E-GOVERNMENT AND POLICY SIMULATION IN INTELLIGENT VIRTUAL ENVIRONMENTS

Fotis Aisopos[i], Magdalini Kardara[i], Philipp Senger[ii], Roman Klinger[ii], Athanasios Papaoikonomou[i], Konstantinos Tserpes[i], Michael Gardner[iii] and Theodora Varvarigou[i]

[i]*Distributed, Knowledge and Media Systems Lab National Technical University of Athens, Greece*
[ii]*Department of Bioinformatics, Fraunhofer SCAI, 53754 Sankt Augustin, Germany*
[iii]*School of Computer Science and Electronic Engineering University of Essex, Colchester, UK*
{fotais, nkardara, tpap, tserpes, dora}@mail.ntua.gr, {philipp.senger, roman.klinger}@scai.fraunhofer.de, mgardner@essex.ac.uk

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Abstract: Recently, there has been an increase of interest in the social impact of virtual reality technologies, as virtual worlds experienced an increase of their popularity in various social groups (teenagers, businesses). The growing trend for people to spend more time in suchlike virtual spaces implies a demand for intelligent virtual environments, that could mimic the real world as a simulation and provide functionalities and tools for behaviour analysis and adaptation to user preferences. Within the context of e-government, this paper presents the ongoing project +Spaces, which is developing a range of virtual environment tools. The platform architecture is presented and technical challenges involved in creating intelligent virtual spaces for e-government as well as draft policies to be used in role-playing simulations are discussed.

1. INTRODUCTION

With the emergence of the 3D internet and the appearance of 3D virtual worlds (VWs) and social networks, for social and business purposes, virtual environments have established themselves into people's life. VWs consultancy K Zero has reported that registered accounts in the virtual worlds sector have reached 1.7 billion during the fourth quarter of 2011, having an increase of 125% over the last two years (KZero Worldswide, 2012). Social networking services, however, still have the biggest market share, as these communities are visited by 67% of the global online population (Nielsen Reports, 2009).

The increase of popularity implies a great social impact of those environments over various user groups. Thus, there is a great deal of interest in using immersive virtual environments for a range of "intelligent" applications, adapting to the preferences and behaviours of the users. The user virtual reactions as well as their social graphs (graphs representing the connections between users of a virtual world) would be useful to be exploited as much as possible. Social networks and virtual worlds harbour a huge amount of structured as well as unstructured data, which can be beneficial for political analysis.

Davies (Davies et al., 2008) reported on how intelligent virtual worlds can be used to simulate real spaces such as an intelligent campus. He described iCampus, which allows people to inhabit a virtual environment, interacting with each other and with devices in a similar way to a real campus. Within this space there were simulations of smart spaces which included the University of Essex' iSpace and MiRTLE facilities (Gardner et al., 2008).

+Spaces ("Positive Spaces" – Policy Simulation in Virtual Spaces) is exploring how virtual environments (virtual worlds and social networks) can be used to allow government bodies measure public opinion in a large scale and maximize the value from prospective policy measures by leveraging the power of these communities. Thus, it is building a range of intelligent applications, varying from polling and debating applications to more advanced role-playing simulations for such environments. This paper presents those applications as well as scenarios illustrating how they can be used to achieve mass participation of citizens and extract valuable conclusions from their behaviour.

The paper is organized as follows: Section 2 describes the current practices on e-government and presents the idea of +Spaces. Section 3 presents the +Spaces applications as well as the supporting intelligent mechanisms for virtual environments, while Section 4 provides implementation scenarios and the platform architecture. Finally, Section 5 presents initial results of the first project pilot including the poll application and Section 6 the conclusions of the current work.

2. PROBLEM FORMULATION AND RELATED WORK

2.1. Current Practice

Over the last years, there is a growing trend for citizens to influence the decision-making process, something that yields many important benefits (Irvin et al., 2004), also encouraged by new technologies allowing mass participation. Government agencies also seek to refine their policy-making processes by assessing the impact of prospective policies on the society prior to their implementation. The advent of the internet and its pervasiveness in Western societies led many developers to create applications based on mass participation, using opinion polls and forums to exploit the crowd sourcing philosophy (Jaeger, 2003).

