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REPORTS & SURVEYS

CURRENT ROBOTIC INITIATIVES

New initiatives in automation and robotics include the following:

- *Plant robot* – ForBio which recently acquired International Plant Laboratories (IPL) near Glastonbury, Somerset UK., claims to have developed the world's first plant propagation robot. It expects the robots to increase IPL's production from six to seven million plants to more than 25 million a year. The company's main focus is on the fast-growing forestry market, which already demands more than eight billion tree seedlings a year. With the aid of robots, which cost $500,000 each, ForBio is aiming to quickly lift production to more than 200 million seedlings a year. With a gene mapping technology licence from DuPont, the US chemicals group, ForBio will be able to identify the plants that are the fastest growing, or are disease or salt resistant, as required.
- *Robosaurus rex* – A European consortium backed by European Community funding is planning to build a full size autonomously controlled walking robot iguanodon to roam around inside European museums. The robosaurus project is an attempt to find out more about how these extinct reptiles walked and moved 120 million years ago. Called the Palaiomation project it is funded to the extent of some £700,000 and backed by a team of European palaeontology and zoology departments. It is to use the latest robot technology and working to the specifications that have been drawn up by Professor Neil Alexander of Leeds University (UK), who is a world expert on biomechanics. In addition, the Heriot-Watt University in Scotland (UK) and Salford University (UK), are contributing to the work. The consortium formed to build the robot was, it is reported, tempted to build *Tyrannosaurus rex,* but after much debate settled on *Iguanodon atherfieldensis* because it was a European dinosaur and a great deal is known about it. Professor Alexander says that:

  ''It is a plant eater. We had a great discussion about how a meat eater might be more commercial, but there are all sorts of things going for this dinosaur''.

  By using lasers fossilised bones of the 4 metres dinosaur were scanned to provide accurate dimensions to build the first dinosaur replica, to a quarter scale model. Then after three more prototypes and two years had elapsed, a half-scale replica was produced. Two of these replicas, each two metres in length, have been wandering around museums in Europe. They are powered by electric motors and can move about for some 40 minutes. They also have sensors so they react to their surroundings and to both people and to themselves. At the same time the team of researchers is developing muscles for the robot and artificial skin to make it more realistic. The Director of the European Association for Research in Legged Robotics, Dr. Papantoniou claimed that:

  ''The walking pattern is rather realistic. It is clear that the full-sized version of this species moved rather slowly, around 10 kilometres per hour, about double human walking pace''.

  Fossil evidence and preserved footprints provided evidence of how it moved, and the researchers concluded that the backbone was relatively rigid and the real dinosaur probably swayed a little from side to side when it walked.
- *Robots in Space* – A great deal of publicity has been given to the development of robots designed for work in space. Headings such as: ''Robot wanders desert on dry run for the moon'' and ''Robot invasion force targets Mars'', indicate the interest shown in the high technological efforts now being made to discover more about space, and, in particular it would seem, about the 'Red Planet'. Testing space vehicles for use in planet terrains is not easy and for one such operation the Atacama desert in Chile was chosen for a 'dry run' for missions to Mars or the Moon. The robot *Nomad* is expected to be able to wander 125 miles across the surface of what has been described as the world's most inhospitable region in order to ascertain its capabilities. It is controlled from Pittsburgh (USA), which is some 5,000 miles away. The robot vehicle is powered by solar energy and fitted with two cameras with panoramic vision. The four-wheeled robot is equipped with sensors and metal detectors to search for meteorites. It is claimed that it has a 'mind' of its own. For example, if the controllers order it to drive directly at an obstacle, it will override the instruction. It can also select the best route to a goal set by the controllers. If it meets rugged terrain it has the capability of expanding, that is, increasing its wheelbase to reduce the risk of toppling over.

  The vision system has cameras which will be able to send back 360 degree pictures of the landscape around the robot. The landscape it will survey is certainly going to be barren with extreme temperature ranges.

