IMIS - An Intelligent Multimedia Interview System

Yanqing Duan[1], Phillip Burrell[2] and Reino Heinanen[2]

[1] Luton Business School, University of Luton, Luton, UK
[2] Knowledge-Based Systems Centre, South Bank University, London, UK

Expert systems have been widely used in many areas, but the traditional expert systems have been criticised for the poor user interface that has limited their capacities. Multimedia is a later developed technology which aims to present information with multiple media usage. The integration of these two technologies has received some attention and the advantages of their synthesis are evident. However, the technology merge is still in its early stage and no attempt has been made to use intelligent multimedia systems in computer-aided interviews. The aim of this research is to demonstrate the enhancement of expert systems with multimedia by developing an intelligent multimedia interview system (IMIS) for psychological assessment. A prototype system IMIS has been built. The system architecture of IMIS and its components are described. Issues associated with integrating expert systems and multimedia are discussed. The IMIS was evaluated and some interesting results emerged.

Keywords: Expert Systems, Multimedia, Computer-aided Interview, Psychological Assessment.

1. Introduction

With the development of Expert Systems (ES) and multimedia, computers are able to mimic many important roles which normally require human actions. Many ESs have been criticised for lacking the capability to provide information in various media format (Bright 1989, Wensley 1989). As a result, the user interfaces of these systems were poor. The integration of ES and multimedia could enhance the performance of both expert systems and multimedia systems and lead to many new application areas.

One application area where the integration of ES and multimedia could be beneficial is that of conducting interviews. Conducting interviews is normally costly and time consuming, and this is particularly true if experts are needed. With the rapid development of information technologies, such as expert systems and multimedia, it is possible to conduct interactive interviews using computers, but a literature review revealed that intelligent multimedia interview systems have not yet been fully explored. For a computer to conduct interviews it must be intelligent and be able to mimic the human interviewer's expertise and also provide a user friendly interface which simulates, as much as possible, a human communication environment. By using ESs and multimedia techniques, it is possible to develop such an intelligent multimedia system to conduct an interactive interview. The aim of this research was to explore the possibility of using an intelligent multimedia system for an interactive interview by developing and testing a prototype system in the psychology assessment domain where domain expert was a Clinical Psychologist. The application domain was in identifying whether the company's employees are psychologically healthy with relation to their physical working environment. This assessment is normally conducted through staff interviews and observation. Interviewing employees is a major part of the assessment process and it is extremely time consuming, given that the assessors time is very expensive. The result of this research has attempted to prove that a computer system, with the domain knowledge and multimedia interface, can replace the domain expert and achieve a similar result.

2. Expert Systems, Multimedia Systems and their Integration

2.1. Expert Systems

An expert system is a computer-based system which can mimic the human expert's performance in a narrow domain. ESs have been in existence for over thirty years and are being used over a wide range of tasks from fault-finding/diagnosis to decision support and planning.

It cannot be denied that the user interface is an important factor for the acceptance of ESs, but there has been considerable criticism concerning the traditional interface of existing ESs (Bright 1989, Wensley 1989). One of the problems associated with poor user interface is that most of the traditional ESs rely on a text-based presentation of information, and this type of presentation, argued by Garrity and Sipior (1994), can be less than satisfactory for users. The text-based interface has limitations in presenting different types of information. Garrity and Sipior assert that traditional knowledge representation schemes are not always effective for presenting knowledge to the user because they force users to translate from problem attributes and characteristics, presented in text (or symbolic) form, into a conceptualisation of the recommended solutions.

Although ESs have been used successfully in performing different tasks, ESs for interviewing purposes have not been well explored. Human communication uses a variety of senses and capabilities, especially in the face-to-face situation, but obviously a traditional text-based ES has limitations in performing such a function.

2.2. Multimedia Systems

A computer-based multimedia system is a synthesis of a computer, video, text and sound, with the computer as the primary control centre. Multimedia interaction is the most prevalent form of human-human communications (Maybury 1994). Maybury (1996) indicates that when people converse with each other, they utilise a wide array of media to interact, including spoken language, gestures, and drawings. People exploit multiple sensory systems or modes of communication including vision, audition, and traction. Although humans have a natural facility for managing and exploiting multiple input and output media, computers do not. Consequently, providing machines with the ability to interpret multimedia input and generate co-ordinated multimedia output would be a valuable facility for a number of key applications such as information retrieval and analysis, training, and decision support (Maybury 1996). Using intelligent interfaces that exploit multiple media and modes to facilitate human-computer communication is a fascinating area with tremendous potential. This will provide great benefits in terms of increased productivity, efficiency, effectiveness and information enjoyment (Neal and Shapiro 1994). Traditionally, information delivered via a computer has been text-based with, perhaps, some basic graphics. Multimedia is able to provide a much richer environment for users. One of the key functions performed by multimedia is the natural presentation of information through text, graphics, audio, images, animation and full motion video (Athappilly et al 1991). Current application areas of multimedia include training, education, kiosk-based product presentation and business communication. More information on the current state of practice among developers of multimedia systems can be found in the survey conducted by Britton, et al (1997). A multimedia progress report by d'Aboville (1996) also provides some information on how far multimedia services have progressed during 1996 and gives a personal insight into how the market may develop in the next few years.

Multimedia systems promise to provide the needed increase in the bandwidth of information exchange between humans and computers, and to enhance human understanding of complex information through better presentation technologies and appropriate combinations of these technologies. However, before these promises can be fulfilled, Neal and Shapiro (1994) point out that there are many problems that need to be solved. Many of these problems are technology areas such as multimedia document authoring, multimedia information and document storage and management, search techniques, computer-supported collaborative work and multimedia human-computer interaction. They suggest that the field of AI will help provide solutions to these problems.

