Providing services through online immersive real-time mirror-worlds. The Immex Program for delivering services in another way at university

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ABSTRACT

This paper introduces the "Immex" program, that experiences how to provide services through virtual immersive online real-time environments. The idea is to offer another way to share data and make it accessible within mirror-worlds. We try to gather the data disseminated in the information system of the university and present them at a relevant place and in a meaningful form to the user experiencing the simulation.

KEYWORDS

virtual worlds, metaverse, mirror-worlds, information system, data accessibility

1 INTRODUCTION

Universities are equivalent to big companies that generate a lot of heterogenous data targeted to various profiles of persons. They are organized around large campuses, with many buildings, and are difficult to apprehend for newcomers but also for other people, for instance when they are in need for a specific service for the first time. Even data centralized on well structured and urbanized information system (IS) [1] is not fully exploited because only a few experts are able to access and process it to generate information and integrate such content into a communication scheme. Examples of these could be websites information, maps, files, databases of all subparts of the university. To ease the apprehension of this information, a dedicated tool to discover and give access to all this content through a centralized, consistent and ludic environment may be an original solution.

The Immex "Immersion Experience" program aims at experimenting and providing innovative services based on immersive representation technologies. This initiative of the University of La Réunion tries to offer an alternative way (compared to traditional interfaces) to access content from information systems, in this frame, the IS of the university. The idea is to shape immersive environments to provide a first-person vision, as if the user was immersed in a simulation. The virtual world, or "metaverse" [10] , reproduces the real-world environment, that is why it is called a mirror-world. It naturally associates documents and digital services with their geo- positioning to create a serious game [11] .

In this paper we first present our past related works and the new approach we engaged in for Immex. Then we describe the created environments, their services and the results of a first survey conducted with users. We conclude by a discussion and the perspectives opened by our work.

2 Previous experimentations and methodology

2.1 e-Campus

e-Campus was a virtual world reproducing the campus of La Reunion island university [9] . This platform was created between 2004 and 2007 in the context of a collaboration between the university and a private company specialized in video games. During 3 years, this project funded by the European Union, the French Government, and the Regional Council of Réunion, allowed a team of computer science engineers, computer graphics experts, animators and designers to create a desktop software reproducing accurately the central part of the campus.

This connected application was based on a game engine initially dedicated to Massive Multiplayer Online Role Playing Game (MMORPG). It provided the same video game features that can be found in a real campus: persistent world and massive multiplayer support. The aim was thus to provide users (students, teachers and administrative members) with the e-services a campus gives, from the online courses [10] to the restaurant's menu, through immersive representations. Eventually, the project did not meet with the numerous expectations in terms of services, mainly because of the game-engine limitation.

2.2 Immex Approach

Since 2011, we decided with Immex to try a new approach, in several ways at the opposite of the way e-Campus was conducted. Indeed, e-Campus was a big project, based on european fundings, employing a team of engineers, qualified computer graphics experts working on blueprints, collaborating with companies mastering proprietary tools and technologies, like their own 3D engine, landscape generator and data integration softwares.

Thanks to the evolution of the 3D engines market, 4 years after e-Campus, an accessible offer had raised and we have been able to evaluate and compare their features. The requirements to create immersive environments had changed to allow more flexible developments. We then decided to make Immex as a program made up of several projects, each project being a virtual environment, offering its own services. At the opposite way of the e-Campus project was conducted, we worked mainly with students, during courses, pedagogical projects and through internship. Focusing on services more than visual appearance, we accepted the fact that the Immex environments will not have the same accuracy and modeling optimizations offered by experts work. However, working with students provided us with a larger team, able to reproduce and cover a larger area, eager to learn and reproduce their campus in order to play in it. This approach also have the advantage to require a dramatically lower funding.

3 Immex Environments

As we explained, the Immex program is composed of several projects, each one corresponding to a metaverse. 6 mirror-worlds were created to experiment a wide variety of services that make sense depending on their nature. They can be sorted in the 3 categories presented below.

