V-ROOM: Virtual Meeting System Trial

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Abstract—Virtual meeting environments are providing a viable alternative for conventional meetings bringing benefits of reduced costs and better use of time by removing the need for attendees to travel to national, international or global locations in order to attend meetings. This paper builds on the work of previous papers which discussed the functional and technical requirements for a virtual meeting system, reporting on a user trial and evaluating the prototype system. The trial was performed by students as users deploying the prototype for collaboration in group work focussed on the design of a computer system as part of the final year of their undergraduate study. The users were asked to comment on the features of the prototype as well as offering suggestions on useful features that should be included in a virtual meeting system. A summary of their comments and suggestions and the results of the evaluation are included in the paper. Security aspects of virtual meeting systems are also considered in some detail.

Keywords—virtual; meeting; system; trial; prototype; classroom; security; travel efficiencies; location independence

I. INTRODUCTION

Virtual meetings are now a reality rather than an idea being pursued as an alternative to face-to-face meetings by a few enterprising organizations. However the increased use has presented problems to travel managers [1] in organisations who now have to be aware of the different ways in which virtual meetings can be conducted both using purchased equipment and software installed at their own business premises or taking advantage of services offered by hotel chains for the purpose.

Airline companies [2] have expressed concerns because increased use of virtual meetings has reduced the need for air travel to meeting locations. The potential of this reduced need for air travel to reduce greenhouse gas emissions [3] has also been explored.

By using virtual meetings busy executives can pursue other tasks while taking part in a meeting, something that a face-to-face meeting cannot easily achieve. Studies have shown [4] that because of this ability to multitask, real gains in productivity can be achieved where organizations have taken advantage of virtual facilities.

Virtual meetings have also had a positive effect on the work-life balance of employees allowing them to manage home commitments as well as carry out work for employers [5]. However problems have been encountered in software projects with the use of virtual meetings when the meetings are cross border or cross organizational [6] because of “spatial separation, diverging communities-of-practice, and unevenly distributed resources” resulting in difficulties with trying to co-ordinate knowledge. Virtual meeting systems able to capture and address such issues would be a welcome contribution to the field.

This paper, building on the work of previous papers by the authors [7, 8, 9], describes the development, implementation, trialling and evaluation of a prototype virtual meeting system, V-ROOM, the requirements of which were influenced by a focus group investigation presented in the last of those papers. The requirements include a number of meeting support concepts that are not available in current meeting systems. A prototype was developed and trialled by groups of students in a classroom setting who were carrying out a group development project to build an enterprise system.

The paper is organised as follows. Section II describes related work and the innovative features of V-ROOM. Section III describes the prototype technical specification. Section IV discusses the development and evaluation methodology while Section V describes the frame for the user trial. The results are analysed and evaluated in section VI and finally Section VII provides conclusions and gives some directions for future work.

II. RELATED WORK AND INNOVATIVE FEATURES

With the emergence of group discussion facilities in many of the online learning products supplied to universities, students are gaining first-hand experience [10] of using virtual collaboration tools and appreciating the appropriateness of the technology chosen for their meetings.

There are a wide range of commercial products available that support virtual meetings at a basic level. Particularly well-known examples are Skype, Microsoft’s Lync and Facebook. Many other products of similar nature exist and are used extensively socially. Whilst these products have merits, they
tend not to be used so extensively in the business and work context however. The researchers contend that this is because the support provided is limited consisting mostly of chat, audio and video facilities. More intelligent structure based around a knowledge of the semantics of the meeting and cultural norms might prove more useful in a business context. Current commercial systems do not have this feature.

In 2008 it was considered that Web based synchronous groupware was still rare, especially that based on standard Web browser and standard Web networking technology [11]. A reason for this was that the traditional web protocol of HTTP was not amenable to efficient fine-grained two-way communication. More latterly the AJAX technology has allowed for finer-gained data passing making synchronous groupware more usable. PowerMeeting [12] is an example of a web-based groupware built in this way and which includes many facilities for participant sessions with agenda items and groupware such as: a brainstorming tool through which ideas can be generated and categorised; a pincard board; a presentation slide for creating remote presentations; a Web page; a group calendar; a task diagram for project planning; and a voting tool with a multi-criteria decision support tool. PowerMeeting is architected as a framework into which different groupware tools can be placed. It also includes a Chat and Skype facility.