2.3. The Integration of Multimedia and Expert Systems

Although multimedia and ESs are two promising technologies, unfortunately (as Maybury (1994) has found) they have to a large extent, advanced independently of one another despite having much to offer each other. Clarke (1994) also indicates that whilst these two technologies have developed independently, they possess capabilities that make them highly suitable for integration. Researchers in both multimedia and ES have realised the limitation of the individual techniques and come to the same conclusion in that the integration of the two systems would provide a much richer environment. Ragusa and Turban (1994) point out that the synergistic integration has the potential to produce innovative applications that should appeal to a large number of users. Intelligent multimedia interface promises to support a rich level of multimedia interaction, which should increase both the efficiency and effectiveness of today's information systems. In summary, multimedia needs to possess knowledge, and ESs need multimedia for better information presentation and knowledge dissemination. The benefits of integration can be discussed from two aspects; as follows:

(1). ESs support multimedia: Multimedia objects are generally very unstructured and often support complex interrelationships among their components. Therefore multimedia needs to possess knowledge. ESs technology can provide analytical power to multimedia technology. ES components can be used to provide suggestions, selection of the media, etc. (Garrity and Sipior 1994). ESs could enhance multimedia in two notable ways: by giving support to the mix of media tools and/or their output and by using an ES as a guide for hypermedia and hypertext (Ragusa and Turban 1994). With respect to hypermedia systems, by including an ES component hypermedia links can be created dynamically using the knowledge stored within the system (Garrity and Sipior 1994).

Maybury (1996) suggests that future multimedia systems need to go beyond the scenario-based example of multimedia information presentation. They should have abilities for online generation of links, content selection, planning and coordination of multimedia information presentation, and adaptation of the presentation to the peculiarities and style of individual users. To be capable of performing these functions, multimedia systems should possess and utilise knowledge about domain, user requirements, context of interaction, and stored information. However, stand-alone multimedia may not be enough and the ultimate success of multimedia systems may be dependent on ES technology. The benefits of intelligent multimedia are summarised by Maybury (1996) as: the ability to present information in the most appropriate medium (or media), to tailor interaction to individual users, to provide context-sensitive help and to assist a user in performing some expert tasks. A similar summary is also provided by Wright (1990).

(2). Multimedia enhances ES: There has been an increased research into finding methods of improving information presentation and knowledge dissemination through multimedia. Ragusa and Turban (1994) find that previous research has suggested that a non-text-based information approach can present information more effectively, and as the amount of media presented increases so does the interest, attention, and retention rate of the audience. They then conclude that multimedia can make a contribution to ESs by improving user dialogue, displaying results of consultation, providing explanations and generally complementing ES tasks. Narasimhalu (1994) also found that multimedia technology can help expert systems by providing a variety of means of visualising interaction between users and an expert system. This applies to input/output, processing, and presentation of results. Research by Donnell (1996) indicates that multimedia explanation led to higher performance than textual explanations and experiments by Miao et al (1994) show that multimedia information processing and analysis are much more powerful and effective than a single medium case.

Literature reviews show that although the integration of ESs and multimedia has received certain attention, reports of such systems are still limited. The reported integrated systems are mainly in two areas: Computer-Aided Learning (CAL) or Computer-Aided Training (CAT) and Intelligent Multimedia Decision Support Systems and Expert Systems.

The traditional area for the use of multimedia is in computer-based tutoring systems and this is

also one of the active ES application domains. The merger of ES and multimedia in CAT or CAL can result in an application with many benefits and few constraints. Some ES and multimedia integration has been reported, for example:

- Intelligent multimedia tutoring for manufacturing education (Rogers et al 1995).
- An intelligent multimedia-supported instructional system (Kong 1994).
- An intelligent multimedia tutoring system to help students learn knowledge acquisition (Liebowitz and Bland 1994).
- A multimedia-based education software with expert system for learning environment problems (Okamoto et al 1994).

Intelligent multimedia decision support systems (DSS) and expert systems are active areas for integration. For DSS, elements of multimedia have always been used when sharing and archiving information and communications. For problem understanding, problem solving and decision making, the intelligent multimedia is vital in its capacity for enhancing the user interface with visual and sound elements (Costea, 1993). Some examples reported include:

- A multimedia information processing and analysing expert systems (Miao et al 1994).
- An integrated system for knowledge management problem found in the maintenance of pipeline equipment in a petroleum company (Urquijo and Rojas 1994).
- A multimedia expert system for wafer polisher maintenance (Hekmatpour and Elkan 1993).
- A multimedia expert system for improved troubleshooting of the city of Los Angeles's computer software (Clarke et al 1994).
- A protocol multimedia ES which provides users with comprehensive advice and recommendations by presenting the various facets of foreign cultures with pictures, text, or video clips (Liebowitz and Baek 1996).
- An integrated multimedia intelligent system for total quality management in dairy companies (Fonseca Filho et al 1997).
- A multimedia expert advisor for vocational guidance (Hasebrook and Nathusius 1997).
- An expert parasite identification system with multimedia support (Theodoropoulos et al 1997).
- A multimedia patient folder management system as an active tool supporting physician's activity (Ferri et al 1994).
- A multimedia expert system for colour TV diagnostic and repair (Seng and Tay 1994).
- A multimedia knowledge-based system for on-line fault diagnosis of material flow in a F.M.C. (Tha and Tan 1994).
- A multimedia knowledge-based system for home care support in the domain of childhood leukaemia (Kim 1995).

