

DIGITAL OBJECT SOFTWARE FOR IMAGES, TEXT AND SOUND (DOSITS)

INTRODUCTION.

Recent advances in the technology for the creation, manipulation and interaction of digital objects whether they are images, static or moving, based on text or sound or a combination of these media provide many new opportunities for research in the arts and humanities. The proposal is built around the Centre for the Understanding of Digital Objects (CUDO) that has been allocated new, *state of the art* laboratories in the University's new Multi-Disciplinary Research Building funded under the SRIF programme. CUDO is a collaboration between the Department of Computer Science and a large number of very highly rated departments in the Faculties of Architecture, Arts and Pure Science. Included in this consortium is the Humanities Research Institute together with many of the existing external research collaborators of these groups.

AIMS AND OBJECTIVES.

Science, engineering, innovation and scholarship are increasingly dependent on computer-based representations of complex structures, whether derived by data capture from the real world, or created from scratch, or a mixture of the two. We introduce the term 'digital objects' to refer to these structures. Examples of these objects are: Visual, audio and audio-visual archives; Virtual Buildings; Archaeological Objects; Textual Archives... etc.

The mission of the centre is to "understand" digital objects: their design, creation, analysis, maintenance, manipulation and application.

Studies based on digital objects require active interaction rather than passive absorption, for instance:

- searching by voice/image in audio-visual archives, resulting in adding "links" into the material, so that the material is enriched and thus more exploitable;
- manipulating and maintaining 3D designs in architecture to assist with the continual revision of aspects of the design which can create enormous document workflow problems, as well as overcoming the many conceptual obstacles to understanding the properties of potential buildings;
- on-line exploration of multi-dimensional and multi-functional molecular species interacting with each other through a variety of structural contexts and constraints;
- examining how created objects can be represented and manipulated so as to study the creation process itself, a major theme here will be music and sound;
- extracting and manipulating information from digitised manuscripts....

EXCITEMENT OF THE RESEARCH CHALLENGES TO BE ADDRESSED.

Research approaches will include:

Information

- information retrieval from Multi-Media Archives - aural, visual and textual;
- extracting and analysing information from electronic texts;
- manipulating and understanding electronic images and animations;
- generating and exploring electronic artefacts from various sources.

Modelling

- experimenting with computational models of artistic appreciation and creativity;
- building models of architectural and archaeological built environments;
- acoustical modelling of buildings (auditory VR);
- acoustic modelling of buildings and urban environment (auralization).

Perception and understanding

- virtual music instruments;
- architectural walk-throughs;
- historical and archaeological reconstructions;
- interactive evaluation of multi-media information retrieval systems.

Creativity

- analysis of music performance and composition;
- study of creativity in architectural design;
- design and fabrication routes to found archaeological relics;
- creativity in literature.

Fundamental research problems from Computer Science, Architecture, Archaeology, Music, History, Literature and the humanities, generally involving the representation, recognition and processing of sounds, images and multi-dimensional digital objects and their use in creating, understanding and applying complex artefacts and computational models will form the core of the research.

THE SIGNIFICANCE OF SELECTED RESEARCH AREAS, HOW THIS MEETS THE VISION OF BASIC TECHNOLOGY AND CONTRIBUTES ACROSS A SPECTRUM OF SUBJECTS.

The vision is twofold - to produce new and interesting challenges to develop the research agenda of computer science and to provide new and powerful ways of investigating important research issues in the arts and humanities. Engagement with technically difficult but practical problems in close collaboration with researchers in exciting application domains will enrich and renew the computer science research agenda. This will benefit the UK computing industry as well as providing many opportunities to exploit our intellectual and archival resources in the arts and humanities.

NATURE OF THE RESEARCH TEAM AND ITS ABILITY TO DELIVER THE RESEARCH PROJECT AIMS.

Professor Mike Holcombe (Computer Science) - coordinator.

Professor Peter Hill (Music); Professor Bryan Lawson (Architecture); Professor Yorick Wilks (Computer Science); Professor David Luscombe (History & Director of the Humanities Research Institute); Professor Phil Green (Computer Science); Professor Mahesan Niranjan (Computer Science); Professor Robin Dennell (Archaeology and Prehistory); Dr. Guy Brown (Computer Science); Dr. Andrew Chamberlain (Archaeology and Prehistory); Dr. Barry Eaglestone (Information Studies); Dr. Rob Gaizauskas (Computer Science); Dr. Jian Kang (Architecture); Dr. Steve Maddock (Computer Science); Dr. Chengzhi Peng (Architecture); Dr. Mick Perkins, (Human Communication Science); Dr. Steve Renals (Computer Science); Dr. Mark Sanderson (Information Studies); Dr. Osman Tokhi (Automatic Control and Systems Engineering); Dr. Claire Warwick (Information Studies); Professor Micheline Beaulieu (Information Studies); Professor Richard Carwardine (History); Mr. Michael Hannon (University Librarian); Professor Andrew Prescott (Humanities Research Institute); Professor Sally Shuttleworth (English Literature); Professor Jeremy Till (Architecture); Professor David Walker (French); Dr. Penny Eley (French); Dr. Sarah Foot (History); Dr. Sarah Howard (Human Communication Science); Dr. Penny Simons (French)