In a previous paper [7] the work performed by a focus group to determine the requirements for an intelligent virtual meeting system was discussed. Together with findings from literature search and observations, these requirements indicated the features and facilities that a virtual meeting system should provide [8, 9]. A software prototype was developed from the draft requirements. The prototype functionality would include standard facilities seen in other virtual meetings and also the following novel features:

- A meeting ontology would be maintained for the execution of the meeting. This would represent the meeting structure, cultural norms and enable intelligent support
- Synchronous and asynchronous mode of interaction would be supported. This means that a meeting may be kept open for an extended period to allow contributors who could not synchronise their time to contribute extemporaneously. This facility can be useful for participants in different time zones as well as being helpful for busy schedules
- Minutes from the meeting would be generated. These would be generated according to the meeting structure and cultural standard with discussions grouped according to agenda item and summarized appropriately. Resolutions and actions would be included.
- An agenda-based polling facility would be implemented. Polling in itself is not an innovative feature but the idea here is to tie the polling to decisions according to the meeting agenda and discussion.

The above features form part of a virtual meeting support system which uses the concept of a meeting assistant agent. The meeting assistant agent runs the meeting according to the dictated structure and stored semantics within the ontology. It manages functions such as initiating the meeting, reacting to time limits on participant contributions and agenda items, calling polls at appropriate points, managing the synchronous and asynchronous interaction and generating the minutes.

III. PROTOTYPE TECHNICAL SPECIFICATION

The prototype implementation is illustrated in the layered diagram in Fig. 1. It shows both the server side and client side functionality. The client side contains the means of accessing the server side functions.

![Prototype Implementation Structure](image)

The server functions reside within the meeting server program on an HTTP web server and are accessed via an internet browser on the client computer. The functions required by the participant could be implemented on any type of computer supporting a web browser and an internet connection. The meeting server uses AJAX technology to call PHP functions from the server side. MySQL is used to process the meeting database.

The meeting client is menu driven supporting the functions required by both the facilitator and the meeting participants. The facilitator or participant will log in to the system using a login name and password. A simple generic ontology was used in the prototype which contained meeting title, date, agenda, duration, time, start-time, end-time and facilitator name. Once logged in the facilitator can set up a meeting. A meeting name, meeting date, start time and end time is then entered and the system generates a meeting id. The facilitator can then create an agenda.
entering each agenda item with the name of the leader of the agenda item and a start and end time for time management.

Once all the agenda items have been entered invitations can be sent (see Fig. 2) by entering the generated meeting id and the email address of the participants. On responding to the email the participant is presented with the chat screen shown in Fig. 3.

Fig. 2. V-ROOM Meeting Invitation

For the sample meeting shown the facilitator had set up a poll for the participants to vote on future meeting dates as well as providing a supporting document to read. At the end of the meeting the facilitator can print a set of minutes which records the dialog of the chat and other meeting details.

Fig. 3. V-ROOM Chat Screen

IV. DEVELOPMENT AND EVALUATION METHODOLOGY

A prototyping methodology is being used for the development and evaluation of the V-ROOM. The benefit of prototyping is that features and functionality can be tested before they are fully developed. This approach is efficient as it avoids wasting time on full development of methods which turn out later to be inappropriate. For the development we used a modified version of the ARREST approach [13]. The arrest approach involves the stages of Analysis, Requirements, Redesign, Evaluation and Summative Evaluation. The adapted ARREST method is illustrated in Fig. 4.

Fig. 4. The ARREST Approach (Adapted)

Initially general meeting activities were analysed through the focus group exercise, readings and observation. From this, requirements were established and a system was designed. In ARREST, following the design stage, an evaluation is carried out which leads to new requirements and design. Finally there is a summative evaluation which could lead to re-analysis. The researchers see the development of the system as an iterative process that will carry on as new requirements are established. In fact the researchers recognise that the type of meeting support possible and needed will vary according to the characteristics of the collaboration. Thus, they see the development of the requirements as moving from the General to many possible Specifics. This paper describes the first prototype evaluation in
which the general features of a meeting support system are being evaluated in the course of a systems development task, in the context of higher education. Thus emerging from this evaluation we expect pointers regarding needs for software support for creative and technical development meetings as well as for coursework development meetings. The evaluation is on-going and further trials in different settings will reveal further requirements. However the trial described here, being the first-stage general feature trial is important because it reveals whether the basic concepts driving the development are valid.