One interesting issue which has emerged from the literature is the importance of using multimedia for presenting information to computer users. This has been recognised and stressed by many researchers, but the use of multimedia to help extracting information from users has not been discussed. The use of multimedia, reported in this paper, is not only to present information, but more importantly to effectively elicit information from its users.

2.4. Intelligent Computer Interview System

Only a limited number of papers have reported in the area of intelligent computer interview systems (Gerbert et al 1997, Suh et al 1995, Johnston and Walton 1995, Warren 1993). Most of these do not use a multimedia interface and are predominately in the medical domain. For example, Suh et al (1995) developed an intelligent medical interview system which is able to elicit information from patients for a medical practice database. The knowledge base contains screening questions and follow-up questions. Screening questions fire rules which trigger in-depth follow-up question sets. Warren et al (1993) developed a knowledge- based data acquisition system to embody interview expertise for primary care medicine. Field experience has shown medical information gathered with this system to be both relevant and sufficient to support a diagnosis. Johnston and Walton's research (1995) is on a computer-assisted self-interview system designed to increase privacy for interviews that asks about potential self-incriminating behaviour. Their research reveals some interesting findings, such as that people would be more likely to tell the truth using the computer rather than a written questionnaire or face-to-face interview. Most users also believe that their answers are more secure with a computer.

Research conducted by Gerbert et al (1997), on using multimedia interview systems to assess a patient's HIV risk shows that one of the benefits of using a multimedia interview system is that researchers could experiment with the effectiveness of different interview styles. Their research shows that a warm communication style elicited more disclosure of risk behaviours than a neutral style.

3. Domain Background

The aim of this research was to demonstrate that ESs could be enhanced by multimedia, by developing an intelligent multimedia interview system for psychological assessment. This section describes the domain background and includes the factors the domain expert considers for the assessment and explains how the assessment is conducted.

To know whether a company has a good psychological and physical working environment and if employees are happy to work in the company is becoming more important. There are cases where employees sue their employers because of a poor working environment. The stress caused by a company can lead to employees' emotional depression and cause them to resign. Also, when employees are stressed, their motivation is low and this may jeopardise the company's performance. It is essential therefore, to ensure that a company provides a psychologically and physically healthy environment for its employees. Our domain expert developed special expertise to identify an organisation's problems. The assessment is conducted through staff interviews and observation. The assessing process mainly consists of two parts:

1. Observation - The expert walks around the company, observes how the staff work, and assesses the physical working environment;
2. Interview - The expert interviews employees who are randomly selected, but who are representatives of different levels within the company.

The observation and interviews are mainly concerned with the following four areas:

1. Decision making, such as: organisational structure, lines of communication - internal/external, participation/responsibility, visibility, complaints procedures
2. Levels of interpersonal contact, such as: working hours, social events, corporate identity
3. Environment, such as: spatial layout, colour schemes, decoration, ventilation, heating, lighting
4. Health, such as: accidents & illness, nutrition, exercise, seating, VDU policy, smoking policy

During the expert consultant process, he needs to spend at least a whole day in the company where most of the time is spent interviewing different members of staff and observing, and checking around the site. The process is described as very time consuming, especially the interview process. Since he uses similar questions and the same interview strategy in each interview, he believes that if a computer system could conduct interviews, the time for the assessment process could then be reduced substantially. There are also other benefits for using electronic interviewing which are discussed later in the conclusion of this paper.

Considering the application, the system IMIS should possess human interview intelligence as well as a multimedia interface for effective communication between the system and the users (interviewees in this case). Why does the system need to be intelligent? When the psychologist interviews employees the questions are not fixed as in a normal questionnaire survey. The interviewees' responses will direct the interviewer to stop questioning or to trigger follow-up questions. Therefore the computer needs to have knowledge about which set of follow-up questions should be asked if certain answers are given.

Why does the system need to be multimedia? A multimedia presentation is closer to the nature of human interviewing. The interviewees are normally manual workers and may be reluctant to read, or have difficulty in reading text-based information and questions. With multimedia, questions can be asked by voice while a picture of the interviewer asking questions appears on the screen. So, voice or video-aided questioning has the persuasive, instructive, and attention-grabbing nature of normal communication and this function may make interviewees feel more engaged and comfortable when the computer can "talk" to them.

The system is considered technically feasible for the following reasons:

- The availability of the domain expert. The expert was involved in this project and willing to contribute and co-operate.
- The expert was able to define the diagnostic procedures, questions used and questioning techniques implemented.
- The integration of Multimedia and ES techniques makes it possible to conduct voice and video-aided questioning.

4. System Development

The development process involved several different stages starting from defining the prototype objectives, representing the knowledge elicited from the domain expert, designing the system architecture, selecting a development tool, programming the prototype and evaluating the prototype system.

4.1. Knowledge Acquisition and Representation

Knowledge acquisition is regarded as the bottleneck of developing any expert system. This bottleneck is mainly caused by communication difficulties between the knowledge engineer (KE) and the expert, the inability of the expert to describe expertise, and the inability of the KE to capture expertise (Liebowitz 1996). The most commonly used form of knowledge acquisition method is face-to- face interview analysis (Turban 1995) and this was the method used in this project to elicit the necessary knowledge from the domain expert. One of the authors acted as the knowledge engineer and once she had gained sufficient domain knowledge, she was able to construct formal and structured interviews. The knowledge engineer used diagrams to represent the expert's decision rules and a process of continuous feedback was used to ensure the knowledge had been correctly represented. This process not only helped the KE to represent the domain knowledge correctly, but also helped the expert to clarify the reasoning process. The knowledge acquisition process was completed before the system was built. All knowledge needed had been analysed and represented in production rules in a rule base and this was used to control the interview process. The follow-up questions were triggered, based on the interviewee's answer to the previous questions.

