I-Room: Applications of a Virtual Space for Intelligent Interaction

Deployed Application Case Study

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Application domains: team and project collaboration; games development industry; whisky industry

AI techniques employed: AI planning, agent-based systems, knowledge-based systems, natural language generation

Application status: deployed system, open source released code, publicly available evaluation sites

Abstract: An I-Room is an "intelligent room" which can act as a knowledge aid to support collaborative meetings and activities, especially when these involve sense-making about the current context, planning, considering options, and decision-making. The I-Room provides a generic technology basis for a wide range of potential collaborative applications and uses. It can provide a conduit for accessing intelligent systems and knowledge bases from collaborative interaction spaces such as virtual worlds. Applications to support a geographically dispersed cross-disciplinary team engaged in the creation of a multi-media video game product and to mixed-initiative whisky-tasting tutorials are described.

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Abstract

An I-Room is an "intelligent room" which can act as a knowledge aid to support collaborative meetings and activities, especially when these involve sense-making about the current context, planning, considering options, and decision-making. The I-Room provides a generic technology basis for a wide range of potential collaborative applications and uses. It provides a conduit for accessing intelligent systems and knowledge bases from collaborative interaction spaces such as virtual worlds. Applications to support a geographically dispersed cross-disciplinary team engaged in the creation of a multi-media video game product and to mixed-initiative tutored whisky-tasting are described.

Introduction

An I-Room is an environment for intelligent interaction. It can provide support for formal business meetings, tutorials, project meetings, discussion groups and ad-hoc interactions. The I-Room can be used to organise and present pre-existing information as well as displaying real-time information feeds from other systems such as sensor networks and web services. It can also be used to communicate with participants, facilitate interactions, record and action the decisions taken during the collaboration.

Using the I-Room concept within virtual worlds gives a collaboration an intuitive grounding in a persistent 3D space in which representations of the participants (their "avatars") appear and the artifacts and resources surrounding the collaboration can be granted a surrogate reality – which, where these items consist of information, might be more meaningful or compelling than their physical reality. Avatars can meet each other 'face-to-face' in a virtual world when their human counterparts cannot. Some of the benefits of a real-world meeting are retained through immersion in the virtual world, and in some cases virtual world meetings may be an effective alternative to face-to-face meetings, telephone calls or video-conferences.

Beyond the advantages conferred by a shared interaction space, the I-Room can be used to deliver intelligent systems support for meetings and collaborative activities. In particular, the I-Room is designed to draw on I-X Technology (Tate 2000) which provides intelligent and intelligible (to human participants) task support, process management, collaborative tools and planning aids to participants. The I-Room can also utilise a range of manual and automated capabilities or agents in a coherent way. The participants share meaningful information about the processes or products they are working on through a common conceptual model called <I-N-C-A> (Tate 2003). The I-Room framework is flexible enough to provide participants in I-Room meetings with access to knowledge-base content and natural language generation technology that tailors utterances to specific experience levels of users.

I-Rooms have been in use since early 2008 for a range of collaborative groups, meetings and training exercises. Some I-Rooms are constantly available to their users through publicly accessible virtual worlds like Second Life™.[1]

This paper describes two deployed applications of I-X and I-Room technology: for product team meeting support and for tutored whisky tastings in the "Virtual World of Whisky".

Background

One could be forgiven for assuming that virtual worlds and their social networking aspects originate mainly from computer game technology. However, significant development originates from research which began in the late 1970s, on multi-user persistent spaces which explored object sharing and chat for collaborative systems (Bartle and Trubshaw 1978). The addition of object-oriented

[1] http://secondlife.com

programming to script or control the objects in the shared space expanded the possibilities. A popular version of such a multi-user, object-oriented virtual space is LambdaMOO (LambdaMOO 2009) which dates from 1990.

This work has continued over a period of two decades, with the emerging environments being used alongside tele and video-conferencing and instant messaging with agent presence and status information. A good example is the Collaborative Virtual Workspace (CVW 2001), originally built by Mitre Corporation between 1994 and 1999, which used a 'buildings and rooms' metaphor for persistent storage of documents and shared assets used in collaborations. Many video-conference support systems utilise the idea of setting up a virtual workspace 'room' to give context to a particular presentation or meeting. Extensions to this within the I-X Research Programme were proposed, and these constitute the foundations of the I-Room project (Tate 1999) to make use of intelligent planning and collaboration aids alongside CVW. These proposals are among a number to have appeared over the last decade that describe a room for intelligent team-based interaction or a room that could itself act as a knowledge-based asset to a group. Some of these concepts were explored in the Collaborative Advanced Knowledge Technologies in the Grid (CoAKTinG) project (Buckingham Shum et al. 2002).