The research methodology used is qualitative. The users taking part in the trial were allowed to express their views freely. Themes were then extracted and categorized from the articulations of the users. The categorized observations were ranked and from the ranking the researchers were able to form a view on the acceptance of the novel developments and on further requirements.

V. THE USER TRIAL

The virtual meeting prototype was deployed it as a support tool for the work performed by students for the final year of their undergraduate degree and who were taking a module entitled Enterprise Systems Development. Students were required to work in groups to develop a computer system as part of an enterprise systems development module. In order to collaborate together for the group work they were asked to use virtual meetings and later to provide some specific comments. Students had the choice on whether or not to use the trial software for their virtual meetings.

There were 40 students on the enterprise system development module who took part in the user trial for the prototype. They were split into 9 groups of up to 6 members. To familiarize themselves with the use of the system the users were given the opportunity in a laboratory environment to operate the prototype in a test scenario. In that environment they were able to practice in their groups, while being located in the same place, in order to resolve any problems that might occur.

A second practice opportunity was provided, but to simulate a true virtual location meeting, on that occasion, trial users were asked to spread themselves across the university campus, as well as some of them being located in their own homes, in order to work on a second test scenario with the prototype.

After the users had taken part in the two practice sessions they were given the actual assignment which was to develop an enterprise system for an aircraft parts manufacturer and supplier. The users were asked to hold at least three of their group meetings virtually in the course of developing their system and provide evidence of those meetings by submitting the meeting log provided by the prototype.

Each user individually submitted their evaluation of the trial system in two parts. In the first part, users were asked to give their comments on the prototype identifying good points and identifying any weaknesses. The users were permitted to express these opinions in free form and a researcher categorised them later. The researcher categorized the opinions into common themes which each represented a feature. The researcher then ranked the resulting features according to the frequency in which they were mentioned. The ranking is shown in Table 1. In the second part, subjects were asked to consider any collaboration systems they have used and comment on what additional features they would recommend which should be included in a comprehensive virtual meeting system. The researcher then categorized the answers into common themes or features. These were ranked.

The questions driving the evaluation were: (a) whether the novel features of the virtual meeting approach would be seen as good; and (b) whether there were any features not yet included in the system that would be useful. The reason for asking these questions were that the researchers wished to check validity of the novel ideas for V-ROOM and also wanted to find out what features are considered most useful for a comprehensive virtual meeting system.

VI. ANALYSIS AND EVALUATION OF TRIAL RESULTS

The trials yielded a set of good points about the system which are interesting to analyse. Weaknesses identified mostly concerned technical aspects such as a function not working quite correctly. For instance an adding error was found in the Polling system. Since such aspects were technical and easy to solve they are not discussed in this paper. A number of additional features were recommended to be included in a comprehensive virtual meeting system. The following sections present the results highlights.

A. Suggested good points

Table 1 shows the functions of the virtual meeting system considered to be good and shows the ranking in terms of how many subjects considered the feature to be good.

<table>
<thead>
<tr>
<th>Features Identified as Good</th>
<th>Ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meeting minutes</td>
<td>1</td>
</tr>
<tr>
<td>Uploading documents</td>
<td>1</td>
</tr>
<tr>
<td>Polling on agenda items</td>
<td>2</td>
</tr>
<tr>
<td>Meeting Structure</td>
<td>3</td>
</tr>
<tr>
<td>Remote Collaboration</td>
<td>4</td>
</tr>
<tr>
<td>Security</td>
<td>4</td>
</tr>
<tr>
<td>Invitations</td>
<td>5</td>
</tr>
<tr>
<td>Asynchronous mode</td>
<td>6</td>
</tr>
</tbody>
</table>

The functions found most useful by the subjects were the creation of minutes and uploading of files. The creation of
minutes would normally be an offline activity which would usually be produced after the meeting is over. To be able to construct the minutes during the meeting while participants are present and append any actions against individuals prevents later disagreement over content.

The next most useful functions identified were the polling facility and visibility of meeting structure. The provision of a meeting structure enables the meeting to stay on focus and on time. The polling facility was used to vote in order to obtain a group consensus on discussion items during the meeting. An essential part of most meetings would be the ability to vote on an issue so this is a feature that should be available in a virtual meeting system.