4.2. Software Selection

As this technology synergy is still in the early stages, a number of researchers have noted the lack of software for integrating multimedia and ES and pointed out that better tools are needed to develop the linkage between the two technologies (Fuerst et al. 1995). At the moment, developers can only choose either multimedia authoring tools or ES development tools. For this project, the authors tried some software with good multimedia functions, but found it difficult to build a knowledge base in the form required. Most intelligent multimedia systems, reported in literature, have used ES tools to build the knowledge base and the multimedia is integrated by using programming language such as C/C++ (Ragusa 1996).

Two important criteria were used in selecting development tools for IMIS: 1. The ability to develop a rule-base knowledge base; 2. The ability to implement a multimedia user interface. An object oriented ES development tool was chosen because it served both requirements. Although this software has certain limitations, it has basically achieved a satisfactory result for prototyping purposes.

The object-oriented features of the chosen software make it easier to write, maintain, reuse and extend functions. It has classes, instances, methods, inheritance, facets reference types, and class libraries. It has an open architecture to support add-on objects, several of which are supplied. These libraries of objects support the latest modern Windows functionality: video, sound, Object DataBase Controller (ODBC) access, sliders, gauges, help systems, new display controls and planning/resource scheduling services. It can access different databases and servers, both locally and remotely. This includes standard SQL-based access to ODBC.

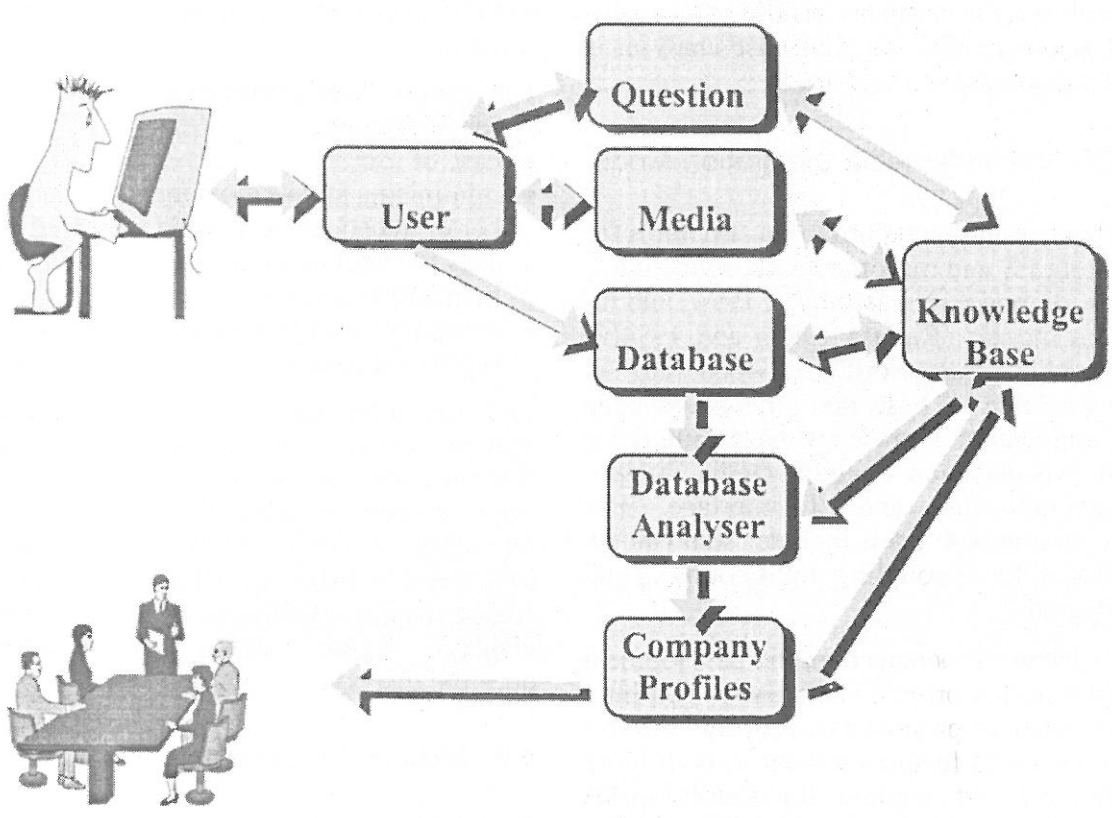

Fig. 1. The system architecture of IMIS.

4.3. The System Architecture

The IMIS system consists of five components: question base; knowledge base; media base; database, and database analyser. Figure 1 shows the basic system architecture of IMIS.

User interface is an interface between the user and the computer system. It is a window based application where a mouse and keyboard are used to navigate through displays and to answer questions.

Question Base contains all the necessary questions that could be asked by the domain expert. The question base was divided into four different sections: *organisational decision-making, levels of interpersonal contact, working environment and health.* Each section is further divided into subsections based on the domain expert's assessment knowledge. This type of structure also makes it easier to add, delete, or modify questions in the question base.

Media Base contains visual and audio sets for questions, help and explanations. The IMIS system has three information presentation and questioning functions: text-based information, voice and video aided questioning and explanations. Users have options in selecting different media according to their preference.