Nonetheless, these tools have not met with the high expectations that agencies had of them (Scott, 2006 and Grönlund, 2010), for a number of reasons: Firstly, most e-government tools are predominantly applied using their own portals, lacking scaling (Oostveen et al, 2004) as they focus on specific groups without being able to easily extend them (e.g. beyond national level). Secondly, due to their very nature, they have a narrow focus, both in time and subject, on specific and simple topics, failing to provide a holistic, long-term view. Thirdly, participation is restricted to a minority, namely citizens motivated enough by the issue in question to invest time in participating, or specific target groups (Phang et al., 2008). Government agencies need to rather take advantage of existing forums in which a representative distribution of individuals from all socio-economic and cultural backgrounds exists.

2.2. e-Governance in Virtual Spaces

In this context, the term "Virtual Space" (VS) is not only restricted to 3D virtualized environments, such as Second Life, but as well referring to other worlds allowing users to socialize online, such as social network platforms. However, although 2D networks also provide the ability for their users to "live" in these spaces, it is the 3D virtual worlds that emulate some complex socio-economic aspect of real-life through an open-market concept, not reaching, though, the popularity of 2D networks, as shown above.

The most evolved virtual worlds have rules and regulations analogous to a legislative framework. In worlds such as massively multi player online role-playing games (MMORPGs) like World of Warcraft, and life simulation games like Farmville, virtual economies exist with their own currency and rules defining the possession and persistence of property. Virtual items can be bought and sold between individuals for real money (Guo et al., 2007). Spontaneous effects including mass-protests, crime, and harassment, with consequent population migrations have been witnessed in these environments (Jenkins et al., 2007). In each of these examples, participants tend to extend their personality through their avatars (Castronova, 2005).

Virtual spaces in general allow individuals to present profiles of themselves, oriented towards work-related contexts, romantic relationship initiation, or connecting those with shared interests (Ellison et al., 2006). Social networking is now often used in political campaigns (Powell, Richmond, & Williams, 2011). The existence of the conditions mentioned above implies an economic and political system with properties similar to those seen in real economies. Several aspects of economic theory could be used to study virtual environments, as significant research has been conducted towards the direction of relating virtual world economics to the economics of the real world (Ondrejka, 2004), (MacInnes, 2004). The relative liberty and anonymity between users, provided through the use of avatars, can reduce the power of peer pressure to conform to societal or cultural norms and stereotypes. For example, in 2007 Italian workers of an international organization went on strike. About 1850 workers expressed their strike related activities across the organization's various sites in Second Life (Attwell, 2008).

Figure 1: Virtual demonstrations in Second Life

2.3. The +Spaces perspective

As derived from the previous paragraphs, virtual spaces seem as an ideal "microsociety", mimicking the real world, where large numbers of citizens can debate on simulated legislations and policies. Exact real-world simulations, however, involve some form of implementation of a game-like environment e.g. public transport or a marketplace, which represents a real-world situation. This can be impossible to implement, requiring an accurate representation of a real-world setting within an artificial virtual environment. The alternative scenario decided to be followed in this work, is to focus on existing virtual spaces in which users are already collaborating with one another, such as online e-learning virtual worlds mentioned above, already providing a simulation of a real-world activity (i.e. learning).

+Spaces aims to provide policy makers with the means for testing their legislation through such applications in a number of virtual environments, coupled with technologies for aggregating, filtering and analysing this information. Information derived from those environments is then represented in an appropriate fashion to enable policy makers to draw conclusions on the potential outcomes of the policies they propose. Our work also targets at increasing participation in this process through social networking sites and extend it to new social communities who are currently not heard. 2D virtual environments can help e-governance applications to achieve critical mass in the participation.

