own, moving the Ipad to view the virtual objects from a different location. The experimenters also used flash lights to better demonstrate the dynamic lighting effects on the virtual objects, captured by the lighting probes through the

camera of the tablet.

3.3.5 - Summary of outcomes and Conclusion

Many people found the technology very interesting and some were surprised about the low computational cost. A few people noted that the virtual objects were too small and thus, the effect was not so easy to see.

The operation of the Reality Mixer - Reflection Mapping SE proved successful and led to integration into the Augmented Resistance game.

3.4 - Scenario "Virtual Character Synchronization on the Web"

3.4.1 - Description of tested application

In the Spider Game Demo, a picture on a table or ground is augmented with a virtual simulated spider character crawling on it. Multiple players, each having a unique view of the game through their handheld devices, share the state of the spider.

The application takes advantage of today's web technologies on mobile devices to augment the camera image based on the marker, mix it with a virtual character and perform efficient scene updates across multiple devices.

3.4.2 - Test objectives and expected outcomes

The purpose of the envisioned experimentation was twofold:

- Generate professional user feedback on the application and its utilised enablers
- Raise awareness among stakeholders and specifically within the developer community of the FI-CONTENT2 project's offering of technological enablers and their possibilities

3.4.3 - Applied methods and tools for evaluation

The evaluation plan for the experiments with this scenario involved two questionnaires. One questionnaire was prepared to elicit the participants' feedback on the application, from the point of view of the end user playing with the game. The other questionnaire was geared towards getting the developers' opinion on the underlying enablers that made the application possible, from the perspective of the professional evaluating the functioning and possibilities of the game prototype.
In the Zurich experimentations a more informal method was applied. We cared especially about the feedback and the impressions of the participants right after the playtest. We observed the participants reactions during the playtest and we carried out brief informal interviews during and after the playtests.

3.4.4 - Summary of Experimentation in Zurich

The full details of the experimentation with this scenario in the Zurich site can be found in D7.6.1.

3.4.4.1 - Dates (Start/end) of the experiment

The Spider demo was presented and tested by interested visitors at the Swiss Vision Day 2013, NEM 2013 and CeBIT 2014.

3.4.4.2 - Role (involvement) of partners

The tested application was developed by DRZ and DFKI. DRZ developed the iOS application while DFKI provided the xml3d website. DRZ, DFKI, ETH and BLRK participated in the field testing in Zurich and helped with the demo setup and support.

3.4.4.3 - Short Report

A booth was prepared to host the demo. It consists in a screen showing the xml3d webpage with an aerial view of the scene and few tablets that provide the AR view of the game and are able to shoot rockets at the spider.
After a short presentation of the app and the technologies behind it participants could experiment on their own with the app. During and after the playtest they were interviewed and asked for feedback. Participants overall seemed to enjoy the game. The application ease of use is really straightforward; the team had to provide very little support. Participants could just pick up the tablet and start shooting the spider while others could watch the game from the xml3d webpage.

3.4.5 - Summary of Experimentation in Barcelona

The full details of the experimentation with this scenario in the Barcelona site can be found in D7.5.1.

3.4.5.1 - Dates (Start/end) of the experiment

The Pervasive gaming platform experiments in this first experimentation cycle were conceived as a set of combined demo workshops of the Spider Game demo and the Augmented Resistance game, running over three phases, from the 6th through the 25th of February. For this reason, most of the descriptions contained in the section below also apply to the experimentation with the scenario “Tabletop Augmented Reality Games” in chapter 4 of this report.

The specific actions performed with the dates and numbers of users involved are listed in Table 2 below:

Table 2 Summary of actions in Pervasive gaming demo workshops

Name of demo workshop	Date	Users involved
I AM workshop	6th February	15-20 AR workshop attendees
BCN Lab	21st February	15-20 event attendees
AR-xperiment (2 sessions)	24th & 25th February	10 + 10 game developers

3.4.5.2 - Role (involvement) of partners

The technical setup and preparation of the demos was carried out in close coordination with the WP4 partners, more specifically DFKI, DRZ and ETH Zurich. Also, Mr Chino Noris of DRZ conducted a presentation and brief training session during both sessions of the AR-xperiment, to be further explained in section 3.4.5.3.