Database is MS Excel-based and is used for storing the answers the respondents give during the interview. All the information of a single respondent is stored in a single row field. The maximum number of responses, in the reported system, is limited to 200, but the limit can be increased or decreased. System settings of IMIS are also stored in MS Excel.

Knowledge Base has production rules for selecting questions, an inference engine for triggering different actions based on users' responses and the knowledge for analysing data and generating a company profile and recommendations for future improvement. The knowledge base is partly integrated into the question base, media base and database. This makes implementation easier and access faster.

Database Analyser contains the analytical tools used by the expert for data processing and result generation. Using the knowledge base and the

data analyser, the company profile can be generated automatically. The database analyser is still in the process of completion.

4.4. ES and Multimedia Integration Model

There have been several proposed structures for integrating ES and multimedia, these include a framework model (Narasimhalu, 1994) and integration models (Ragusa 1994a and 1994b). Narasimhalu's framework is divided into six major modules. These are: metaknowledge base; application knowledge base; inference engine; visualisation engine; media integration/decomposition; and I/O interface. Ragusa's integration models include: stand alone, transitional, loose coupling, tight coupling and full integration.

From a technical perspective, the development tool used in this project is closest to full integration model as proposed by Ragusa (1994b). It also possesses features similar to both loose coupling and tight coupling. It has most aspects of full integration because, after the information needed is retrieved from the database, the information can be stored in objects and used in a co-operative way. Multimedia is embedded into the tool and can be used as an object to perform a number of desired actions. Some of the loose coupling features are applied, as the development tool uses external databases to store the information. It also needs an external file to hold set-up information, as it is not possible to change the values of the objects permanently during the run-time. Tight coupling is possible because other Windows compatible programs can call the program created by the development tool or be called by it to perform desired actions. From a user perspective, the integration orientation is ES supported by multimedia as described by Ragusa (1994b).

4.5. User Interface Design

The IMIS serves two types of users: the system users (interviewees) and the expert users (psychologists in this case). The interviewees use this computerised system to answer the questions which would otherwise be asked face-to-face by the psychologist. The expert user is the domain expert (psychologist) who, at the end of the staff interview, can use the results collected by IMIS to provide a final report on a company's situation.

The design of the interface involved a number of considerations:

- ease of use
- minimising mouse movement, as a large number of questions need to be answered
- easy to understand the text provided, such as help, explanation and error messages
- consistent background colours for different types of displays.

The user interface design was an interactive process between design, testing and redesign. Several colleagues were consulted during this stage in order to select the appropriate interface features. There are basically 4 major types of screens in IMIS: question displays, system setting displays, IMIS-menu displays and help displays. Figure 2 shows a sample screen of question display.

4.6. Multimedia Development

Sound files were created during development and stored in digital mode on the hard disk. As an interesting sideline, it was found that the sound quality was improved by speaking through a paper cone, length 10 cm, attached to a microphone.

Creating video clips requires the time and co-operation of the domain expert. A complete set of video files, using the domain expert were not created for this initial stage, as his time was limited. To demonstrate that the system could easily implement this function some sample video clips were used. This demonstrated an improved user interface and multimedia performance. Video files do require very large amounts of storage space and the hardware capacity may limit the use of large numbers of video files.

Animation could be used to make the system more user-friendly and attractive, but its role in IMIS was limited. The first welcome screen and some menu screens contain animation to attract the user's attention. The lack of libraries containing appropriate graphics also make it difficult to create animation. In the chosen development tool, pictures are stored into a 'picture' attribute as bitmap graphic images and then attached to a valuebox. Valuebox is an attribute that contains the picture object.

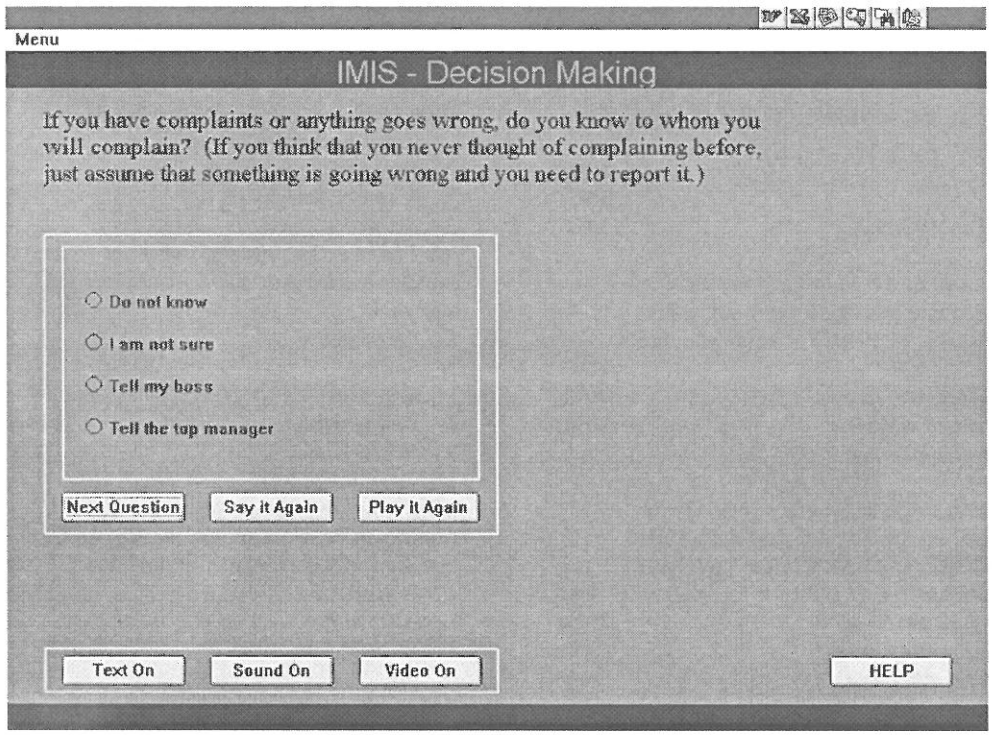

Fig. 2. A sample screen of interview questions.