  To test the robot vehicle, missions are to be simulated based on Mars and the Moon, but initially Earth is the priority target. *Nomad's* successor, it is reported, is to be designed to explore the Antarctic for meteorites similar to the ones found by human explorers and which have given some evidence of life on Mars. *Nomad* was developed and built by Carnegie-Mellon University (USA) under contract From Nasa. It is claimed to be more sophisticated than *Sojourner,* which is the robot vehicle that landed on Mars in July 1997. *Nomad* has been built to cover up to three miles a day, whereas *Sojourner* is expected to move only a few metres a day. *Nomad* is also capable of sending back continuous real-time video footage whilst moving at speeds of about one foot a second.
- *Robotics Technology Programme* – Nasa's Jet Propulsion Laboratory (JPL), in Pasadena, California (US), has a robot technology programme that is producing an army of robots. Some of these have been described here in previous reports. Future robots will use different types of artificial intelligence and will range from brain-like neural systems and networks to rule-based systems. They will include:
  Nanorobots – small surface explorers weighing about 3.5 ounces. Their function will be to search for resources such as water or ice or to take photographs of surface features.
  Aerobots – planetary aerobots are a new type of lightweight and lowcost telerobot that can explore and analyse the Martian atmosphere.
  Burrowing robots – these will aid the hunt for water, a key requirement for life, a driver of climate and a vital resource.

  New types of robot arms are also being developed. The 1998 Mars lander will have a 6 ft telescopic limb that can be used to pick up samples collected by a robot so that they can be taken back to earth on a future launcher. It has to be appreciated that these new robots and other more exotic ones may not appear for some time – perhaps as long as three years, which is the time when technology is frozen prior to a scheduled mission.

ELECTRONIC NOSE – NEW APPLICATIONS

Applications of the electronic nose must surely be endless. We have reported its use in truffle seeking expeditions, in the food industry where its capacity to tell whether goods are past their

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best is essential to good trading practice and in detecting the presence of 'illegal' substances such as banned drugs and dangerous explosives. Such noses have been developed worldwide and their efficiency is continually improving. There have already been reports of their use in medical applications and more reports are now being made available of their successes and the versatility of the tasks they now are tackling.

The journal *Chemistry in Britain* (April, 1997) has recently published a summary of some of its uses under the heading 'Sniffing out the bad guys'. The report suggests that for centuries doctors have been able to tell if a wound is infected simply by sniffing. This is now an obvious target for the electronic nose which can perform the task more quickly with the added advantage of identifying which bacteria are present. The report says that:

''This speedy diagnosis could help doctors to treat infections earlier with the correct antibiotics, which might prevent infections getting a hold and then not responding to treatment. In addition, it could help to reduce costs of prolonged and expensive treatment''.

Applications where the electronic nose has been used on a patient's breath have been outlined in this and other literature sources. In this report the use of an electronic device called the *AromaScanner* is described at the Withington Hospital, Manchester (UK). The nose was used to smell venous ulcers and urinary infections. The research trials are described and the early results are said to be promising. To identify an aroma the scanner uses an array of 32 conducting polymer sensors, which are sensitive to the stereochemical and polar characteristics of the mixture of volatile chemicals that produce an aroma. This was described in an earlier issue of the journal (*Chem. Br.,* 513, July 1995). The sensors rapidly absorb and desorb the volatiles at the polymer surface, causing temporary measurable alterations to their electrical resistance. In addition, the nose can be programmed to compare an aroma pattern or to 'fingerprint' to a variety of internal standards on a 2-dimensional or a 3-dimensional map, in a similar way to the brain's memory, to recognise a familiar smell. The reports say that:

''Chronic venous leg ulcers are believed to affect about 150,000 people in the UK costing the NHS £300–400m per annum. Research has shown that chronic deep ulcer infection, which delays healing and increases patient suffering produces a characteristic aroma that the AromaScanner can identify. In 13 out of 15 cases studied at Withington Hospital changes in the odour pattern from ulcer dressings recorded by the *AromaScanner* correlated well with patient healing''.

Further trials and studies are planned.

Other applications by the microbiologists are also summarised. The scanner has been used to screen for bacterial vaginosis (BV), a condition linked with pre-term labour and sterility. Early findings suggest the electronic nose may be used as a screening test for BV. More potential applications are being persued and scientists are convinced that other studies into clinical conditions, where a characteristic odour is associated, should also be evaluated.

There is now little doubt about both the versatility and the potential applications for the electronic nose. The applications reported to date, have been very wide ranging and reports of new studies, worldwide, are now being regularly distributed.

FLEXIBLE MANUFACTURING SYSTEMS

1. The ALASCA project

The ALASCA project is another endeavour that follows the FAMOS umbrella that cover developments in the flexible manufacturing systems area. Known as the FAMOS-ALASCA project it had the following aims:

- Develop a multi-purpose robot assembly cell for building large items
- Design and develop a control system to link high level scheduling with low level automation
- Demonstrate its capability with commercial applications

The project work brought together partners from:

Italy (Prima Industrie) Finland (Tehdasllit OY); France (ITMI APTOR SA); and the United Kingdom (University of the West of England and British Nuclear Fuels plc).

