D4.1

SCENARIO, FUNCTIONAL AND TECHNICAL REQUIREMENTS - RELEASE 1

March 2014

ABSTRACT

This document describes use cases developed in the "Pervasive Game Platform" (1st release). The scenarios are composed of technologies grouped into key strategic areas for interactive entertainment, including virtual and augmented reality environments on the Future Internet.

This document is a deliverable of the FI-CONTENT 2 integrated project supported by the European Commission under its FP7 research funding programme, and contributes to the FI-PPP (Future Internet Public Private Partnership) initiative.

DISCLAIMER

DELIVERABLE DETAILS

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EXECUTIVE SUMMARY

This document specifies the “Pervasive Game Platform” reference applications. The main use cases introduced in this document have been identified by all WP4 partners, technical partners and experimentations site owners. The scenarios are composed of technologies grouped into key strategic areas for interactive entertainment, including virtual and augmented reality environments on the Future Internet.

The Reality Mixer group of enablers deals with seamless context aware presentation of content blended with the real world, including audio, visual and physical axes. The Augmented Reality group of enablers deals with recognition and tracking of targets in real-time for locating internet sourced content with sufficient accuracy for realistic mixing with the real world. The Game Content group of enablers is composed of advanced authoring enablers to aid rapid construction of connected experiences. Finally, Games with Things deals with connectivity to real objects instrumented either actively (such as RFID/digital IDs) or passively (such as through object recognition).

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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
XML3D	Three Dimensional Extensible Markup Language

1 - INTRODUCTION

1.1 - Overview

In phase 1 of FI-CONTENT and in firmly establishing WP4 for phase 2, we have created and described our 3-tiered scenarios that, together, address the main types of today's content for the Game Platform; we have extracted from them architectural and technical requirements for the FI-CONTENT 2 platform, as well as the liaison with the Core Platform. From this list of phase 1 requirements, we have built the FI-CONTENT 2 architecture and identified the needed building blocks, namely enablers that will fit the use case scenarios. The enablers are divided in two types: generic and specific enablers. Generic enablers are common to most use case projects linked to FI-WARE while specific ones are specific to the FI-CONTENT 2 project.

The goal of WP4 is to draw upon and refine earlier requirements towards building the open Games Platform for games and virtual worlds. Careful consideration with depth is employed in scenario specification, application platform development, content preparation and management, deployment and establishing user testing criteria and analysis of feedback.

In this document, we present the specification of game platform scenarios, which will provide real world basis for dissemination, and distribution of the open game platform. These application scenarios are thus defined here and will be implemented to serve as early trials of the platforms. The specifications are comprised of the following,

- Tiered definition and detailed description of scenarios of the Pervasive Game Platform according to commercial, academic and cultural criteria
- Functional and Technical specification of enablers of the Pervasive Game Platform

We assess the list of generic and critical specific enablers and distinguished between the first stage release of initial enablers to apply within the game platform and next key stage enablers within release 2, as follows,

1.1.1 - User-centred design and development

All three platforms within FIcontent have decided to follow a harmonized methodology to design and develop applications and services for each specific platform. These methodologies adopt user-centred design and agile development methods. The user-centred design method as described in Annex A of deliverable D3.1 and the agile development have been integrated to reflect the nature of this research project. As opportunities for face-to-face communication are less frequent than usual due to the size of the project, we combined both methods to reflect this reality. The resulting development process embraces an iterative rather than a fully agile approach and ensures regularly feedback from users and testing groups through all phases of the project.

This approach is divided into three phases covering the early design phase, the development phase and finally the experimentation phase. The following sections describe the methods applied to design and development of applications utilizing the open Games platform.

1.1.2 - The early design phase

During the early design phase we formalised concepts, technical foundations, user interaction designs, data interfaces and their representations. In addition, we built a vision of the applications to be developed on the open Games platform. Inputs were created through discussions with experts and student groups regarding the scenarios for digital consumer products, location based experiences and city-wide gaming.

Using the functional requirements generated, we began the design phase. Initial rapid testing was used to guide the technical considerations as well as the UI design process. The result was a first release of application features and their representations to kick-off the development phase.
Release I:

- Advanced UI - 3D Web Services (Generic Enabler – FI-WARE)
- Advanced UI - Data Flow Processing (Generic Enabler – FI-WARE)
- Identity Manager (Generic Enabler – FI-WARE)
- Reality Mixer – Reflection Mapping (Specific Enabler – FI-CONTENT)
- Reality Mixer – Camera Artefact Rendering (Specific Enabler – FI-CONTENT)
- Leaderboard (Specific Enabler – FI-CONTENT)
- Games with Things - Spatial Matchmaking (Specific Enabler – FI-CONTENT)
- Augmented Reality – Fast Feature Tracking (Specific Enabler – FI-CONTENT)
- Augmented Reality – Marker Tracking (Specific Enabler – FI-CONTENT)
- Social Network (common Specific Enabler – FI-CONTENT)
- Game Synchronization (Specific Enabler – FI-CONTENT)

1.1.3 - The development phase

Development of the pervasive game platform is based on the Scrum agile method. Feedback from interim testing and ongoing work was included during the development phase when possible. To this end, we organised the development in sections having an ongoing, parallel exchange between designers, developers and technical experts in charge of the pervasive games platform.
Each sprint lasted weeks of development, between a planning and review phases. In addition, simple testing was performed consisting of assessment of the use-cases (scenarios), clarity of the specific functionality and collecting other feedback from the testers. Incorporating such feedback into the platform, led to a second release.

1.1.4 - The experimental phase

Experiments for the pervasive game platform were conducted at Zurich and will also be conducted at Barcelona. Zurich was the main experimentation site for the Pervasive Games Platform. As a lot of the development is also done in Zurich, the experiments include many early informal studies to evaluate the programs and enablers during the development. The experiments were conducted in April 2013 (Attractions Driving Content Sharing), July 2013 (Augmented Reality in the Wild), November 2013 (Seamless Augmented Reality on the Web), November 2013 (Virtual Character Synchronization on the Web), December 2013 (Tabletop Augmented Reality Games) and February 2014 (Immersive Control Systems). Feedback was collected using surveys and user-feedback in each of these experiments and was fed back into the design. A second experimental site is Barcelona. The Barcelona Experimentation Site runs combined trials of the City Guide and Pervasive Games platforms through the Barcelona Lab, an open living lab embracing an open innovation community in the city, which is the framework of the user-driven open innovation activities in FIcontent for the city of Barcelona. Barcelona Lab was created by i2CAT, the Municipality of Barcelona and other entities as a thriving hub for creative communities, citizen scientists, digital hackers, social innovators, open infrastructures, and global entrepreneurs. The following experiments have been/will be conducted in Barcelona: Tabletop AR games and Virtual Character Synchronization on the Web (Feb 2014 and Mar 2014).