5. Initial Evaluation of IMIS

Issues on ES evaluation have been well addressed in the literature (Berry and Hart 1990, Davis and Liebowitz 1990, Preece 1990, Rees 1992). Maybury (1994) points out the need to measure how well intelligent multimedia interfaces will support users. An expert system would not be complete without thorough evaluation. This is particularly important for IMIS, as how interviewees feel about being interviewed by a computer could reveal interesting issues. More importantly, the evaluation process should be carried out as the development of the system progresses.

Since IMIS was built to replace the human interviewer, its success depends not only on the system's performance, but also on the interviewee's perception of using it. It is necessary to assess the impact of the system to see whether it will be accepted by them. As the interviewee's perception is normally a subjective measure, it would be very difficult to compare the expert interview and the computer interview by using objective measures. Several researchers have conducted user evaluation using questionnaires and interviews (Davis and Liebowitz 1990, Preece 1990, Rees 1991, 1992). This type of evaluation was used to obtain the users' opinions on the system's usability. They were asked to evaluate the system's usability in terms of its ease of use, user-friendliness and their perception of the differences between human and computer interviewing.

Questionnaires on IMIS evaluation were issued to the users. The questionnaire is divided into two parts. The first part contains questions about the user's background, their previous experience of using computers, and computerised interview systems. The second part was designed to survey the user's opinion on computerised interview systems in general and the use of IMIS in particular. Ten users were used to test the system, most of these were university students. The evaluation aimed to test the system quality, such as the ease of use, the quality of the multimedia elements, the help functions, etc., as well as the users' attitudes towards using a computerised interview. The survey results showed that most of users were satisfied with the system quality. Only two of them felt that they had some problems while answering questions and this related to the system not running smoothly enough because of the waiting time for loading video files. This weakness could

questions	% (n=10)	questions	%(n=10)
Do you think that a computerised interview is superior when compared to other interview methods (e.g. paper-based or face-to-face interviews)?		Which interview method would encourage people to be more truthful whilst being interviewed?	
1. Yes	40%	*1. Computerised interview*	70%
2. No	30%	*2. Face-to-face interview*	10%
3. *It makes no difference.*	30%	3. *It makes no difference.*	20%
Given the choice of a face-to-face interview or a computerised one, which do you think would give you MORE PRIVACY whilst you are answering questions?		After using the system, what is your overall experience of a computerised interview?	
	10%	*1. Very positive*	20%
1. Face-to-face interview	70%	*2. Positive*	70%
2. *Computerised interview*	20%	*3. Negative*	10%
3. *It makes no difference.*		*4. Very negative*	0%
		5. *Do not know.*	0%
Given the choice of a face-to-face interview or a computerised one, which do you think would give you MORE PRIVACY after you have answered questions?		After your experience with the system, would you be more or less willing to be interviewed by a computer in the future?	80%
	10%	*1. More willing*	0%
1. Face-to-face interview	80%	2. *Less willing*	20%
2. *Computerised interview*	10%	3. *No difference.*	
3. *It makes no difference.*			

Table 1. A sample of the survey results on users' attitude towards using a computerised interview

be overcome in the future with a much faster computer. Nine indicated that they preferred to use text and audio when being interviewed by IMIS. Overall, 90% had a positive (7 users) or very positive attitudes (2 users) towards using IMIS, while only one had some reservations.

The most interesting findings from the initial system evaluation were people's attitude towards using computerised interviews. Table 1 shows a sample of the results after the users had tried the system. As you can see from the table 1, when asked about their general opinions towards computerised interview comparing with face-to-face or paper-and-pencil interview, most indicated that computerised interviews are superior to the other two interview methods in terms of privacy and truthfulness. At the end, eight expressed that they were more willing to be interviewed by a computer and two felt that it made no difference at all. This initial evaluation provided encouraging results and a more formal evaluation is intended for the future.

6. Conclusions

Literature surveys have shown that limited research has been undertaken in the area of multimedia intelligent systems for interactive interviews. The systems reported have been developed mostly in the medical domain. They either use a knowledge base to represent questions without using a multimedia interface, or have an audio function to question interviewees without using an intelligent questioning process.

This research demonstrated that the use of an intelligent multimedia interview system can:

- *Save the expert's time*: If a computer could do most of the interviewing, the expert could concentrate on the observation. It is estimated that, if using a computerised interview system, the time saving could be as high as 60 percent of the total time spent for consultation.
- *Analyse the survey results easily.* The data collected during the interview is stored in the database and can be easily analysed by the system built-in database analyser. In a face-to-face interview an expert has to make notes and analyse these immediately afterwards.

It also has some benefits that a face-to-face interview lacks:

- A computerised interview system can *be a useful tool for anonymous interviews* in cases where people are reluctant to have a face-to-face interview.
- It can *eliminate the personal bias.* The computerised interview system will not be

affected by environment, emotions, interviewees' personal styles, and their personal prejudice attitudes.
- It is more *attractive and appealing* to interviewees.