For the organisation of the event in the Fabra & Coats building, I2CAT also collaborated directly with Sigma Orionis.

3.4.5.3 - Short Report

The purpose of the initial demo at the I AM workshop was to fine-tune the technical setup of the demos and improve the feedback questionnaires. The initial feedback received from users provided a first assessment of the gaming demos, and allowed the refinement of the questionnaires with a set of more specific and deeper-probing questions.

This was followed by a larger, real-world demo workshop at the BCNLab event. The BCNLab demo was a response to an emerging opportunity to disseminate the project's enablers and gather feedback from a professional audience, composed of multidisciplinary artists, creative industries representatives, and ICT officials from city councils across Europe.

Finally, The AR-xperiment was a two-day training and testing session with two groups of 10 professional developers. These sessions lasted approximately two hours and a half each (see Table 8 below), and consisted in an introductory presentation and brief training on the enablers delivered via videoconference (Bluejeans) by Mr Chino Noris, and a hands-on session in which the attending developers were encouraged to try and test both applications themselves. At the end of the session, attendees were asked to fill in two feedback forms for each tested application, providing their detailed opinion on these prototypes.

3.4.6 - Summary of outcomes and Conclusion

The main recommendations that arise from the experimentation in this scenario in the Barcelona site are:

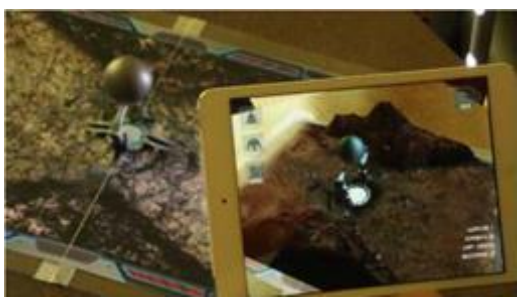
1. More functionality should be added to turn this very promising demo into an attractive and addictive AR game.
2. Specifically, the development of more game modes, options and actions offers possibilities to create attractive gameplay elements which make Augmented Reality an integral element of the game experience.
3. Exciting gameplay dynamics that users considered interesting for this game are enabling coopetition strategies (users cooperate to shoot at high-value targets, but end up with more or less points depending on their ability to defect at the right moment), enabling combo hits, having the spider shoot back at users (so that they must move to avoid damage), and adding more enemies with different score values to give rise to different game-winning strategies (focusing on few high-value, high-profile values or many easier low-value targets).
4. The visual elements of the terrain could also be integrated into the game experience, with permanent effects of explosions on landscape, and the spider being able to hide behind rocks, trees and other elements.

Finally, from the developer point of view, the existing documentation should be enhanced with step-by-step tutorial for beginners, more images and diagrams, source code examples, video demos, and a downloadable mock project.

3.5 - Scenario "Tabletop Augmented Reality Games"

3.5.1 - Description of tested application

In the Augmented Resistance demo, a physical tower on the center of a board must be defended against hordes of virtual characters in augmented reality.



In this application, the augmentation of traditional board games with the help of mobile devices is explored. AR Tracking is used to situate the device with respect to the board. Real objects are mixed with virtual ones. A light-probe system is used to capture

the light of the environment, and uses it to illuminate the virtual content, obtaining a better matching of the virtual elements to the real ones.

3.5.2 - Test objectives and expected outcomes

The purpose of the envisioned experimentation was twofold:

- Generate professional user feedback on the application and its utilised enablers
- Raise awareness among stakeholders and specifically within the developer community of the FI-CONTENT2 project's offering of technological enablers and their possibilities

3.5.3 - Applied methods and tools for evaluation

The evaluation plan for the experiments with this scenario involved two questionnaires. One questionnaire was prepared to elicit the participants' feedback on the application, from the point of view of the end user playing with the game. The other questionnaire was geared towards getting the developers' opinion on the underlying enablers that made the application possible, from the perspective of the professional evaluating the functioning and possibilities of the game prototype. Both questionnaires can be found in Annex B of this report.
In the Zurich experimentations a more informal method was applied. We cared especially about the feedback and the impressions of the participants right after the playtest. We observed the participants reactions during the playtest and we carried out brief informal interviews during and after the playtests.