3.1 Campuses outdoors

Campuses outdoors refer to the possibility to explore the outsides of the building composing the campus. The aim of this modality is to allow the user to navigate and discover the campus through its whole reproduction. The spatial range of the area is wide and the accuracy of the models approximative. Three of the main campuses were reproduced:

- Moufia Virtual Campus. This metaverse is one of the first realized, as it reproduces the largest campus of the university. Almost all faculties, services, departments or laboratories have a dedicated area in it. The basic outdoors services were experienced in the Moufia Virtual Campus.

- Virtual UTP. UTP stands for University Technological Park and refers to the campus located on the science park of the city.

- Tampon Virtual Campus. This campus is located in the south of the island and has specific infrastructure for sports learning.

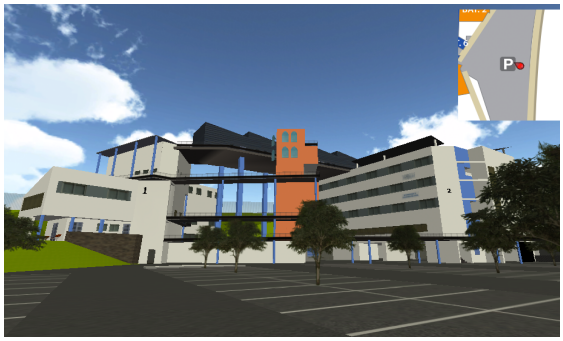

Figure 1: virtual UTP metaverse

3.2 Inside building focus

As its name refer, this type of metaverse focuses on one building and its related features and services. A special effort is made on the presence of the tools and objects available in the place. 2 particular indoor environments were created:

- Virtual Library. This project was developed with the documentation service of the university, in order to provide some of the services offered in the real world, through its virtual reproduction. Each year, new students visit the building in small groups, an event which causes disturbance to regular users. The idea of this virtual environment is thus to allow them to discover the place and its services through the playful approach of the project.

- Virtual Data Center. The University of La Reunion owns a state-of-the-art Data Center that hosts several servers. The building matches high-end security standards, with restricted access, an attractive configuration could lead to commercial offers for partners. That is why, the information system service partnered with Immex program in order to ease the visit and the promoting of the place though a metaverse.

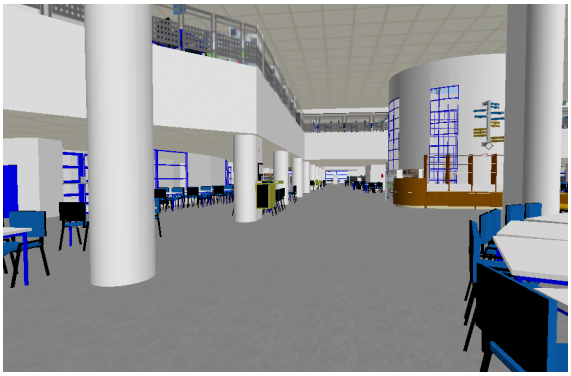

Figure 2: virtual Library metaverse

3.3 Complete environment

Complete environment refers to a place where the outsides and the insides of the buildings can be visited. A compromise had to be found between level of details and the range of the reproduced area.

The Virtual Maïdo project is dedicated to the Atmospheric Sciences Observatory at La Reunion. This scientific station is difficult to access (away from all cities, located 2200m above the sea level high in the mountain), with an instrumental set composed by more than 40 instruments. The LACy laboratory, that runs the Observatory, teamed with us to create a virtual immersive replica. Their goal is to ease the discovery of the site, the buildings and the main instruments for general public, but also for researchers who will have to carry out missions there.

Figure 3: virtual Maïdo metaverse

4 IMMEX SERVICES AND TECHNOLOGIES

As we worked for data accessibility, we built Immex with technologies providing the easiest appropriation level for end- users. Each metaverse is available through simple a Web page, using a Web-browser and the Unity plugin from Unity Technologies [6] . We also had the constraint to not force content providers, who feed the information system, to modify their practices. Our services must adapt to the IS the way it is but not try to change it. Each metaverse was the opportunity to develop and test new services that can be sorted in 3 categories.

