



**Integrated Project on Interaction and Presence
in Urban Environments**

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**Final Demonstrator of City Tales II application
“Second City”**

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Abstract

This document describes the research of the WP9 CityTales II showcase of IPCity for the period 4 of the research project. CityTales concentrates on providing mixed reality experiences with an emphasis on a story-telling and user participation available to a wide range of user groups in an urban context. The aim of the showcase is to create a homogeneous, self-governing mixed reality platform accessible to all city inhabitants as well as to visitors.

Finalizing the year 3 objectives to create a stable platform for prototyping and evaluating the story-telling approach using MR technology the server/client based infrastructure of the Second City System was refined and extended to support multiple access strategies. Further media types that have been proven crucial and multiple-platform support was integrated.

In year four of IPCity research CityTales applied the concepts to different use scenarios, investigated and analysed user acceptance in form of field-trials and summarised the results in form of design guidelines providing a starting point for further investigators of the field of mixed reality story-telling.

Given the fact that the current period finalizes, the research activities within the scope of IPCity we were onward looking to find opportunities to disseminate results reached both in the academic as well as in the commercial world at the end of the project.

Intended Audience

This document is intended to all partners of the project, the EC and to the reviewers of the fourth project phase.

1 Work-package objectives

<p>Objectives Final Phase</p>	<p>Objectives of the final phase of WP 9 were to create and evaluate the combination of the diverse, singular prototype applications of the previous period.</p> <p>To answer the research questions and formulate design guidelines the further major objective in this period was to create detailed use scenarios, field test and evaluate them and as the summary of all activities to disseminate results.</p>
<p>Results Final Phase</p>	<p>During final phase of the research project we accomplished following results:</p> <ul style="list-style-type: none"> • Compared early prototypes and merged functionality based on findings. • Refined both database features and integration with clients, created a flexible and scalable architecture to support different applications. • Conducted participatory workshop to create innovative use scenarios of the system. • Invited professional authors to participate to try mixed reality story-telling as a new form of creative media. • In a participatory workshop extended stories to prove the feasibility of community based content creation. • Evaluated stories in two field trials. • Summarized findings in form of design guidelines. • Organized participatory workshops on the future use of mixed reality story-telling technology.
<p>Evaluation Final Phase</p>	<p>Our evaluation results suggest that mixed reality story in an urban environment must broaden the sense of the used media-types, when perceived using available technology.</p> <p>Research findings show that user experience fulfills hypotheses partially, some practical issues in the urban context may however deliver contradictory results. Especially these findings can give interesting starting points to future developers of MR story-telling applications.</p> <p>At the end of the project we prepared the Second City client/server architecture to serve as a prototyping basis to a phenomenon that is developing to become a new form of communicating stories in a multi-participant scenario with the use of technology. We are convinced that in future academic and commercial deployments our technology can support the many types of use scenarios to come.</p>

2 Overview

2.1 Introduction to our research field

Mixed Reality (MR) refers to imaging technologies that seamlessly integrate the real and virtual worlds in real time. IPCity develops MR technology for practical outdoor use in urban environments, moving the technology out from the labs. In our application work package we drive infrastructure development with specific research questions. Using prototype applications that are field tested, observed, analyzed and evaluated with a number of users key findings are formulated as conclusion.

The City Tales II work package (WP9) is investigating the process to establish a digital layer over the city that contains a story-telling environment integrating participant contributions. The power of a community driven content creation approach has been shown in many other applications available in our information society, such as encyclopaedia¹, social networking portals² and geo-information³. Our aim is to focus this power on the creation of content into the mixed reality layer of an urban environment, supported with easy to use yet powerful tools for content creation.

As part of our work we developed a set of applications to play back mixed reality content on commercially available mobile devices (e.g. smart-phones) to support a large user basis, to perceive location based content on-site when strolling through an urban environment.

2.2 Technical basis for MR Story-telling

We understand our Second City server/client architecture as a complete story-telling environment needed to implement the complete procedure of content creation, management/deployment and playback. This translates into following summary (Table 1):

Architecture Element	Content Creation	Management/ Deployment	Mobile Playback
Application	Customized web-based Flash Interface, Google Earth, E-Mail Gateway, Mobile Data Entry	Second City Server with web-based management interface	MR-Player client; Other research clients such as MapLens, Panorama viewer, AndroidAR client
Features	Locations-based story creation with mixed reality elements; Based on industry standards and HTTP interface further extending list of compatible applications	Flexible database concept indexing content by geo-location and fiducial referencing creating a local/global aspect to MR-data; Data once entered is provided in different data export formats for dynamic adaption	Location aware networked mobile client with hybrid tracking (GPS and visual local reference) allow retrieval of massive data amount in a wide area with context based levels of precision for placement

¹ Wikipedia – The Free Encyclopaedia [www.wikipedia.org] – accessed last 19.12.2008

² e.g. Facebook [www.facebook.com] – not freely accessible;
MySpace [www.myspace.com] – accessed last 19.12.2008

³ Google Earth Community [http://mw2.google.com/mw-earth-vector/db/gallery_layers/network_links/google_earth_community/google_earth_community_en.kml] – accessed last 19.12.2008

Platform	Desktop based (Window, MacOS) Mobile (currently Windows Mobile, Symbian S60 3 rd edition, Android)	SuSE Linux R11, management interface arbitrary	Windows Mobile, Symbian S60 3 rd edition
Development Stage	Solid prototype and industrial proof	Solid prototype in multiple installations now	Working prototype, additional media types platform dependent
Dissemination	Most components of this part of the content pipeline are industry standard, the specialized Flash client can be part of the server installation	Second City server technology has been successfully deployed to other installations among scientific partners, commercial application is in progress	MR-Player and variants of it are in commercial exploitation as standalone applications or with more simple server infrastructure

Table 1: The technical basis for MR story-telling along the content pipeline

2.3 Application Scenarios for MR Story-telling

During the phase III of the project in the previous year we have discovered, that story-telling in an urban environment is neither a linear transcript or a film-like narrative with a red-line, nor it is a completely single user phenomenon. Especially with the added context of an unfinished, user-created, in theory ever-extensible environment the domain of MR story-telling resembles characteristics of on-line social community based gaming, communication and collaboration environments.

2.3.1 Technology Vision

To investigate this and analyse possibilities going beyond our ideas in mixed reality we organized a technology vision workshop for students of urban planning to brainstorm ideas together how an inherently 'digitised city' would benefit from the idea of story-telling and what future technology could be useful to establish this. The results of this are show in chapter 5.1.

2.3.2 Story-telling with Gaming Background

In a following workshop we decided to go one step further than drafting the vision only. After an intense process to create ideas we selected two concepts that then were detailed further. In the following days these ideas were implemented on the basis of the Second City technology with extensions and modifications where necessary. To investigate the different scenarios various data was collected in the follow-up field trials and evaluated. Details on this are summarized in section 5.

2.3.3 Authored Story-telling

Perceiving stories while on the go creates a rather new context for story-telling. The closest to this situation would be listening to a podcast or an audio-book while on the move. As we know from previous studies that a drivers attention is largely captured by various sources of distraction (e.g. mobile phone calls, audio sources, eating, small-talk) we assume that perceiving a mixed reality story in urban environments also creates a similar distraction.

The first stage of the envisioned process originally in mind included users first creating single elements of information that are spread over an area in a digital layer stretching on top of an

urban environment. In a follow-up procedure these singular information elements are woven into a net of stories that interconnect places, time and information realms that otherwise would be disconnected.

To accelerate these steps for the research project and to create a basis for field trials on the scenario of non-linear stories we invited a number of professional authors during summer 2009. They created – on the basis of the environment, shared assumptions, assumed available additional commonly shared information – independent stories that span across our target investigation region the Naschmarkt (see D9.3). The stories created in multiple steps are entirely different in their own way. Ranging from mystery to love they share both the place of action of Naschmarkt and also some of the characters. In a real co-located environment this happens naturally, people of different background do meet and interact with each other when in the same urban neighbourhood. The results of the examination of user behaviour in this environment are summarized in section 5.3.

2.3.4 Participative Story-telling

A further workshop organized during the IPCity Summer School in September 2009 yielded one of the most promising key findings of the WP9 work-package. When confronted with existing stories spread in elements over the Naschmarkt area, participants of the workshop came up unexpectedly with the idea: instead of just investigating the existing stories to create a new story in a community approach. The new story should not conflict with existing ones, rather – as in our originally planned scenario – use existing elements, either standalone or interconnected as part of already existing stories and create a narrative on it's own. On the one hand the initiative of the students to introduce a new story, on the other to show a lot of motivation to actually create and implement the story elements, were the best justification of the previously speculated community based aspect of such a story-telling environment. Follow chapter 5.4 on details of these studies.

2.4 Research Questions

In response to reviewer comments of the review on period III of the project in the final round of evaluation the four showcases focused on three overall research questions:

1. Which **design features** of Outdoor Urban Mixed Reality are essential in supporting participants in engaging in novel ways with the city?
2. What is the potential of the concept of **presence** in analyzing participant experience?
3. What do we learn from this analysis for the design of MR applications, interfaces, as well as for how to enable participant experience?

Summarizing the investigations the CityTales II showcase in the final year of the project the work package objectives were simplified compared to the originally set ambitious goals to allow better focus. In accordance with the common research questions we are focusing on answering:

1. What are the key design features of a mobile phone based story-telling user experience, with regard to the content mix and amount?
2. How tight are and should be mixed reality stories integrated with the urban environment? Are they easy to transport and relocate?
3. Can we show that the individual experience of mobile mixed reality can create communities or is it a solely private and particularized experience?

3 Related Work



Figure 1: Related projects – Urban Tapestries, Mobile Bristol, mscape, IPerg, Sonic City

Several projects (Figure 1) investigate the possibility contained in the possibility of nowadays emerging technology to interlink locations with information. Global Positioning System (GPS) provides for most approaches the basis to locate the user's "playback device" on global scale and to provide information from a database related to this location. Games, experiences, narratives are provided and many of the below detailed systems also try to involve the community to introduce the content themselves. Lack of standards, diverse "playback technologies", technical pitfalls, non oriented user base however let's most of the existing systems stay in a beta-phase. Also none of the investigated systems is using the power of 3D display to create a compelling mixed reality experience.

Urban Tapestries⁴ investigated the social and cultural uses and behaviors to annotate a city; Hewlett Packard runs the project mscape⁵ as a continuation of Mobile Bristol dating back to 2002 to allow participants to create games, guides, stories triggered by GPS location – currently containing about 300 "mediascapes". MIT's M-Views⁶ is a context sensitive mobile cinematic narrative system that enhances real world with video clips based on WiFi triggering. MIT's Museum Without Walls Project⁷ puts history and science in the user's hand and turns the world into a museum by adding location based information and stories to historic relevant places. The project is currently on hold due to funding issues. IPerg⁸ investigated crossmedia games as a special form of pervasive gaming using different platforms as diverse as smartphones, TV-sets, notebooks and augmented reality rigs.

A relatively new system is bliin YourLIVE!⁹ which is dedicated to creating a fluid social network for sharing personal experiences - photos, videos, sound & text - in real-time, located on a world map and focuses since 2007 directly as a Web 2.0 application on a young community with currently about 23.000 "shares". GPS Mission¹⁰ is a GPS game for mobile phones where the community can create missions and riddles to other members. The last two systems are purely commercial, however all services are free so the business model behind is not obviously visible currently.

⁴ <http://research.urbantapestries.net/> – accessed last 19.12.2008

⁵ <http://www.mscape.com/> – accessed last 19.12.2008

⁶ Crow, D., Pan, P., Kam, L., Davenport, G., M-views: A system for location based storytelling, Proceedings of Ubiquitous Computing (UbiComp), Seattle, Washington, October 12-15, 2003, pp 31-34.; more information available at <http://ic.media.mit.edu/projects/M-Views/>

⁷ <http://museum.mit.edu/mwow> – accessed last 19.12.2008

⁸ <http://www.pervasive-gaming.org/> - accessed last 12.11.2009

⁹ <http://www.bliin.com/> – accessed last 19.12.2008

¹⁰ <http://gpsmission.com/> – accessed last 19.12.2008

A special class of more content focused applications can be defined, such as Sonic City¹¹ which generates a personal soundscape co-produced by physical movement, local activity, and urban ambiance. Sony's Street Beat followed a similar approach to enhance the audio environment in a city. Landvermesser.tv¹² – a new Berlin art project creates fiction literature stories on real places in the city, written by 10 participating professional writers. The stories can be perceived as a combination of audio stories and video clips played on city embedded displays or on-line.

Combining existing resources and location based information in a mixed reality environment is demoed by the WikiTude¹³ project that allows users of the new Android G1 phone to overlay the camera image of the user's environment with Wikipedia entries related to the actual location of the user with a definable range. Available geo-located Wikipedia entries (around 350.000 worldwide) are represented with balloons of information over the real buildings or points of interest. Selection enables to read the attached Wikipedia entry on-line.

A similar concept lies beyond the recently launched concept of Layar, that acts as a community edited overlay concept, similar in display and visualization to that of Wikitude. The reason we see that Layar gained more popularity in recent months is that it was a community based approach to create the overlays from the start, contrary to the "web 1.0"-type one source vs. many users concept behind Wikitude. Wikitude also added recently wikitude.me as an extension to publish user content.

Based on both technologies in 2009 a huge range of spin-off platforms have surfaced cramming the visual environment with more and more information on the user's video overlay (e.g. Twitter messages, currently shopped items, etc.). By popular demand the technologies to filter this data get more and more sophisticated to make these types of applications more useful. In 2010 Google entered the world of visual analysis based information overlay and provides geo-referenced search results as part of the Google Goggles¹⁴ application.