3.5.4 - Summary of Experimentation in Zurich

The full details of the experimentation with this scenario in the Zurich site can be found in D7.6.1.

3.5.4.1 - Dates (Start/end) of the experiment

The Spider demo was presented and tested by interested visitors at the Swiss Vision Day 2013, NEM 2013 and CeBIT 2014. Also few informal playtests were done internally by DRZ where people visiting our lab could try the game.

3.5.4.2 - Role (involvement) of partners

Augmented Resistance app was developed by DRZ. DRZ, ETH and BLRK contributed in the development of the SEs used by the application. Both partners helped the setup of the demo and participated in the field testing. Future collaboration with DFKI is planned to integrate more SE and GE functionality in the game.

3.5.4.3 - Short Report

In both these events a booth was set up to host the demos. The setup consists in a few tablets and a game board with a 3d printed base stand where a ball is placed. First a brief presentation of the app is given to the public, and then the participants are given the opportunity to play with the app.
Participants were observed in general during the play test and a few people were briefly interviewed for informal feedback. Most of the feedback came spontaneously from the participants who seemed to enjoy the game and started competing for the highest score thanks to the Leaderboard SE implementation from ETH. Also worth saying that some participants started playing with the Reflection Mapping SE by pointing LED lamplights or their cell phones lights to the light probe ball.

3.5.5 - Summary of Experimentation in Barcelona

The full details of the experimentation with this scenario in the Barcelona site can be found in D7.5.1.

3.5.5.1 - Dates (Start/end) of the experiment

The Pervasive gaming platform experiments in this first experimentation cycle were conceived as a set of combined demo workshops of the Spider Game demo and the Augmented Resistance game, running over three phases, from the 6th through the 25th of February.

3.5.5.2 - Role (involvement) of partners

The technical setup and preparation of the demos was carried out in close coordination with the WP4 partners, more specifically DFKI, DRZ and ETH Zurich. Also, Mr Chino Noris of DRZ conducted a presentation and brief training session during both sessions of the AR-xperiment.

For the organisation of the event in the Fabra & Coats building, I2CAT also collaborated directly with Sigma Orionis.

3.5.5.3 - Short Report

This experiment was carried out simultaneously with the aforementioned experimentation of scenario "Virtual Character Synchronisation on the Web". A detailed account of the running of the experimentation can be found in section 3.3.1 of deliverable D7.5.1, and in section 3.4.1 of the present report.

3.5.6 - Summary of outcomes and Conclusion

1. Overall, the Augmented Resistance game was received quite satisfactorily by the experimentation events' attendees, who produced a series of recommendations in several areas.
2. First of all, making light more important for gameplay would increase the innovativeness of the game and serve as a good demonstrator of the reflection mapping enabler. For example, some enemy waves could be more or less visible depending on light level (prompting players to add external additional light sources or moving to a more strongly lit location), and some waves could even be stealth waves, only detectable by defending forces if pinpointed by the user with a lamp or light probe.
3. In terms of game dynamics and elements, users recommended the addition of ground elements that have an impact on the gameplay (rivers can slow down attackers momentarily, trees provide them with some cover), enabling the destruction of ground elements and their integration into the game story (blast craters are used as cover by the advancing forces), and allowing for the redeployment of forces between several fixed defence points ("fortresses").

3.6 - Scenario "Immersive Control Systems"

3.6.1 - Description of tested application

Dragon Flight is a game where the user takes control of a flying dragon. The user's body is mapped one-to-one to the dragon's body. The user will have to move his arms to simulate the flapping wings of the dragon in order to fly and try to pick the coins scattered around the map.