4.1 Movement-based services

The very first natural service offered by a real-time metaverse is the possibility to freely stroll in the environment to discover its structure from several perspectives. This requires users to be able to move in the direction of their choice inside the 3D space. As a first person point of view was selected for this program, we chose to rely on the most common interaction scheme based on keyboard (to move) and mouse (to set the angle of viewing). This tend to be rapidly natural as most 3D immersive video games rely on this convention. But to help those who are not used to navigate in an immersive environment, we implemented 3 features:

- assisted moves, when toggled, this feature limits the angle of inclination of the vision to 20° above and below the horizon, and reduces the speed of movements. Indeed, we noticed during early testing that certain users were uncomfortable with first person view resulting in them looking to the sky or the floor because of bad mouse control.

- point and click to move, so that it is not necessary to master the combination of mouse and keyboard to reach a visible location. The application calculates the shortest path, getting around the obstacles, and automatically moves the user to the targeted place.

- reset position, that restores the initial position of the camera when the defined key is pressed. This feature is useful if the user feels lost or in case of bugs (for instance an invisible hole in the floor).

4.2 Orientation-based services

These services aim at helping users to realize where they are, find their way to the place they want to go, and match their experience in the virtual world and its counterpart in real world. To achieve this goal, we developed 6 features:

- mini-map is a classic of Head-Up Display (HUD) for Graphical User Interface (GUI) yet useful to comprehend the direct surroundings.

- global map, when the dedicated keyboard key is pressed, displays the full map of the metaverse and locates the user on it.

- panoramic jump, for outdoors metaverses, produces the highest vertical jump possible, while tilting down the view. It offers an automatic, smooth, transition sequence between

the first-person view and the global map representation. It is a link between immersive view, 3D view, and 2D map.

- photo-sphere, positioned as an icon at interest points of the environment, triggers the immersion in a sphere whose interior is textured with a 360° photo of the real place. This feature completes the immersive view, which is flexible but limited in term of Level Of Details (LOD), by providing a panoramic photo which is a detailed point of view from a fixed position.

- navigation to remarkable place offers an automatic guiding, adapted to the current position of the user in the metaverse. At anytime, the user can display the list of remarkable places of the metaverse and select one of them. This action triggers an analysis of the shortest path and an automatic driving to the chosen position.

- introduction sequence, as its name refers, is the integration of a video that introduces the environment and the original position where the user is placed at the beginning of the simulation. For outdoors metaverses, a relevant approach is to match the end of a sequence shot with a drone that lands in a particular position with the same position in the virtual world, hence allowing the user to start his exploration at a well defined place. It provides a smooth transition between the realistic view of video and the simulation.

Figure 4: remarkable places list with automatic guiding

4.3 Information-based services

These services aim at offering information to users experiencing the simulation. The idea is to gather information from the IS and dynamically connect it with the virtual environment. Several modalities were developed in order to disseminate the provided information:

- contextual information automatically displays a message depending on the location of the user in the metaverse. It is a static information whose appearance is triggered by the user entering into a geographically defined area, often near a building or in a room.

- dynamic data injection refers to the importation and display of files in the metaverse. Their appearance is adapted to the needs and actions of the user in the simulation. We implemented the connection between a 3D object and several file formats : plain text to provide textual descriptions of buildings or instruments, Really Simple Syndication (RSS) to automate the display of up- to date news, and pictures that dynamically wrap a 3D model when the metaverse is loaded. Indeed, in our case, university campuses support offices have their own websites that regularly post news referenced as RSS feeds. We added a board on their

respective buildings to indicate the availability of news. When no RSS feed is available, and the information is only shared on static websites, we used an automatic and periodic web-page cutting system that generated a picture used as a texture. This allowed us, for instance, to display the menu of the university restaurant. As this feature can be triggered by clicking on an object or a specific keyboard key, we used this latter with textual input to display all the simulation commands and the application credits.