ES and multimedia integration is still in its infancy. Many potential application areas have not yet been fully identified. The research described in this paper aims to explore the feasibility of integrating ES and multimedia technologies and demonstrate the advantages of using an intelligent interactive interview system. Although the application domain of the developed system is Psychological Assessment, the proposed system architecture is applicable to different types of interviews. The advantages and difficulties involved in developing such a system are identified. The major advantages are the enhancement of a user interface for ESs and the improvement of the system functions. However it is also more difficult to build a multimedia intelligent system than traditional text-based ESs for several reasons. It was found that software availability, lack of skills by ES developers with multimedia development and inadequate multimedia authoring equipment in developing integration have limited the systems performance. Certain techniques have been used to overcome the limitations of the chosen development tool, such as using EXCEL for system settings and as an external database for storing interview results These have proved to be effective. The feedback from the system evaluation was very encouraging. Most users felt that a computerised interview could reduce bias, provide more privacy, encourage more truthful answers and was easy to conduct. Most indicated that they would like to take a computerised interview rather than a face-to-face or paper-and-pencil interview in the future.

Although the chosen development tool served the purpose of developing the prototype system, the authors are still not satisfied with using ES tools to build multimedia interfaces. There is a need for better software to support the multimedia authoring as well as designing the knowledge base.

Acknowledgement

The authors would like to thank Professor Tony Canavan, a Clinical Psychologist who provided the domain expertise for this research, for his enthusiasm and cooperation throughout the project.

References

K.K. ATHAPPILLY, C. DURBEN, S. WOODS, Multimedia Computing: An overview. In *Multimedia Computing: Prepare for the 21 Century* (S. Reisman, Ed.), (1994) pp. 103–124, Idea Group Publishing.

D.C. BERRY, A.E. HART Evaluating expert systems, *Expert Systems*, 7(4) (1990), 199–207.

C. BRITTON, M. JONES, M. MYERS, M. SHARIF, A Survey of Current Practice in the Developemtn of Multimedia Systems, *Information and Software Technology*, 39(10) (1997), 695–705.

D.E. CLARKE, E. TURBAN, P. WANG, Integrating Expert System and Multimedia for Improved Troubleshooting of the City of Los Angeles's Computer Hardware, *Expert Systems With Applications*, 7(3) (1994), 441–449.

I. COSTEA, IMM-DSS: Intelligent multimedia decision support systems. Presented at the *Proceedings of the International Conference on Systems, Man and Cybernetics*, (1993), pp. 169–172.

L. DAVIS, J. LIEBOWITZ, Testing and evaluation of expert system prototype: a case study, *Information Age*, 12(2) (1990), 75–82.

A. D'ABOVILLE, Multimedia — a progress report, *EBU Technical Review* (270), 1996, pp. 38–44.

M.I. DONNELL, Human cognition and the expert systems interface: mental models and explanation facilities, Presented at the *Proceedings of Human Interaction with Complex Systems: Conceptual Principles and Design Practice*, (1996), USA.

F. FERRI, R. MINARELLI DELLA VALLE, D.M. PISANELLI, F.L. RICCI, F. TITTARELLI, A multimedia patient folder management system as an active tool supporting physician's activity, Presented at the *Proceedings of the Twelfth IASTED International Conference Applied Informatics*, (1994).

A.A. FONSECA, C.A.B. DA SILVA, J.B.P. CHAVES, Integrating multimedia and Artificial Intelligence: An Application for Total Management in Dairy Companies, Presented at the *Proceedings of the First European Conference for Information Technology in Agricultur*, (1997), Copenhagen, Denmark.

W. FUERST, J.M. RAGUSA, E. TURBAN (1995) Expert Systems and Multimedia: Examining the potential for integration, *Journal of Management Information Systems*, 11(3) (1995), 155–179.

E.J. GARRITY, J.C. SIPIOR, Multimedia as a Vehicle for Knowledge Modelling in Expert Systems, *Expert Systems With Applications*, 7(3) (1994) 397–406.

B. GERBERT, K. JONSTON, T. BLEECKER, A. BRONSTONE, S. FLATT, M. ALLERTON, N. CASPERS, HIV risk assessment: a video doctor seeks patient disclosure, *M.D.Computing*, 14(4) (1997), 288–294.

J.P. HASEBROOK, W. NATHUSIUS, An expert advisor for vocational guidance *Journal of Artificial Intelligence in Education*, 8(1) (1997), 21–41.

J. JOHNSTON, C. WALTON, Reducing response effects for sensitive questions: a computer-assisted self interview with audio, *Social Science Computer Review*, 13(3) (1995), 304–319.

M.Y. KIM, A multimedia information system for home health-care support, *IEEE Multimedia*, 2(4) (1995), 83–87.

H. KONG, An Intelligent, Multimedia-Supported Instructional System, *Expert Systems With Applications*, 7(3) (1994), 451–465.

J. LIEBOWITZ, S.I. BAEK, The protocol multimedia expert system, *The New Review of Applied Expert Systems*, 1 (1996), 3–17.

J. LIEBOWITZ, K. BLAND, Using multimedia to help students learn knowledge acquisition, *Multimedia Computing: Prepare for the 21 Century* (S. Reisman, Ed.), (1996) pp. 536–557, Idea Group Publishing.

Z. MIAO, B. YUAN, Q. RUAN, A multimedia information processing and analyzing expert system. Presented at the *Proceedings of Safety, Reliability and Applications of Emerging Intelligent Control Technologies*, (1994), Hong Kong.