So far - to our knowledge - no other main application or community platform that goes beyond the idea of providing disconnected information spots has been rolled out in the past year. Some gaming ideas – like Sony's Inzimals – tackle the idea of a common story behind the AR game, but here the story-line is an introduction to justify for the gaming idea. A new project that started in 2009 is run at the University of Wisconsin's Games, Learning and Society research group. ARIS – Augmented Reality and Interactive Storytelling – is an exploratory project into the possible role mobile media may play in learning.

Alongside from above detailed solutions an interesting approach is to omit the necessity of a continuous tracking throughout the story-telling domain by not relying in GPS or similar approaches, but by using discrete points of identification or tracking, e.g. 2D-markers. The method of "mobile tagging" becomes widely popular as the link between the real world and the digital content is achieved with a simple to create 2D barcode marker that is placed at an exactly defined location. As one example of the many-many we point to the Active Print¹⁵ project which is exploring how printed materials and digital displays can be linked to online content, services and applications in all kinds of urban/suburban/rural situations. Participating on this success Google offers small shop owners a possibility to "tag" their shops using Google provided QR-code tags and thus become a part of a growing community of businesses to be interlinked with this feature, called Google Favourite Place¹⁶.

¹¹ <http://www.tii.se/reform/projects/pps/soniccity/index.html> – accessed last 19.12.2008

¹² <http://landvermesser.tv/> – accessed last 19.12.2008

¹³ <http://www.wikitude.org/> and <http://www.youtube.com/watch?v=8EA8xlicmT8> – accessed last 19.12.2008

¹⁴ <http://www.google.com/mobile/goggles/> - accessed last 21.01.2010

¹⁵ <http://www.activeprint.org/> – accessed last 19.12.2008

¹⁶ <http://www.google.com/help/maps/favoriteplaces/gallery/index.html> – accessed last 21.01.2010

4 Technology Background

Finalizing the year 3 objectives to create a stable platform for prototyping and evaluating the story-telling approach using MR technology the server/client based infrastructure of the Second City System was refined and extended to support multiple access strategies, further media types that have been proven crucial and multiple-platform support. Figure 2 shows the revised and extended system architecture:

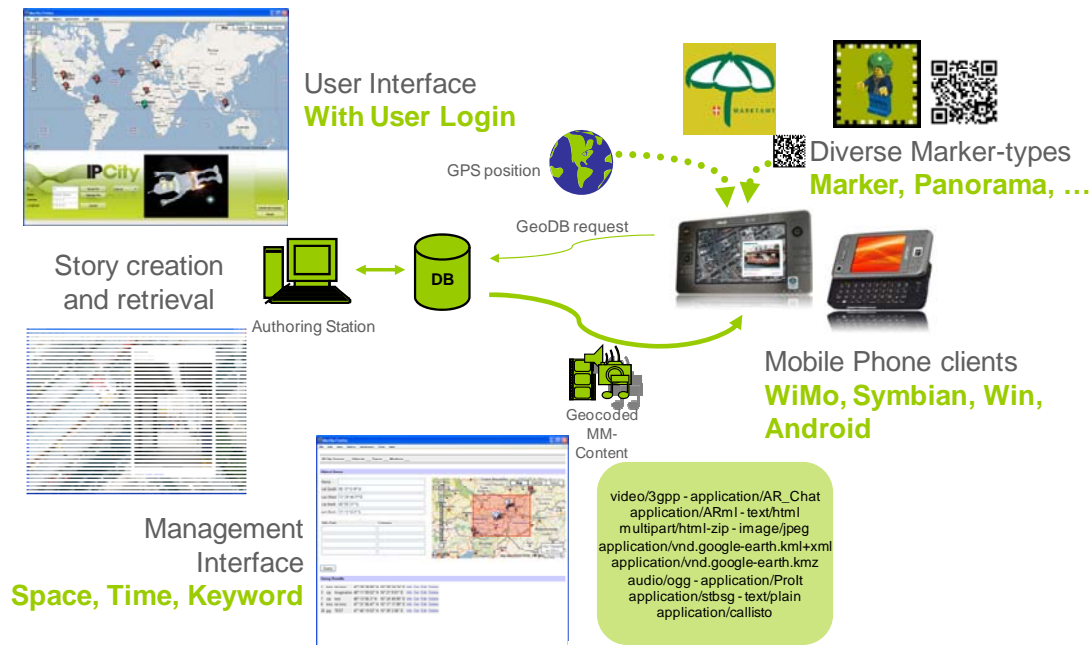


Figure 2: Revised system architecture of the Second City System in year 4 of IPCity

4.1 Second City Database

At the beginning of year 3 the WP9 team investigated the use of the existing HMDB to store media elements for our City Tales approach. The hierarchical structure of the HMDB puts the hierarchy of the media elements into the foreground and by meta-information added we would have had the possibility to add certain functionality to it.

On the progress in the design, user management, geo-location as a key index and time based queries were of major importance. The largest step towards a new database was however our internal decision to use KML as the major communication protocol to both export AND import data into the database. One of the reasons was to keep compatibility with industry standard clients such as Google Earth and others. These allow to browse all data contained in the Second City DB, but also to provide simple content creation tools in the same application to submit new elements.

We have developed and installed a new database that is also running as service to all IPCity partners. We installed a dedicated server that holds all types of (mime-typed) data files that are stored in geo-coded indices. The server does validation of uploaded (KML or any type of XML) files against freely definable schemas. Upload and download is running using standard HTTP protocol to ease integration and provide access with a wide number of clients.

The core feature of Second City Database is the capability to re-render content stored once in multiple, different, client conformant types allowing the most diverse connections to the database such as a simple web-browser, an Adobe Flash-based client, an email gateway, Google Maps Mobile, Google Earth, MRPlayer and a number of other specialized clients. The potential lies in the flexibility to extend beyond the project to upcoming new data formats and clients with using industry standard APIs.

The database relies on MySQL 5.0.51.a and Apache TomCat 5.5 technology running on a SuSE Linux 11 server. Any mime-typed data file and packaged archive is stored within the database using multiple indices, such as geo-location, validity time period, references to arbitrary fiducial marker or natural feature tracking target, keywords etc. Data access uses fully conformant HTTP protocol requests to ease integration with a wide number of clients.

Among the features are XML schema validation; automated data decompression; content indexing and tag extraction; user-, marker-, and keywords management; on-the-fly marker generation and database manipulation and extension using a web-based interface.

The dedicated server is on a public reachable IP in the internet, so any IPCity partner is invited to use the service then. We see also a chance that content of other IPCity prototype applications and demonstrators is stored in our database compared to the current situation of storing them in several dislocated and separated databases. Our idea was to demonstrate the possibility of combing different work packages also on the content level in order to provide a common view on data.

Testing and Public Demonstration

Multiple testing scenarios have been carried out during YR4 of the project to test and demonstrate the system. In workshops organized by the UniAK and IMAG the technologies have been tested at Naschmarkt in scenarios where participants were invited to run the complete process of authoring, injecting and retrieving content on the go. Summerschool provided a possibility also for the MapLens system to contribute data to the Second City database.

Specification

Hardware and OS	<ul style="list-style-type: none"> ▪ Intel Based PC Platform ▪ SUSE Linux 11
Software	<ul style="list-style-type: none"> ▪ MySQL DataBase Server ▪ Apache TomCat 5.5
Core Features	<ul style="list-style-type: none"> ▪ Multimedia content database ▪ Geolocated indexing of content ▪ Data-type management ▪ Marker Management ▪ User Management ▪ Keyword Management ▪ KML import/export ▪ XML schema checking
Status	Stable prototype
Intended users	> 10, content providers, story authors
Test users	~ 40
Research Workpackages	WP7, WP9, HitLabNZ
Relevance Beyond Project	Stable community server for geo-located content. Flexible and extendible, support other functions and request types. High.

Table 2: Technical Specification of Second City Server

4.2 MR Player

The MR Player client application builds the bridge between the tracking technologies, establishes the basic communication with the Second City database, and performs display of content. It supports the dynamic retrieval, download and playback of multimedia content associated with geo-coordinates and/or fiducial markers (2D barcodes) on various mobile devices such as cell phones, PDAs and UMPCs. The MR Player client is a cross-platform application targeted at mobile platforms, which is capable of recognizing 2D barcode markers in various visual forms such as 2D barcodes, iconic symbols by employing advanced computer vision techniques and supports GPS position based queries (see also Table 3).

The core module is using Studierstube Tracker to decode the camera image and register the marker and Studierstube ES framework to render 3D content. Identification data is generated from a GPS readout or read from the marker and is used to generate the HTTP request to the database. GPS queries deliver results within a 100m radius of the user. The query result depending also on the UserID, that must be defined in the application as a setting, is displayed as a situated information layer on the device using the Google Maps application.

The selected data item on the map or the directly accessed element using the fiducial marker is requested from the database as a description XML document and associated media files, such as images, sound-files, videos, and 3d geometry objects. For the download all available network connections such as WiFi, GPRS or HSDPA can be used, in the field tests we used the available 3G HSDPA network of the local provider A1 using bfree prepaid SIM cards. Figure 3 and shows the application running here on a Symbian S60 3rd edition platform Nokia N95 phone.



Figure 3: MR-Player application in Symbian environment (left) and while scanning the newly designed fiducial markers during our story field trial (right).

The integration of the Walking Explorer metaphor as a map-based view into the MR-Player application was achieved at the beginning of year 4 research by integrating GPS-functionality into the MR-Player to create location based requests in addition to the fiducial only request previously. The tight coupling between the MR-Player and the Google Maps client on the phone allows now a local close vicinity investigation of information using camera based techniques at high precision and a wider area lookup possibility of information that also eases navigation and finding of relevant information during the experience.

Further effect of the integration of the GPS based queries is marker reuse. As database requests are now filtered to a certain region on the map getting information to a dedicated fiducial marker scanned can be cross-correlated with the course geo-location of the marker. This allows to use the same marker arbitrarily often if the distance between two similar markers can be kept at a "safety" distance, that is defined by the error in the precision of the GPS data and can be in the range of 50-100m in a dense urban environment.

4.2.1 Technical Specification

Hardware and OS	<ul style="list-style-type: none"> ▪ Nokia Symbian 3rd Edition S60 and Windows Mobile 6 mobile phones ▪ compatible with different off the shelf, commercially available phones, for the field trials Nokia Np5 8GB phones and Samsung BlackJack II phones have been used
Software	<ul style="list-style-type: none"> ▪ Studierstube Tracker ▪ Studierstube ES ▪ MR-Player Application ▪ integration of local phone applications: image viewer, media player, Google Maps app
Core Features	<ul style="list-style-type: none"> ▪ 2D Marker recognition and decoding ▪ GPS location based query ▪ Content retrieval over 3Gnetwork
Status	stable prototype

Table 3: Technical Specification of MR-Player

4.3 Mobile Media Collector, MapLens and Interaction Prototyping

The Mobile Media Collector (MMC) is a mobile device and a set of accompanying application(s) for supporting collecting, browsing, and saving location specific and directional media (using a digital compass) related to a urban design site. MMC has gone through two prototype development cycles during last two project years. Mobile phones with the Symbian OS and S60 user interface was selected as the platform. Reasons being the availability of 3G and WLAN connectivity on the devices, as well as having devices with integrated GPS and cameras. These features allow the collection of media (sound, photographs, video), geo-tagging the media and uploading the media to the Server.

Similarly, MapLens is an application for Symbian OS S60 on Nokia N95 phones with camera and GPS. When a paper map is viewed through the phone camera, the system analyses and identifies the GPS coordinates of the map area visible on the phone screen. Based on these coordinates, location based media (photos and their metadata) is fetched from Second City server. Markers to access the media by clicking the selected marker showing the thumbnail of the photo are then provided on top of the map image on the phone screen.

FIT's Interaction prototyping framework has been investigated as a story-telling toolkit to be used. Due to the focus on the field tests and evaluation the examination has been done separately, the extension with the prototyping language technology is a possible future task.

While Mobile Media Collector is capable of supporting uploads to the Second City sever to provide rich media elements it has been not investigated in actual field trials. There is a natural opportunity to build new user studies and projects around this in future. MapLens has been however successfully integrated and used in the context of Second City server technology in a number of test runs and field studies running in Vienna, Finland and Graz, also during the IPCity Summer School 2009. More details on these trials are to be found in the according work package deliverables.

5 Year 4 Application Prototypes and Studies

As described in the overview we focussed last year's investigations around the added context of an un-finished, user-created, in theory ever-extensible environment in a MR story-telling environment. We organized field trials and participative workshops to investigate this form of content creation and perception.

In these workshops based on the student's earlier experiences and in conjunction with the course topic the basic idea of the workshop was to design collaborative games with a story-telling background. Several gaming ideas were proposed and brainstormed, two selected for implementation. A "Virtual Development" Monopoly-style game and a "Sound Meal" named new gaming concept has been implemented on the basis of the City Tales architecture.

The technology has been used to implement the original idea of city tales, that were written by invited authors. These writers did create fictional urban stories related to the specific location of the Naschmarkt. The stories are interwoven so characters can appear in multiple contexts – a true non-linear story experience.

5.1 Technology Vision Workshop

To explore the potential of an inherently 'digitised city' benefitting from the idea of story-telling and the type of future technology needed to do this within work package 9, students of Urban Strategies were asked to develop concepts for applications regarding story-telling with relation to urban issues. This work was also building upon their earlier mapping projects where a base-line of information was created for the target region of Naschmarkt.

As a theoretical background of investigation the students were first asked to experience the city in a particular way, which allows for creating subjective narratives tight to the urban environment by strolling through the city. Related to the concept of "dérive" (drifting), which traces back to the avant-garde movement "Situationist International" in the 1960s, the students were asked to set some rules of behavior to explore the built environment without preconceptions.