- 3D information layer allowed us to represent specific information, dedicated to a particular metaverse, through simplified visualisations. These layers can be activated on demand, like in Geographic Information Systems (GIS). In the frame of Immex, we experienced a static representation of the position of WiFi and its coverage

- educational module is a short scripted experience where the user must accomplish a succession of tasks to fulfill a mission. It is a mini-serious game dedicated to a specific environment. For Virtual Maïdo, we developed an educational module simulating the main steps to activate the atmospheric laser of the station, acquire and visualize data.

- web-link allows to connect a model in the metaverse with an URL. On click, the link is triggered and either downloads a file or opens a popup browser with the targeted web-page. We used this feature to connect the main buildings of the university faculties, services, departments or laboratories to its dedicated website. It is another way to navigate between the websites of the university, through the positioning of their infrastructures.

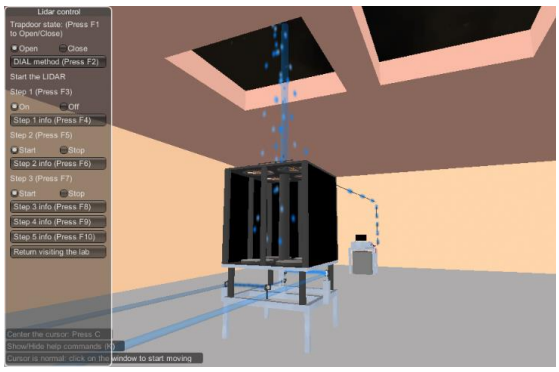

Figure 5: educational module in Virtual Maïdo

5 FIRST FEEDBACKS

As Immex aims at offering new ways of accessing content for university users, we found useful to set a survey especially dedicated to students (but not only) at an early stage of the project. The goal was to determine their profile regarding immersive technologies as well as to gather their feelings toward the Immex environments. 50 replies were obtained, 3 from university staff and 47 from students ranging from first postgraduate year to Master of Science in the fields of Laws, Economics and Computer Science. The number of participants involved is not so high, but it is sufficient to gather early feedbacks that are to be used firstly to set development directions for the future and secondly to prepare a larger evaluation stage. In the frame of this article, they are useful to present a trend on how the community welcomes such a service.

All testers were thus presented the application and the first choice they were given was to try it on their own or not. One quarter of them made the effort to install the Unity plugin to access Immex outside the campus. This is a first interesting feedback because this particular action requires the user to have the knowledge to download and install such a plugin. 91% of the persons who tried it reported that it was a very simple action. This is quite

encouraging as this plugin is a requisite until a real time 3D-content playback standard for the Web emerges. Indeed, WebGL [8] and X3D [4] are interesting technologies but despite their support from major organisms and companies (including main browsers editors), they are not so popular.

The second point that was evaluated was the maneuverability. This is a major concern as moving in a 3D immersive environment with a first person point of view is of course easy for gamers (the typical controls are always the same whatever the application is) but may be difficult for newcomers. Regarding this point, 83% of testers responded that it was easy, an answer that goes beyond the number of students in Computer Science who might be sometimes considered as a specific public, who tend to be more used to videogames. Ease of use was also rated as rather good as only 20% of testers found Immex quite hard to use. The same feeling was perceived concerning the attractiveness of the solution, with the same amount of users seeing it as low.

Finally, the last aspect evoked was related to the desirability of features. Each person was asked to rate the following proposed features that are specific to immersive worlds: Figure 6 shows the feedbacks for each one with a visualization ranging from 1 (= no interest) to 5 (=strong interest). All the features receive a rather positive opinion, therefore it is interesting to focus on the subset of them which are shown the strongest interest. The most awaited ones, features (b) and (c) and at a lower point (a), relate to spatial localization indicating that users are very concerned by the relationship between the real world and the virtual world for their moves. The social aspect of the virtual environment then follows : a strong interest is shown from more than one user out of three for feature (g) which aims at enabling virtual interaction. This can be explained by the current trend that promotes various social media along with mobility. Quite surprisingly, using the application to study and learn in the 3D space is less popular than the previous features.