1.2 - Terminology

The following terminology is used:

Enabler: Software module or web service providing well-specified functionalities, accessible and usable by application developers through clearly-described APIs (Application Programming Interfaces).

Generic Enabler (GE): An enabler realized by the FI-WARE project or its follow-up sustainability project.

Specific Enabler (SE): An enabler realized by the FI-CONTENT 2 project. Specific Enablers may be layered on top of, or otherwise make use of, Generic Enablers. Please refer to the definition of a FI-CONTENT 2 SE from Deliverable D6.1 Architecture specification.

Platform: A comprehensive combination of technology infrastructure and Generic and Specific Enablers capable of hosting and supporting development of application software.

Application or **Application software**: Software layered on top of one or several platforms for realizing tasks for end-users.

Scenario: Description of foreseeable interactions of users with one or several applications.

Experiment or **Experimentation**: Concrete test with actual users of one scenario in one of the experimentation sites within a given time frame.

Functional requirement: Either calculations, technical details, data manipulation, processing or other specific functionality that define what a system is intended to accomplish.

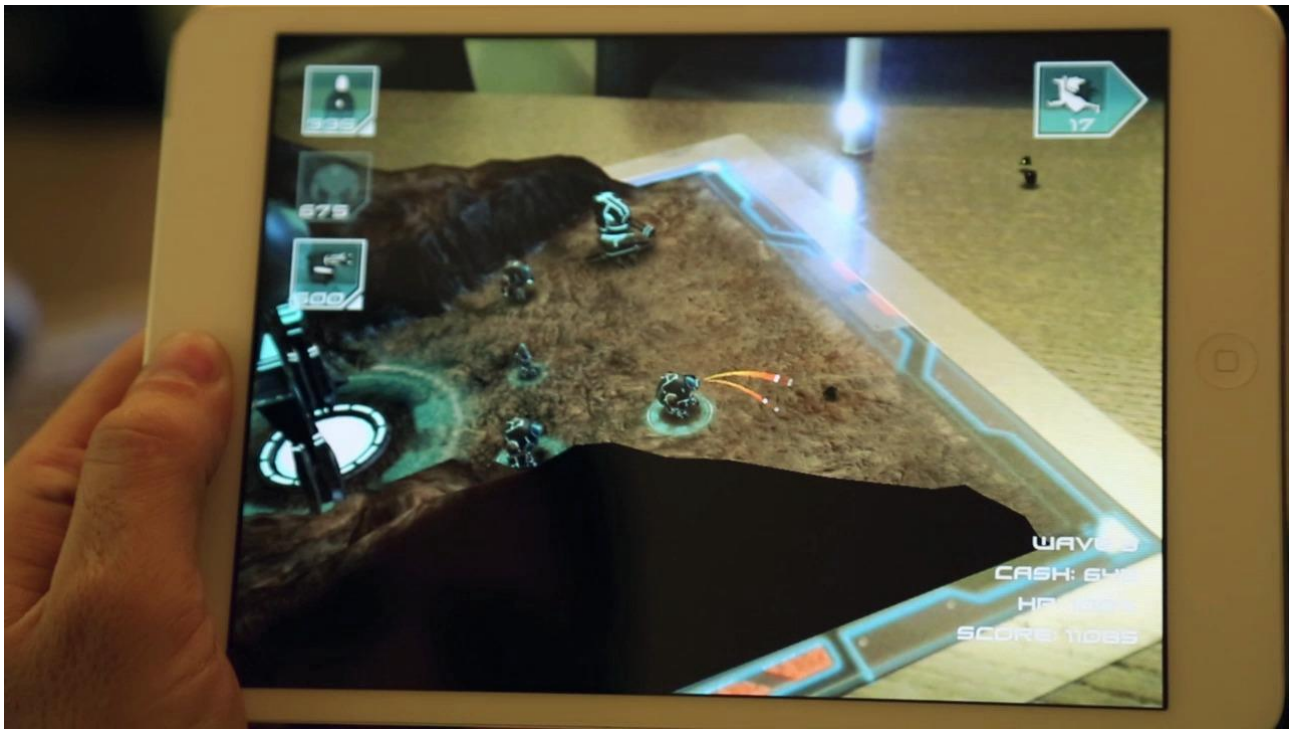
1.3 - Cooperation with other FI-Content platforms

Deliverables 2.1 (Social Connected TV), 3.1 (Smart City Guide) and 4.1 (Pervasive Gaming) share commonalities at many levels. First, the Reality Mixer will be used for Augmented Reality applied to any of the scenarios in these deliverables. For example, AR may be equally applicable to tour guides as it is to games. A second connection, is the social component which requires synchronisation of multiple users using hand held devices or TVs. For example, while such synchronisation is potentially across multiple devices in D2.1, it is also useful for synchronising the view of AR across multiple users for D3.1 as well as D4.1. Further, new ideas such as leader-boards for gaming are potentially applicable to gamified tour-guide scenarios. As an example, one of the field tests held at Aulani Hotel in Hawaii was using reality mixer in a tour guide application, combined with an element of gameplay. Finally, at the core of providing a credible AR experience lies the ability to track objects in video at real-time. The advanced UI GE's provide such 3D web and tracking for points-of-interest. For example, the POI Data Provider GE is a key component in many tour-guide applications as well as games. Thus, the design of the GEs is versatile and ties the scenarios proposed in the three deliverables together at the level of functionality.

