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Book reviews

W. Niblack, chairman and editor, *Storage and Retrieval for Image and Video Databases, Proceedings of the International Society for Optical Engineering* (SPIE), Volume 1908. San Jose CA, 1993, 236 pp.

This volume contains papers presented at four sessions of the February 1993 meeting under the headings:
- Retrieval methods and systems for video databases.
- Retrieval methods and systems for image databases (two sessions).
- Data storage, organisation, and servers.

SPIE Meetings/Proceedings have become one of the preferred places to report imaging current research, so these 22 current papers about imaging selected for presentation provide an opportunity for analysing research and publication practice – in particular by an examination of their references.

The similarity of subject content may be assessed from papers having common references ("bibliographic coupling"). Thus 2 papers each with 10 identical references are likely to cover the same ground, while 2 papers with 10 references of which 3 are identical will be less similar.

In a previous article [1] following an examination of a corpus of articles about "image processing" and "image indexing", I concluded that the two schools of authors "rarely talked to each other", and suggested that more communication would be mutually beneficial.

Although the SPIE authors presumably met and talked to each other at the meeting, it appears from their articles that this conference may usually have been their first encounter – in other words that even "image processing people rarely talk between themselves". The collection of articles is not large enough to form firm conclusions, but an alternative explanation may be that the field is too new or too diffuse to determine trends from its current literature.

There are a total of 226 references in the 22 SPIE papers, an average of 10.27 per paper, ranging from three papers with 0 references to 5 with 15 or more. Bibliographic coupling data indicates a lack of similarity between papers. There are two papers containing 15 and 6 references respectively each contain 5 references in common, but there is only one other example of any significance – two papers containing two common references. The first example is easily explained – the two articles are both from the University of Manchester and are by the same authors! One explains the Manchester Visual Query Language, and the other is a classification application using that language.

Identifying papers by first authors, the first two papers in the Proceedings

(Arman, Swanberg) covering Video Database retrieval systems are aimed at identifying different scenes in video sequences. The following paper (Lee) describes a method of following video sequences of object motion between the first and last appearances of an object. The last paper (Holtz) in the section covers "Autosophy", described as "an emerging new science ... of self-assembling structures". It may "dramatically change database technology" and "access or search speed is entirely independent of database size". I was unable to judge how effective the "associated networks" described by the author might be for image retrieval.

The first three papers in the Image Database (Session 1) section describe methods of selecting objects of rather simple limited types from specialised databases – aurora from an aurora database, shapes such as clouds from a database of cloud patterns, and industrial plant diagrams from a database of such diagrams.

Three papers of more general application follow. Rickman describes a system for matching images in an image database against a query image using a neural network to detect principal component feature similarities. Nodes in the network learn the principal component features of the query image which are then matched against the principal features of database images. A set of database images rank-ordered by similarity are presented as "best matches".

In the "Data storage, organisation, and servers section", Sakamoto et al (NTT) describe a crossbar switch to interconnect server units in a distributed visual information system for allocating time slots to blocks of switched data. The system is fast – for example eight 200 microsecond slots are used in 1.65 millisecond frames to transmit data to users. The system is designed to minimise fluctuations in video frames.

Hersch (Swiss Federal institute of Technology) describes a multi-processor multi-RAID-disc system where a disc can store up to 2 Gbytes. T800 transputers are used for linking communication channels. The parallel system provides at least twice the performance of a conventional disc storage system. Images are segmented into rectangular bit-segments which are fetched from disc nodes.

Most people would feel that the most interesting papers in the volume are those within two sections both entitled "Retrieval methods and systems for image databases". Some deal with technical processing functions such as boundary detection, and some describe methods for retrieval from collections of single-domain relatively simple bit-mapped images. The most interesting are those describing retrieval from collections of multiple-domain complex pictures without regard to complexity.

For example Niblack et al (IBM) talk about the QBIC project in which pictures may be recalled by shape, colour, or texture, or a combination of all three. The recall mechanism also allows for the retrieval of objects within a picture – for example a horse in a farm-yard.

The pictures in the collection are reduced in size to 100 × 100 pixel representations. Sketched shape queries may be aimed at a whole picture in the collection, or at objects within it which have been previously processed to create edge-detected "boundary" shapes. Sketch tools are provided enabling a user to draw an outline

picture-query and the software will supply pictures from the collection as "hits" which most nearly match sketched outlines in the reduced representations.