- After a detailed explanation of the basic function of the devices the students were asked to imagine a future use of technologies and applications within their field of profession along the following topics: Technologies: how to envision further development and future use of these technologies; what could/should be the purpose of use; how to display and access information.
- Content: who will produce, provide what content; method of representation.
- Users: who are the users; what would be the benefit.
- Spatial vision: how will the new technologies leverage or shape future changes of the city; what could be the impact on the daily urban protocol and effects; how will it affect the physical environment (short term and long-term changes).

The outcome of the proposal was interesting and diverse, whereby three main categories arose. Some were clearly matching with the related topic of storytelling, such as a proposal that suggested superimposing ordinary street signs with additional information, as directions to coffee shops or tourist attractions. With user generated content (images, text) "Feature Alleys" should emerge to form narrative pathways through the city (Figure 4).

Technologies

Routes



Street Corner Signs

Combine the street corner signs and GPS system:
Setup a sensor in the corner with the signs.
The GPS could get or send the information always.
The GPS users can chose the way they want.



Figure 4: Feature Alleys, 2nd layer information attached to street signs

Others were more focusing on the potential of the device itself, such as a digital urban archive that should allow creating and accessing a growing pool of additional information about individual buildings (Figure 5).



Figure 5: Digital Archive, recording and display Information of buildings

Most of the concepts freely exceeded the assortment of the given devices and technologies and furthermore dealt with the question of virtual information display in public spaces, ranging from small scale interventions, such as additional interfaces at the market stalls up to more general ideas about virtually appropriating and reshaping the built environment within an elaborated system that incorporates existing applications such as Google Earth (Figure 6).



Figure 6: Novel interfaces for information display (left), Game like application for collaborative re-design of public spaces (right)

To take away restrictions induced by actual implementations the students were not given the possibility of actually using the devices with the current technology, they were free in interpreting its purposes of use. This led to a broad range of answers of the given task. All students limited the type of content to merely visual information, which might relate to their professional background in architecture as a visual art.

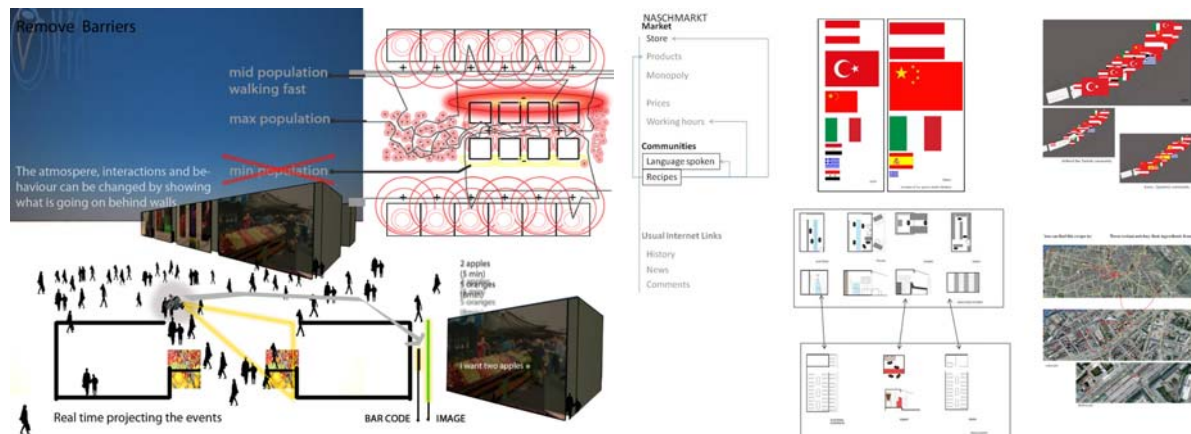


Figure 7: Showing the urban environment's behaviour in real-time attaches lets individuals digitally integrate into the community surrounding them (left) other suggestions even try this with the integration into national communities.

The significant outcome of these design ideas were (see also Figure 7) that when confronted with the possibilities almost all students saw MR story-telling experiences as

- a community building shared experience, and that
- individual contribution is not perceived as must but as something people will want to do in future.

5.2 Collaborative Urban Gaming with Story-Telling Background



Figure 8: 2nd Urban Gaming Workshop during presentation of first brainstorming results

Based on the earlier investigations UniAK conducted a one-week workshop in close collaboration with IMAG to test the technologies at Naschmarkt (Figure 8). Based on the student's earlier experiences, the technology vision workshop results and in conjunction with the course topic "gaming", the basic idea of the workshop was to design collaborative games on the basis of the idea of story-telling. The workshop fulfilled in the end multiple purposes at the same time:

- it served as a first user participative workshop to apply the Second City technology to a specific use scenario;
- it allowed the rapid prototyping of new ideas and see how participants behave in community to brainstorm, prototype and test a new MR scenario;
- the resulting scenarios served as first field trial for WP9 providing valuable data for evaluation;
- and finally the workshop provided experience for the later IPCity Summer School concerning several issues:
 - Organization: agenda of a five-days workshop for a group of students,
 - Task: development of a scenario and task, which would produce meaningful results within the given timeframe and possibilities of implementation,
 - Technical requirements: what sort of technical background is needed to accomplish the task in a tight schedule, and
 - Site: reaction and effects of the Naschmarkt environment: administration, suppliers, customers, passers-by.

5.2.1 Organization of the workshop

The starting point of the workshop was to develop two game concepts by two groups, each playing the game of the other, and presenting the results in front of a group of experts from various related fields at the end of the workshop. In order to match the time frame while still gaining maximum output we decided to allow a brainstorm session for the whole of the first day. Fortunately the introduction phase and explanation of the site could be kept short, since the students already worked with the concepts of City Tales as well on the issue of story-telling and gaming, also they were familiar with the the Naschmarkt. For the second and third day two game concepts were further developed, followed by an implementation workshop and the production of game manuals, to allow easy communicating the game. Day four was reserved for playing and documenting the games consecutively. During a morning session of day 5 presentation material was prepared for the final presentation during afternoon (see Figure 9).

2ndCITY GAME WP9Workshop Urban Strategies
Vienna, July, 13th-17th

Agenda DAY1		DAY2		DAY3		DAY4		DAY5	
Time	Monday 13th	Time	Tuesday 14th	Time	Wednesday 15th	Time	Thursday 16th	Time	Friday 17th
	GAME: Kick Off Exploring Concepts		RULES: Agents and Territories		INTERFACE: Real and Virtual Environment		GAMEPLAY / EVALUATION		Preparation and Final Presentation
Place	cross over / studio	cross over / Naschmarkt		cross over / Naschmarkt		cross over / Naschmarkt		cross over / studio	
10:00	Introduction; Input use of Technologies;	09:30	Lecture F. Ledermann: Story Telling: linear, non linear	10:00	Input perceptual Space	10:00	Meeting / cross over	10:00	Meeting
10:30	Questions	10:00	Questions / group organization	10:30	Mapspace?	10:30	Workshop: Gameplay 1st	10:30	Workshop: preparing presentation
11:00	Workshop: KICK OFF: Brainstorm	10:30	Workshop: CONCEPTION	11:00	Workshop: finalization of the games, production	11:00	Game and Dokumentation:	11:00	presentation
11:30	diverse approaches, towards 5 concepts	11:00	developing the 2 winning concepts: game strategy, rules, how to use technologies	11:30	scenarios: google interface, support by IMAG if required	11:30		11:30	
12:00	for possible games on Naschmarkt in conjunction with the technologies	12:00		12:00		12:00		12:00	
12:30		12:30		12:30		12:30		12:30	
13:00	Lunch + Pin up and informal discussions	13:00	Lunch + Pin up and informal discussions	13:00	Lunch + Pin up and informal discussions	13:00	Lunch at Naschmarkt	13:00	
13:30		13:30	discussions	13:30	discussions	13:30		13:30	
14:00	Workshop: development and preparation of presentation: 5 different concept should be illustrated with 20 slides and 20 sentences (Petcha Kucha)	14:00	Workshop: Implementation	14:00	Workshop: Implementation	14:00		14:00	Hand in Plots
14:30		14:30	gathering data, start production of contents; and use of technologies, with support of IMAG	14:30	gathering data, start production of contents; and use of technologies, with support of IMAG	14:30		14:30	
15:00		15:00		15:00		15:00	Workshop: Gameplay 2nd	15:00	
15:30		15:30		15:30		15:30	Game and Dokumentation:	15:30	presentation set up
16:00		16:00		16:00		16:00		16:00	Final Presentation with guests: slideshow, animation and plots
16:30		16:30	buffer, printing	16:30	buffer, printing	16:30		16:30	
17:00	buffer	17:00		17:00		17:00		17:00	
17:30	Presentation of 5 concepts: 5 Slideshows (20 slides) presentation time for each: 6,40 min (Petcha Kucha) Discussion, winning concepts, use of interfaces	17:30		17:30		17:30		17:30	
18:00		18:00	material review: discussion and burning questions (techn)	18:00	buffer	18:00		18:00	
18:30		18:30		18:30		18:30		18:30	
19:00		19:00		19:00	Slide Show + drinks:	19:00		19:00	
19:30		19:30		19:30	discussion / final advices,	19:30		19:30	
20:00		20:00		20:00	organization gameplay	20:00		20:00	
20:30		20:30		20:30	Workshop: preparation	20:30		20:30	
21:00		21:00		21:00	gameplay	21:00		21:00	
21:30		21:30		21:30		21:30		21:30	
22:00		22:00		22:00		22:00		22:00	
22:30		22:30		22:30		22:30		22:30	
23:00		23:00		23:00		23:00		23:00	

Figure 9: "2nd City Game Workshop" Agenda

5.2.2 Why we look for a combination of story-telling and gaming?

Located between the domain of traditional story-telling, narratives the world of interactive story-telling¹⁷ and such things as role-playing games (Dungeons & Dragons), MMORPGs (World of Warcraft) the domain of story-telling games are emerging.

As Mitchell and McGee point out¹⁸: "Story-telling games are a form of competitive storytelling framed in the context of gameplay. However, most existing storytelling games emphasize competitive gameplay and winning at the expense of competitive narrative play; they tend to be storytelling *games* rather than *storytelling* games."

In the context of mixed reality story-telling we would like to integrate stories into the urban environment without breaking the audience of players' suspension of disbelief. To investigate the effect of the altered environment and the user's behaviour with methods described in D3.5 – given the possibility to rely on the background of the students in Urban Strategies – we decided to find an intermediate point on the scale between urban/pervasive gaming and digital story-telling.

The purposeful engagement of the participants has been a key issue to the previous studies conducted within IPCity. If this is the driving power for story-telling in MR environments must be carefully examined. Hindmarch¹⁹ describes in his work: "The goal of a storytelling game isn't to produce a good story; it's to participate in good storytelling. Storytelling games are about the challenge of conceiving and telling stories, not the enjoyment of having a story or reading one. The process is the point, not the output."

An important point is that the involvement in the creation is superficial to the simply perceiving role that a participant would encounter. This naturally leads to the situation that such stories would have multiple (simultaneous) authors. Hindmarch writes: "Storytelling games, and potentially any paper RPG played with an emphasis on narrative, are especially good at enabling multiple players to share in the challenge and entertainment of the storytelling process. Players enjoy the total narrative and creative freedom of writing their

¹⁷ Cavazza, M., Charles, F., Mead, S.J.: Character-based interactive storytelling. IEEE Intelligent Systems, special issue on AI in Interactive Entertainment (2002), 17-24

¹⁸ Mitchell, A., McGee, K.: Designing Storytelling Games That Encourage Narrative Play. In Proceedings of the ICIDS 2009 International Conference on Interactive Digital Storytelling, Guimarães, Portugal, December 2009, pp. 98-108.

¹⁹ Hindmarch, W.: Storytelling games as a creative medium. In Harrigan, P., Wardrip-Fruin, N., eds.: Second Person: Role-Playing and Story in Games and Playable,Media. MIT Press (2007)

own novel, and it's the fun that comes with that freedom that's important, not the ultimate quality of the tale told." Clearly we can see that a community aspect can arise in this shared working situation. With our trials we would like to investigate if this is also true for mixed reality story-telling in urban environments.

Having multiple authors motivated to contribute raises the question in what way a closed story would be created. Our speculation is that one does not have to end the narrative as in an ever growing net of multiple interconnected episodes such as envisioned in City Tales II many parallel and crossing narratives can co-exist. Hindmarch's findings in story-telling games suggest this, when he writes: "A novel is already complete when it is read, the story has been told, the game is over. That's what makes the reader a passive participant in the story rather than an agent in its telling; she's arrived too late to participate - the interactive part of the storytelling process has ended." In our workshops we wanted to bring in participants "in-time" to become part of the creation process with influence on the outcome.

5.2.3 Conduction of the workshop

After a general introduction of the workshop aims and agenda, we prepared a short presentation of the student's earlier investigation on the Naschmarkt that was followed by an introduction naming generic game elements as kick off lecture to further discuss the notion of the elements and possibilities of translating to the real environment of the Market. We introduced the elements: territory, agents, task & goals and players, giving various examples from a broad range of topics that relate to different ways of perception, representation and awareness of space to enhance individual associations (Figure 10).