2 - GAME SCENARIOS

2.1 - Tier 1 – Digital Consumer Products

2.1.1 - Tabletop Augmented Reality Games



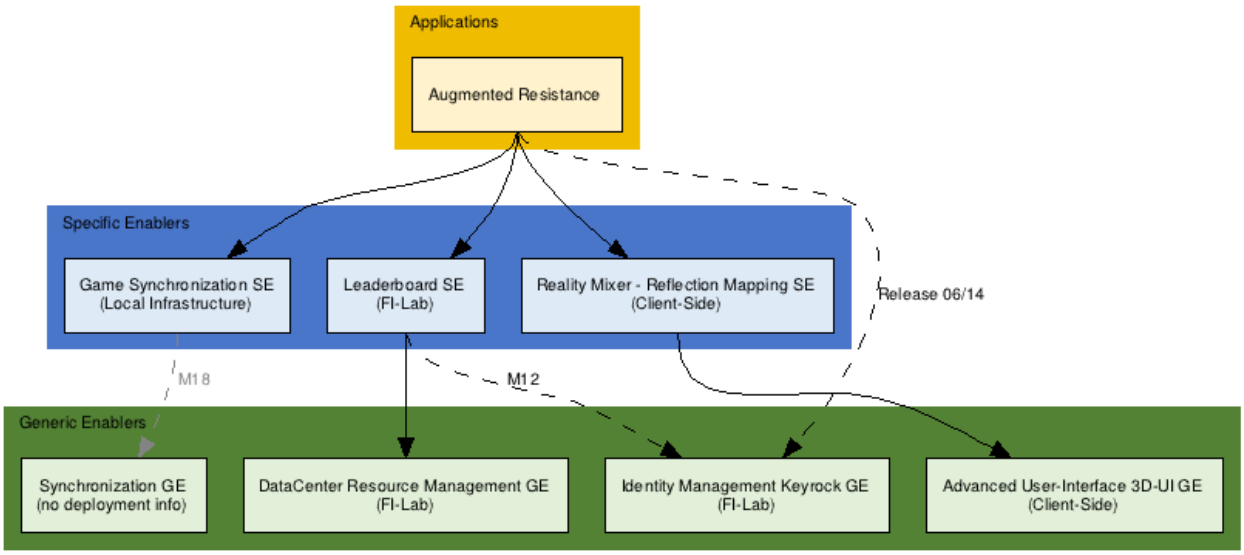
Tabletop Augmented Reality Games (Augmented Resistance)	
Category/topic/context	Tier 1 – Digital Consumer Products
Owner(s)/contacts	Chino Noris (DRZ), Kenny Mitchell (BLRK)
Abstract	In this scenario, we consider the augmentation of traditional board games with the help of mobile devices. AR Tracking 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.
Detailed description	This scenario build is part of tier 1, which targets augmented-reality games based on toys, fashion, and other physical products. These games use the physical product as a known and structured environment (level) which is populated with virtual elements displayed on a handheld device. This tier includes a limited number of networked uses. When two or more players are physically located at the same place, they can play over local network. The physical toy or board is shared and acts common base to localize all players. Each player has a unique view of the game, based on where they are located as well as what role they have in the game, which may influence what information they have access to. Alternatively, a leaderboard system is used for player to compete at the level of points collected in the game. In this case, the smart phone device communicates the outcome of a play to a server, and the server stores the result associated with a unique ID of the player.

Tabletop Augmented Reality Games (Augmented Resistance)		
Justification for inclusion of scenario	Audience/cultural criteria	The target audience for Toys and Board games includes children and teenagers. The maturity and complexity of the virtual content can be tailored to appeal to a wide range of users, accounting for various age groups. Adults may be involved in their children's game and play more complex roles.
	Commercial criteria	This scenario builds on top of the existing business of tabletop games and toys, and adds the aspect of apps for the mobile devices. Different models can be considered, where the mobile app and its content can be sold or redeemed through a physical token sold within the physical toy box. New content can be sold separately in the future, to keep the game up to date.
	Academic criteria	This scenario demonstrates a new level visual quality for augmented reality games and serves as an example of advanced video game content for further research.

Planned experimentation		
01.	Experimentation site(s)	Zurich
	Estimated schedule	Demonstration July'13. Study December'13
	Maturity of implementation	Production ready
	Content, provider, availability	Provided by DRZ & BLRK

Functional requirements and their candidate enablers			
Functional requirement		*Candidate enabler*	*GE/SE/Gap*
01.	Low-latency Context Aware Rendering	Reality Mixer – Reflection Mapping	SE
02.	Synchronization of the Game World for Multiplayer	Game Synchronization	SE
03.	User Authentication	Identity Management	GE
04.	Competitive and Collaborative Ranking	Leaderboard	SE
		Socio-Aware Ranking	Gap

Performance requirements	
Type	*Requirements*
Hardware	Recent handheld device with powerful processor, good camera, GPS, gyroscopes and accelerometers.
Software	• Fast (~50Hz) object recognition of known objects. • Fast lighting estimation (50 Hz). • Real-time (30Hz) rendering • Leaderboard system on server to cope with dozens of users
Miscellaneous	**Network:** A bandwidth of 1 Mbps is required


Applications
Augmented Resistance
Specific Enablers
Game Synchronization SE
(Local Infrastructure)
Leaderboard SE
(FI-Lab)
Reality Mixer - Reflection Mapping SE
(Client-Side)
Release 06/14
M18
M12
Generic Enablers
Synchronization GE
(no deployment info)
DataCenter Resource Management GE
(FI-Lab)
Identity Management Keyrock GE
(FI-Lab)
Advanced User-Interface 3D-UI GE
(Client-Side)

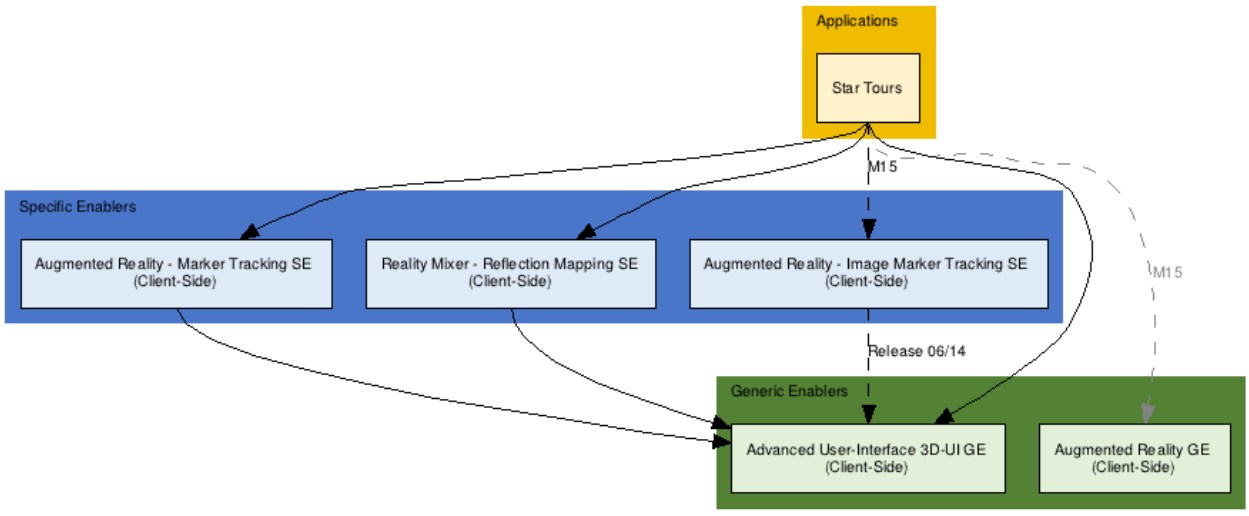
2.1.2 - Seamless Augmented Reality on the Web