3.6.2 - Test objectives and expected outcomes

Gather feedback and reactions from the users. The data gathered will be very useful to improve the system. We hope that people will find the experience much more immersive than with traditional controller.

3.6.3 - Applied methods and tools for evaluation

Participants were asked to learn to fly the dragon and try to collect the coins around the map. Participants are informally interviewed after playing the game. They were asked about how immersive and fun the experience has been and if they had any ideas for improvement

3.6.4 - Summary of Experimentation in Zurich

3.6.4.1 - Dates (Start/end) of the experiment

The dragon flight playtest took place at DRZ offices the 17th February 2014, where 20 non-expert participants were invited to an informal test of the application and briefly interviewed right after.

3.6.4.2 - Role (involvement) of partners

The dragon flight demo application was entirely developed by DRZ. It uses the Immersive control system SE that was also developed by DRZ and will use the Synchronization GE developed by DFKI and the Leaderboard enabler from ETH. DRZ team took care of setting up the demo and giving support during the event.

3.6.4.3 - Short Report

A booth was prepared were the dragon flight app was deployed. The application setup consists in a Microsoft Kinect placed over a monitor where the game is shown. Participants took turns flying the dragon after a short introduction by the DRZ team. During the informal playtest the participants were watched in general and were briefly interviewed for informal feedback about the experience.

Support was provided by the DRZ team explaining a few tricks on how to fly the dragon properly.

3.6.5 - Summary of outcomes and Conclusion

Feedback was very positive and complimentary. All participants were able to learn to control and fly the dragon. Most of them found the experience very fun and more immersive compared to a traditional controller, such as a game pad. A good portion of the participants complained about the physical effort. Some of them would have liked an even more immersive system, including a head mounted display and a microphone.

This experiment verified the functionality of the Immersive Control System SE and gave us a lot of feedback for improvements.

4 - PLATFORM INTEGRATION OF ANALYSIS TOOLS

As described Task 4.5 of work package 4, in the description of work (DOW) of the FI-CONTENT project, one of the goals of the Pervasive Game Platform is to provide tools to the developers to monitor user activity, monitor network usage, and validate their application. This is motivated by the recent trends in game development practices [1]:

> *The science of game analytics has gained a tremendous amount of attention in recent years. Introducing analytics into the game development cycle was driven by a need for better knowledge about the players, which benefits many divisions of a game company, including business, design, etc. Game analytics is, therefore, becoming an increasingly important area of business intelligence for the industry. Quantitative data obtained via telemetry, market reports, QA systems, benchmark tests, and numerous other sources all feed into business intelligence management, informing decision-making.*

We have conducted a study of the state of the art in game analytics, and identified potential tools which can be integrated into the Pervasive Game Platform.

It should be noted that this is an area rapidly evolving. We envision the integration of external tools created by dedicated professionals in this field rather than competing against it with our internal efforts which could easily side track our focus from the main goal. This is in line with similar choices we have done for the platform, adopting tools like Unity3D, and allows us to extend the reach of the platform while ensuring our ability to focus on FI-PPP technology.

4.1 - State of The Art in Game Analytics

4.1.1 - Introduction

Game analytics is a discipline that studies three main sources of data, namely **performance data**, i.e. technical and software infrastructure data (such as the frame rate at which the game executes, the stability of the server, etc.), **process data**, i.e. data about the process of developing the application, and **user data**, i.e. data generated by users who play the games.

User data is by far the most common source analysed. Analysis is based on the creation metrics which the analyst (application developer) studies to derive some conclusions. Common metrics include: **customer metrics**, which covers aspects of the users as customers, like the cost of acquisition and retention, **community metrics**, which cover user activity within the community (sharing on social network, forum activity, etc.), and **gameplay metrics**, which study the behaviour of players within the game.

A common set of customer metrics is called informally the “pirate” set, because of the AARRR acronym referring to players **Acquisition**, **Activation** (what percentage is happy with the first experience), **Retention**, **Referral**, and **Revenue**.