I-X Technology

I-X (Tate 2000) is a suite of tools designed to aid in processes that create or modify one or more "products" (such as a document, a plan, a physical entity or even some desired changes in the world state). The I-X approach involves the use of shared models for task-directed communication between human and computer agents.

An I-X agent (or system of agents) carries out a process, which leads to the production of (one or more alternative options for) a product. The I-X agent/system considers this synthesised artefact to be represented by a set of constraints on the space of all possible artefacts in the application domain. This provides a common conceptual basis for sharing information on processes and process products. It is intended to provide a framework that is shared, intelligible to humans and machines, easily communicated, as formal or informal as the situation demands, and extendible.

The underlying conceptual information-sharing model on which I-X is based is the <I-N-C-A> (Issues-Nodes-Constraints-Annotations) ontology (Tate 2003) which represents a set of restrictions on processes or products:

- Issues: e.g. what to do? How to do it?
- Nodes: e.g. include specified activities or product parts;
- Constraints: e.g. temporal, spatial, or on resources;
- Annotations: e.g. rationale, provenance, progress.

To move towards achieving the goals of the collaboration, an I-X agent or system repeatedly moves through cycles of handling issues and managing domain constraints. To do this, a number of differing 'mixed-initiative' collaborative processes can be invoked, including:

- Issue-based sense-making, e.g. such as the gIBIS approach with its 7 question types (Conklin 2005).
- Activity planning and execution.
- Constraint Satisfaction, using AI and OR methods, or simulation.
- Note-making, rationale capture, logging, reporting.

The I-X Process Panel (I-P^2) (Tate et al. 2002) provides the principal interface for a human user of an I-X system; its underlying representation and reasoning act on the current world state to present the user with context-sensitive options for action. The aim is to provide a planning, workflow and communications 'catch all' for the user. On behalf of its user, an I-P^2 can accept process-level activities to:

- Handle an issue;
- Perform an activity;
- Respect a constraint;
- Note an annotation.

Where appropriate, it can suggest performing these activities through:

- Manual performance;
- The invocation of internal or external capabilities;
- Delegation to other agents or services;
- Planning and executing a composite of these approaches.

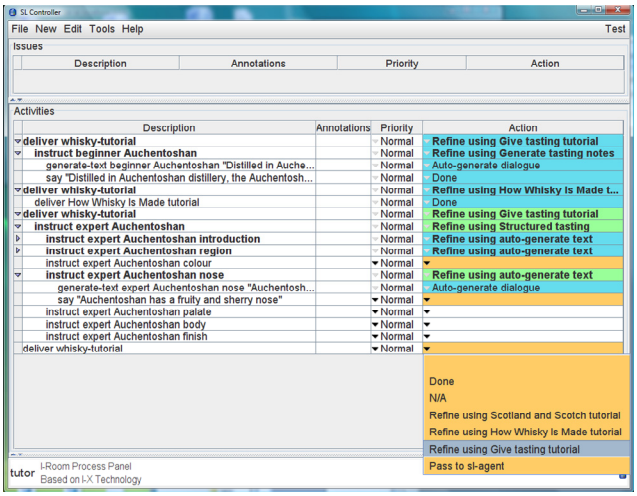

Figure 1: I-X Process Panel with its Action Selection Menu

Through reporting mechanisms, the I-P^2 helps the user to understand both the current state of the world and the current status and progress of issues, activities and constraints within the system. At its simplest, the I-P^2 acts like an intelligent 'to do' list providing context-sensitive assistance (Figure 1). The panel shows a user his or her current issues and activities, for which business processes, plans or Standard Operating Procedures (SOPs) can be

selected or combined. Constraints can be imposed, and rationale or other information kept as annotations. An intelligent planning system, I-Plan, is included in the I-X tool suite to generate novel options based on stored domain models. The I-X suite also supports the collaborative element, with tools such as a structured content instant messenger allowing issues and activities to be passed between different agents to support workflow across an organization. Web services can be called to gather information or can automatically enact steps of the processes involved.