Seamless Augmented Reality on the Web (Star Tours)		
Category/topic/context	Tier 1 – Digital Consumer Products	
Owner(s)/contacts	Stefan Lemme (DFKI), Kenny Mitchell (BLKR)	
Abstract	This scenario is part of tier 1, which targets augmented-reality games based on toys, fashion, and other physical products. It shows a setting of animated virtual star fighters around the Death Star toy on the web. The scenario showcases the seamless incorporation of virtual objects into an augmented reality scene based on toys by adapting the lighting model according to the physical environmental lighting conditions.	
Detailed description	The seamless incorporation of virtual objects into an augmented reality scene requires a light probe to measure surrounding lighting conditions. Thus, a lighting model according to the physical environmental lighting conditions can be applied to rendered virtual objects. Therefore, we utilize the Reality Mixer - Reflection Mapping SE to extract the light conditions from a camera image and create the respective lighting model. Furthermore, the estimation of the camera pose relative to the physical toy requires an augmented reality tracking method provided through one of the Augmented Reality enablers. This scenario runs completely on the web and utilizes the Advanced-User Interface GE to render 3D-scene content with XML3D and Xflow.	
Justification for inclusion of scenario	Audience/cultural criteria	The main audience for seamless augmented reality applications are players who claim to a high-degree of immersive gaming experience. Games, incorporating virtual objects into real world settings, need to mimic the appearance of physical objects, even if they are virtual, in order to achieve a seamless augmented reality experience to the player.
	Commercial criteria	Games, incorporating virtual objects into real world settings, may attract additional players through the increased immersive experience while playing. In addition to that, in mixed reality applications real world places may become important within game levels. Thus, an advertisement of the game attached to the respective physical object might attract new players.
	Academic criteria	Measure physical properties of objects and simulating a similar behaviour of virtual objects is a well-established research field in computer graphics. But the seamless mix-up of physical and virtual objects in augmented reality applications is a challenging task and the subject of current research in the field of computer graphics and vision.
Planned experimentation		
	Experimentation site(s)	n/a
	Estimated schedule	*Ready as showcase in Nov. 2013*
	Maturity of implementation	*First Prototype*

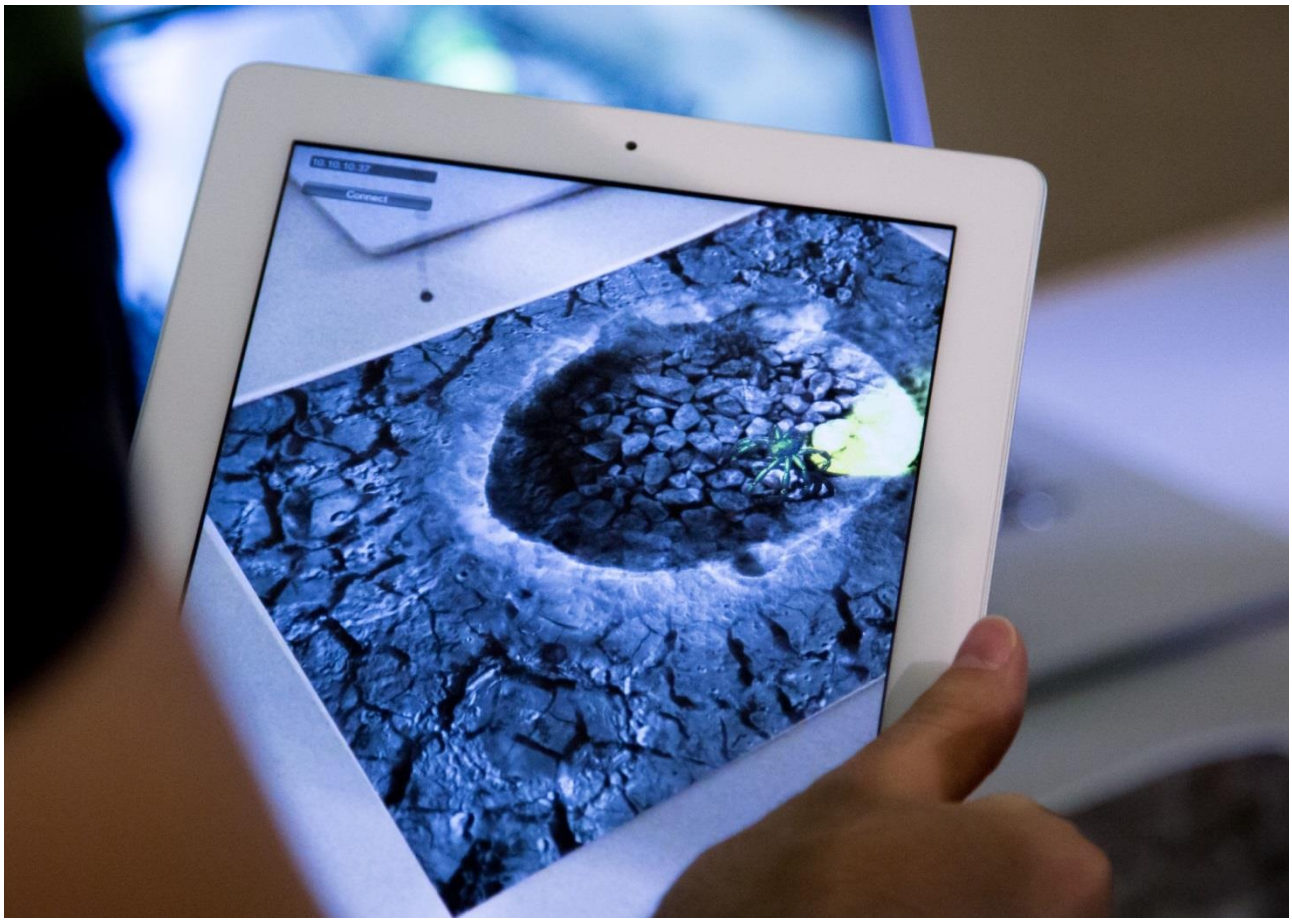
Seamless Augmented Reality on the Web (Star Tours)		
	Content, provider, availability	Content will be provided by DFKI and BLRK. Bi-lateral demonstration not for test site study.