2. ALASCA Demonstrations

ALASCA's first demonstration was hosted last December by British Nuclear Fuels (BFNL). The second, in June (97) involved assembling washing machine components for Zanussi, the italian manufacturer of household electrical goods.

Manufacturers like Zanussi need to be able to switch rapidly between different products on the same production line. ''Zanussi's largest factory produces 600 types of washing machine, with a minimum batch size of 12 units'', says Dr Piero Chiabra, a consultant working with Prima Industrie, the Italian firm leading the project.

ALASCA follows *INFACT,* another project under the FAMOS umbrella that also dealt with flexible manufacturing systems. But where *INFACT* was designed for small products like circuit boards or electric motors, *ALASCA* focuses on larger items, combining automation, standardisation and simulation.

The Robot-based Manufacturing Cell. It has developed a robot-based manufacturing cell that is versatile enough to tackle different assembly jobs with the minimum of customisation, so that building a new factory is largely a matter of slotting together standard *ALASCA* components. ''We aim to make 70 per cent of the technology re-usable, so only 30 per cent is specific to each job,'' explains Christophe Baradel of French partner ITMI APTOR, a division of the CAP GEMINI group.

Large parts can be awkward to handle, especially if they are heavy or made of flexible materials such as sheet metal, so the *ALASCA* cell has two robots working together. Zanussi's demonstration project, for example, uses the robots to assemble concrete counterweights for washing machine drums – a tricky job because the rough texture of the concrete makes it hard to locate the attachment points in exactly the right places.

The solution was to equip one of the robot arms with a flexible ''wrist'' developed at the University of the West of England, another of the project's robotics specialists. The wrist incorporates a pneumatic spring whose stiffness can be varied to suit the job in hand: rigid for precision work or flexible to match the sensitivity of a human worker.

Systems for Control, scheduling and simulation. A shopfloor full of robot manufacturing cells is not much use if it cannot make the right product at the right time. Systems for control, scheduling and simulation are therefore an important part of the work.

ITMI APTOR has developed an information system that links the plant's existing high-level scheduling system with the low-level automation systems that control the robots and parts feeders. ''You need an information system that doesn't limit the flexibility of the mechanical system,'' explains Mr Baradel. ''Often manufacturers have to make a large number of manual adjustments to the output from their scheduling systems before they can use the data on the shop floor. We want to eliminate that.''

In addition, *ALASCA's* emphasis on computer simulation allows engineers to work with a 'virtual factory' while the real one is being built, accelerating factory start-ups. This was the focus of the demonstration at BFNL. They have shown that it is possible to cut factory development time by using a simulator

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to check out the bottleneckes before the plant is built. The demonstration project takes the idea of the 'virtual factory' even further, mixing real assembly operations with simulated ones.

Commercial Future. When *ALASCA* comes to an end in the summer of 1997 its commercial future will be as flexible as the products it will manufacture. "We will sell the complete cell, including the information systems, or each component separately, or in various combinations," says Mr Baradel. "We are very pleased with the results and the help we obtained through *EUREKA*."

Further information about the developments in the *FAMOS-ALASCA* project can be found on the World Wide Web: Http://*www*.itmi.cgs.fr/ and Http://*www*.bnfl.com.

PROMOTING EUROPEAN INDUSTRY

EUREKA was created in the 1980s to strengthen the global competitiveness of European Industry by promoting Europe-wide co-operative R&D. Twenty four European countries and the European Union are now members. Each *EUREKA* project involves partners from at least two Member States and aims to develop advanced civilian products, processes or services for the world market.

1. WWW site re-launched

EUREKA has now relaunched its *WWW* site at a new address after what has been described as a highly successful initial phase. The *WWW* site became operational in June 1996 and during each of the following seven months the server replied to an average of almost 50,000 requests for information resulting in a monthly transfer of almost 180 Mbytes of data. Access was from as far afield as Brazil, New Zealand, the United Arab Emirates and Pakistan. The Home Page has been facelifted and allows users to access the most recently added information. New information about EUREKA Members has also been added as well as the *EUREKA* Agenda and descriptions of forthcoming events. In addition articles about *EUREKA* are included and the site is under continuous development. *EUREKA*'s new address is :http://*www*.eureka.be.