Underlying Concepts for I-Room Collaboration

The underlying concepts employed by the I-Room enable human participants to benefit from intelligent systems support in meetings and collaborative activities. I-Room concepts include:

- A mixed-initiative collaborative model for refining and constraining processes and products;
- Principled communication based on sharing issues, activities, state information, events, agent presence, options, argumentation, rationale and reports;
- The use of the <I-N-C-A> ontology for representing the products that are developed during meetings;
- The use of the I-X technology and tool suite to provide task and process support;
- The use of issue-based argumentation, through the use of the Questions-Options-Criteria (QOC) methodology (Conklin 2005) and links to the Compendium sense-making tool (Buckingham-Shum et al. 2006);
- The use of agent presence models, as in instant messaging, and an I-X 'I-Space' for awareness of agent context, status, organizational relationships, capabilities and authorities;
- The use of external shared repositories of processes, products and other objects.

I-Room Meeting Support

An I-Room can be linked to I-X Process Panels to support meetings in virtual worlds or in the real world. It can support common requirements for meetings by:

- Loading a predefined meeting agenda or template;
- Making available a set of standard procedures for the conduct of the meeting;
- Keeping track of the progress through agenda items during the meeting itself;
- Recording decisions and taking minutes;
- Tracking existing actions and adding new ones;
- Providing access to minutes from previous meetings;
- Automatic generation of a draft of the meeting minutes;
- Automatic generation of an agenda for the next meeting including generic items (e.g. review of previous actions, AOB, date of next meeting).

Through a link to an autonomous object in the virtual world (the "I-X Helper") that is able to sense the presence of avatars and respond to commands, it is possible to provide additional support by:

- Monitoring the participants in the meeting, and potentially noting their presence status throughout, and at which points they may leave and return;
- Displaying on in-world 'screens' and wallboards information and media content, such as the meeting agenda, or any relevant images or documents, at appropriate times during the meeting;
- Unobtrusively documenting the progress of the meeting and its outcomes.

While some of these tasks are simple, more complex tasks can only be completed to a high standard where the I-Room has background knowledge of meeting formats and the current collaboration. Linking the I-Room to existing, real-world knowledge-based systems can potentially extend the support offered into this virtual space, thereby distributing the knowledge they embody.

I-X Helper – Connectivity between I-X and a Virtual I-Room

Participants meeting in an I-Room may connect via I-X Process Panels or via their avatar using an appropriate virtual world viewer or interface. An I-X Helper, which can be any convenient object in the virtual world, acts as a conduit for channelling communications to the participants connecting via their avatars and to related capabilities available within the virtual world. This may take different forms depending on the communication and programming facilities within the virtual world platform.

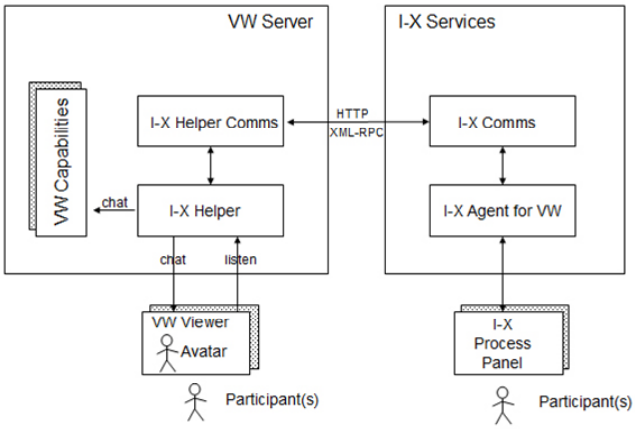

Figure 2: I-X Helper Connects Virtual World to I-X Services

Within Second Life for example, as shown in Figure 2, the I-X Helper communicates to I-X Services via a communications channel that uses a mixture of HTTP and XML-RPC requests and responses. Messages can be queued and sent later if either the I-X Helper or I-X Services ends are not available, enabling asynchronous operations. The I-X Helper can communicate with avatars in the I-Room via open chat channels and can control suitable devices in the virtual world, such as displays, objects etc. Specific capabilities to provide flexible display of images, external web pages, and I-X screens are also incorporated.

I-Room Capabilities

There is a set of tools that can support participants in the I-Room. These can be accessed in a convenient fashion through avatars in the virtual world, or via I-X Services.