3. CREATING POLICY MAKING APPLICATIONS IN VIRTUAL SPACES

3.1. +Spaces Applications

+Spaces aims to act as a mediator between government applications and virtual environments. The functionality of +Spaces is exposed through a usable API that allows application developers to implement and deploy experiment applications on various virtual spaces and provides tools to support those, by processing and analysing aggregated data, grouping user behaviours and protecting the platform from malicious use. Interaction with citizens in +Spaces involves sensitive personal data, thus it is necessary for all users to give their consent prior to participating in an experiment. For validating the platform, three policy making applications have been selected to be used, presented in the following sections.

3.1.1. Polling

A polling application is appropriate for investigating policy issues requiring only simple feedback. Polls typically include presenting a topic with one or more questions. Questions may encourage various types of responses, selecting a single or multiple possible answers or providing a level of agreement with a statement, giving unstructured text-based responses. From a virtual environment perspective, a poll is a simple forum where people provide feedback through their avatars/profiles. In +Spaces, it is formed as a public polling booth that only one user can take control of at a time, taking into account users' privacy. The main advantage of polls over other applications is that they enable strictly defined questions, so they are appropriate in cases where such definition is possible.

3.1.2. Debating

Unlike polling, the debate application requires not only quantitative but mainly qualitative feedback from the citizens. Debating experiments are initiated by presenting a topic of interest, raising various arguments and questions, and calling for responses. Participants' contribution to debates, synchronous or a-synchronous, is typically not structured, and relates not only to the initial statement but also to other users' contributions. Through debate application, users of virtual environments experience the sense of participating in a meeting, hearing opinions, and even expressing their opinions. For virtual worlds, a scenario as such can be illustrated in the work of Drew Harry (Harry et al., 2008), exploring novel ways to support meetings in those worlds, including elements of both polls and debates (**Error! Reference source not found.**Figure 2).

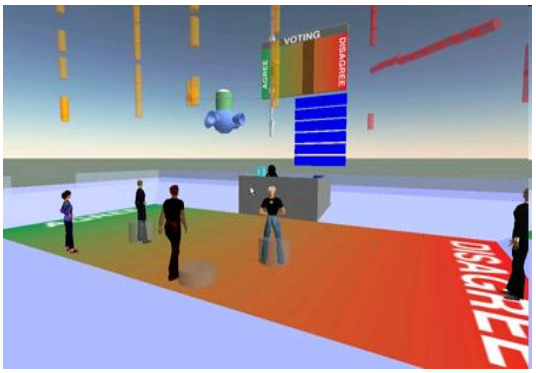

Figure 2: Debating in a virtual world meeting space

3.1.3. Role-playing Simulation

The role-playing simulation applications are the most challenging to implement, providing a virtual space in which the participants are assigned roles (e.g. policy maker, civil servant, local government agent, citizen, etc.) to act out a particular government policy scenario (e.g. implementation of a new waste removal service by private contractors) through an online role-play simulation activity. In role-playing, even when acknowledged to be artificial, participants adapt their personalities to their roles, as in the case of Stanford prison experiment (Zimbardo et al., 2000). The role-play simulations can take place in a virtual world visually recreating the location of the intended policy (e.g. town hall, local street), using the appropriate avatar's outfits and respective rights, to approach simulation as much as possible. By monitoring users' behaviour throughout the whole role-playing simulation and analysing it via an intelligent data analysis service, we can investigate the effect of the applied changes to each role.

3.2. Intelligent Virtual Spaces

In Figure 3, an overview of the information flow in +Spaces can be seen. The last stage before all data is collected from virtual environments to be distributed to policy makers are the recommendation and reputation functionalities, as well as the data and statistical analysis. Those operations are adding 'intelligence' to the platform, processing data from the virtual spaces to derive new information. They include tasks such as performing data correlations and graphs for policy makers, recommendations for virtual environments users etc.