2. EUREKA New Proposals

Below are some of the new project proposals due to be launched in the near future. Many are looking for additional partners, and further information can be obtained from the project contact shown:

ADTT2-EU1711 – Research to allow enhanced video-conferencing for distant learning, telework, business catalogues, etc. by focusing on advanced digital film production systems and high-speed symmetrical interactive communication systems (Contact: Theo Peek, Phillips Business Electronics B.V. The Netherlands. Tel: +31 40 2732263).

POINT-EU1694 – For the development of an internet-based search and information program for machine parts, giving the user detailed information on the products. (Contact: Prof. Markus Meier, Swiss Federal Institute of Technology, Switzerland. Tel: +41 1 6322 358).

VGNT-EU1695 – To build an information system for the retail industry to improve distribution and customer services, to include a virtual store for home shopping and to be able to work on any tax system, generic and user defined. (Contact: Blas Moreno Rodado, Geinsa SA, Spain. Tel: +34 3 2651950).

FACTORY PYRAMID-EU1704 – To integrate methodological software tools in the manufacturing industry with integrated programs such as CAD/CAM by creating a software platform to bring together all the manufacturing stages. (Contact: Alain Roumiguier, Matra Datavision, France. Tel: +33 1 6982 2449).

STICK-EU1707 – Development of a new point of Sale terminal with enhanced communication capabilities to banks, payment houses, data bases etc. (Contact: Hitos Rafael, Electrovac, Spain. Tel: +34 803 3767).

MAIN FUZHEAT-EU1708 – The application of Fuzzy logic to a heating control system to optimise heat distribution and the heat exchange unit. (Contact: Milan Jeram, Miel doo, Spain. Tel: +34 386 63 851096).

SAFEVIEW-EU1716 – To simplify the method of checking the luminance and retroreflection of high visibility warning garments by simultaneously taking both measurements and logging the results. (Contact: Peter Sommerlade, Sophus Berendsen A/S, Denmark (Tel: +45 3969 7500).

MARKET97-EU1718 – To develop a virtual factory, i.e. a temporary unification of companies within a stable network where each company can pool resources and specialist skills. This means new markets can be created because of a continuous production cycle. (Contact: Prof. Güntheter Schuh, Item-HSG, Switzerland. Tel: +41 71 2282452).

FACTORY ARIAL-EU1721 - Using a Wire Electrical Discharge Machine and an automatic storage and handling system, the project aims to create a high level of automation in the manufacture of various parts. (Contact: Dr. Xabier Maidagan, Ona Electro-Erosian, SA, Spain. Tel: +34 4 6200800).

MAINE MAIL-EU 1722 – To develop new tools for the sensoring and diagnostics of electric energy rotating equipment. As well as the hardware, software for the control and evaluation of the products will have to be developed. (Contact: Teo Vitoria, AIN, Spain. Tel: +34 48 421181).

3. New Partners in Romania.

In May of this year a Partnering Event took place which focussed on Automation. Held in Timisoara, which is a base for many Romanian electronics companies, its aim was to help stimulate projects with Romanian participation. About 30 Romanian organisations took part and many *EUREKA* members were present. A second partnering event at Constanta, Romania's second largest city, has been scheduled. Details from: Romanian *EUREKA* Workshops (Tel: +40 1 210 92 75; Fax: +40 1 210 92 75; e-mail: dbogdan@scoul.mot.ro).

ROBOTICS AND AUTOMATION WORLDWIDE

AUSTRALIA

1. Australian Robot Association

A number of the Australian Robot Association (ARA) publications are available. They provide an essential guide to activities in robotics and automation in Australia and are available for the worldwide community. They include:

- *Robots for Australian Industries* – Proceedings of the ARA National Conference, Melbourne 1995.
- *An Automation Policy for Australia* – An ARA Discussion Paper 1995.
- *Robotics for the Service Industries* – Proceedings of the IARP First International Workshop, Sydney, 1995.
- *Robots for Competitive Industries* – Proceedings of the ARA/IFR International Conference, Brisbane, 1993.
- *Robotics in Agriculture and the Food Industry* – Proceedings of the IARP Third International Workshop, Brisbane, 1993.
- *Third International Conference on Robotics* – Conference Proceedings, Melbourne, 1990.
- *Proceedings of the International Symposium and Exposition on Robots* – 19th ISIR, Sydney, 1988.

Full details of the publications can be obtained from:
Australian Robot Association, G.P.O. Box 1527, Sydney

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NSW 2001, Australia (Fax: (02) 9959 4632. The Association is also on the World Wide Web: http://*www*.cs.uow.edu.au/isasc/ara.