- I-X Helper: to communicate with external knowledge-based systems and to reliably set up the communications link to I-X Services and pass back and forth requests, content, and reports, and to act as a chat conduit between I-P[2] and the I-Room on need.
- Image Generator: a mechanism outside of the virtual world to take screens from I-P[2] and other external applications, web accessible images (however generated) and other video and live feed content and to make composite images suitable for display in virtual worlds[2].
- Display Screen: a screen that can show various images, media, movies or live video feeds. It can extract and display (tagged) elements from the composite images created by the Image Generator.
- LED Display: to display text in a number of different colours, fonts and styles.
- Media Controller: to change media and audio streams within the virtual world reliably for different types of virtual world land areas, and on group-owned areas.
- Avatar Sensor: to give information on avatars' names, id, location, etc. to external systems and maintain a model of who is present in the I-Room.
- Inventory Giver: to offer avatars items relating to the current events and processes in the I-Room. [experimental]
- I-Room Questioner: to ask participants (multiple-choice) questions, letting them answer individually. This can be used, for example, to vote, to agree on a course of action, or to make a selection from a number of available options. [experimental]

Slam Games I-Room – Support for Product Team Meetings

Working in partnership with Slam Games Ltd., an I-Room has been created to assist the company's game development process, which involves an international team of designers, artists and managers. The I-Room exterior along with a 'campfire' area for informal gatherings is shown in Figure 3. Although the Slam Games I-Room[3] was created in Second Life, the capabilities developed are designed to be independent of the virtual world platform used.

Figure 3: Slam Games I-Room Exterior and Campfire Area

For game development, Slam Games itself concentrates on the design, programming and development of the game core, while the design and production of most artwork, sound and other media are outsourced, often to geographically remote locations (e.g. Malaysia). Communication with its third party collaborators is mainly via the following mechanisms:

- e-mail, for sending files and messages relating to the project;
- telephone, for verbal discussions;
- Confluence[4] Enterprise Wiki. This stores all contacts, media, data, etc. This is used extensively in-house, with contractors having limited access, restricted to only the area directly relevant to their work;
- JIRA[5] for reporting bugs, testing, and milestone management;

[2] Different virtual worlds provide different flexibility for displaying external web pages, images, etc. Some allow an HTML or image URL to be shown on any face of any 3D object. Others, such as Second Life currently limit any land plot to a single media URL. Using an MxN matrix of images composed into a single entity that can be unpacked in Second Life can overcome such limitations.

[3] http://slurl.com/secondlife/Informatics/202/214/29
[4] http://www.atlassian.com/software/confluence/
[5] http://www.atlassian.com/software/jira/

- Campfire[6] Group Chat Environment using (typed, not voice) instant messaging with multiple participants. A room metaphor is used for virtual meetings, and records are kept for future reference.

Internal company meetings also happen at weekly intervals during which issues are discussed, progress is monitored and milestones are managed. For this, Slam Games uses the Agile development methodology specifically the Scrum method (Schwaber 2004). These meetings are also supported with the tools above.

Slam Games I-Room

The motivating scenario involves supporting the collaborative development of an ocean-themed computer game. In one particular project meeting, the design of characters in the game and the game's development progress are to be discussed. Several design images need to be compared and feedback for the artists is to be prepared.
The scenario represents a meeting some way through a project. A project plan has already been generated and milestones have been set. Some weekly meetings have already been held. Actions from the previous meeting are discussed in turn and dealt with. Progress against the next set of milestones is also checked. Any carried forward or new tasks are noted.