Functional requirements and their candidate enablers		
Functional requirement	*Candidate enabler*	*GE/SE/Gap*
Camera pose estimation for augmented reality	Image Feature Tracking	SE
	Marker Tracking	SE
Simulation of environmental lighting condition for virtual objects	Reflection Mapping	SE
3D-scene rendering on the web	Advanced-User Interface	GE

Performance requirements	
Type	*Requirements*
Hardware	Recent handheld device with powerful processor, good camera, GPS, gyroscopes and accelerometers.
Software	Fast, local pose estimation using • markers at 50 Hz • image features at 50 Hz • Real-time many-light (with environment map) rendering of virtual objects. • Fast (20 Hz) rendering of 3D scenes on the web
Miscellaneous	**Network**: A minimum bandwidth of 1MBps **Scalability**: powerful server to cope with dozens of users.



2.1.3 - Virtual Character Synchronization on the Web(Spider Demo)



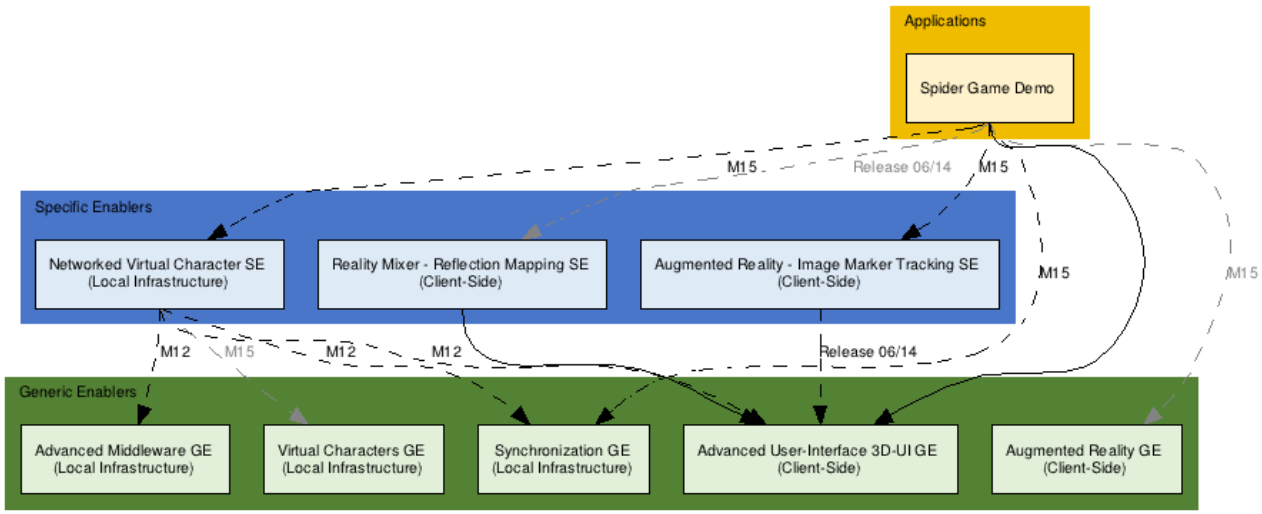
Virtual Character Synchronization on the Web (Spider Demo)	
Category/topic/context	Tier 1 – Digital Consumer Products
Owner(s)/contacts	Stefan Lemme (DFKI), Kenny Mitchell (BLKR)
Abstract	In this scenario a picture on a table or ground is augmented with a virtual simulated spider character crawling on it. Multiple players, each having a unique view of the game through their handheld devices, share the state of the spider. The scenario 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.
Detailed description	This scenario is part of tier 1, which targets augmented-reality games based on toys, fashion, and other physical products. It shows a virtual animated spider character synchronized between multiple client devices on the web. The scenario showcases a synchronization mechanism based on a network communication capability, which allows efficient updates on the web. Therefore, the scenario takes advantage of the Efficient Middleware GE, which handles and hides all the network functionality from the game developer. Moreover, it utilizes an AR tracking enabler to estimate the camera pose of the mobile device in relation to the physical objects used as marker. The actual rendering of the augmented scene is done by XML3D together with Xflow using the Advanced-User Interface GE.

Virtual Character Synchronization on the Web (Spider Demo)		
Justification for inclusion of scenario	Audience/cultural criteria	The usual serialize/transfer/deserialize method to propagate updates within a game setting is a difficult task for game developers. An easy-to-use synchronization mechanism for overcoming this approach is interesting for inexperienced game developers. Together with state-of-the-art efficiency this might become relevant for professional game developers as well.
	Commercial criteria	Almost all multiplayer games rely on an approach similar to the described one. For these, an out-of-the box solution provides interoperability on different platforms and maybe with existing games.
	Academic criteria	An abstraction layer across different platforms and architectures providing an easy-to-use and common interface while preserving a maximum of efficiency is a challenging task and subject of current research.

Planned experimentation		
	Experimentation site(s)	n/a
	Estimated schedule	*Ready as showcase in Nov. 2013*
	Maturity of implementation	*First Prototype*
	Content, provider, availability	Content will be provided by DFKI and BLRK. Bi-lateral study/demonstration not for test-site study.

Functional requirements and their candidate enablers		
Functional requirement	*Candidate enabler*	*GE/SE/Gap*
Camera pose estimation for augmented reality	Augmented Reality - Image Feature Tracking	SE
	Augmented Reality - Marker Tracking	SE
Simulation of environmental lighting condition for virtual objects	Reality Mixer - Reflection Mapping	SE
3D-scene rendering on the web	Advanced-User Interface	GE

Performance requirements	
Type	*Requirements*
Hardware	Recent handheld device with powerful processor, good camera, GPS, gyroscopes and accelerometers.
Software	Requirements for rendering using XML3D Fast, local pose estimation using • markers at 50Hz • image features at 50Hz • Real-time many-light (with environment map) rendering of virtual objects. • Fast (20 Hz) rendering of 3D scenes on the web • Requirements for physical simulation of spider
Miscellaneous	**Network**: A minimum bandwidth of 1 MBps for synchronization of client devices **Scalability**: A powerful server would be required to handle physical simulation as well as dozens of users.