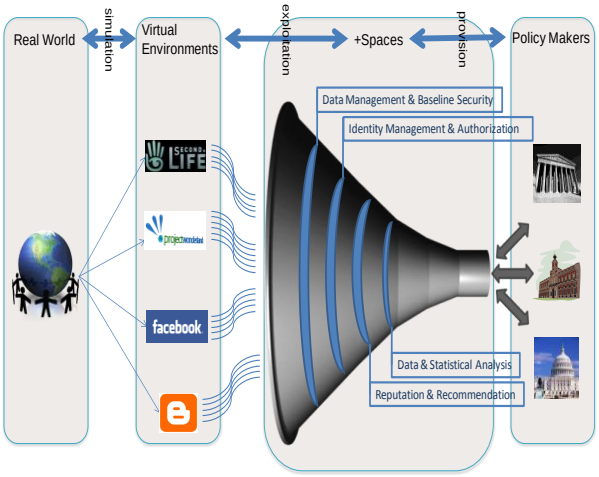

Figure 3: +Spaces data flow

3.2.1. Recommendation Service

In +Spaces, the recommendation service uses content-based techniques, to provide personalized recommendations to virtual environment users, proposing experiments of interest (Guy, et al., 2009)and recommend participants for a new experiment. This supports the platform by attracting people to different polls and debates, based on their own and their friends' behaviour. Based on their profile, they may be invited in a particular virtual space, for a role-playing simulation.

Thus, this service also assists towards creating a critical mass for the project scenarios. A recommendation may be initiated by the experiment owner himself, by providing an initial list of potential participants during the creation process, which will be passed on to the Recommendation Service by the middleware. This capability makes the virtual environment more attractive to users, and helps with the diffusion of +Spaces applications among users (Freyne et al., 2009).

3.2.2. Reputation Service

The reputation framework depends on users' actions and social network. For instance, the popularity of some users or the positive responses to them in debates can contribute to their reputation. Information derived from this service is essential to analyse the user behaviour, filtering the data delivered to the data analysis service. The main scope of this tool is to identify patterns of malicious behaviour, and assign low reputation rates to such users.

Additional types of reputation are involvement, influence, etc. that weigh experiments' participants.

Based on the reputation rate is passed on to the data analysis mechanism, the system assesses each user's credibility and trustworthiness. The results of the reputation service is used in order to support the experiments moderators, who can potentially ban or mute malicious users.

3.2.3. Data Analysis Service

The data analysis of the different types of applications provides aggregated information about the results of a question of interest. In polls, according to a main question we get the distribution of different answers in pie or bar charts. To further investigate the results, another question can be selected as a filter for the results, or a filter on demographic data can also be applied to those.

Debates are less structured, consisting of a chronologic and not contextual sequence of different free text contributions. To get an overview of the debate topics, we incorporate latent Dirichlet allocation as topic models (Blei et al., 2003). This results in lists of the most important words representing a topic and links between them, in an intuitive overview of the whole debate structure and development over time. Additionally, an adapted sentiment analysis (Kim et al., 2006) is applied, to assign a measure to each topic.

In role-playing simulations, a combination of the previous tools combined with clustering algorithms leads to a specific and detailed analysis of each. The outcome provides an analysis, which records the changes in the opinion of the participants on arguments and/or time. This can especially be coupled to debate analysis, to understand the reasons of certain user behaviours.

4. IMPLEMENTATION ARCHITECTURE

To bring all these capabilities together, a service oriented architecture is created, based on loosely coupled distributed services, ensuring flexibility and fault tolerance and also safeguarding the anonymity and confidentiality of the sensitive data processed within the platform. Towards interoperability, we abstract each virtual environment's functionality to a basic set of services that are exposed in a standardized way, to create a so-called middleware. Hosting the services outside of the platforms enables combinations into larger application workflows, thus we deliver both platform and software as a service.

A high level view of the architecture is illustrated in Figure 4. The +Spaces platform acts as the middle layer between the underlying virtual platforms and the e-Government application layer that allows policy makers to deploy and manage applications through a Front-End. A key concept is to support existing and future virtual spaces through adaptors on top of their existing interfaces (APIs). Seamless access to those adaptors is provided through the VS Management Layer, acting as an abstraction layer on top of them. The +Spaces Middleware handles the communication and data flow between the government end-users, the VS Management Layer and the built-in and external analysis services. Apart from the three built-in analysis services mentioned, the platform potentially supports the addition of more services with similar or different functionalities, to provide a wider variety of tools.

