

SCIENCE AND ENGINEERING RESEARCH COUNCIL  
RUTHERFORD & APPLETON LABORATORIES

COMPUTING DIVISION

D I S T R I B U T E D   C O M P U T I N G   N O T E   4 9 1

MEETINGS

Notes on a Panel Visit to Dr Edmonds, Leicester  
Polytechnic 22 October 1981  
(Final Version - approved by Chairman)

Issued by  
D A Duce

26 October 1981

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In Confidence

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Computing and Communications Sub-Committee

Notes of a Panel Visit to Dr E Edmonds, Leicester Polytechnic,  
on 22 October 1981

Panel

The Panel consisted of:

Mr R Boot, NCC, Chairman  
Mr E C P Portman, ICL  
Mr D Pearce, Ferranti  
Dr D Duce, SERC RAL

Objectives

The Panel was charged to:

- a. discuss the research proposals with the applicants;
- b. to formulate a recommendation to the Computing and Communications Sub-committee.

Recommendations

The Panel were unanimous in the belief that they should recommend strong support to the Sub-Committee for this application. They were extremely impressed by the group and by the quality of their presentations and demonstrations.

Mr Pearce was of the opinion that the group should find and study at least one single low technology application at an early phase in the work. He accepted the need for a balance between the technologically challenging and the more mundane. Both industrial representatives (Mr Pearce and Mr Portman) felt the need for this work. At least one will be seeking an early meeting between his organisation and Dr Edmond's group. Both were impressed by the Dialogue Description Language work and hope to pursue this further. They felt this tool merited more widespread publicity, and should be available as a common tool.

Mr Portman felt the speech input work was novel in nature and should be encouraged.

Mr Pearce said he would welcome further applications from this group in the future.

As a general point, the Panel felt that grants of this size should be subject to at least an informal review every year, not least because of

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the discipline this imposes on a team to demonstrate progress annually.

#### First Private Panel Discussion

The Chairman detailed the background to the visit. An informal Panel, under the Chairmanship of Mr S L H Clarke of GEC had visited Dr Edmonds on 5 March 1981 following the submission by Dr Edmonds of a draft application for a rolling grant for man-machine interaction research, produced in response to SERC's invitation for industrially relevant grant applications in the Roberts Category 3 areas (Software Technology, resilient systems, database utilisation and man-machine interaction).

The Panel had thought that the group were basically sound and had the necessary qualities to be a centre of excellence in man-machine interaction. Many of the Panel's initial doubts were dispelled by the group's presentation. The Panel felt however that the group's proposals appeared to be spreading their resources too thinly and made a number of suggestions for curtailing the programme and changing emphasis in some areas, but that they should not reduce the level of staffing.

The Chairman considered that the recommendations of the March Panel had been acted upon in the preparation of the submission under consideration. The supporting papers presented seemed to be sound, though he had reservations about how specific the application was in some areas, in particular the application contained a number of vague phrases such as 'investigate tools'.

Mr Portman and Mr Pearce were both of the view that the application was one of the best they had seen for this level of funding requested.

Mr Pearce felt that a major question to be considered was whether the group could tackle the proposed programme if given the resources. He was also concerned at the lack of studies related to specific applications; experience suggests that one should generalise from specific examples rather than map from the general to the specific in this research area. The involvement with Unilever was thought to be worthy of clarification.

The Panel were not deterred by the size of the application, given the breadth of the proposed programme of work. A certain critical mass is necessary to establish a viable research unit, more should be obtained by investing in one promising group than through investing in a number of small projects at different institutions. There appeared not to be a surfeit of grant applications before the Council in this area, so other groups working in the same area would not be deprived of funds were the Council to fund this application.

#### Presentation

Dr Edmonds introduced the presentation. The group have been working in the area for about 10 years. A special issue of the International Journal of Man-Machine Studies is to be devoted to the work of the group. The papers will include:

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Man Computer Interface: Note on Design and Concepts  
Evaluation of Published Recommendations of the Design  
of Man Computer Dialogues  
Use of Software Tools for Dialogue Design  
Towards Self-Adaptive Interface Systems

The group is multi-disciplinary. The backgrounds of the researches include computer graphics, computer ergonomics, signal processing, mathematical logic, applied statistics, linguistics and electronics. Current research work within the group includes computer graphics, speech input, evaluation of computer systems, expert systems, computer aided learning, software tools.