2.2 - Tier 2 – Location Based Experiences

2.2.1 - Attractions Driving Content Sharing

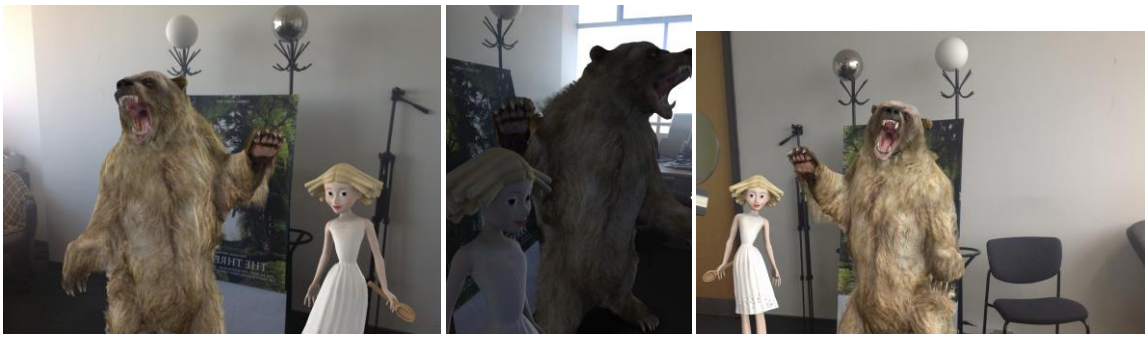
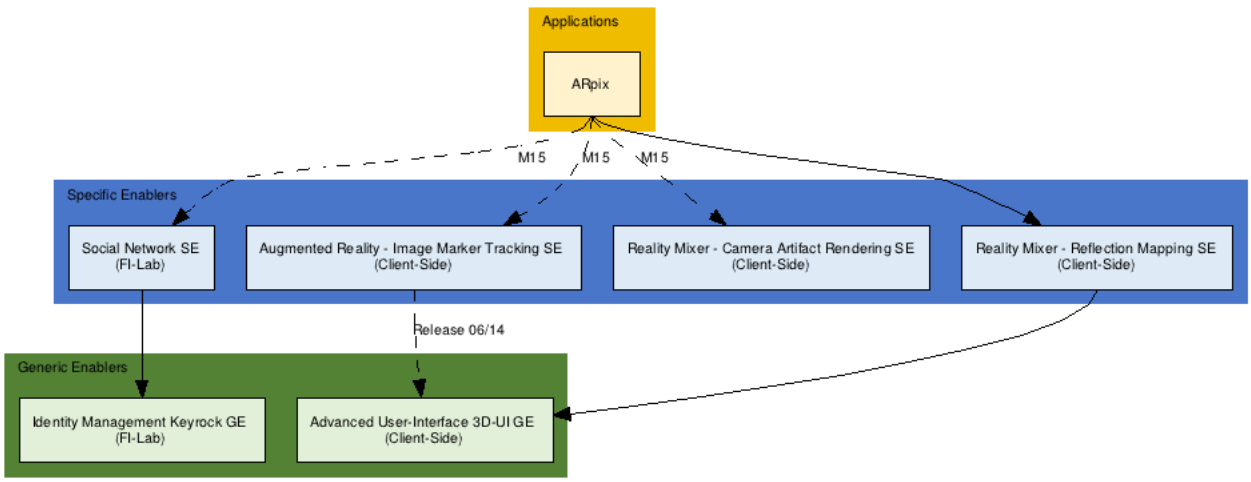


Figure 1 ARpix, Reality Mixer cinema attraction study.

Attractions Driving Content Sharing – (ARpix)		
Category/topic/context	Tier 2: Location-based Games	
Owner(s)/contacts	Kenny Mitchell, Marcel Lancelle	
Abstract	ARpix application scenario augments photos taken on a mobile device with virtual characters so that they look realistically part of the real-world and may be shared with friends on social networking sites.	
Detailed description	A commercial quality application delivered on Android and iOS to coincide with a film release. The app allows fans to line-up and take pictures of the film's marketing billboards located in cinema foyers, and then integrates the film star, digitally augmented into the real photo. The photos are aligned using real-time augmented reality tracking and reality-mixer techniques. When the camera button is clicked, a full resolution photo is rendered to yield the highest quality image as a memorable keepsake for guests.	
Justification for inclusion of scenario	Audience/cultural criteria	Tying into media release schedules and contemporary stories & films, this scenario is intended for broad appeal.
	Commercial criteria	Sharing content associated with billboard/poster/standee content to provide an online viral marketing route associated with media/product advertising and conversion to in app purchases.
	Academic criteria	Realistic character rendering in augmented reality is a new level of context aware content on the future internet.
Planned experimentation		
	Experimentation site(s)	Zurich
	Estimated schedule	Demonstration April'13 Internal User Study April'13
	Maturity of implementation	Production Ready
	Content, provider, availability	Provided by BLRK. Installation platform demonstration and bi-lateral study not for source distribution.

Functional requirements and their candidate enablers		
Functional requirement	*Candidate enabler*	*GE/SE/Gap*
Realistic augmented reality virtual character appearance	Reality Mixer – Camera Artifact Rendering	SE
	Reality Mixer – Reflection Mapping	SE
Poster image tracking	Augmented Reality – Image Marker Tracking	SE
Social network sharing	Social Network	GE

Performance requirements	
Type	*Requirements*
Hardware	Recent handheld device with powerful processor, good camera, GPS, gyroscopes and accelerometers.
Software	For a satisfactory user experience, the tracking and rendering frame rates should be at least 15 Hz.
Miscellaneous	**Scalability**: It is preferable to have models with low numbers of polygons, to keep the seamlessness of the AR component.



2.2.2 - Immersive Control Systems

Immersive Control Systems (Dragon Flight)		
Category/topic/context	Tier 2: Location-based Games	
Owner(s)/contacts	Chino Noris, Kenny Mitchell	
Abstract	In this scenario, we consider an installation of the size of a small room, where one or more users interact with a game application. The user is standing in the middle of the room and his body posture is tracked. Anybody motion is transmitted to a virtual character, like a dragon, which is displayed on a screen, projected on the wall, or displayed via a head-mounted display that the user is wearing. The user controls the character to complete certain tasks.	
Detailed description	Motion tracking has been introduced to the masses via new devices such Nintendo Wiimote, Playstation Move, and XBox kinect. These devices offer the developers a simple way to capture the motion of different part of the body. On top of that, products such as the Oculus Rift and Google Glass are pushing head-mounted display technology for virtual and augmented reality. This technology can be used to create an immersive control system, where the user can impersonate a fantasy creature, like a dragon, and use his or her body to control the creature in a natural way. To achieve this, one has to solve the problem of mapping the motion of a human body to the body of the target character, whose topology may be different. We envision a simple mapping where specific body parts are mapped in a one-to-one fashion. For instance, in case of a dragon, the motion of the arms could be mapped to the wings, so that the user could easily control the speed and range of the wing waving.	
Justification for inclusion of scenario	Audience/cultural criteria	The primary audience for such an application is children. It is a common thing to see a child using his arms as wings, mimicking a plane or a bird. For an adult audience, the control system has to be deep enough so that mastery is possible. This involves adapting the difficulty of the task at hand so that there is actually a challenge involved to push for the user to learn how to beat it.
	Commercial criteria	In the console market, the push for interactive motion tracking devices has happened and is being pushed even

		further with the next console generation.
	Academic criteria	This use case is a simple example of HCI problem and, if generalized, deals with the problems of mapping different body topologies and of creating a control system that can be used efficiently by the users.