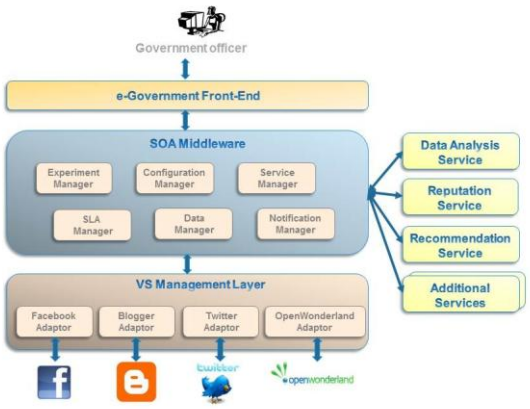

Figure 4: +Spaces Architecture

5. FIRST PILOT EVALUATION

The first pilot focused on deploying and testing the poll application in three different Virtual Spaces (Wonderland[1], Facebook, Twitter). Thus, we recruited participants applying one real policy in order to measure the technical feasibility of running an experiment in several environments. A specific poll concerning smoking banning in all public spaces was created, monitoring and aggregating the information back to the governmental agency. Figure 5**Error! Reference source not found.** provides the distribution of the user participation for all virtual spaces. The total number of answered questions in these 77 participations of the first pilot is about 473 (~7 answers per poll).

[1] Open source 3D virtual collaboration toolkit | Open Wonderland, http:// http://openwonderland.org/

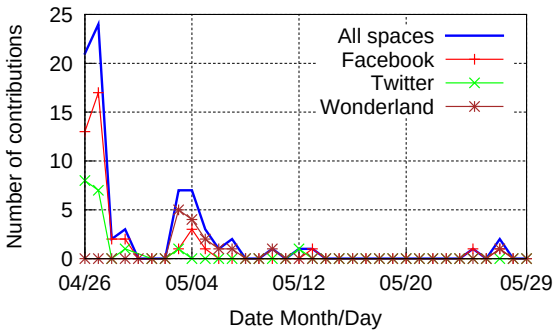

Figure 5: Distribution of the participation of the first pilot phase splitted into different virtual spaces compared to all spaces

Initial trials were successful, with the platform being stable even when receiving tens of concurrent actions and the end-users being satisfied from depth and user friendliness of the poll results analysis.

6. CONCLUSIONS AND FUTURE WORK

In this paper, we presented the work being performed for +Spaces to create an intelligent platform that will support policy makers and involve virtual citizens in the policy making process. The interoperability supported, along with intelligent auxiliary services (Recommendation Service, Reputation Service and Data Analysis Service), illustrate the added value of the platform.

The first pilot provided valuable feedback, which led to various correction actions concerning the user-friendliness and the intelligent services functionality. A more concrete evaluation along with some more useful conclusions will be extracted during the next two pilots operation and evaluation, including debates and role-playing simulations respectively. The policy will be the same for both, so as to make a correlation between them and richer results expected, will be helpful to evaluate data analysis efficiency.

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REFERENCES

KZero Worldswide. (2012), Virtual World registered accounts reach 1.7bn in Q4 2011: http://www.kzero.co.uk/blog/virtual-world-registered-accounts-reach-1-7bn-q4-2011/

Social Networks & Blogs Now 4th Most Popular Online Activity, Ahead of Personal Email, Nielsen Reports. March 9, 2009.