Other useful functions mentioned were security and remote collaboration, both essential aspects of a virtual meeting system. The ability of the facilitator to send invitations by email to prospective attendees was quite well received and one group used the asynchronous mode to add additional discussion points to the meeting. It could be said that invitations would normally be sent as part of a meeting scheduling currently available in office automation products and would not need to be an integral part of a virtual meeting system. However it provided a useful facility in that only those individuals who had been sent invitations would be allowed to take part in the meeting. There were some negative responses regarding the asynchronous mode because it allowed the meeting log to be compromised by later entries.

Overall emerging from this part of the evaluation was an indication that the novel features of the system, namely the meeting structure, minutes generation and polling attached to agenda, were considered to be good and useful features. The fourth novel feature, namely the synchronous and asynchronous support was regarded by some to be a good feature but was not recognized as predominantly as the other novel features. Some standard features available in many types of meeting support system were also mentioned as useful features. Of the top four features identified as good, three constituted innovative features of the system and thus validated the approach. In fact all four novel features were identified as good but the asynchronous feature was ranked lower and had some negative comments (as mentioned above).  

B. Suggested additional features

Table 2 shows the ranking of the features suggested by the users to be included in a comprehensive virtual meeting system.

As can be seen, the additional feature most users recommend to include was audio and visual support to the virtual meeting system. One of the observations by the focus group in a previous paper by the authors [7] was that where possible software already in existence should be integrated with the system rather than re-inventing the wheel. There are many other products commercially available which give audio and visual support to both one-to-one and group communications. However there would be a need to capture the audio and video streams if a comprehensive meeting log was to be produced.

<table>
<thead>
<tr>
<th>Features Identified as Good</th>
<th>Ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Audio/Visual Support</td>
<td>1</td>
</tr>
<tr>
<td>Document Sharing</td>
<td>2</td>
</tr>
<tr>
<td>Desktop Sharing</td>
<td>3</td>
</tr>
<tr>
<td>On-line Whiteboard Support</td>
<td>4</td>
</tr>
<tr>
<td>Mobile Phone Interface</td>
<td>5</td>
</tr>
<tr>
<td>List of Participants Present</td>
<td>6</td>
</tr>
<tr>
<td>Use of Emoticons</td>
<td>6</td>
</tr>
<tr>
<td>Instant Messaging between Participants</td>
<td>7</td>
</tr>
<tr>
<td>Timed Agenda Items</td>
<td>8</td>
</tr>
<tr>
<td>Personalisation of Environment</td>
<td>8</td>
</tr>
</tbody>
</table>

Desktop sharing, shared interaction on documents and online whiteboard support were the next most mentioned items in the users’ comments. The users found it necessary during the course of their meetings to be able to describe concepts which would be best done on a whiteboard. The sharing of documents was suggested to prevent the need for all users to have to individually upload documents. By allowing a screen to be shared anything that a participant already had on their screen could be made available for discussion in the meeting. Again commercial products are already in existence to provide these shared facilities. It would be necessary to integrate them in order to provide a more complete virtual meeting system.

Some users requested the need for mobile phone support to allow participants to access the meeting when they do not have a personal computer at hand. Mobile phone support would offer a minimum capability with a chat service and with more sophisticated phones could provide an audio visual support. Developing a limited functionality mobile client would be a possible option.

Other suggestions included: providing a list of participants present at the meeting; the use of emoticons to show emotion; instant messaging between participants; personalization of environment; timed agenda items and meeting scheduling. Let us consider each one. The list of participants to enable each participant to see who is actually on-line at that moment is usually provided in chat applications but was not included in the prototype. The use of emoticons would add another dimension to a system without audio/visual support allowing emotion to be portrayed through the text of the chat. Instant messaging to allow participants to have a sub-discussion with one or more other participants would be useful in a large meeting where there
are different interests being represented by groups of people attending. Personalisation of the environment, while mainly cosmetic, is becoming expected in generic software such as social networking although it is not really applicable in a business environment where a more professional presentation would be appropriate. Timed agenda items already exist in V-ROOM. However the timing support in the system could usefully be made stronger and more visible or audible.

C. Suggested security considerations

During the trial the importance of security was noted and observed at various times. In this section we give consideration to the security features that should be built into a virtual meeting system. Most importantly, there is a need for protection against unauthorized access to the system. This protection is required at different levels. Firstly restriction on access to the meeting to allow only authorized participants. Secondly having gained access to the system participants should not be able to access any other information held at the location at which the system resides. Thirdly any audio or textual information being transferred from the participants location either via the Internet or network should be protected against interception en route by a third party. Fourthly any information relating to meetings held at the location where the system resides should not be accessible other than through the meeting system. Other security concerns include:

- **Access to the meeting.** When the meeting is set up on the system by either the facilitator or other authorized person the meeting participants should be identified and invitations sent out to participants. Only those participants who respond to the invitations should be given access to the system. In the prototype a simple user identification and password was pre-allocated for each participant although this was not failsafe and a more robust method could be employed.