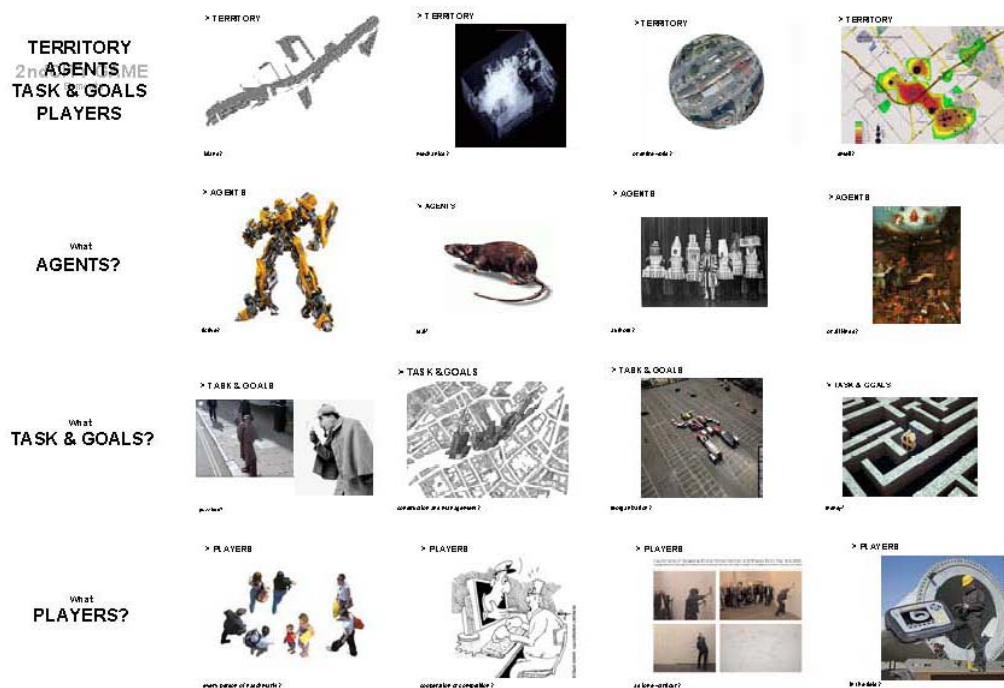


Figure 10: Compendium of kick off lecture, game elements

In order to allow the students to design their games in conjunction with the condition of the given site, we prepared two table-long plots, one for each group of the Market area, for them to envision and analyze the space, plan and test the game procedure in advance. Students successfully used the plots as "gameboard", for allocating information or placing agents while testing game play (Figure 11).

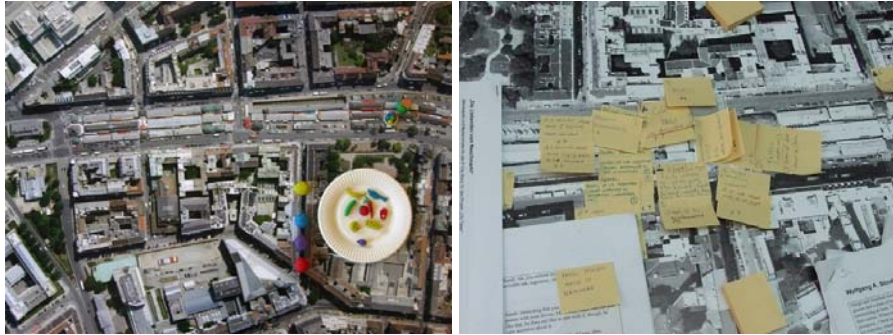


Figure 11: Plot of Naschmarkt area, plot with annotations and scenarios during planning phase

Further preparation was related to the use of devices and technologies. Since it was not possible to equip each student with the same device, the allocation and use of technologies and devices was - to a certain extent - part of the student's task of their game design. This also created a diversity of tools that was perfectly resembling the real world situation in this scenario (the applied devices were Motorola BlackJack II phones, and the ASUS RE2 UMPC). After a first brainstorm session and discussion of general project outlines, we introduced the various devices and their potentials. This discussion underwent several cycles, as the students needed to understand current limits and possibilities with the given set of technologies. Interestingly the students tended to take technological limitation as design parameter, as opposed to tackle the boundaries of possibilities simply by imagination. This might be explained by their architectural background, in which restrictions are often used as potentials for problem solving, e.g. organic open architecture with natural ventilation for desert regions.

Content preparation for the actual games was done by the students themselves. Once they tackled the possibilities images of the Naschmarkt and sounds from various sources were collected. For the use of markers we prepared 100 different code files that were provided in pdf-format to the students. Since they were all familiar with the relevant software packages, preparation did not cause problems. During the testing phase, the students explored possibilities of how to attach markers to the real environment. They agreed on producing two types of markers; stickers that should be attached to Naschmarkt stalls, and markers that are printed on cardboard carried by the players or agents. We further produced A3 maps for each game that allowed for navigation and annotations during the games.

Within the two groups, the students developed game concepts: *Sound Meal* and *Virtual Development*. *Sound Meal* can be described as a marriage of a treasure hunting scavenger game and "Musical Chairs", whereas *Virtual Development* originates in the board game "Monopoly".

5.2.4 Sound Meal

Sound Meal challenges orientation, spatial navigation and recognition of specific features and places of the Naschmarkt itself. The aim is to identify as fast as possible specific stores based on audio-visual information that the players receive by moving inside the market. The given information indicating particular spots in the marked is composed of three elements, addressing different perceptual features in spatial comprehension: photographs, showing particular details of the shops (architectural or furniture details, signs, name fragments or goods), an audio file playing sounds that relate to the theme/type of the shop, and an abstract representation of the market layout – a map indicating the different stalls by numbers.

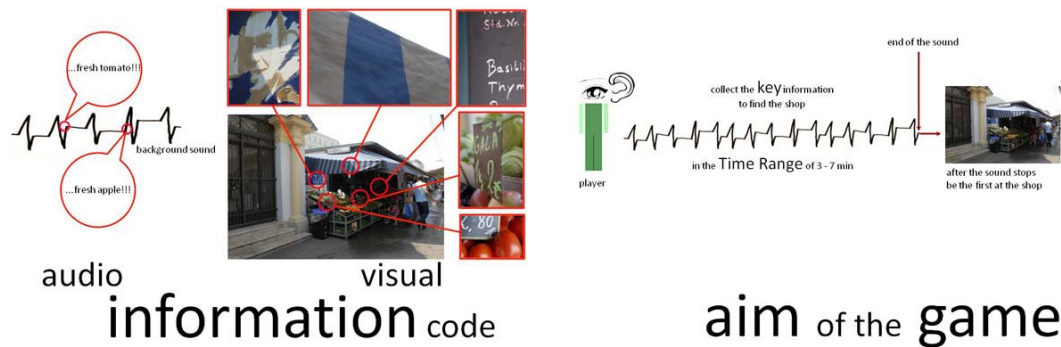


Figure 12: Visual and audio clues encode a target shop that has to be reached at the end of each level. The winner can shop, the loser has to pay for and must leave the game (right).

Each player received at the beginning of the game 10 Euros and was equipped with following additional devices/features:

- a device to play MP3 audio files that are used to synchronise events throughout the game; this provides the sound clues (Figure 12).
- a map false map with store numbers only to find the shop definitely after one level has finished; the number of the target shop is being told at the end of each level sound sequence.
- visual clues are provided to the different players in different ways; we equipped users with
 - a "scanner device" = MR-Player;
 - a "map viewing device" = map view of MR-Player running on an UMPC device;
 - no device = visual clues – if location found – were presented as picture to the player.

To "integrate" the fiducial markers and the pictures (for the non device using players) we employed "agents" who moved inside the market and give the visual information to the players that they meet. They had a fixed program to go to certain locations for the different levels, so that players would have the same chance to find them (Figure 13). This mechanism allowed the most easy prototyping of the game without huge interventions into the busy Naschmarkt.

The player had to collect as many visual clues as possible – so he or she can combine them – with the additional audio clues provided in the sound-track – in order to locate the store- when the music stops at the end of the level (Figure 12 right). This time triggering created a fast paced game but also ensured that players would meet at the end of each level.



Figure 13: During the process of the game visual clues were presented either as fiducial markers for the player with MR-Player (left), as pictures to the non equipped person (middle), or not at all – to the person with the map overlay on a digital map with close surroundings (right)

The player had to run to the store before it was revealed through the sound information at the end of the level's sound track (ex. G4). The social part of the game started, when the player who locates the store first starts purchasing goods for the common picnic as the winner. As bonus he or she decides what to buy. The player arriving last has to pay for the purchased goods and also carry them for the rest of the time until all levels are finished. In our implementation all money was spent in one level, so players who actually lost at one level, were disqualified from the further runs. At the end of the game all players went to a nearby location to eat and drink the purchased goods together as a finale of their community game.

5.2.5 Virtual Development

The game Virtual Development was composed as "Monopoly"-type game connected to the real space of the Naschmarkt, further addressing urban development related issues such as land value, connectivity of public and open spaces. Basic rules and trigger criteria's of the board were applied to a section of the market area, within which game players could buy and sell stalls, decide on their maintenance, vertical extensions, change of uses or removal for sake of public space (Figure 14). Additionally exploration of access roads to the market areas allow investors to gain more valuable properties around the Naschmarkt for enabling further investments within the Market area.

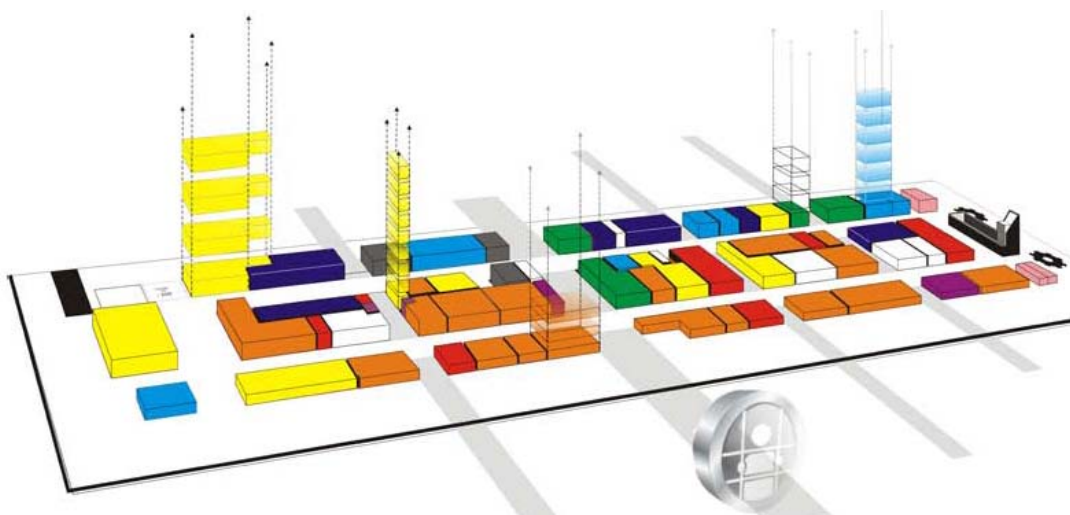


Figure 14: Diagram showing different types of property (colors), and potential developments of the different plots

Each player starts with 3000 points given by the bank as basic stock. Like in the monopoly board game players roll a dice for stepping to the next shop that can be either purchased from stock, or are offered by other players for bidding. Player's movement within the "game-board-space", is directed by rolling electronic dices and collectively walk along one of three predefined paths, that were designed in advance to ensure exploration of the two alleys within the market.

Collective movement of all players was decided in order to allow communication among the players during the game. This was partly due limited to amount and type of devices that were available.

Additionally specific features were allocated to specific spaces, such as empty plots, junctions or access roads. These fields were designated as specific fields of action; such as

- action boxes enabling to move further, go behind, gain or lose points;
- jail box, losing a turn, in order to go out of jail the player could use the action card "go out of jail" or pay 100 points;
- chance boxes, the player has the possibility for 2 minutes, to walk to nearest perpendicular street and make at most 2 pictures of any property the player decides, for example: post office, apartment, commercial place, etc.

For the player's guidance and provision of property information we used charcoal for designating the three paths within the Naschmarkt section during the previous night to the gameplay, and prepared stickers to temporarily attach markers to stall fronts, or floor sections in front of the shops.

In order to provide the history of the game during the play the ASUS UMPC was used to connect to the Second City Server with the map view of the MR Player application, similar to Walking Explorer. It served as interface that constantly updated the players with actual state of ownership and value.

After several rounds following the designed path between the stalls a number of properties were purchased, sold, bid for, etc. The game was intentionally ended with a time limit, as after a period of 2,5-3 hours still many players had points left, so no winner could be defined.

In effect we had to admit that the proposed and implemented games were more related with gaming than with narrative story-telling, but in effect of the investigation of user behaviour in the urban environment, the use of tools, the collaboration and community aspect the basis for investigations were met.

5.3 Narrative Story-Telling with Professional Authors

In year 3 of IPCity the envisioned process to create MR stories included users first creating single elements of information that are spread over an area in a digital layer stretching on top of an urban environment. In a follow-up procedure these singular information elements would have been woven into a net of stories that interconnect places, time and information realms that otherwise would be disconnected.



Figure 15: Two of the authors during the workshop – Wolfgang Stindl (left) and Uwe Neuhold (right)

To accelerate these steps for the research project and to create a basis for field trials on the scenario of non-linear stories we invited a number of professional authors during summer 2009 to create – on the basis of the environment, shared assumptions, assumed available additional commonly shared information – independent stories that would span the Naschmarkt (Figure 15).

5.3.1 Authoring Process

The stories created in multiple steps are entirely different in their own way, spanning a spectrum from mystery to love however sharing both the place of action and also some of the characters as it would happen in a co-located real environment that persons do meet and interact with different background when in the same urban neighbourhood. A short exposé is given on each of the stories to understand the underlying mechanism.

Story I: Peter Brandstätter – "At journey's end"

Fritz "Fritzl" Pokorny is mid forty, and has now reached more at the lower third of the society. Before this was quite different - in a company for alarm systems he had an acceptable job and was able to care for himself and his girlfriend, Ulrike. In fact he was never ultimately happy as he always had "something of his own" in mind.

He got off the rails as Ulrike was found dead some twelve years ago under mysterious circumstances at Naschmarkt. Under her coat she wore a black leather outfits and platform boots - an outfit in which Fritzl had never seen her. A matchbook of the SM-club scene TRAMS has been found at her and she had a henna tattoo resembling a magic symbol. The police concluded the case as an accident of overdose of drugs, but Ulrike was never into such things - neither SM nor drugs. The Viennese cosiness, hierarchies and complex official channels stopped this apparently clear case from being further investigated.