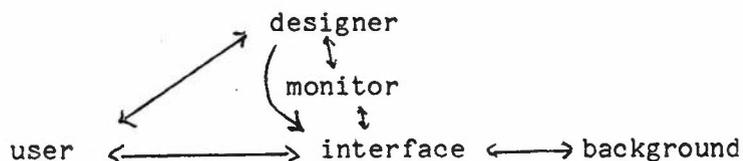
The man computer interface is more than the shape of the buttons and the colour of the screen. The group's view is of the interface as a virtual machine, representing the user's model of the system. This is thought of in terms of three parallel processes; the human the interface processor and the background processor. However it is more complex than that as the "designer" and his relation to the interface and exchanges between the designer and the system need to be considered also. The aim is to produce software tools, devices etc for system designers.

The interface processor may be thought of as a set of i/o processors communicating with a dynamics processor which in turn communicates with background tasks. The i/o processors perform conceptually simple operations, as do the background tasks (for example, update this file, find the edges in this image). The dynamics processor handles abstract versions of the i/o and background tasks and is responsible for changes of state (e.g. a menu system in which a given button has a menu-dependent meaning and hence action).

The group consider:  
specificatrion of dynamics  
handling of speech and images  
evaluation  
as very important topics.

Evaluation is considered to be especially important. Firstly from the general consideration that there is no point in doing anything unless the results are evaluated afterwards but secondly and more importantly the interface is the hardest part of the system to design and one can never know whether it is good or not until it is used. Systems built have to be capable of adaption, partly because the first interface built will probably be wrong but also because user requirements are not static. Adaption alone is pointless, unless an evaluation is carried out first.

Consider the following diagram:



The design team have to communicate with the user, the interface and the

monitor. The group have recently been working with child users of CAL systems. Each child was interviewed after using the system to discover what problems they encountered, what protocols they used for tackling specific tasks etc. This technique is useful, but is very expensive. One aim of the research is to build a monitor to observe user behaviour for example dialogue paths, user response time.

The presentation then moved on to consider the four main themes of the research in some detail. The themes are:

1. speech input
2. interactive computer graphics
3. implementation of interface dynamics
4. evaluation of interfaces

The group have specific industrial links in each area. The BBC and Marconi are linked with area 1, Marconi and T W Kempton Ltd (a local textile company) with area 2, and Unilever's with areas 3 and 4. Dr Hashim gave the presentation on area 1, speech input. The generally accepted classification of speech input systems is into 6 categories:

- (1) isolated word recognition systems - "brute force" pattern matching
- (2) restricted continuous speech - vocabulary usually not greater than 1000 words
- (3) restricted continuous understanding - task recognition
- (4) restricted dictation machines accepting continuous speech input
- (5) unrestricted speech understanding systems
- (6) unrestricted continuous speech recognition systems

The state of the art in isolated word recognition systems is a vocabulary of between 30 and 1000 words at costing between 200 and 6700 dollars with 95-99% accuracy.

Dr Hashim as part of a feasibility study into a system for speech input directly into computers funded by SERC, has surveyed work in speech recognition in the UK. Institutions/organisations considered include JSRU, NPL, Queen's University Belfast, Edinburgh, Sussex, Keele, North Staffordshire Polytechnic, Aston, University College, Imperial College, ICL AND RSRE MALVERN.

The Joint Speech Research Unit was established with MoD backing. Their approach is basically "brute force" pattern recognition, using dynamic programming techniques to remove the variation in timescale. Logica are building an advanced connected speech recognition system for JSRU, but for commercial reasons details are not available.

The NPL system is more ambitious and follows a different philosophy to the JSRU approach. This is based on linguistic speech recognition with

front end phoneme structure processing and is of comparable quality to work in the USA.

The RSRE work started in October 1980. They have a large multidisciplinary team including signal processing, computing and phonetics expertise. Their approach is based on matching patterns described by spectrographs. Dr Hashim feels this is the 'right' approach.

The Leicester team consists of

- Dr Edmonds - computing
- Dr Hashim - signal processing
- Dr Connolly - linguistics and phonetics
- Mr Smith SERC studentship - signal processing
- Mr Guzy SERC Case studentship - computing
- Mr Butler - hardware
- Dr L Thomas - N E Wales College of Further Education

The group also have connections with the JSRU and the BBC. Dr Thomas, formerly of Leicester Polytechnic developed the system for the transcription of palantype input into English text in real time which was used by the BBC for providing sub-titles for the deaf for President Regan's inaugural address and for the Royal Wedding. The BBC want continuous speech to English text transcription, but since this is likely to take 20 years (!) it was decided to adopt an interim solution using a human operator.

Leicester believe that this could be a route to speech input if the transformations from speech to a raw phonetic representation and from this representation to palantype like phonetic structures can be found.