- **Access to meeting information while in the meeting.** The prototype allowed information to be accessed by using an upload facility adopting a browser allowing access to a database set up for the meeting. Any documents which were uploadable by participants should be secured to a database specifically for that meeting and made available by the individual who set up the meeting. Restrictions should also be placed on data passed from participant to participant in the event of a sharing facility being employed as mentioned above.

- **Access by interception from third party en route via Internet or network.** The information flowing from participant in textual or audio form should be sent over a secure connection, ideally over a virtual private network (VPN) and be encrypted to prevent unauthorized interception. In particular participants accessing via wireless network should be protected from intruder access through unsecured routers. This protection could be achieved where the wireless access is from the university campus or over a corporate network but would present problems of enforcement if at a participant’s home location.

- **Access to meeting information by outside agencies.** Information held on any backend repositories relating to the meeting as previously indicated could be personal, confidential or contain industry secrets important to the company. The organization should already be taking appropriate measures to secure this sort of data from unauthorized access from outside as well as providing adequate backup facilities as previously mentioned to prevent data loss.

- **Data loss or corruption, either deliberate or accidental.** Under the category of malicious intent are viruses and other malware or denial of service attacks. Measures to prevent participants introducing viruses or malware onto the corporate network should be put into place. Participants should be prevented from deleting information relating to the meeting although this information should be properly backed-up in the event of accidental loss. Denial of service attacks are the most difficult to guard against except by limiting the number of accesses to the server in a particular time period according to the processing power of the server.

VII. CONCLUSIONS AND FUTURE WORK

A prototype virtual meeting assistant system was developed based on a set of requirements arising from a focus group study, literature review and observation. The focus group results were discussed in a previous paper by some of the authors [7]. An evaluation of the prototype took place following a user trial of the functions defined in the requirements.

The user trial was performed in a classroom setting by university students who used the prototype to support group meetings. The feedback from the students was analysed in order to identify the usefulness of the software in supporting those meetings as well as identifying additional functions that could be implemented in a comprehensive virtual meeting system.

The questions driving the evaluation were: (a) whether the novel features of the virtual meeting approach would be seen as good; and (b) whether there were any features not yet included in the system that would be useful. The results showed (a) that the novel features incorporated in V-ROOM (Meeting Minutes, Structured Polling, Meeting Structure and Synchronous/Asynchronous Mode) were considered to be good; and (b) that a number of additional features (Audio/Visual Support; Document Sharing; Desktop Sharing; On-line Whiteboard Support; Mobile Phone Interface; List of Participants Present; Use of Emoticons; Instant Messaging between Participants; Timed Agenda Items; and Personalisation of Environment, which mostly were not currently incorporated in the prototype, would be useful. From the results of the first prototype trial, the researchers are satisfied that the innovative features being incorporated in V-ROOM are valid and useful. The additional features identified as being required are actually
currently available in other virtual meeting products which means that V-ROOM can utilise them.

Challenges arising from the evaluation consist of the need to integrate existing commercially available software to the final design rather than try to better the functions of already established products. The number of products entering the market place is increasing rapidly and much effort and money is going to be expended by organizations developing their own solutions which consist of elements that other companies have perfected. There is a need for a portfolio approach to virtual meeting support containing complementary products from different suppliers, able to coexist technically to provide a seamless solution to the user. The use of coexisting and complementary products will require specific attention to be paid to coordination, resilience and selection management and as such will draw on previous work in this area from within the Distributed Systems and Modelling research group [14, 15, 16].

Future work, as well as exploring the challenges already mentioned, will consist of researching the areas where intelligent agents can usefully be applied to the meeting situation in more detail. Another area of work will be in moving from the general towards various specifics (see section IV) as the researchers develop the ontology to provide more intelligent support according to specific semantics of specific meetings. Other work will focus on intercepting the meeting dialogue whether in textual, video or audio form so as to recognize keywords. The keywords could then be used to organize meeting logs or to trigger events which could be executed by intelligent agents.

References