Since his job has never meant much to Fritzl, he has lost it as a further consequence and started his fast descended. At the beginning he wanted to uncover the case of Ulrike's death but eventually he landed in an impasse. With sporadic jobs he keeps his head above water. He just enjoys having his coffee and a beer, and live. Just to live ... death comes naturally anyway.

Story II: Uwe Neuhold – "Lovers on Naschmarkt"

Xandi a young bohemian who officially studies literature, spends most of his time writing commissioned poems or secretly placing own love poetry in various locations on and around the Naschmarkt. In his wanderings he met Yasmin and falls in love

with her, but does not know how to tell her – to write love poems is one thing to pronounce them without stutter, this is very different.

Yasmin is the daughter of an Armenian groceries-shop owner on Naschmarkt and the pride of her family. To supplement the income of their parents, she sells with a mobile shop packets of flower seeds and homemade floral wreath to tourists and shoppers.

Zeppo considers himself a great painter. The only problem is: he has indeed insanely great ideas for pictures, but never the time, to paint them. Some say he never could paint, but that certainly is not true – when someone has such ideas for art, he must be just a great artist. He sees friendship as a means to live on expense of others – and he would sell his own grandmother if it would bring him an advantage.

These main characters are living in a "ménage à trois" that can be resolved over time. Their steps are influenced by further side characters, like Viktor, who is firmly convinced that from time-to-time disappeared celebrities and "supposedly" dead celebrities are appearing on the Naschmarkt; or Ricardo – a former high-wire artist – who writes down license plate numbers of passing-by cars at a corner of Naschmarkt to derive oracles; Yasmin's father, who's shop is neighbouring a secret underground entrance, and some others.

Story III: Wolfgang Stindl – "Screaming Stone"

In the Vienna underground a mysterious temple – Templum Aphopis – is told to be existing, which has dedicated itself to the dark path of knowledge. This organization has a not inconsiderable influence in Vienna due to the fact that in the last two decades, all Egyptian was a real fad, and that there are some very wealthy members of this group.

Because some of them know something "really" magical and occult in Vienna happening, they started to develop the belief that they are the guardians of this place and nobody else should know about it. They regularly hold their initiations at the "man from the wall", the true horror impressing every neophyte. It is also part of their statutes that anybody who sighted the man can only leave the temple by the death. In addition, joining the group must be associated with the occurrence of at least one weighty breach of law that is emotionally detaching themselves from the normal society. This explains why many here are willing to put horrible illegal acts such as first murder Ulrike and execute eventually murder of Fritzl.

5.3.2 Synthesis

It has been a complicated process to integrate authors, normally working stand-alone into a collaborative content creation process for a non-linear environment. Significant amount of time and discussion went into the set-up phase of the stories as it was totally not clear in the beginning how one can write separate stories that are interlocked in a way, so that the order of perception of the different story pieces can be arbitrary.

Finally we decided trying to find similar complex narrative environments to understand the authoring process of these. As a model for understanding we have looked into popular literature, where participative, community based content authoring, co-writing could be observed before. Soon we have realized that we would be able to build upon a series of previous scenarios.

In ancient times sagas and legends – partially with religious motivation – were carrying told information about gods, heroes, kings, their life and achievements. In most cases not being documented in written form first these stories morphed between real and imaginary, mixed these elements and crossed the border of fictional often. As the modern continuation of this form of narrative fantasy and some science fiction literature can be considered, as well as the so called phenomenon of urban legends or urban myths. Common to all these story-telling approaches is that the story itself creates an universe of its own that possesses own rules, laws of physics, time and space – not necessarily overlapping or even resembling our own world.

As the stories are not written endless, their description in of the universe is reflecting only a slice of the new world, leaving space to imagination and speculation – which is certainly a desire of the original author(s). Taking up on such stories after a fan community has established itself some self-appointed authors integrate their thoughts into such universes, extending, further detailing, adding new characters or complete story-lines, or just simply complementing certain parts left open.

After we have experienced this process to happen to the above described three stories – which we created by design to be part of our self designed "Naschmarkt universe" – during the IPCity Summer School workshop, we are almost certain that we have found a very effective model to create mixed reality narratives.

The success of creating the three Naschmarkt stories with three independent authors was

- to **define the** above mentioned **rules and physics of the universe** together as a starting point.

Then the world was populated by the authors with three different types of characters during their separate exposé process:

- **main characters** – being of central interest to their narrative and also often appearing or being mentioned throughout the story;
- **supporting characters** – complementing the story with minor details, sometimes carrying key elements to the complete line or acting as a sidekick to the main characters;
- **backgrounders** – persons mentioned, related to, but not necessarily acting during the story, sometimes also just naturally appearing players, e.g. market stall operators on Naschmarkt.

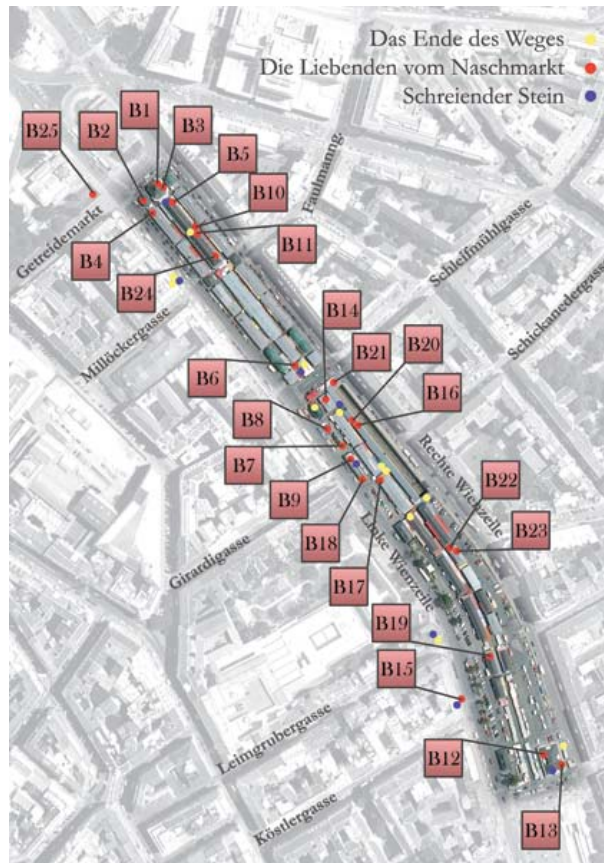


Figure 16: Episodes of "Lovers on Naschmarkt" placed in the real environment

The episodes of the stories are spread over the Naschmarkt area, as an example Figure 16 shows the distribution of the story "Lovers on Naschmarkt". Other stories are marked here with a different colour to show co-location.

The focus and types of characters are only related to one story. This means that a person appearing as main character in the one narrative can play a supporting role or even just act as a backgrounder in another story line. This quality of multiple functions is a key element to interconnect and extend the imaginary story universe with arbitrary stories. As in our everyday life every person has his or her own focus and "main" issues and actions, these might in parallel influence other persons activities.

5.4 Supplementary Storytelling with User Participation

During the IPCity Summer School in September 2009 a new form of participative workshop was set-up based on the success of the previous Urban Strategies workshops.

5.4.1 IPCity Summer School 2009

At the beginning of the Summer School theory presentations given by the leading senior researchers of the IPCity helped to bring understanding into the aims of the research directions of the general project (Figure 17).

Time	Tuesday Sep.22	Wednesday Sep.23	Thursday Sep.24	Friday Sep.25	
08:00					
08:30					
09:00	Morning Session				
09:30	Theory presentation 1	Workshop 1-5 specific preparation and planning in groups	Workshop 1-5 specific work in groups, test sessions/field trials	Presentation preparation by student groups	
10:00	Theory presentation 2				
10:30	Theory presentation 3				
11:30	Theory presentation 4				
12:00					
12:30	Lunch				
13:00					
13:30	Afternoon Session				
14:00	IPCity Project Overview	Workshop 1-5 specific work in groups	Workshop 1-5 specific work in groups, test sessions/field trials, evaluation	Group 1 Presentation	
14:30	Urban Issues			Group 2 Presentation	
15:00	WP 6 Presentation			Group 3 Presentation	
15:30	WP 7 Presentation			Group 4 Presentation	
16:00	WP 8 Presentation			Group 5 Presentation	
16:30	WP 9 Presentation			Discussion	
17:00	Discussion			Closing	
17:30					
18:00					
18:30					

Figure 17: Timetable of the IPCity Summer School 2009

The workshops were conducted then during the following three days in smaller groups of 5-6 students. As an introduction participants were familiarized with the concepts of the City Tales approach, including the story-telling aspect, as well as the technical background, server-client architecture. The plan was based on pre-existing content and the imagination of students to create a story environment and make up stories that happen in them with characters, roles, etc.

New conditions compared to the Urban Strategies workshops were:

- participants had more diverse background, such as computer science, digital design, urban planning, and history;
- three stories of external authors were already available.

5.4.2 The authoring process

After reviewing the actual stories and learning their behaviour and interconnectedness on the Naschmarkt (Figure 18) a debate started how this stories are finished or not. Also the original stories were told from the perspectives of three different main characters even though it was one universe.



Figure 18: Storytelling workshop during arguing story lines (left), collaborative synchronization of story elements (middle), and discussion with one of the story authors W. Stindl (right)

Following challenges were found when conducting the analysis:

- Which character's perspective should the user experience the story through?
- It would be desirable to give the user an active role in the story instead of a passive one!
- What events and locations are common to the experiences of two or three of these main characters?
- What specific events should we choose for the field trial that could provide the user with adequate information to experience the individual stories of all the main characters?

The participants of the workshop quickly realized that the stories are part of one universe and rather than just participating or experiencing these it is far more engaging, motivating, and of course demanding to create own ideas into such an environment.

To accomplish this the existing stories were analyzed, a new story around a boy, who is following the girl-friend to Vienna, who was lost – much like Ulrike in the story "At journey's end" – was created and written up in situated parts:

- A new character (Adrian) in the same universe whose perspective, the user would experience the story through.
- Adrian's quest to find his missing friend, Brigitta leads him to discover mysterious events around the Naschmarkt that concern the three other main characters.
- By interacting with certain locations around the Naschmarkt, certain people could provide Adrian with information about these events.
- The three original stories were summarized in twelve special events which gave the user an idea of the events linking the main characters.

Narrative was written, voice over formulated and recorded, pseudo "documentary" pictures were taken on site (Figure 19) – all in the course of the Summer School.



Figure 19: While acting for a photography situation – Xandi and Zeppo with a love poem (left), the team during creating the assets on the Naschmarkt (right)



Figure 20: Fake image of a person lying on the railroad-tracks – after being murdered? (left), Audio narration and voice over created an important part of the immersion (right)

During the content creation process the key importance of integrating the story well into the urban environment to produce believable stories was well understood. Apart from creating the situation pseudo documentary pictures this went as far as creating fake images, that do "document" steps in the story (see Figure 20). The significance of mobility during the experience was already well known during this field trial from previous results, so students were advised to use short text to be read on the device only and to use audio as part of the storytelling mechanism to allow continuous connection of attention to the environment.

5.4.3 Field trial

Later during the workshop after finishing the authoring process the participants were briefed about the process of exploring the environment and usage of the mobile phone based MR-Player interface in detail (Figure 21). The field trial was started at one common location, as we had enough mobile phones each participant in this round could experience the stories in parallel (Figure 22). In addition we involved some other colleagues to document an log the data during the trial.



Figure 21: Common briefing session at the beginning of the field-trial (left), participants start their tour through Naschmarkt from the same location (right)



Figure 22: Users using the MR-Player to experience the story on-site

As part of the IPCity Summer School the first hand experience could be presented right back to all other participants of the one week workshop to share between the workshops created around the different work packages (Figure 23).



Figure 23: The authoring team presenting the story-telling workshop results to the audience

6 Evaluation

6.1 Field Trials and Participatory Workshops



Figure 24: Modeling the Naschmarkt using high-resolution aerial photo as a semi-on-site situation

During 2009-2010 WP9 organised a series of field trials in the urban environment around the showcase prototypes. Where the use of field trials is deliberately implemented in IPCity, we look to address a more real-world evaluation of use. We seek rigorous use and feedback and more realistic use-case scenarios, with the view to iterate, progress and implement the applications in commercial and actual future use.

In order to prepare an analytical base-line for further investigations in WP9 we created an in-depth urban site analysis of the “Naschmarkt” region during 2008 with students of the Urban Strategies studies at the UniAK (Figure 24). Particular information was collected and mapped to the location by spending several hours on different days of the week on the place, documenting observations with photographs, videos and notes (written and sketched), followed with internet and library research. This step generated a huge set of initial data.

To explore the potential of the various devices and technologies used within WP9, together with students we developed concepts for applications based on story-telling concepts in relation to urban issues in May 2009. As the theoretical background of investigation the students were first asked to experience the city in a particular way, which allows for creating subjective narratives tight to the urban environment by strolling through the city – called “dérive” (drifting).

6.1.1 Field Trial Set-Up

The trials were designed in the Urban Strategies workshop as collaborative gaming scenarios, in the case of the story-telling applications, users participated separately but exchanged their experiences later. In both cases participants were immersed into the real environment of the living Naschmarkt. This confrontation to the urban surroundings was important as we wanted to investigate the mobility issues caused by not only the mixed reality story, but also the given actual possibilities.

In the course of a five-day tightly scheduled workshop in July 2009 the creation of story based gaming in the urban environment was prototyped. After a brainstorm session for the whole of the first day, two of the presented ten concepts were selected and further

developed. Following days included implementation workshops and the production of the game materials. Day four was reserved for playing the games consecutively, where photo and video documentation was used with open interviews and game logging to record evaluation data. Recorded material was evaluated in detail later, as part of the workshop however participants – both “game developers” and “players” – created presentations to an audience of thirty as immediate reflection to the participatory experience.