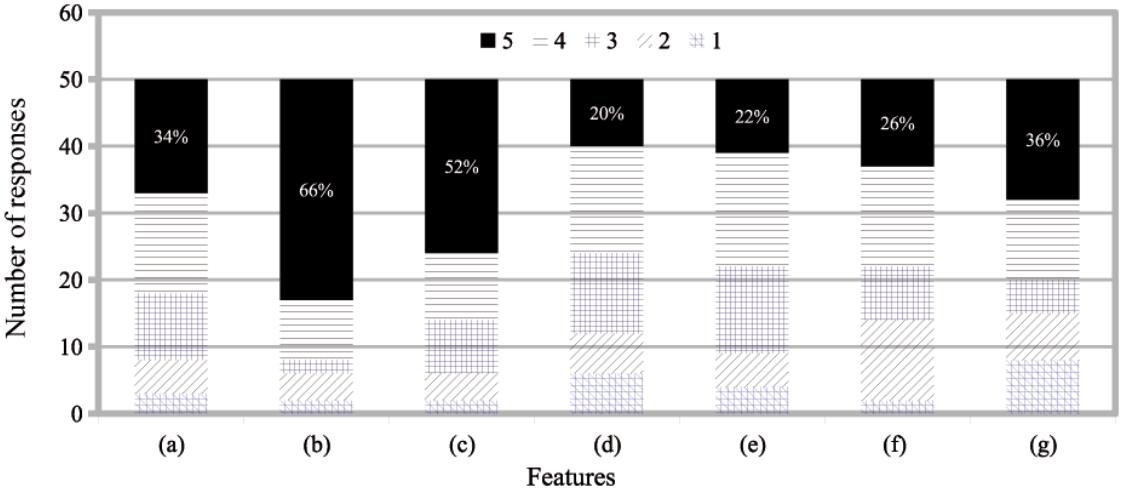

Figure 6: interest in several services

(a) Virtually visit of technical or scientific locations that are not opened to general public
(b) Locate a place before having to go to it
(c) Benefit from a visual guidance system to a building or a room
(d) Match buildings or rooms to their corresponding website
(e) Retrieve contextual information by clicking on 3D objects
(f) Learn new knowledge in 3D worlds dedicated to a given topic
(g) Enable discussions and interactions between campus users

6 DISCUSSION

Through the different projects of the Immex program, we increased the number of services. The idea is to match the needs of the two main types of users: those using the simulation to freely stroll in the virtual environment and discover the experience, and those who came with a precise idea and want to fulfil a goal, like identify the path to reach a precise place.

For each new environment, we tried to deploy the previously conceived services and imagine new ones. In terms of re-usability, the services could be sorted in 3 categories:

- replicable services rely on scripts and assets that can be directly deployed from a scene to another. For instance, it is the case for all the presented movement-based services.

- transposable services is about features that are relevant from a metaverse to another one, but need transformation in order to be adapted to the new environment. For example, the navigation to remarkable place had to be adapted from the Moufia Virtual Campus (lead to a specific amphitheater) to the Virtual Library metaverse (lead to a thematic section, adapted to multi-floor building).

- specific services are dedicated to a specific environment. It is the case for educational modules : the mission to activate the atmospheric laser obviously only makes sense for the Virtual Maïdo environment. In this way, even if these services are often the more relevant in the context of a virtual world, they also are the less re-usable.

If the information based services represent our main goal, we realized that we spent a lot of time creating services dedicated to movement and orientation. Indeed, as evoked previously, we made the university community test our metaverses during the whole developing process [7] . Depending on the public, we received feedback about the three categories of services in different proportions. Elderly and middle-aged colleagues mainly focused on their movement and orientation difficulties. Implementing these assistance services was a necessity. To work on data accessibility, we first had to ensure a good level of appropriation of our simulations.