The grant will enable us to build a highly multi-disciplinary group of researchers. We envisage appointing research fellows to work in pairs, one a computer scientist the other from the application domain and to harness and exploit generic technology developed across several areas. We also request funds for PhD students to support the research clusters. Some funds for administrative running costs and specialist computing and digitisation equipment are also requested.

OUTLINE OF PROPOSED METHODOLOGY.

The construction of digital object repositories will be based around the use of suitable XML dialects and smart semantics and feature based searching tools built upon the achievements of a number of experts in Computer Science for example in speech recognition and natural language processing. The development of tools for creating virtual reality environments to exploit the advanced CAVE facilities that the centre will have will be important. Already much work has been done creating a Virtual Model of Sheffield 1900 but progress is affected by the slow, painstaking process of converting the available information into complete virtual

representations of the city at that time. We need to develop smart methods for generating such virtual worlds from the available data. Introducing acoustic phenomena into the model will also be a key issue. New models for understanding music composition through interaction with digital sound objects will be developed. Advanced text processing and information extraction software developed in Sheffield will facilitate major advances in literature and historical archive research. Throughout a key objective will be to develop systems that are easy to use and meet the requirements of the researchers in the arts and humanities. This will provide a major impetus to computer science by way of providing stimulating new research challenges for the field which are driven by the applications use of the technology and not the technology for its own sake.

EVIDENCE OF DISCIPLINES WORKING TOGETHER AND VALUE OF ANY PROPOSED COLLABORATION.

Within the University are a number of important research centres including the National Centre for English Cultural Tradition, National Fairground Archive, Centre for Research in Music Performance & Perception, Institute of Language, Speech & Hearing, Centre for Research into Freemasonry together with a large number of important collections of artefacts and scholarly materials including the Sheffield Urban Study Archive, National Fairground Archive, Hartlib Papers, Pérez Galdós Editions, Strafford Papers, Fairbank Papers and access to the Cotton Manuscripts, the British Library's illuminated manuscripts etc. etc. The existence of these resources provides the motivation for the development of highly sophisticated software that will maximise their use and exploitation. Many opportunities for manipulating and transforming the digital objects derived from these resources are opening up through major advances in text processing, image feature recognition, semantics based sound recognition, virtual reality environments and so on.

OUTLINE OF THE MANAGEMENT STRUCTURES.

The main top level management will be through a termly meeting of the principal investigators with invited representatives from partners such as BBC and British Library. This will set general objectives, plan outlines and review progress. On a weekly basis there will be meetings of the research teams to monitor progress and discuss opportunities. The ethos of the proposal is one of intense personal interaction across the disciplines and we intend to build on the current open collegiate atmosphere and encourage widespread involvement in the activities.

It is envisaged that a number of advanced Computer Science undergraduate and masters students will be doing intensive software development projects with clients from the centre. This is a major aspect of added value for the project and will involve the Computer Science academics who will supervise these students in detailed collaboration with researchers from a wide range of other departments.

ARRANGEMENTS FOR TAKE UP (EG. IPR OWNERSHIP) AND DISSEMINATION OF RESULTS.

Much of the work carried out in these projects will be made available over the World Wide Web. This is an important motivation for the research as it spreads the user community far beyond Sheffield and the UK and provides many new opportunities for further novel collaborations. Naturally, there will be many papers submitted to high quality journals in computer science and all the application areas - humanities, arts, architecture etc.

It is also expected that some commercial exploitation with partners such as BBC and British Library as well as through the University's own spin off activities. This will enable attractive products and services to be developed that exploit in novel ways some of the cultural heritage and resources that are available to the researchers and significantly raise the profile of British cultural and artistic influence in the world.

The research will also motivate new developments in software and create opportunities to exploit digital object software in the marketplace.

Professor M. Holcombe, Professor of Computer Science and Dean of the Faculty of Engineering (Project co-ordinator).