In the case of within-picture object matching, objects in the collection must have first been individually outlined – approximately outlined, that is; the software will automatically re-arrange the "indexers" attempt to make a rough outline closely fit the object of interest.

To retrieve, the machine fuzzy-matches pixel blocks from a query-sketch against pixel blocks from pictures in the database. A block from the query-sketch is moved around picture blocks and the best match in terms of edges is noted. The next block receives the same treatment. A particular picture having been matched in this manner, every other picture is also matched. The pictures most similar to the sketch are presented as visual hits for consideration.

A "colour picker" selection screen-interface to enable a user to match by colour is also provided. It allows for specifying areas by their relative proportions, for example "does it (e.g., a beach scene) contain 25% in sand-colour and 50% in sea/sky colour?". The particular colours are specified using the colour picker. A combination of shape and colour selection reduces the number of hit-candidates. Additionally, texture features in terms of coarseness, directionality, etc., may be selected for matching.

If schemes like this become available – and judging by the illustrations in the article the scheme works quite well – the method will be a break-through in dealing with the well known problems of indexing and retrieving pictures by words.

Reference

[1] A.E. Cawkell, Selected aspects of image processing and management: review and future prospects, *Journal of Information Science* 18, 179–192, 1992.

R.S. Clark, ed., *Image Market '92. A strategic analysis of the international image and graphics management marketplace.* New York: Frost & Sullivan Inc. 1992. 326 pp. £295.

The intolerable wrestle with words and meanings
T.S. Eliot

Image processing has become a diverse subject divided into numerous areas some of which are difficult to define. This diversity and difficulty are reflected in this report.

The words "management", "image", "picture" and "marketplace" have different connotations. I have just written a piece entitled "An introduction to image processing and picture management" [1] in a new journal. This title was intended to reflect the impersonal, mechanistic operations of "image processing" as opposed to "picture management" – supposed to cover the matter of "picture sys-

tem and database management'' where ''picture'' has artistic overtones. But these nuances may not be apparent to readers.

My article was mainly about pictures in the art, museum, and photographic world, managing the huge bit-volumes of high quality pictures in electronic format, and the problems of indexing. So how is this kind of information handled in the F&S report?

I could not find it under the section most likely to contain it, at least in Europe – ''Generic image processing systems: European market'' covering general purpose systems or ''Application specific image processing systems: European market''. Nor is it in either of the two major sections – ''Commercial Image Processing Systems'', or ''Commercial Computer Graphics''.

This may be because pictures are not usually commercial and it is the technical rather then the administrative management which is important. I could find no mention of image databases or indexing. Incidentally the difference between ''image'' and ''graphic'' is not easy to resolve.

However there is a section containing a lot of detail about a relatively small market ''Pictorial archiving and communications systems'' usually known as PACS. It should be MPACS because this market is medical imaging where ''teleradiology'' is used. In 1992 the market was worth $87 million.

F&S's classification is arbitrary. For example the sub-sections ''Electronic image data management systems and equipment: US market'' and ''Commercial image processing: US market'' contain virtually the same lists of hardware. Both have the same suppliers in common although one list is called ''Document automation systems'' and the other ''Competitive environment suppliers''.

I sympathise. The fact is that ''imaging'' is hard to break down into tidy mutually exclusive groups. No doubt this publication is aimed at managers in the imaging industry, and for them it contains a wealth of detail about competitors and trends. Paradoxically the summary ''Image Market Overview'' is about standards, PCs, workstations, optical discs, etc., while only the last paragraph dwells on markets.

One point seems to have escaped F&S. The two areas where there is a degree of mutual exclusivity are ''Image processing'' and ''Document image processing''. These unsatisfactory titles conceal a substantial classificatory difference – the former contains the people who are interested in images, the latter contains those who are not. The second group are interested in paperwork management, not image management; images of papers may be stored, retrieved, and handled much more easily than the huge volume of paperwork from which they are derived. The other major difference between the two areas follows naturally. The first group are not primarily businessmen, whereas the second group certainly are.

These remarks are no reflection upon the huge amount of valuable data contained in the publication of which I can give only a few examples. For example the US market for the input and output imaging devices which are so essential will increase from $1048 million to $1814 million in the three year period 1991 and 1994. Unlike may other IT forecasts I believe it. I also believe the forecast for the US micrographics market – still large but slow-growing from $1626 million to $1961 million in the same period.