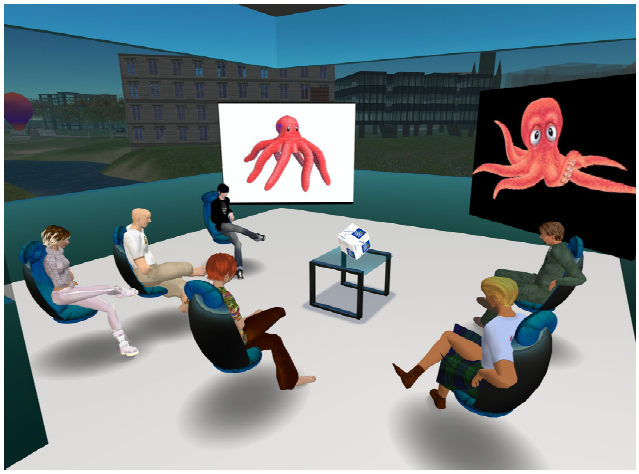

Figure 4: Slam Games I-Room Meeting with Character Designs

In this particular meeting, artwork is to be discussed and is presented by the resident artist in the form of 2D stills from 3D models.
As shown in Figure 4, the I-Room has mechanisms for displaying artwork and other media and showing animations, as well as supporting the flow of meetings (e.g. via display of information derived from the I-P^2 of the meeting chairperson) and for recording arguments, communications, and decisions. The I-Room is voice-enabled to support discussions to reach a proper consensus on issues.
The actions from previous meetings and agenda items for the current meeting are presented, allowing actions to be discussed and marked as completed, carried forward to the next meeting, or marked as no longer applicable. Decisions may be noted, actions items placed on avatars, etc. In this application, anything that is to be recorded in the minutes must be 'said' in the virtual world by meeting participants on a specific chat channel (a common way to communicate between objects in such virtual worlds). The in-world I-X Helper agent listens on this channel for specific keywords which indicate how to process the message. For instance "*action* Ai Austin improve seating in meeting room" would indicate an action placed on the participant "Ai Austin" to be recorded, and "*minute* we cannot agree on this issue without JeffD Arida" indicates a minute to be associated with the current phase of the meeting. The use of a dedicated channel (which will not necessarily be known to all participants, and could anyway be made accessible only to nominated avatars or groups) allows a certain degree of control to be maintained, effectively allowing the chair of the meeting or a designated secretary to determine which items are destined for the meeting records; however the I-X Helper echoes each item it receives to all in the room so that all meeting participants are aware of the items that are being recorded.
The project milestones for the period under review at the meeting may also be available as a list of issues to address. Each of these should be discussed, addressing any risks related to meeting the milestone. New actions may arise from such discussions.
The use of a virtual world for meetings has the potential to address one of the main weaknesses of current practice, namely the inability to view and contrast artwork and media in a shared setting. Accordingly, there are mechanisms in the I-Room (the I-Room screens) for displaying and suitably labeling different media, allowing the participants to discuss and compare and, where appropriate, to reach some consensus on which alternative to use. The labels shared between I-X and the I-Room makes sure that the same assets are referred to in a consistent way by all participants.
In this project, an operational demonstrator was produced. This addresses many of the support requirements outlined for the scenario above. A video of a sample meeting using the I-Room is available (I-Room 2009).
Slam Games participated in trial meetings using a real game design and related media. They provided an evaluation of the value of the I-Room technology against their requirements. In summary, they indicated that the I-Room provides a direct solution to many of the issues of communication as encountered in a distributed workplace such as at Slam Games in support of the creative and collaborative games development process. The company has undertaken to give serious consideration to the possibility of adding this facility to its existing set of collaboration technologies.

[6] http://www.campfirenow.com/

Virtual World of Whisky I-Room

The Virtual World of Whisky (VWoW) project represents a combination of virtual world technologies[7] and intelligent systems to provide collaborative systems for educational purposes. Specifically, the goal of the project was to examine the technical feasibility of using virtual world technology to promote one of Scotland's iconic products, whisky, by supporting a community of interest in this area, including supporting meetings during which tutored tastings are conducted.

Glenkeir Whiskies (trading as The Whisky Shop) had a successful e-commerce portal already in place, and Ian Bankier (Chief Executive of Glenkeir Whiskies) joined with AIAI to examine the feasibility of developing a virtual world based social network focused around an interest in Scotch Whisky.

A number of I-Room experiments have been conducted and resources have been developed during the VWoW project including a set of educational virtual tours that can be used as a template for creating other tours; a virtual tutored whisky tasting room deployed in Second Life built on Virtual University of Edinburgh (Vue)[8] virtual real estate provides a venue for demonstrations and for holding tutored whisky-tasting events.

Outcomes of this project include a set of generic educational resources which, in this instance, have been applied to the Scottish whisky industry, but could easily be utilised in other domains.

A virtual tutored whisky tasting was held in the Second Life VWoW I-Room[9] on January 25th, 2008, to coincide with the traditional Scottish celebration of Burns Night[10] and another live whisky-tasting event was held that focused on demonstrating how different intelligent tools may work together to support an educational event in a virtual world. As a part of this virtual event, human participants, at various physical locations, gathered virtually in the guise of their Second Life avatars in the VWoW I-Room. Via a live video feed, a tutored whisky tasting was delivered by an expert, with the participants prompted to sample the (real) whisky in question at appropriate times. A question-and-answer session with the Chairman of Glenkeir Whiskies encouraged the participants' interaction in the tutorial.