The problem seems to be the missing relationship between accoustic, phonetic and linguistic components of a speech recognition system. There is a general lack of knowledge or perhaps rather lack of a common language and understanding covering the human understanding of spoken language, linguistic rules and rules of phonetics and prosodics.

There is a requirement for a multi-disciplinary survey covering linguistics, speech psychology, phonetics and philosophy. There is also a need for a prototyping system in which new ideas can be developed, tested and evaluated.

Leicester are exploring ways in which existing technology can be applied to problems of human machine communication.

Emphasis is being placed on:

- prosodics
- reading "visible speech" spectrograms

A strong team is needed to be able to understand what is being done by other groups around the world and to work on the front-end system.

In response to a question from Chairman, Dr Hashim said that 1 year elapsed time had been allowed for the proposed survey work and that

after 4-6 years they hoped to have built a 1000 word vocabulary continuous speech recognition system.

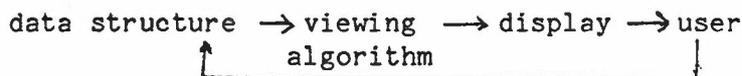
Dr Shrivener gave the presentation on graphics and image handling.

This project is concerned with the development of techniques applicable to directly generated images (e.g. from a TV camera). Specifically they are concerned with the textile and graphic designer communities, but the techniques should be more generally applicable.

This class of user poses 2 problems:

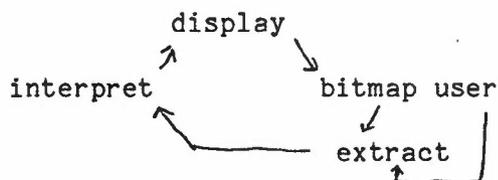
1. typically they produce images by combining components from a variety of media
2. typically a user does not know in advance what he will want to do with a given image.

From the hardware viewpoint the components of the designers system are TV camera, tablet, video disc, printer, computer, display. The classical system model is:



in which the user manipulates the machines model of the image.

In the Leicester model, the image is stored in a bitmap and the user manipulates this directly:



Work to date has lead to the development of the RGOLL language and its use as a development tool. The language is recursive, typical primitives are:

extract  
shrink  
expand  
save  
deposit

which may be combined to produce operators such as:

move  
copy  
external boundary  
internal boundary

A sparse matrix package has been implemented as most operations can be viewed as operations between matrices. Some preliminary work on extraction and manipulation of greyscale and colour images has been done based on lattice fuzzy logic (the topic of Dr Edmond's PhD thesis).

Applications planned for the immediate future include:

- (i) the design of Jersey knitwear. T W Kempton Ltd, a local textile design company, use a design system running on Apples for the production of knitting machine control tapes. The group intend to implement their techniques in this system.
- (ii) implement existing routines on PERQ (if grant application successful).

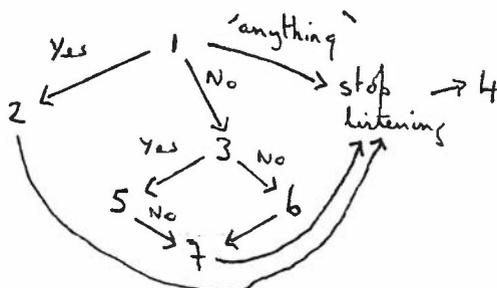
For the future, work will continue in generalising existing primitives to handle greyscale and colour images. Work will also proceed on primitives for handling complex regions, i.e. handling perceived entities and relationships. They have already done some work on 2 1/2 dimensional images.

As the ability to handle more complex entities increases, so does the difficulty of describing the entity, e.g. how is the threshold for a greyscale extraction determined? An evolutionary approach is being taken.

Dr Edmonds gave a presentation of the group's work on the implementation of interface dynamics.

The group have developed a dialogue definition language (DDL).

As a simple example, consider the network:



- 1. are you well?
- 2. good, goodbye
- 3. is it serious?
- 4. I must rush, goodbye
- 5. Is it fatal?
- 6. good
- 7. life could be worse, goodbye

A flavour of the coding of this example in their language is given by:

```
AT NODE 1
; Are you feeling well
; ?

TO 2 IF
  8 `YES' ['smile]/B `yes' ['smile']
```

B is a rule recognising zero or more blanks, `smile' is the name of a task to be evoked.

The system is based on recursive transition networks - a net can be called at any node.

DDL is built on top of the SYNICS translator writing system developed by the group some time ago. Users found SYNICS extremely difficult to use, but DDL has been much more successful.

SYNICS is implemented as a production system, but recursive transition networks have been found to be easier to manipulate than production system of representations.