Based upon these results during the IPCity Summer School in September 2009 we were organizing a successful participatory story-telling workshop with international students. During the workshop authored, geo-located stories of professional authors were investigated, re-told using Mixed Reality story-telling methods and media as well as extended further with participatory authored content.

In the field trials and workshops following data was collected (Table 4):

WP9	
Field trials/participatory workshops (PWS)	Vienna: 1) 1 st Urban Strategies Workshop; May 2009; N=12 2) 2 nd Urban Strategies Workshop; July 2009; N=14 3) Summer School Workshop; Sept. 2009; N=10 4) Field Trial: Naschmarkt Stories; Okt/Nov. 2009; N=6 5) Field Trial: Naschmarkt Stories; Jan. 2010; N=8
Video documentation	2) Urb. Strat. WS: 1 camera; 1,5h video 3) Sum. School: 1 camera; 1h video by students
Photo documentation	2) Urb. Strat. WS: ~300 pictures + video stills 3) Sum. School: ~250 pictures 5) Field Trial: ~150 pictures
Log-in data	Database transactions logged, phone activities logged
Interviews	Open interviews with participants, discussions, and presentations by qualified participants after participatory workshops

Table 4: Data collected and methods used in the field trials and workshops of WP9

6.2 Data collection and Data Logging Methods

To answer the common and specific research questions in addition to the visual observation the below described measurement data was logged to receive precise documentation of the field trials. This included digital data logging and on site note-taking to preserve game results during the course of the game and after each consecutive level.

6.2.1 Visual data collection

During the Urban Strategies workshops several observers were applied during the course of play. This was necessary due to the nature of the game – as especially for Sound Meal – players moved at high speed through the market area. Also we wanted to be at the same time at many locations – i.e. following the players and see the first user arriving to the target location, which in this moment was not known to the players yet.

Most field trials had a researcher video-recording the situation at least from one perspective. During the course of the game-play we changed from following a player equipped with technology, to one without, or to a steady position where players left and observe them in the field. Photographs were taken to conserve certain significant moments in the interaction process, such as pointing gestures or situation where users shared the display of the mobile device.

6.2.2 Server-side data logging

Each data request to the Second City Server is logged in detail allowing later reconstruction of when, what was downloaded – by whom if necessary in multi-user scenarios; also a course location tracking can happen server-side – e.g. where was the user – as sparsely requests are made based on the geographic location (Figure 25).

```
...
129.27.200.230 - - [19/Jan/2010:13:56:17 +0100] "GET /ipcity/servlet/IPCity?Command=queryNearestObject&MarkerTypeName=frame&MarkerValue=146 HTTP/1.0" 200 334238

129.27.200.230 - - [19/Jan/2010:14:01:25 +0100] "GET /ipcity/servlet/IPCity?Lat=48%2E205642489821294&Keyword=&Lat2=48%2E20907453318557&Lon=16%2E377173623180408&Command=queryObjects&nocache=1267709265320&Lon2=16%2E388159951305408 HTTP/1.1" 200 230

129.27.200.230 - - [19/Jan/2010:14:04:18 +0100] "GET /ipcity/servlet/IPCity?Lat=48%2E207465791494904&Keyword=&Lat2=48%2E20918178083482&Lon=16%2E381014546489734&Command=queryObjects&nocache=1267709267568&Lon2=16%2E386507710552234 HTTP/1.1" 200 230

129.27.200.230 - - [19/Jan/2010:14:07:56 +0100] "GET /ipcity/servlet/IPCity?Command=queryNearestObject&MarkerTypeName=frame&MarkerValue=157 HTTP/1.0" 200 249143

129.27.200.230 - - [19/Jan/2010:14:27:45 +0100] "GET /ipcity/servlet/IPCity?Command=queryNearestObject&MarkerTypeName=frame&MarkerValue=175 HTTP/1.0" 200 11196

129.27.200.230 - - [19/Jan/2010:14:27:47 +0100] "GET /ipcity/servlet/IPCity?Command=queryNearestObject&MarkerTypeName=frame&MarkerValue=174 HTTP/1.0" 200 107858

129.27.200.230 - - [19/Jan/2010:14:28:34 +0100] "GET /ipcity/servlet/IPCity?Lat=48%2E20619663739188&Keyword=&Lat2=48%2E20791266925579&Lon=16%2E379244288539905&Command=queryObjects&nocache=1267709314500&Lon2=16%2E384737452602405 HTTP/1.1" 200 68
...
```

Figure 25: Second City server-side access log with requests from clients

6.2.3 Client-side data logging

In addition to logging the requests on the server the mobile phone maintains an extensive log of all actions conserving users actions, showing all recognised fiducials or GPS readings, recording requests sent to the server, continuous logs of data really received and how it was handled, using which MIME-type. Behaviour of the modular MR-Player application plug-ins is written out into the log-file (Figure 26).

```
...
2010-01-19 16:18:12: INFO: MRPlayer: HTTP request
'/ipcity/servlet/IPCity?Command=queryNearestObject&MarkerTypeName=frame&MarkerValue=123' sent to
server
2010-01-19 16:18:12: INFO: HTTPClient: 1000 bytes received
2010-01-19 16:18:12: INFO: HTTPClient: 1000 bytes received
2010-01-19 16:18:12: INFO: HTTPClient: 2000 bytes received
2010-01-19 16:18:12: INFO: HTTPClient: 4000 bytes received
2010-01-19 16:18:12: INFO: HTTPClient: 5787 bytes received
2010-01-19 16:18:12: INFO: MRPlayer: detected content MIME type: multipart/html-zip
2010-01-19 16:18:12: INFO: MRPlayer: detected content disposition info: filename=1926.htz;
2010-01-19 16:18:13: INFO: MRPlayer: content file '1926.htz' successfully saved
2010-01-19 16:18:13: INFO: MRPlayer: HTTP status code OK, 13498 bytes of content received,
processed successfully
2010-01-19 16:18:13: INFO: MRPlayer: searching for plugin for MIME type 'multipart/html-zip'
2010-01-19 16:18:13: INFO: MRPlayer: plugin 'AppPluginHtml' found, attempt to load...
2010-01-19 16:18:13: INFO: Application PluginHtml started.
2010-01-19 16:18:13: INFO: PluginHtml: unzipping compressed HTML
2010-01-19 16:18:14: INFO: PluginHtml: opening URL
'file:///E:/Data/e3b096b9/data/downloads/cache/htz/index.html'
2010-01-19 16:19:44: INFO: MRPlayer: stopping current content plugin
2010-01-19 16:19:50: INFO: MRPlayer: initializing HTTP server 'ipcity.imagination.at' at port 8080
2010-01-19 16:19:55: INFO: MRPlayer: HTTP client initialized
2010-01-19 16:19:55: INFO: SocketClient: Connected to host 'ipcity.imagination.at : 8080'
2010-01-19 16:19:55: INFO: HTTPClient: sent HTTP request 'GET
/ipcity/servlet/IPCity?Command=queryNearestObject&MarkerTypeName=frame&MarkerValue=124 HTTP/1.0
Host: ipcity.imagination.at:8080
User-Agent: StBES 1.0
'
2010-01-19 16:19:55: INFO: MRPlayer: HTTP request
'/ipcity/servlet/IPCity?Command=queryNearestObject&MarkerTypeName=frame&MarkerValue=124' sent to
server
2010-01-19 16:19:55: INFO: HTTPClient: 1000 bytes received
2010-01-19 16:19:55: INFO: HTTPClient: 121 bytes received
2010-01-19 16:21:33: INFO: MRPlayer: initializing HTTP server 'ipcity.imagination.at' at port 8080
2010-01-19 16:21:38: INFO: MRPlayer: HTTP client initialized
```

```

2010-01-19 16:21:38: INFO: SocketClient: Connected to host 'ipcity.imagination.at : 8080'
2010-01-19 16:21:38: INFO: HTTPClient: sent HTTP request 'GET
/ipcity/servlet/IPCity?Command=queryNearestObject&MarkerTypeName=frame&MarkerValue=97 HTTP/1.0
Host: ipcity.imagination.at:8080
User-Agent: StbES 1.0
...

```

Figure 26: Client-side data logging recording user actions into local log on mobile phone for later analysis

6.2.4 GPS position logging

As we have encountered that during the course of the game the logged position information of the users using the above two logging mechanisms is only sparse – in fact we record only position information of the user when he generates a request. This is however a very efficient use of the available bandwidth and storage space in normal use scenarios, for our investigations and evaluation work this was too sparse.

To overcome this we used GPS data loggers to record the users position during the trial at a much higher rate. The data was collected on the device and harvested for off-line processing after the field trial finished. In one trial we also experimented with data processing in real-time. For this the location data was sent over 3G network to our centralized server. A live data connection in Google Earth allowed to follow the position of the player in real-time at an observation console.

The off-line data analysis can be used to estimate walking speed and temporal behaviour (stopping, walking, running) as well as directional activities (forward going, returning, re-visiting a location again, etc.). The data analysis lets – at a certain level of detail and precision – recap the complete field trial situation. In combination with other time-stamped data, such as photographs, video tracks or even the game status the situation is preserved at a high quality for later remote analysis.

Figure 27 shows how individual player performance can be analyzed based on numeric data, while Figure 28 displays also the actual game status information in combination with the environment. The 3D buildings displayed in Google Earth provide a high level of realism to conduct analysis in a "birds-eye-view" metaphor overlooking the complete game area.

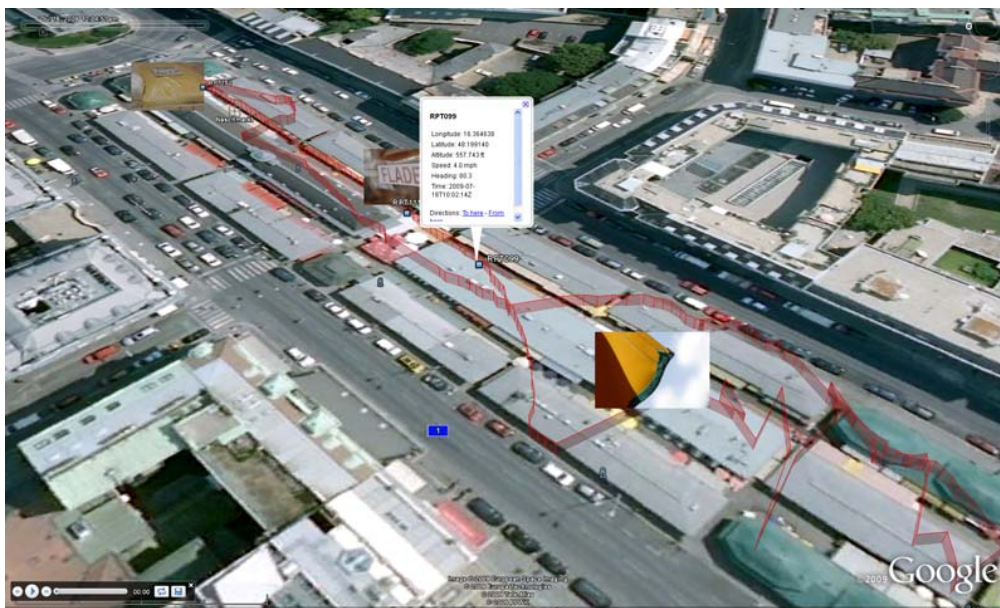


Figure 27: Player position recorded the Sound Meal game. Note the three visual clues represented as images placed in the environment. These were the intermediate targets of the player to be found. We can measure his or her performance exactly as we have time-stamped location data.

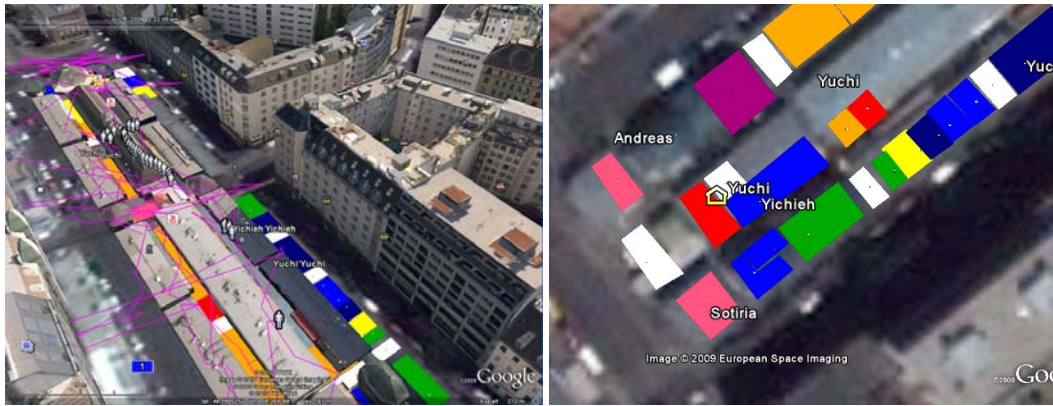


Figure 28: During the Virtual Development game the location can be displayed in combination with the progress of the game (right – from above). The position information shows a more erratic behavior (left) due to a mis-placed GPS-logger in the backpack between other electronic devices.

6.2.5 Collecting data on-site

Just relying the findings on the pure technical measurements would yield quantitative result only which does not support the method of multimodal analysis synchronized over all work packages. Therefore before, during and after the experience of the participants tabular data was collected and interviews between observers and players were conducted. These questions and answers provided a valuable support to analyze and understand the social actions performed (Figure 29).