M.T. MAYBURY, Knowledge Based Multimedia: The Future of Expert Systems and Multimedia, *Expert Systems With Applications*, 7(3) (1994), 387–396.

M.T. MAYBURY, Intelligent Multimedia Interfaces. Presented at the *12th European Conference on Artificial Intelligence*, (1996) Budapest, Hungary.

A. NARASIMHALU, A Framework for the Integration of Expert Systems With Multimedia Technologies, *Expert Systems With Applications*, 7(3) (1994), 427–439.

J.G. NEAL, S.C. SHAPIRO, Knowledge-based multimedia systems, *Multimedia Systems* (John F. K. Buford, Ed.), (1996) pp. 403–438, ACM Press.

T. OKAMOTO, N. KAWASHIMA, S. KOTO, A development of multimedia CAI software with expert system for learning environment problems, Presented at the *Proceedings of Educational Multimedia and Hypermedia conference*, (1994) Vancouver, BC, Canada.

A.D. PREECE, Towards a methodology for evaluating expert systems, *Expert Systems*, 7(4) (1990), 215–223.

J.M. RAGUSA, Models and Applications of Multimedia, Hypermedia, and Intellimedia Integration With Expert Systems, *Expert Systems With Applications*, 7(3) (1994a), 407–426.

J.M. RAGUSA, Models of Multimedia, Hypermedia, and 'Intellimedia' Integration with Expert Systems, *Moving Towards Expert Systems Globally in the 21st Century*, Presented at the Second World Congress on Expert Systems, (1994b), Lisbon, Portugal.

J.M. RAGUSA, E. TURBAN, Integrating Expert Systems and Multimedia: a review of the literature, *International Journal of applied Expert Systems*, 2(1) (1994), 54–71.

J. RAGUSA, Expert system integration with multimedia, Tutorial session at the *Third world congress on expert systems*, (1996) Seoul, Korea.

P. REES, A case study of user evaluation of an expert system, *Journal of Systems Management*, December, 10–11 (1991), 36–37.

P. REES, User evaluation of expert systems, *Industrial Management & Data Systems*, 92(6) (1992), 17–23.

B.H.A. SENG, B.H. TAY, A practical expert system solution for colour TV diagnostic and repair, Presented at the *Proceedings of the Second Singapore International Conference on Intelligent Systems (SPICIS'94)*, (1994) Singapore.

S.C. SUH, J. KOCUR JR, R. SELVAGGI, Intelligent medical interviewer, Presented at the *Proceedings of the ISCA Intelligent Conference, Fourth Golden West Conference on Intelligent Systems*, (1995) San Francisco, USA.

N. THA, H.S. TAN, A knowledge-based system incorporating multimedia for on-line fault diagnosis of material flow in a F.M.C., Presented at the *Proceedings of the Second Singapore International Conference on Intelligent Systems (SPICIS'94)*, (1994) Singapore.

G. THEODOROPOULOS, V. LOUMOS, N. TSOUROULAS, An expert parasite identification (EPAION) system with multimedia support, *Medical Informatics*, 22(3) (1997), 263–273.

E. TURBAN, *Decision Support Systems and Expert Systems*, Fourth Edition, Prentice-Hall International, Inc. Englewood Cliffs, NJ, USA, 1995.

J. URQUIJO, G. ROJAS, Expert Systems and Hypermedia/Multimedia integration: an industrial maintenance solution, Presented at the *Proceedings of the Second World Congress on Expert Systems*, (1994), Lisabon, Portugal.

J.R. WARREN, D.E. WARRENT, R.W. FREEDMAN, A knowledge-based patient data acquisition system for primary care medicine, Presented at the *Proceedings of the Second International Conference on Information and Knowledge Management*, (1993) Washington DC, USA.

A. WENSLEY, (1989) Research directions in expert systems, *Knowledge-based Management Support Systems* (G.I. Doukidis et al., Ed.), (1989) pp. 248–275, Ellis Horwood.

J. WRIGHT, ES technology is set to come to the aid of multimedia interaction, *Expert System User*, 6(2) (1990), 12–14.

Received: January, 1998
Revised: March, 1998
Accepted: May, 1998

Contact address:
Dr. Yanqing Duan,
Luton Business School
University of Luton
Luton LU1 3JU
UK
phone: (44) 01582 743134
fax: (44) 01582 743143
e-mail: yanqing.duan@luton.ac.uk

Dr. Phillip Burrell
Knowledge-Based Systems Centre
School of Computing, Information Systems and Mathematics
South Bank University
Borough Road
London SE1 0AA
UK
phone: (44) 0171 815 7408
fax: (44) 0171 815 7499
e-mail: phillb@sbu.ac.uk

YANQING DUAN Ph.D is a Senior Research Fellow at Luton Business School. Her research interests include the development and use of intelligent systems and decision support systems for business decision making and marketing planning. She is also interested in integrating multimedia with expert systems and decision support systems. She has published a number of papers in her research areas.

PHILLIP BURRELL is a Principal Lecturer and Director of the Knowledge-Based Systems Centre at South Bank University, UK. He studied at the University of Leeds, UK, Kings College, UK and was involved in further research at Imperial College, UK. He has researched in the area of Artificial Intelligence for many years and has been involved with a number of funded projects over this period. His main areas of interest are the hybrid approach for intelligent support systems and reasoning with uncertainty.

REINO HEINANEN worked as a researcher in the Knowledge-Based System Centre on a European exchange programme with Finland. His major interests are in multimedia systems where he is now applying his skills in industry.