There are some difficulties associated with the system:

1. multistream i/o
2. graphics
3. soft keyboard

It should be possible to handle multistream i/o as a network/production blend. The facilities of the underlying production system are available at the network level.

Commands to be transmitted to the terminal can be inserted in the DDL description, which forms the basis for a graphics device handler. A keyboard definition language extension to DDL is under consideration.

Dr Innocent was prevented from describing the evaluation techniques by lack of time, but his firm belief in the importance of evaluation, feedback and adaption became clear during informal discussion.

### Demonstrations

The Panel were shown demonstrations of the speech processing work, image enhancement work which is relevant to the proposed prosodics work; the image manipulation work and DDL. The Panel were impressed by the quality of the demonstrations and presentations.

### General Discussion

Mr Portman wondered if the group had consciously omitted reference to speech output. The group apparently have access to a speech synthesiser and as funds for this are not being requested, had made no mention of it.

Mr Portman also commented on the lack of reference to the work of Page/Coulouris at QMC. Dr Edmonds felt this work was based on a specific model of a specific environment which was not relevant to their work.

Mr Pearce was worried that the group were considering complex techniques for complex applications, when ever simple interfaces have not yet been sorted out. The Chairman asked the group to describe the connection with Unilever as this might involve less complex interfaces.

The group will be working with the Unilever Research Laboratory (Port Sunlight) Computer Support Unit. The DDL software will be mounted at the Laboratory and will be used to described the interface to an expert system for scientific usage. The objective is to use the Leicester tools in a real environment with real people to discover how it performs. The group have also been doing some work with CAL systems for school children, and their software is used in MSc projects. The group have discovered that projects starting life as applications studies have shown the need for fundamental research which has subsequently been started.

Dr Innocent commented on the need to continually evaluate, to discover for example the level of DDC appropriate in a particular environment. Criteria for evaluations will include: ease of use, learning, flexibility, acceptability, ease of achieving goals.

Dr Innocent has done some comparative work, using students, between Pascal and DDL implementations of an interface, but stresses the limitations of this, though it is a useful pilot activity. It is likely, though unofficial, that Unilever will make more use of DDL than is required by the contract.

The Chairman commented that the interface processor embodies the user's model. Ease of use depends on the model the system designer adopts and this must be a conceptually manageable picture of the problem. Dr Innocent agreed that selecting and presenting the right user model is crucial. This leads to a multilevel problem in evaluation. In the course of his research he has applied various techniques from the human sciences to this problem. He intends to persue an approach based on a device for monitoring airline pilot activity and to connect the visual observations with a software trace.

The Chairman noted that the list of projects for exploratory study looked very comprehensive and wondered how much effort would be devoted to them. Dr Edmonds said one third of a man. The PhD studentships requested will be associated with the mainstream work.

The Chairman also inquired about the scale of the hardware implementation projects. The manpower for this is being provided by Marconi, presently three technicians are placed in the Department. This agreement is one of long standing between the Polytechnic and Marconi. SERC are being asked to provide consumables only. This can be regarded as a peripheral activity, but one which will be very beneficial to the individuals concerned.

### Second Private Meeting

The Panel were unanimous in the belief that they should recommend strong support to the Sub-Committee for this application. They were extremely impressed by the group and by the quality of their presentations and demonstrations.

Mr Pearce was of the opinion that the group should find and study at least one single low technology application at an early phase in the work. He accepted the need for a balance between the technologically challenging and the more mundane. Both industrial representatives (Mr Pearce and Mr Portman) felt the need for this work. At least one will be seeking an early meeting between his organisation and Dr Edmond's group. Both were impressed by the Dialogue Description Language work and hope to pursue this further. They felt this tool merited more widespread publicity, and should be available as a common tool.

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As a general point, the Panel felt that grants of this size should be subject to at least an informal review every year, not least because of the discipline this imposes on a team to demonstrate progress annually.

### Feedback

The group were informed of the Recommendations the Panel would be making.

1. The Panel were very impressed with what they had seen.
2. The group are encouraged to make more of the applications work; the Panel were pleased that specific applications studies had emerged during the course of the discussion.
3. More should be made of DDL and evaluations. The group were encouraged to seek applications in more conventional areas, for example information retrieval and office automation for the small business. DDL should be given more publicity.

On point 3, Dr Edmonds commented that DDL is described in a chapter in the recent book edited by Coombs and Alty "Computing Skills and the User Interface" published by Academic Press.

On point 2 Dr Edmonds commented that the group has only spoken of links for which formal agreements exist, and which they were free to disclose (there are some agreements for which they are not able to divulge the name of the company concerned). There were several other agreements pending which they were not yet free to disclose.