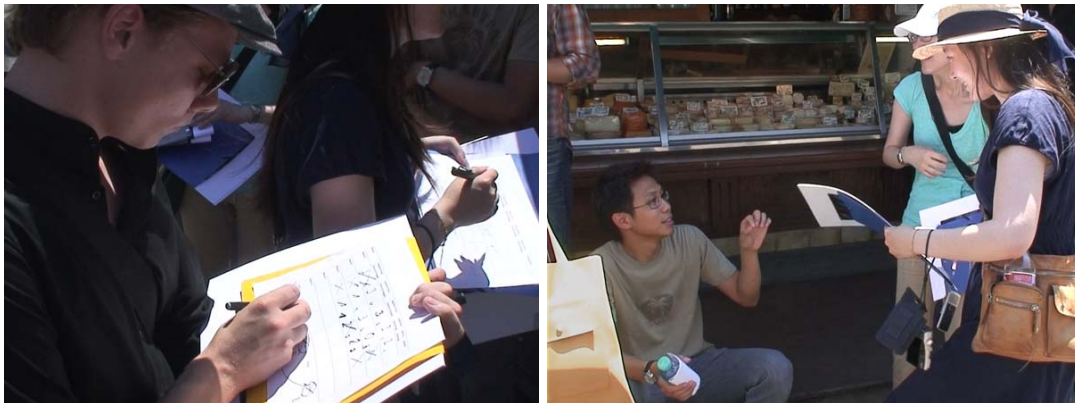


Figure 29: Manual data logging of game status and user behaviour during game-play (left) and interviews with (exhausted) player between two levels of the Sound Meal field trial (right)

6.3 Data Analysis and Findings

6.3.1 Visual documentation

To analyse the data we performed inspection of the documentation in form of an ethnographic analysis approach. This qualitative analysis of the ethnographic material (using video, photographic images, screenshots, notes, etc.) was carried out collaboratively in the research team. Supporting the available photo, logging data and notes documentation significant scenes from the video material were selected. The significance of scenes is judged on the basis of a set of concepts that compromise the research questions and reflect the theoretical approach developed within IPCity. Consolidated observations were made upon the collected data together in the team. Observation with focus on certain interactions and activities was carried out. Larger activities were broken up into fairly generic tasks. Table 5 below lists the actions and gestures that were observed in the visual documentation to evaluate the prototype.

Gestures	Representation of Story	Scale of MR	Object manipulations
Pointing of onward direction when pair of users discuss path	Switch attention between screen and environment	Zoom attention in and out:	Only object is the device for participating the story experience
Pointing at markers in environment as sign of localization	Change of representation (real world, MR info on device, browse inside info, map display)	1) content focus 2) map view 3) world view	Alignment of the device (e.g. vertical/horizontal, near/far from the body, can others see the screen etc.)
Pointing device against markers in environment		Urban environment gives 1:1 scale story stage and requires interaction with it	Usage of buttons for scrolling content, switching pages, switching functions (e.g. MR-view, map-view)
Alignment of device with real surroundings when using map based view			

Table 5: Action elements and gestures observed separately

6.3.2 Gestures

Conducting a multimodal analysis such as suggested by the WP3 workshops in Oulu and Aalborg we inspected the gathered data for certain elements. Gestures are seen as an important part of referential practice and researchers analyze how bodily gestures and actions are used in relation to talk in order to direct and encourage one another to look at a particular object. Gestures help to render a feature of the world visible and gaze (as well as the whole body) follows the gesture that displays an object.

In our analysis in WP9 we distinguish different types of gestures (compare D3.5):

- Collaborative gestures – two or more people pointing or tracing or gesturally describing simultaneously;
- Deictic pointing gestures – pointing something out on a map, on a screen, in the environment;
- Creative pointing gestures – pointing directed towards non-present objects' - things imagined (e.g. a person pointing at an imagined building or event while telling a story).

During our observations we identified these gestures in the following situations (Table 6):




Gesture	Situation	Example
<p>Collaborative Gestures</p>	<p>when discussing direction of further path during story or game</p> <p>Player in Sound Meal is communicating with butcher to ask for the next meat shop. An interactive exchange of gestures is happening during the discussion to reach common understanding of the further path.</p>	
<p>Deictic Gestures</p>	<p>pointing at markers in environment as sign of localization</p> <p>Player in the story-telling field trial identified a marker and is pointing the MR-Player towards it.</p>	
<p>Creative Pointing Gestures</p>	<p>e.g. trying to identify story elements, a hidden door, dead person – in real environment</p> <p>Player points towards a non-existing secret hidden door and tries to locate by tapping on the wall.</p>	

Table 6: Classes of gestures documented during the field trials and exemplary photographs

6.3.3 Object manipulations

Analysis of object manipulations involves different types of objects in the different showcases. Aspects to consider are (compare D3.5):

- Touch dimensions - size, weight, form, position in space, texture, temperature, flexibility, continuity of surfaces, etc.
- Type of manipulation – grasp, lift/heave, turn, shift, stroke, press, align/adjust, etc.
- Number and structure of activities – different manipulations in a particular sequence may be necessary to perform an activity
- Character of manipulation – flowing, accentuating each step, etc.

As in WP9 participants operate basically the mobile device only, we focussed on some aspects of object manipulation that concern the mobile device (see Table 7).

Object manipulation	Situation	Example
<p>Position device to look at display.</p>	<p>User is looking at mobile phone display to avoid reflection of sun-light.</p>	
<p>Pointing device towards marker in environment.</p>	<p>Player in the story-telling field trial identified a marker and is pointing the MR-Player towards it. – This is simultaneously a pointing gesture, as described above.</p>	
<p>Sharing device screen when reading/observing content.</p>	<p>During the Sound Meal player (right person) is showing the collected pictures to one of the observers (person left) as he does not understand the visual clues and asks for help.</p> <p>In another situation the player shows what she has found to another participant, when the level target already was reached.</p>	
<p>Aligning it (e.g. horizontal/vertical, near/far the body) to get more details.</p>	<p>Alignment of the device in relation to the fiducial to use the screen space better to read the augmented artefact of a secret love poem.</p>	




	<p>Holding the device with a different grip using the same orientation.</p> <p>Positioning forth and back towards and from the fiducial could be observed in certain situations when users had difficulties to read the marker in complicated lighting situations.</p>	
<p>Usage of buttons for scrolling content, switching pages, switching functions (e.g. MR-view, map-view).</p>	<p>Operating the mobile device while looking at the display.</p>	
<p>Aligning device with environment in map-view to get better spatial reference with surroundings.</p>	<p>Wayfinding with the map display, simultaneously pointing to the real location. This is also a collaborative gesture as others are following the person in the middle.</p>	

Table 7: Overview of categories of object manipulations in City Tales

6.3.4 Further dimensions of investigation

Representation of Story

During the review of the video analysis we observed that users do often switch attention between the device screen and environment. Depending on the speed of movement through the environment this focus switch could be very rapid – within 2-3 seconds – and repeating over and over. Especially the fast pace of the games required walking at higher speed through Naschmarkt, so to avoid collisions and to still see the display the focus was changed very often. Due to the fast pace and probably distracted by the ongoing focus change after the trial users were not aware of the path they have chosen (Figure 30).



Figure 30: During the navigation through the real environment the user changes rapidly focus between the device (left upper, here to memorize visual clues) and the real environment (right upper); also sudden stops to visually browse the environment occur often

As in the story-telling scenario time to accomplish the task did not play a significant role, users stopped for a longer time to engage with the device and started off again when they already selected their direction. This has happened partially with the help of the map to locate the next spot of information, or by visually "scanning" the environment for next fiducials – which would in turn deliver new episodes of the story. Thanks to the slower and better planned motion in the story-telling field trial we could observe users building a cognitive map of the environment, they could locate elements of the story on the map and point at them. This detail would need further in depth investigation and would be a valuable research result for the starting field of pedestrian navigation systems to come to mobile phones in the next years.

Scale of the Mixed Reality Environment

Apart from the map display mode on the mobile device City Tales is working in a 1:1 scale urban environment, as the user has to actually move to the location of information. It acts as a full-scale story stage and requires locomotion in and interaction with it.

In the participative workshop when content was created anew the scale of the place was a problem. As we have used both static printed maps, as well as digital, scalable map displays going as far as 3D visualizations of the Naschmarkt we can conduct that we did provide all means of remote tools (Figure 31).

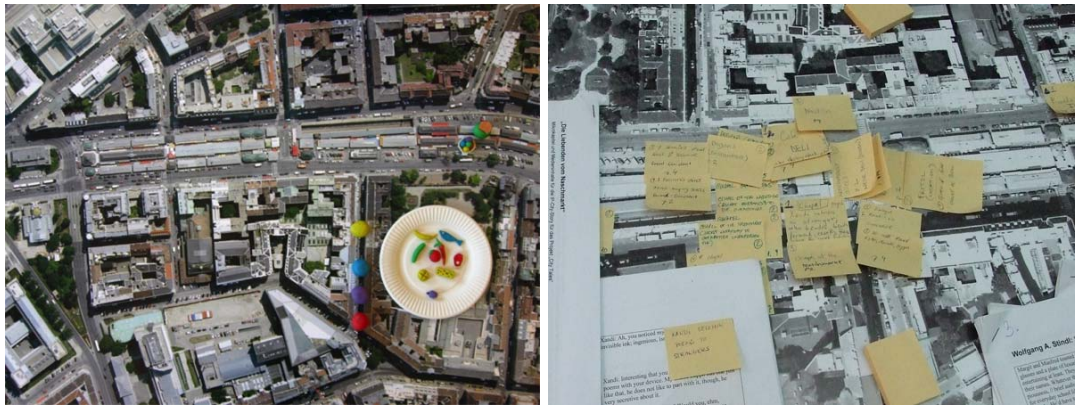


Figure 31: Scaled model-representations of the real-scale story-telling environment during the authoring process; (left – Sound Meal, right – Story-telling)

Nevertheless with all authoring groups we did intensive visits to the place as the locality, the pace, the real size can only be perceived on the location. Working *with* the urban environment in MR story-telling means also working *in* the environment!

6.3.5 Evaluation from the perspective of urbanism

The focus of the City Tales work package was set on providing mixed reality with an emphasis on story-telling in an urban mixed reality environment with user generated content that involves wide range of user groups. The aim was to investigate options to let users participate both actively and passively by enabling them to create mixed reality content via very simple user interfaces and providing technology to browse the these. On the long term our target is to make mixed reality content available to a mass market and by doing so take away the technology based stigmatism in and around mixed reality applications and to provide an alternative forum for urban development (Figure 33).

Relating to Space

The user can interact in different ways with the urban space: by strolling around in the search for content elements he or she creates a subjective map of the environment. Creating location based information and other actions of documentation, multi-sensorial perception of experiences and visualization the urban fabric contributes to place making as described above. In the fast paced games we experienced the lack of this map building (Figure 32).

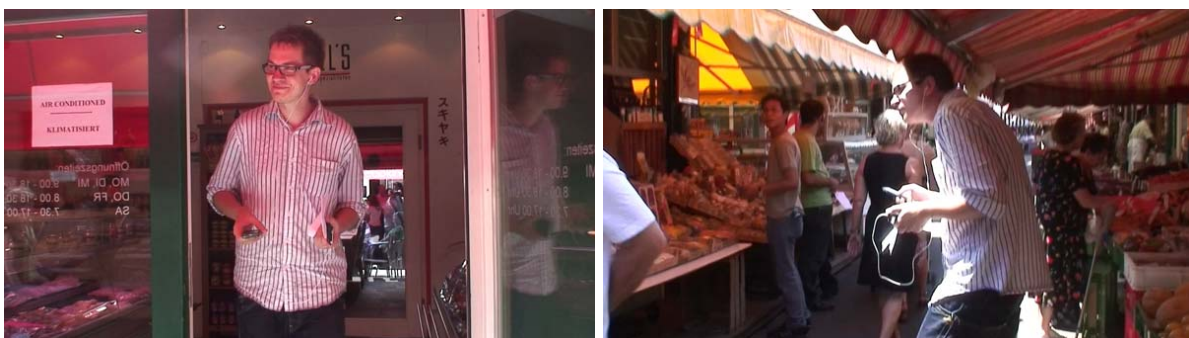


Figure 32: User entered a shop. When leaving he tries to remember the direction to follow, but lost orientation.

Manipulating Space

The urban scene is acting as both the object of observation and visualization and the support of a mixed reality system where real-actual environment and virtual past-future narrative expression reach a certain balance and produce a new experience of the city.

Augmenting Space with Content

Groups of users co-construct narrative layers of information that augment the urban space. These layers could eventually constitute coherent data that can be exploited by specific group of people: tourists, archaeologist, historians, students, professionals, associations, citizens of special interest groups etc.



Figure 33: Snapshot of the previous year's Wall-Blogging application and the Storytelling Application on Naschmarkt

7 Key Design Guidelines and Conclusion

7.1 Preliminary Findings and Guidelines

During the field trials and workshop presentations some intermediate questions and findings were communicated we would like to share and explain at this point:

- "Role play elements" – when designing an MR story the designer should consider the player as a participating actor, possibly provide a task or a certain personality to him or her. This gives them the ability to play through the perspectives of new characters with a background story related to the universe.
- "More advanced media types such as video and animated clips" – very quickly came the demand to set-up the MR-story as a multi-sensory, multi-media environment. Relying on one channel only does not get to the point.
- "Inclusion of more markers to tell the story in a more in depth way" – the density of the MR coverage plays a significant role in the persistence and continuity feeling. As we never reached the point of clutter or information overload yet, we can support this thought fully and hope that in a community based environment gaps are quickly closed.
- "How to start participation on story?" – during our field trials – especially the story-telling workshops – we have experienced, that the best approach is to create an "always on / always there" type environment, where participants are not directed to a specific location to start with. This question is tightly related to the model for story authoring we investigated and successfully tested, as described in section 2.3.3.
- "Where does the story end and how?" – as an answer to this question we reformulated it saying "Not where, but why ending it?". Again, with the model of a story universe one can overcome this problem as the episode like description the complete universe cannot be traversed in theory and the ending of one story-line does not necessarily mean the annihilation of the complete story world, see also section 5.2.2.
- "Existing „other“ content elements can create ambience for stories during playback" – the interplay between the real environment and the mixed reality overlay is crucial to the acceptance of such a system, see also key findings in following section. The border between the real existing and the virtually augmented can be washed away at some point in the story in clever way, when elements of the real environment are interlocked in the narrative at the same existence level as would "augmented artefacts" be. This overlapping of the real and virtual – and the uncertainty where one ends and the other starts – is the most interesting aspects in MR story-telling and should be explored much more in future!