Once the helpers are in a mature state, it is possible to focus on information based services, namely, develop more connectors between the university IS and the metaverses. A challenge is to find a way to enrich the data so that they can be represented inside the virtual environment. Although a transitional approach is to use a simple icon that links outside the metaverse though a popup, the best integration scheme should avoid to force the user to change the environment and allow him/her to consult all informations directly in the 3D space.

Thus, apart from developing a connector, integrating a piece of information in a metaverse means identifying:

- a proper representation, that is to say a 3D model with the suitable texture to display information,

- a precise position (geographical positioning and orientation/inclination), obviously, in mirror-worlds, the geo-referencing of each object is strongly linked to its use,

- a behavior, when the user will interact with its representation. For instance, a 3D chart should orientate itself toward the user in order to ease its reading whatever his approach is.

That is why our recent researches led us to conceive a module dedicated to the

centralization and the enrichment of information, in order to prepare their injection into multiple metaverses through metaphor of representation. The idea is that this metaphor instantiation system (MIS) would gather the connectors and the data flows to the IS so that human content provider can choose what piece of information should be inserted in a given metaverse, at a given place and through a given representation to support a specific interaction. Thereby, a component added on each metaverse would, on each load, check MIS and fetch each flow dedicated to him. This system is currently in early development stage in our team and focuses on connectors with the pedagogical and schooling parts of our IS, in order to involve students.

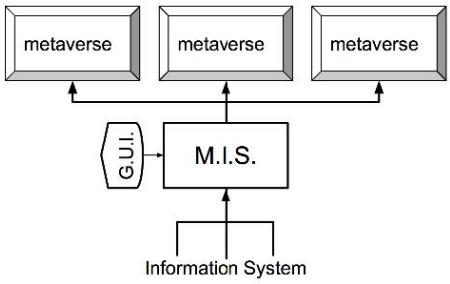

Figure 7: MIS positionning in IS

This system could also be used for 3D objects that have a direct representation in metaverses, but need to change their arrangement regularly. For instance, Virtual Library was modeled as a reproduction of all the shelving and indexing configuration. However, this configuration changed and the static positioning realized is now obsolete. By using a module like MIS, it would be possible to insert all shelves dynamically and let the library staff change only their positions when needed.
Apart from this major structuration work that targets to facilitate the filing of the virtual worlds the automation and reuse of processes, we are also considering two ways to enhance the experience of the simulation. The first one is the possibility to personalize the virtual worlds. Indeed, in the frame of the university, users have different roles and access to different flows of information. For instance, researchers working on Virtual Maïdo instruments can access in real time to all the measures provided by the station sensors. By authenticating them before their immersive navigation, a click on each three-dimensional reproduction of instrument should allow them to access their data at the level of accuracy they are granted for. In the same way, an authenticated student should easily access his personal course schedule on campuses.

The second enhancement we are considering is to offer a multi-users experience. It is one of the major feature we lost from eCampus, who was built on an MMORPG engine, to Immex. Indeed, the current simulation let the user visit virtual worlds full of objects but empty from people. First feedbacks also encourage us to develop this feature. Even if the experience does not support a massive amount of users, group simulations could improve the experience [2] and allow new kind of collaborative educational module scenarios [3] .

7 CONCLUSION AND PERSPECTIVES

In this paper we presented the Immex program, that aims at providing services through virtual, real-time, online environments. As we have seen, Immex is more than just a collection of virtual worlds or a list of features : it is a real attempt to experiment and offer users an alternative to discover and share information in an alternative, ludic way. First feedbacks are encouraging, especially those from young students, although we also produced services to ease the use of older publics.

Future developments of the program aim at centralizing the data flow in a module that will enrich it and dynamically inject them in the targeted metaverses, through the chosen appearance. An improvement of the user experience will also mean offering simulations supporting personalized multi-user to open a

new field of interactions and learning oriented toward serious gaming.

ACKNOWLEDGMENTS

The Immex program was funded by the UNR RUN-CO and the French Ministry of Higher Education and Research. The authors are grateful to the university services that contributed to the program. We also would like to thanks M.-H. Rakotobe, C. Porlier, P. Letellier and all students that worked on the Immex program.

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