There are large sections about Desktop Publishing and Multimedia. In the US, DTP was worth $3868 million in 1992 and about $3000 million in Europe, and Multimedia was worth about $7000 million and £2178 million respectively. The expected expansion of Multimedia in the US is enormous – to over $25,000 million in 1995, but the European expansion rate is much slower – to $3066 million by 1996. In the US Multimedia is said to have "attracted much attention and generated great excitement throughout diversified sections of business, industry, government and academe".

Apple had 40% of the US "Multimedia basic systems" market in 1990, but in Europe in 1991 it was dominant with 58.5% of the "Multimedia market", the next contender being Acorn with 4.1%.

Reference

[1] A.E. Cawkell, An introduction to image processing and picture management. *Journal of Document and Text Management* 1(1), 53–63, 1993.

M. Lavery and A. Templeton, *Flexible Working with Information Technology*. London: Ovum. 190 pp. ISBN 0 903969 81 5. £725.

The popular name for Flexible Working is Telecommuting – a title beneath which dozens of articles have been written. The majority of them provide the same list of companies who have embraced the idea – well, two actually, F1 and Xerox. Having read many articles during the last ten years, all discussing this "new" idea and proclaiming its rapid growth, I concluded that since their authors could usually only find two practitioners the idea was catching on rather slowly.

In the Ovum report Xerox and F1 do not get a mention, and I am no longer so sceptical. Flexible working is growing rapidly. 59 companies who use flexible working were interviewed. The activities of nine major organisations who employ telecommuters are discussed at length. Furthermore, Ovum believe that in 1992 there were 583,000 flexible workers worldwide of which 345,000 are in the US, and 47,000 in the UK. By 2000 there will be 11,738,000 of them – an average annual compound growth rate of 46% This remarkable growth excludes self-employed people and those in the agricultural, military, and manufacturing industries.

The methods used to calculate this total are described; Ovum must have devoted quite a lot of time to devise it and it is probably the best that can be done. It is necessarily based on extrapolating from a large non-random sample so is not subject to the accuracy considerations applying to random sampling from a large population. The question is how accurate are the figures? Might it be said that they are accurate to, say, plus or minus 25%?

I cannot answer these questions because I am not a statistician. However, I have learned to distrust forecasts ever since *Computer Decisions* said "Small businesses are not going to have small computers. It's not a practical way to go. Small com-

panies are going to use a piece of a large computer''. Understandably *Computer Decisions* was unable to predict the imminent arrival of the inexpensive microcomputer. I have noted that many forecasts turn out to be wrong, sometimes wildly wrong, usually because they are based on projections from past events using inadequate samples, or because their regular growth characteristics are upset by unforseen non-regular future events.

However Ovum are making a serious attempt and the 1992 figures may not be too wide of the mark. Their future estimates, particularly those beyond 1996, are more doubtful. From these estimates stem Ovum's tables covering the associated growth in hardware sales and data traffic.

But forecasting problems aside, most of this report is highly informative. Of the 583 flexible workers in the 59 ''leading edge users'', 77% are mobile/field workers, 17% professional, and 6% office support. Flexible workers are mainly salesmen or maintenance people. The report includes sections covering hardware, software, and communications providers, followed by a lengthy analysis of the markets.

Ovum provide examples of the benefits of flexible working. Martini Rossi increased its sales by up to 10% when its sales force was able to make immediate quotations by using notebook computers and a printer. The Daily Telegraph's size increase was largely due to more news from journalists using portable computers. Hewlett-Packard saved $300,000 a year by enabling its maintenance engineers to become flexible workers.

The most interesting of the case examples for readers of IS&U concerns Crossaig, Helensburg, Scotland, a company dealing with data-entry and classification of journal data. It is now owned by ISI/Thomson. The company's staff, apart from a few in the office, are outworkers, connected to the office by the ISDN. Images of Medical journals, scanned in the office, are sent to the outworkers who create indexing records for each article. The records are then sorted by subject and this data is returned to the office which sends it en bloc to Elsevier in the Netherlands.

Crossaig was indexing up to 6000 articles per month but expected to increase rapidly to 8000. Outworkers could reside in any country.

This report is by far the most systematically compiled and thorough work on this subject that I have seen. In spite of its high cost, no doubt reflecting the cost of collecting comprehensive data, it must surely be purchased by any company interested in flexible working.

A.E. Cawkell