M. Davies, V Callaghan and M Gardner, “Towards a Mixed Reality Intelligent Campus” in Proceedings of the 4th International Conference on Intelligent Environments, IE04, 2008

M. Gardner, J. Scott and B. Horan, “Reflections on the use of Project Wonderland as a mixed-reality environment for teaching and learning”, ReLIVE 08 conference, Open University, UK, 2008

R. A. Irvin and J. Stansbury, “Citizen Participation in Decision Making: Is It Worth the Effort?”, Public Administration Review Volume 64, Issue 1, pages 55–65, February 2004, DOI: 10.1111/j.1540-6210.2004.00346.x

P. Jaeger, “E-government around the world: lessons, challenges, and future directions”, Government Information Quarterly, Vol. 20, No. 4. (2003), pp. 389-394

J. K. Scott, ““E” the People: Do U.S. Municipal Government Web Sites Support Public Involvement?”, Public Administration Review Volume 66, Issue 3, pages 341–353, May - June 2006

Å. Grönlund, (2010). Ten Years of E-Government: The ‘End of History’ and New Beginning. Electronic Government (pp. 13-24).

A.M. Oostveen and P. Besselaar, "From small scale to large scale user participation: a case study of participatory design in e-government systems". In Proceedings of the eighth conference on Participatory design: Artful integration: interweaving media, materials and practices - Volume 1 (PDC 04), Vol. 1. ACM, New York, NY, USA, 2004, 173-182. DOI=10.1145/1011870.1011891

C. W. Phang and A. Kankanhalli, "A framework of ICT exploitation for e-participation initiatives". *Commun. ACM* 51, 12 (December 2008), 128-132. DOI=10.1145/1409360

Y. Guo and S. Barnes, "Why people buy virtual items in virtual worlds with real money". SIGMIS Database 38, 4 (October 2007), 69-76. DOI=10.1145/1314234.1314247

P. S. Jenkins, "Virtual Worlds as a New Game Theoretic Model for International Law: The Case of Bilateral Investment Treaties", (2009) 6:1 SCRIPTed 4, http://www.law.ed.ac.uk/ahrc/script-ed/vol6-1/jenkins.asp

E Castronova, “Synthetic Worlds: The Business and Culture of Online Games”, University of Chicago Press (2005). ISBN 0-226-09626-2

N. Ellison, C. Steinfield and C. Lampe, "Spatially Bounded Online Social Networks and Social Capital: The Role of Facebook", Conference of the International Communication Association (ICA), June 19-23, 2006 in Dresden, Germany

Powell, L., Richmond, V. P., & Williams, G. C. (2011). Social networking and political campaigns: perceptions of candidates as interpersonal constructs. North American Journal of Psychology.

C. R.Ondrejka, “Living on the Edge: Digital Worlds Which Embrace the Real World”, June 5, 2004.

I. MacInnes, "The Implications of Property Rights in Virtual World Business Models". Americas Conference of Information Systems (AMCIS 2004), New York, NY

G. Attwell, “IBM Centre occupied by protesting avatars”, posted in Pontydysgu MUVEs, March 28th, 2008, photo by RSU

D. Harry and J. Donath, "Information spaces -- building meeting rooms in virtual environments". In *CHI '08 extended abstracts on Human factors in computing systems* (CHI '08). ACM, New York, NY, USA, 3741-3746. DOI=10.1145/1358628.1358923

P. G. Zimbardo, C. Maslach, and C. Haney, "Reflections on the Stanford Prison Experiment: Genesis, transformations, consquences". In T. Blass (Ed.). Obedience to authority: Current Perspectives on the Milgram paradigm (pp.193-237). Mahwah, N.J.: Erlbaum, 2000

Guy, I., Zwerdling, N., Carmel, D., Ronen, I., Uziel, E., Yogev, S., et al. (2009). Personalized recommendation of social software items based on social relations. Third ACM conference on Recommender systems , (pp. 53-60).

J. Freyne, M. Jacovi, I. Guy and W. Geyer, "Increasing engagement through early recommender intervention". Proc. RecSys'09, (2009), 85-92

D. M. Blei, A. Y Ng, M. I. Jordan and John Lafferty, "Latent Dirichlet allocation". Journal of Machine Learning Research 3: pp. 993-1022. January 2003

S.M. Kim, and E.H. Hovy, "Identifying and Analyzing Judgment Opinions.". Proceedings of the Human Language Technology / North American Association of Computational Linguistics conference (HLT-NAACL 2006). New York, NY