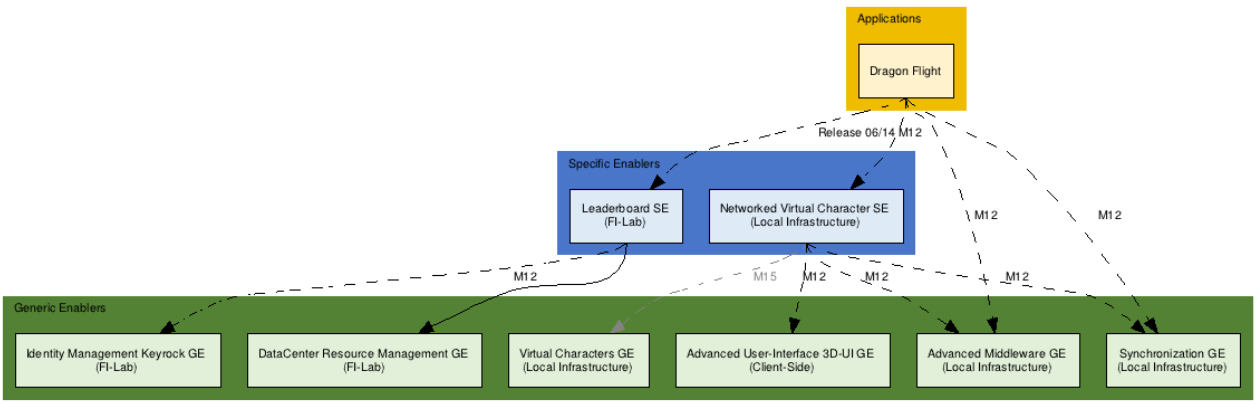
Planned experimentation		
	Experimentation site(s)	Zurich
	Estimated schedule	*During November-December 2013*
	Maturity of implementation	*Pending Prototype*
	Content, provider, availability	*The content will be provided by BLRK, DRZ, ETHZ.*

Functional requirements and their candidate enablers		
Functional requirement	*Candidate enabler*	*GE/SE/Gap*
Realistic augmented physics	Reality Mixer – Simulation Continuum	SE
Realistic augmented audio	Reality Mixer – Augmented Audio	SE
Body movement context awareness. Existing commercial solution by Zingfu (http://zigfu.com/en/zdk/unity3d/)	Augmented Reality – Skeletal Tracking	Gap
Player competition	Leaderboard	SE

Performance requirements	
Type	*Requirements*
Hardware	A few cameras will be required for image acquisition of the interaction gestures. The displays need to be large and high enough resolution for effective AR.

Software	• Total max latency budget: 15Hz
	  ○ tracking: 50 Hz
	  ○ motion mapping: 30Hz
	  ○ rendering: 30 Hz

Miscellaneous	



2.3 - Tier 3 – City-Wide Gaming

2.3.1 - Adjacent Player Discovery

Adjacent Player Discovery (Agent vs Agent)		
Category/topic/context	Tier 3: City-Wide Games	
Owner(s)/contacts	Jim Callin, Chino Noris	
Abstract	The third tier targets city-wide games in which larger numbers of players interact in unstructured environments. GPS is used to direct players to point of interest. AR Tracking is used to find particular objects and elements and recognize them with a smart phone. The game logic involves writing and reading hidden messages that only appear when the phone recognizes the appropriate image. Two factions play against each other.	
Detailed description	Testing will take place in Zurich, and possibly Barcelona and Cologne. The game should be constructed so that it can be played in different cities, i.e. the game-play should treat POIs independently of their actual historical context. All devices are connected to a server, and can query for the relevant data based on their GPS location. The data will consist of the images for AR tracking that the players have to find, as well as the actual game content (messages, audiovisual content, etc.). Locally, the smart phone will use the camera and try to match the video content with one of the images received. When a match is found, the AR data is displayed, revealing the virtual content to the players who can then decide on their next move. The user can then decide to destroy the message or replace it with an answer. The smart phone will communicate to the server the alteration. This use of GPS and AR Image tracking supports different gameplay elements, such as scavenger/treasure hunt, and agent-to-agent message exchange.	
Justification for inclusion of scenario	Audience/cultural criteria	The target audience includes teenagers and young adults with a passion for outdoor activities, team games, and exploration. The game involves exploring the city, possibly in a time-critical manner (to beat the opposing team), so fit individuals may find it more appropriate. The game can be adapted for less physical exercise by making riddles more complicated, making the difficulty of solving a puzzle outweigh the need for fast travelling between POIs.
	Commercial criteria	The game gives an incentive for people to explore specific POIs. A city or region may benefit by attracting more visitors through the popularity of the game. POIs may present users with real world and virtual world advertisement.
	Academic criteria	This scenario may combine with other enablers to enable novel interaction designs.

Planned experimentation		
	Experimentation site(s)	Zurich, Barcelona, Cologne
	Estimated schedule	*August 2014*
	Maturity of implementation	*Pending Prototype*
	Content, provider, availability	Content will be provided by DRZ, ETHZ, and GOBO

Functional requirements and their candidate enablers		
Functional requirement	*Candidate enabler*	*GE/SE/Gap*
To find players and POI in geographically similar locations in a unified manner	Spatial Matchmaking	SE
IoT Thing Discovery	Configuration Management	GE
Synthesize complex events based on simple events and logic	Complex Event Processing	GE
User Authentication	User Management	GE
Via spatial matchmaking find players	Point of Interest	GE

Performance requirements	
Type	*Requirements*
Hardware	Handheld device with the following specs: • High resolution cam for accurate tracking • Enough processing power for tracking and rendering • GPS capability and inertial sensors (accelerometer)

Software	• Total max latency budget: 20 Hz
	  ○ IoT thing discovery updates at 50Hz
	  ○ Rendering at 15 Hz
	• Event handler that can cope with hundreds of events per second on the client.

Miscellaneous	Server requirements • Enough processing power to handle hundreds of players • Event handler on server must deal with thousands of messaging events per sec.

2.3.2 - Augmented Reality in the Wild

Figure 2 Skye Wars, the first FI-PPP application to be released on the iTunes Store.