7.2 Key Findings for MR story-telling and collaboration

As the summary of our work in coordination with the basic research and the other application work packages we have collected our results in form of key findings and guidelines that are created from these to be recommended to future content creators in the field of Mixed Reality story-telling:

Personal mobility is a key aspect in urban environment

and that is what highly influences the way content should be integrated into the urban tissue. Lengthy text, videos or MR content calling for more complicated interaction is causing users to settle at locations for longer times and distract from the flow in the city. This literally removes the user from the urban environment, transforming him or her into a foreign particle.



Left: in the very crowded and pulsating environment of the Naschmarkt target investigation area user (outlined person on left) often had to face encounters with other pedestrians (two ladies on left) so moving/walking while browsing content was a hardly possible option.

Middle: Two users (outlined) using one device clog the way, have to move close to the seated guests of a restaurant where the flow of persons is stopped, so they can concentrate on the content and share this among each other.

Right: User (outlined) is reading a lengthy text on the mobile device again standing in the way for other pedestrians. If such stops can be minimized the experience and the connection of it to the urban flow is much more viable.

Design guidelines:

Provide shorter experiences rather often than longer 'chapters'!

If text is needed keep it to a minimum, not longer than a minute to read!

Favour audio, video, MR, images, over text!

Use audio in a consistent and supporting way in high-quality as narration or to personate your characters. This can bring them 'alive'!

MR content for story-telling in urban environment is a valuable feature,

but not a continuous must. From our field trials we can deduct that story-telling on the go by just one type of media only creates an imperfect balance of sensual stimulation. As the urban environment itself excites us with visual, aural, tactile, etc. influences the mixed reality experience should not rely on one channel only! To tell stories a careful design and balance between text, imagery, audio and – what we call – "augmented artefacts" creates the best user experience.



Left: User is decoding a hidden poem as part of the story "The lovers on the Naschmarkt". After having identified the exact location of the content in the environment by finding the standardized fiducial marker the mobile phone is used to decode the content. The love poem is displayed as a virtual scrap of paper placed on the wall. Additionally the user can hear protagonist conversation as an addition.

Middle: the user passes even fences to decode 'secret' content, such as the 3D model of a mystic symbol of an underground society. Finding such 'augmented artefacts' enhances the story experience and engage users more in depth.

Right: User is decoding a marker placed on the ground, displaying a message augmented over the otherwise readable instructions and adds a message for the community. Tagging in 3D with content created by users on the go in combination with the urban environment allows extension of the metaphor to the community aspect.

Design guidelines:

Design the assets well to understand where and why to include MR-content!

Depending on the story universe this can be more or less, but it should definitely fit!

Go first to the actual location before starting to design something! Misfit MR content can ruin more than help.

The idea of "augmented artefacts" seems to create the best suspension of disbelief – objects or place extensions you would expect when entering the story!

Content integration into the actual urban environment

is the only way to create compelling stories! With the different scenarios tested during the course of the project and attempting to transfer content to other locations a very important finding influencing future urban story-telling was discovered. Relocating stories is hardly possible as taking out all urban context completely destroys the experience or creates an enormous overhead on the integration to a new site.



Understanding the place is a key issue to a successful story-telling experience in urban environments as we discovered. It is not enough to visit the place once as – especially busy spaces as the Naschmarkt – constantly change with the times of day, show different faces on weekends in summer/winter. To do this significant effort was put in "understanding" the place by creating a baseline for story-telling and investigations. Our experience suggests that this is crucial to any new project!



Left: Based on the knowledge of the locality the course placement of story elements is an offline procedure. Here the situation aware parts of the story are localized or in actually "staged" making it problematic to transfer the content easily to a new urban location.

Middle: On the fine level placement – in our case of fiducial markers – is an on-site task. Integrating the marker or/and the content attached to it influences the success of the experience. Embedding the marker next to other stickers on an advertisement poster seems natural and well integrated. In this case even the augmented artefact fits well as it displays a scrap of paper with a hidden love poem.

Right: Situations where the augmentation merges with the real can be really powerful. Here a dead person (outlined) is lying on the tracks of the subway that can be seen from a bridge within Naschmarkt area. In the story this character was murdered by an unknown person. Discovering him on the tracks really creates a moment of shock at the actual location as mind starts to process possible consequences of such an event!

Design guidelines:

Start from the real environment by investigating it deeply!

Do create the story in conjunction with the urban environment's features!

Do rather 'stage' – like a play for theatre, rather than write a book.

The improbable way experiencing the pieces of your story must warn you to create rather momentary 'snapshots' in the story-line acting at places, than a fully engineered story-line. Think of the MR-experience as a separate 'story universe' that you document and the user will enter to explore!

MR story-telling is a community building shared experience,

in the sense that users do interact, communicate both during and away from the experience what they have discovered or found interesting. Much like after holiday experiences which are shared in a group if participants who did visit the same location, users are sharing their distributed know-how on the stories.



Left two: Users – even while using one device or just meeting by coincidence – are sharing information discovered during their experience. In this situation their mobile device cached story elements that could be retrieved later. Originally this feature was integrated to shorten download times when returning to the same location. The feature was then rather used to show-off to others and synchronize what was found.

Right: In the "SoundMeal" urban game based on the Second City story-telling architecture users had to meet after a certain period in time at a specific location – the target shop of the actual round (see details in D9.4). This meeting point recurring during the experience regularly was encountered as a major event of the game as it provided the opportunity to exchange. In this field trial even the final aim of the game was to organize a picnic together what further enhanced the effect of community building.

Design guidelines:

Entering the 'story universe' brings users onto a journey! Make sure to prepare them for this – i.e. give an introduction how this story is to be perceived, some instructions how to discover the MR part of the experience.

Try to enhance the community building aspect with supporting acts that brings participants together for exchange, such as synchronised events occurring in time.

Giving the chance to contribute and designing a game around the experience opens back-channels, attracting to participate (see also below).

Adding content to a mixed reality urban story universe is attractive

and could greatly be a success factor for both social networking scenarios and commercial implementations. If given the chance and the access the motivation to add arises inherently not only in the current social network affine generation of youngsters, but also in the mind of professional authors, cultural heritage preservation specialists and further groups working in the urban context.



Process from upper left to lower right (1-6): When confronted to the author one of the urban stories (Wolfgang Stindl on the right in 1), participants of the IPCity Summer School started to develop an enthusiasm for the topic, as it was clear the MR urban story-telling environment is not a finished given situation, but rather a framework that allows extension, expansion and any further detail in-between.

After laying out the situation and developing a new idea how to extend the 'story universe' (2), significant effort was taken to develop details (3), content creation including audio recordings (4) were carried out and results were integrated into the database (5). The results were investigated on site (6) creating much applause and proud. We are very convinced that such a system rolled out into the real world could easily create a community contributing based on the same empowering motivation we experienced the most during the week of the IPCity Summer School!

Design guidelines:

Starting off with less content is shameful if system allows easy contribution. Do start rather early and ignite your users imagination to add their own contribution!

Focusing the stories around a dedicated user group (by age, by interest, etc.) will help to create a stronger attraction to the 'story universe' and thus encourage better to add content!

7.3 Conclusion and Future Outlook

Engagement of co-authoring users

Both IT-professionals and non-IT affine participants showed in our studies quickly the behavior of "contributing creators" rather than only "perceiving only users". Compared to our initial assumptions that the relation contributors vs. preceptors will not be equal, that more users will be passive participating in the system, while a small group of users will create more elements we had to learn that the mixed reality story-telling environment is very attractive. Community based content creation – like in other scenarios such as Wikipedia – is quickly appealing many creators to "publish" the own ideas. There is a characteristic pattern

that users are willing to extensively contribute especially taking into account the new possibilities given by a location based technology!

Immersion into the stories

Perceiving location based information on the spot the interaction of the urban surroundings with the digital information creates a mixed reality experience that is able to change our view onto the city rapidly. Strolling through an area with the augmentations provided, heavily alter the perception and engage users beyond the actual experience. Rather than specific elements of the story perceived on singular spots, narration or mixed reality artifacts the whole of the story experience is that what impacts most. Filling in the gap between the real and the virtual the users seems to be immersed into a parallel reality that allows for additions beyond what the authors of the actual story created and ignites imagination. This to some extent agrees with one position within the presence research community which argues that form as well as content (narrative), have an impact on the feelings of immersion and presence.

MR technology for story-telling

Using different prototypes during the actual phases of the project we conducted comparisons between the different underlying hardware/software solutions and user interfaces. One of the most encouraging – and also a brainteaser for future applications – is our experience showing the type of interface users are willing to enter into the field of mixed reality story-telling. The bottom line of our investigations show that most accepted are interfaces that do rely on the simplest interaction metaphor, including 'magic lens' metaphor to see virtual elements; map view to find elements nearby and narration to listen to virtual conversations and audio commentary. On the content creation side users do want to comment existing elements on site but creating new stories happens rather in an off-location story-telling process in the more traditional sense. This impacts to future content creation pipelines and will give rise to other technologies such as remote presence and the technology described as scouting.

(Re-)application of the methods, content and technology

Our own experiences with the application of the technology to story-telling, content retrieval and initial gaming demonstrated the flexibility of the construct. These results convinced other participants within the project – among them are TUG, TKK and Hit Lab NZ – to investigate our solution and apply its technology to their own specific problems within and beyond the scope of IPCity.

The amount of work to adapt the application to a different location is highly dependent on the quality of the content and its ties to the real environment. The system lives from the availability of the basic layer of content and the created stories. The Second City database was specifically designed not to include platform, location, system, client, and content specific limitations. The open architecture permits to enter data from other locations as well – so adaptation is content creation carried out by the community. Our findings show however that the created content is in fact published for the specific location, surroundings, local sights & sounds – making it either impossible or not advantageous to transfer to another location. This can be seen also as a big limitation to story-telling using mixed reality technologies as compared to a book one must enter the real situation to be part, we do however encounter here a new opportunity to see a new way of communicating stories on global scale using a new metaphor for staging ideas, thoughts and share imagination.

8 Dissemination

8.1 Events/Workshops/Trials

The dissemination activities at events, workshops, trials and the successful IPCity Summer School event is summarized in D2.9 and D1.15. Please refer for further details to those deliverables.

8.2 Technology

8.2.1 Second City Database

The Second City Database has been successfully proven to act as the data management backbone of large-scale, multi-user, geo-located, multi-media data databases. The flexibility of the database structure, the application of industrial standards, the use of widely available development tools and accepted content formats allows the easy integration of existing augmented reality clients, approaches, prototypes into the system. This integration capability creates a great opportunity to AR and MR experts worldwide – both commercial as well as non-commercial – to build large-scale AR application scenarios based on our technology.

The open architecture of the Second City database permits to enter data from different locations using diverse interfaces, such as Second City Flash User-Interface, Google Earth, the E-Mail attachment gateway, or the mobile Wall Blogging client. Our findings show however that the created content is in fact published for the specific location, surroundings, local sights & sounds – making it either impossible or not advantageous to transfer to another location. This can be seen also as a big limitation to story-telling using mixed reality technologies, we do however encounter here a new opportunity to see this as a new way of communicating stories on large scale in urban environments.

Apart from the internal use and integration of the Second City Database in following work-packages:

- WP9 – City Tales system with multiple clients, such as MR-Player, Wall Blogging, Walking Explorer, Authoring User Client, DB Management Interface;
- WP7 – MapLense application for data storage and retrieval of location based imagery

external projects are already making use of the database, such as research projects:

- AndroidAR – a HitlabNZ internal project to create AR applications based on the Android platform
- WorldWideSignpost – a TUG internal project to combine panoramic tracking with global coverage of augmented overlay data, see D5.4.
- several other non-public prototype projects based on the aspect of storing, retrieving data in a hybrid tracking environment on global scale.

8.2.2 MR-Player

Based on the framework of Studierstube ES (see D5.4) several mobile client applications have been developed within IPCity in work package WP9. The MR-Player described in detail in the Deliverable D9.3 and D9.4 and the Wall Blogging client described in Deliverable D9.3.

City Tales gaming and story-telling scenarios make extensive use of the Studierstube ES framework by basing the client application development onto this platform. The scenario of being connected to a distributed MR system calls for highly transportable applications as participants are possibly using different flavors of OS on their mobile devices.

MR-Player as one of the applications based on the Studierstube ES platform was presented at several testing and dissemination activities of IPCity, like the FET'09 Conference 'Science

beyond Fiction' in Prague, the IPCity Summer School 2009 in Vienna, MIRACLE Workshop 2009 in St. Augustin and a number of other presentations to academic and commercial world.

8.3 Commercialization

IMAG is in the phase of commercializing parts of above technology. At the moment of the deliverable submission additional details cannot be shared because of reasons of trade secrecy.

8.4 Publication

Scientific results on the evaluation, key findings and the technology in WP9 have at the time of the preparation of the deliverable not been published yet by IMAG, partially also because of reasons of commercialization. As soon as this process finishes we are considering to publish results together with partner TUG.

To preserve the stories created by the invited authors a non-linear to read book was published with three interconnected stories in 100 copies. The book was edited by IMAG and will be distributed throughout the final event and used to promote the research of City Tales within IPCity at marketing activities.



Figure 34: "Naschmarkt Geschichten" – non-linear fiction at a real place

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For further information regarding the IPCity project please visit the project web site at:

ipcity.eu