The tutorial itself was represented as a process within I-X, and supported by materials used to illustrate the talk and discussions. A knowledge base about Scotch whiskies and distilleries was available to augment the tutorial. Natural language generation was possible from within I-X as part of the overall tutorial process support.

[7] Using (publicly accessible) Second Life and (privately hosted) OpenSim – http://opensimulator.org.

[8] http://vue.ed.ac.uk

[9] http://slurl.com/secondlife/Informatics/208/159/25

[10] Burns Night Supper is a traditional Scottish celebration to commemorate the life and works of Scotland's most famous poet, Robert Burns. For this event, whisky drinking is an important part of the ceremony as well as a part of the meal.

The tutored whisky tastings conducted in the VWoW I-Room mirror whisky-tasting events that The Whisky Shop regularly holds in real life. Videos of both events are available through the I-Room project website (I-Room 2009).

Figure 5: Virtual World of Whisky I-Room in Second Life

The VWoW I-Room in Second Life can be seen in Figure 5. This room contains a number of objects and decorative elements that help create the atmosphere of a real whisky shop[11], chairs for avatars to be seated on during the tasting (reinforcing the notion of attendance at an event) and animated whisky glass objects that the avatars are free to use (reinforcing the idea that this is specifically a whisky-tasting event). Two screens are used to relay external video streams (and their audio tracks) and static images to the participants.

The link to the intelligent systems technology, in the form of an I-X system external to the virtual world, is provided through the presence of an I-X Helper object in the room. The Helper plays a mediating role, receiving and executing tutoring activities from I-X on the one hand, and on the other, passing information about the occupants of the room and the state of the session out of Second Life and back to the I-X system.

With this mechanism in place, an I-X whisky related tutorial application has been developed. It is assumed that the tutor has access to an I-X Process Panel, which provides a primary 'to do' list interface for the tutorial and allows the tutor to access a number of different process models specifically tailored for this domain. These include models representing different tutorials to deliver to the occupants of the room: a tutorial giving a general introduction to Scotch Whisky and Scottish whisky regions, a tutorial describing the process of making whisky, and support for tutored tasting of specific regional types of Scotch Whisky.

[11] Based on The Whisky Shop in London.

To exploit the visual and auditory capabilities of Second Life, these processes contain references to video and image content. A number of short video segments to support tutored tastings were recorded by the Chairman of Glenkeir Whiskies and made available as web accessible resources. This content is available using URLs to allow the easy delivery of this sort of structured tutorial (and perhaps even the automation of tutorials). However, the system is also flexible enough to allow a tutor to provide a less rigid tutorial as and when the occasion dictates, providing mechanisms by which appropriate images or video clips can be dynamically selected and displayed on screens in the VWoW I-Room.

A further aspect of the tutorial support offered by I-X lies in the use of Natural Language Generation (NLG) technologies to automatically generate text. This exploits a comprehensive Scotch Whisky knowledge base (in OWL), underpinned by a rich ontology, which describes whisky types, their characteristics and classifications, distilleries and so on.

One use of the NLG technology incorporated in the VWoW I-Room generates simple sentences introducing the whisky in question, saying something about the distillery and the whisky's geographical classification, and describing its characteristics of nose, colour, palate, and so on. These sentences could be used by the tutor as the factual basis of his tutorial or to supplement his words, or else could be used to support simple automated tasting tutorials. During one of the live events run in the VWoW I-Room, I-X offered to the room a chat line indicating the colour of the specific whisky (Auchentoshan) that was being tasted. The tutor picked up on that information, in an interesting example of true mixed-initiative engagement, to point out to the VWoW I-Room participants that the colour was due to a specific form of barrel that had earlier held sherry which is only used in the whisky making process in that one region of Scotland. If the participants and tutor had chosen to, they could have used I-Room support and in-built process models to explore the whisky making process and see images of that process, the equipment involved, and even specific distilleries.

A more complex use of NLG that has been explored is to provide richer tasting descriptions, closer in style to the sort of tasting notes that a human expert would use (and developed from an analysis of the language used in such tasting notes)[12]. In doing this it is hoped that something of the enthusiasm of the expert can be captured and conveyed to those who visit the VWoW I-Room even when a human expert is not in attendance.