Augmented Reality in the Wild (Skye Wars)		
Category/topic/context	Tier 3: City-Wide Games	
Owner(s)/contacts	Kenny Mitchell, Chino Noris	
Abstract	Skye Wars merges an advanced markerless tracking system with augmented reality launched to enhance the SKYE experience at SIGGRAPH 2013 Computer Animation Festival. Point your camera at the moon (or any other single colored object) and witness an epic battle to defend the humanity!!! Shoot the enemy star ships with the Skye laser and see who can get the highest score. But watch out for friendly fire! The ability to track objects anywhere in the wild or around a cityscape is illustrated by this scenario.	
Detailed description	The Skye Wars scenario shown at the 2013 SIGGRAPH conference – the premier international event on computer graphics and interactive techniques is the first app developed on the FIcontent pervasive games platform. Skye Wars combines the elegant and energy efficient flight of a blimp with the precise handling characteristics of a quadcopter. Internal LEDs are used for the creation of aerial visual effects and provide a color target for the first demonstration of the Augmented Reality - Fast Feature Tracking enabler. In order to fully enjoy robots and graphics meeting in mid-air, the conference attendees downloaded the Skye Wars app. Thanks to the SIGGRAPH presence and audience interest, the iTunes page of the app has become really popular: the Augmented Reality app has reached 2000 downloads. A great goal for the first FI-PPP app released on iTunes.	
Justification for inclusion of scenario	Audience/cultural criteria	The target audience for the Anahiem (California) event was the most- respected technical and creative people from all over the world gathered for SIGGRAPH premier graphics conference.
	Commercial criteria	The specific aerial robot tracking application represents a new business model for large scale gatherings and events. The markerless tracking ability of the Augmented Reality - Fast Feature Tracking enabler battle tested in public large scale event is applicable to the widest range of general purpose tracking scenarios with broad commercial applicability.
	Academic criteria	The blob tracking method developed for this scenario uses a GPU reduction method for fast localisation of the centre of a tracked colored region. This combined with a moment of integral analysis of the camera image may be novel and the basis for further novel tracking algorithms.

Planned experimentation		
	Experimentation site(s)	Anaheim, CA
	Estimated schedule	*Deployment July'13 Study July'13 Source Release Sept'13*
	Maturity of implementation	*Deployed*
	Content, provider, availability	Provided by BLRK, DRZ, ETH. Released on App Store (http://bit.ly/SkyeAR), pending Unity Asset Store

Functional requirements and their candidate enablers		
Functional requirement	*Candidate enabler*	*GE/SE/Gap*
Tracking of objects defined by their color in contrast to the background	Reality Mixer - Fast Feature Tracking	SE

Performance requirements	
Type	*Requirements*
Hardware	Recent handheld device with powerful processor, good camera, GPS, gyroscopes and accelerometers. In addition, for one location with around 50 active users we estimate to use one powerful server to compute the physics simulation. A robot that can navigate through space, with an embedded light source to enable tracking.
Software	For a satisfactory user experience, the tracking and rendering frame rates should be at least 20 Hz. The software should also support interactive rendering of models with thousands of polygons.
Miscellaneous	A physical particle simulator that can cope with the computation for thousands of particles is required on the client.

2.3.3 - Augmented Reality Physics Games Downtown

Augmented Reality Physics Games Downtown (Augmented Marble Run)		
Category/topic/context	Tier 3: City-Wide Games	
Owner(s)/contacts	Marcel Lancelle, Chino Noris	
Abstract	Each player can select one volume of space in a street in the pedestrian zone. The start and end points for a marble are fixed on the boundary. The player will combine virtual 3D models of components in a creative way to get the marble across the own volume. These marble runs of all players are linked and can be viewed and tested by inserting virtual marbles at any start position.	
Detailed description	This scenario is a tier 3 game that will demonstrate new ways of Augmented Reality games. Using the combination of GPS and image based localization, the mobile device location and orientation is known with a good accuracy. This will likely work best in a pedestrian zone street. A park or forest will probably not work very well due to the properties of the vision-based tracking. We will prepare at least one location in a Zurich pedestrian zone for this type of tracking. Eventually, the system should learn by itself and extend this region. The envisioned game play enables users to place virtual content to a location so that other users can also see them. In this setup, the game is collaborative and requires many users to increase the length of the marble run. Instead of a marble, a domino run and other physically moving prebuilt components can be used. A challenge is the physically-based simulation of the run. Players should be able to insert marbles at any of the start points. This simulation might be too time-consuming for a mobile device. Instead, this simulation could run on a server and the simulation results can be streamed with a small constant delay to the mobile devices. In case of the marble run, only the trajectory of the marbles and triggers of some sound effects need to be sent. The requirements for this scenario are very similar to other ideas such as virtual graffiti or other location-based arts projects.	
Justification for inclusion of scenario	Audience/cultural criteria	Children as well as adults with access to a smart phone are likely to enjoy this sort of game. With a limited number of patches there might be a motivation to be quick to 'own' a prominent location or one that has a special meaning to the player or is e.g. on the way to work. Once the creation is finished, the player can guide friends and show his achievement.
	Commercial criteria	Similar games might be interesting for advertisement for specific locations.
	Academic criteria	Physical interaction on a city-wide scale is novel and serves as an example for further research.
Planned experimentation		
	Experimentation site(s)	Zurich
	Estimated schedule	Deployment July'14 Study July'14 Source Release Sept'14
	Maturity of implementation	Concept
	Content, provider, availability	Content will be provided by ETHZ and DRZ

Functional requirements and their candidate enablers		
Functional requirement	*Candidate enabler*	*GE/SE/Gap*
Coarse grained location of area of interest	Point of Interest	GE
Realistic augmented reality content	Reality Mixer – Camera Artifact Rendering	SE
Markerless tracking city-wide	Augmented Reality – SLAM	Gap
Player competition	Leaderboard	SE

Performance requirements	
Type	*Requirements*
Hardware	Recent handheld device with powerful processor, good camera, GPS, gyroscopes and accelerometers. In addition, for one location with around 50 active users we estimate to use one powerful server to compute the physics simulation.
Software	For a satisfactory user experience, the tracking and rendering frame rates should be at least 15 Hz. For a physics simulation, time steps must be short but the rate must also be at least 15 Hz.
Miscellaneous	**Network**: There should be a low network latency to quickly transfer the state of the physical simulation to the mobile devices. **Scalability**: We expect to have at most a few dozen active users per site and plan to use physics that are simple enough to achieve this. The results can potentially be streamed to many more observers.

3 - CONTENT SOURCES

Not applicable.

4 - CONCLUSION

This document gives a first vision of the “Pervasive Game Platform”; it will now evolve over the following months according to feedback from end-users, PMEs and developers.

end of the document