4.1.2 - Analysis Tools Survey

The number of available tools and services for Game Analytics is large and rapidly evolving [2, 3], in particular, the offers targeting mobile development. One difficulty when reviewing these services is the lack of consistent vocabulary and the improper extension of analysis limited to “users as customers” to the whole domain of game analytics.

Table 3 List of top ranked user data analysis tools

Name	*Code*	*Price*	*Platform*
Countly	Open Source	Free	iOS, Android, Windows Phone, Blackberry
Flurry Analytics	Proprietary	Free	iOS, Android, Windows Phone, Blackberry
Localytics	Proprietary	Free + Licensing	iOS, Android
Google Analytics	Proprietary	Free	iOS, Android
Smart Fox Server	Proprietary	Free + Licensing	Flash, Unity3D, HTML5, iOS, Android, W. Phones
App Annie	Proprietary	Free	Mobile Stores Tracker
Distimo	Proprietary	Free	Mobile Stores Tracker
Bango	Proprietary	Licensing	Facebook, Blackb., Opera, Telefonica, EA mobile
GameAnalytics	Proprietary	Free + Licensing	Unity3D
Apsalar ApScience	Proprietary	Free	iOS, Android
Mixpanel	Proprietary	Free + Licensing	iOS, Android
AskingPoint	Proprietary	Free	iOS, Android
Mopapp	Proprietary	Free + Licensing	iOS, Android, Widnwos Phone, Blackberry
KSuite	Proprietary	Free + Licensing	Multi-platform
AD-X	Proprietary	Licensing	Mobile Stores Tracker
Katana	Proprietary	Licensing	iOS, Android

Table 3 gather some of the tools appearing on top ranking lists via web search. These tools provide customer metrics to analyse success of the game. Most of the available tools present similar features, and mainly differ in how they integrate into the game being developed (via SDK and code, monitoring stores), in their pricing, and in their look and feel.

One entry that stands out is the offer from Game Analytics. First, it is based on Unity 3D, the current leader in mobile game engines [4]. Second, it provides gameplay metrics on top of customer ones. Another interesting entry is Katana by Ninjametric. In contrast to the other services, Katana offers a variety of community metrics (which they call social metrics). Finally, Smart Fox Server stands out for its tools for analysis of performance data, which makes it unique in the landscape of analysis tools we have encountered. It should be noted however, that Smart Fox Server is actually a much larger framework which covers most aspect of game networking with analytics built on top, and should therefore not be compared directly.

4.2 - Platform Integration

From the list of tools we have surveyed, we identified two candidates as potential partner for the pervasive game platform.

The first one is the German company GameAnalytics. Their solution provides a wide range of tools to consider player acquisition, retention, monetization, as well as in game player behaviors. The integration with Unity3D makes the use of their tool fully compatible without further development needed on our end.

The second one is Smart Fox Server. Their solution tackles a number of important problems with respect to networked games, such as the creation of game lobbies for players to create or join game instances. The Leaderboard enabler of the pervasive platform has been integrated into Smart Fox Server, and we are looking to strengthen the integration to allow user of the Pervasive Game Platform to benefit from their analytics tools.

5 - CONCLUSION AND OUTLOOK FOR SECOND EXPERIMENTATION CYCLE

With the Pervasive Game Platform, we have begun experimentation early on in the project and continued performing a number of experiment, most of which were performed after the first platform release in September. Experiments have been run in Zurich and Barcelona Experimentation Sites.

Overall, the outcome of the experimentations is positive. The users have reacted positively to both the scenarios we have identified, as well as the test application built with the platform technology. We have collected the user feedback per scenario and will work on the improvements suggested.

In the second experimentation cycle, our main focus is to test and validate Tier 3 scenarios, i.e. city-wide games. These types of applications are more challenging because they are distributed over larger areas, with virtually no control on network quality and various difficulties in equipping locations with the necessary infrastructure. These scenarios however open the opportunity to combine efforts with the Smart City Platform more tightly.

REFERENCES

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