Each of these tutorial processes is supported by the in-world I-X Helper object. In accordance with the notions of I-X as an activity-support tool, this is accomplished by passing activities to the Helper. These can be activities that the Helper can perform directly (such as "say" something to the occupants of the room), or activities that the Helper can perform through exploiting the capabilities of other objects in the room (such as "display" some image, which is passed on to one or other of the screens). (Activities that the Helper can neither perform directly or indirectly are echoed to the room in the hope that a listening avatar or object can perform this action.) In addition, the Helper can monitor certain events, such as the arrival or departure of avatars, which are represented to the I-X system as state information. This state information can be used to guide or qualify behaviour; for example, the start of a certain tutorial process may require (as a precondition) the presence of a certain number of avatars in the room. The Helper also provides some indication of when its activities have been performed; this can be useful in processes containing strict sequential constraints (for example, before describing the whisky regions of Scotland, one might first want to ensure that the corresponding map has been displayed to the occupants of the room).

As feedback after the project, Ian Bankier, Chairman of Glenkeir Whiskies and owner of The Scotch Whisky retail chain said:

> "The VWoW project opened our eyes to how potentially important the development of virtual worlds can be to the whole cross section of industry and commerce. I am convinced that 3D is going to be the next big thing in business, and intelligent systems in them add to the potential. The applications are obvious and intriguing and for me it is only a matter of time. Our particular project, the virtual whisky shop, allied with a real demonstration and tasting of the product, delivered a neat method of taking a product or brand concept to an extremely wide audience or focus group. It was also clear that this medium would be a novel and effective learning tool. The virtual whisky shop works and can be commercialised without too much difficulty."

Summary, Status and Future Work

An I-Room provides a shared persistent space with intelligent systems support for interaction and collaboration between users, systems and agents. It allows for the integration of a range of intelligent system aids, services and agents into the meeting.

An I-Room consists of elements inside a virtual world and external knowledge-based and intelligent systems. This especially includes the I-X planning, process and task support aids.

I-Rooms have been deployed in Second Life (on publicly accessible areas) and in OpenSim (on privately hosted servers). The software for I-X Services and the I-X Helper are available as open source code. Sample 3D I-Rooms have been packaged with the software to make for simple deployment and set up for trials.

I-Rooms have been running continuously since early 2008, and a number have been used for live events, collaboration meetings and discussions. This has included meetings in

[12] Work done in collaboration with C. Christodoulopoulos, Informatics M.Sc. student at the University of Edinburgh.

which participants have been located on three continents. AIAI regularly opens an I-Room in support of teleconferences to give a visual indication of presence, rich media sharing, and simple ways to initiate back channel interactions for participants, even when traditional video and audio channels outside of those available through the virtual world are in use with collaborators. Simulation scenarios and trials have been conducted in I-Rooms with companies such as Disney, EADS, Kodak and Tata.

I-Rooms are also being applied to a range of national and international crisis and emergency response areas (Tate et al. 2009), homeland security, UAV mission monitoring, product design and review meetings, scientific project regular reviews, team training and simulation exercises. More details and software download links can be found at the I-Room project web site (I-Room 2009).

The basic I-Room AI concepts and technology are now being refined and made more generic. This work includes: the development of generalised links to knowledge-based systems; tailored natural language generation; capability modelling to identify and exploit opportunities in the virtual worlds; and semantic tagging of the various media and communication streams that constitute a virtual meeting to allow a higher level of context-sensitive support, with documentation, indexing and playback facilities.

A number of in-world capabilities are being created to augment I-X support for intelligent interaction in virtual meeting spaces, virtual operations centres, and training rooms including the provision of non-player characters.

The I-Room project is exploring the potential for (partially) automated tutorial support, for example for visitors to an unattended VWoW I-Room[13]. Visitors would be sensed entering the room, and a process initiated through the I-X Helper calling on I-X Services to offer a number of experiences and tutorials, or tutored tasting tailored to specific whiskies that the participant may have to hand, and to encourage them to try Single Malt Scotch.

The VWoW project even explored a capability to take a (talking) balloon ride over a virtual Scotland and its Whisky regions, dipping down to visit a 3D model of a distillery and interact with the processes in action, or visit various areas of Scotland as a "tourist".

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[13] Visit http://slurl.com/secondlife/Informatics/208/159/25

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