2. Robots in Australia

The World Robot statistics published by the United Nations and the International Federation of Robotics estimates the world robot population at the beginning of 1996 to be 650,000 units which is an increase of 6% from the year before. Australia's robot population grew in that period by 3.6% compared with increases in USA (16.1%), Germany (13.3%). Both Singapore at 49.8% and Korean Republic at 45.9% show outstanding increases. Japan had a growth in robots of 2.7%. The publication also included what is described as the 'density' of robot penetration in some countries. This is defined as the ratio of the robot population to 10,000 people employed in the countries manufacturing industry. The figures make interesting reading. Densities in Singapore (at 336) and in Japan (at 251) are by far the highest, with the US at 36, the UK at 17 which also matches that of Australia. How these statistics are interpreted, however, is another matter. The definition of 'density' has to be carefully analysed before any conclusions can be made.

3. Indonesia

Writing in an article for the *International Federation of Robotics* Dr Iman Kartowisastro says that because of the country's large labour force the penetration of automation into Indonesian industry has been slow in the past, but is now increasing. The motive, it seems, for the introduction of automation into the country has been to anticipate an era when a 'global market' is in existence.

Currently, he reports, automation in Indonesia is found not only in the automotive industry but also in the electronics industry. In this industry robots are used in semiconductor manufacturing to load and unload wafers whilst in other electronics manufacturing the main use of robots is for picking, placing and for soldering components.

The Indonesian manufacturing industry today consists of some 300 large companies, 17,500 medium-size and 134,000 small ones. Other industries such as automotive, satellite and other telecommunications are growing.

Unfortunately, he reports, in contrast to the manufacturing sector, there is only a slow rate of development of robotics in the supporting academic institutions. The institutions are, however, well aware of the country's need for automation technology. In fact, robot study amongst students is very popular. Robotitcs research in Indonesia includes studies of the dynamics of flexible links, positions and force-control algorithms and robot vision. Statistics have been gathered since 1966 on the robot installations. There appears to be some doubt about their reliability, but by 1996 (October), responses from 31 companies indicated that 13 were using robots. Dr Kartowisastro say that this obviously incomplete response recorded 59 'robots' and more than 400 CNC machines at work in the Indonesian automotive industry. It has to be noted that 11 of these were two-axis machines; these are not accepted as robots in the International Federation of Robotics statistics on robot population. Some of the installations given below give a picture of the spread of robots and the different applications that are involved;

- Panasonic robot – Aisin Indonesia – for welding door frames – Automotive Sector.
- Motoman robot – Dasa Windu Agung PT – for water-jet cutting – Automotive Sector.
- Fanuc robot – Dasa Windu Agung PT – for boring applications – Automotive Sector.
- Kobelco robots – ten in number – Toyota Astra Motor Engine Plant – for painting automotive bodies
- Hitachi robot – Nihon Plasr Indonesia PT – for welding involved with manufacturing steering wheels.
- Yaskawa Motoman robot – Kadera–Ar.Indonesia PT – injecting polyurethane material in manufacture of car seats.
- Toshiba robots – seven in all – Chemco Harapan Nasatara, PT – for ladling aluminium in manufacture of brake systems and components.
- ABB robot – Meshindo Alloy Wheel Corp, PT – for painting in the manufacture of aluminium wheel rims.

The report by Dr Kartowisastro also revealed that Japan is the main supplier of robots in Indonesia today.

Putting the problems of introducing automation to the country into perspective he pointed out that the country consists of more than 17,000 islands and has about 200 million people. Its economy is traditionally agricultural but that in recent years the contribution from manufacturing has exceeded that from agriculture. In 1993 the value of manufacturing in the country's GDP was 22.3% compared to 18.5% for agriculture. It was only in 1969 that the statistics showed that agriculture contributed 49.3% to the GDP and manufacturing only 9.2%. Hence with such a rapid change in its economy the need to automate and introduce robots to its up and coming industry is paramount if a place is to be retained in the global market.

4. Japan

A report from the *British Robot Association* (BRA) says that Japanese industrial robot manufacturers arw now moving their production overseas. This, of course, is for a number of reasons, but one is to avoid the uncertainty produced by the currency-exchange swings of recent times. Amongst those involved are the Yaskawa Electric Corporation, which is considered to be Japan's fourth largest robot manufacturer. It now has begun the production of welding and conveyor-routing controllers in the USA and in Sweden. The company based in Fukuoka Prefecture plans to manufacture ten robots and 75 controllers each month at its Ohio subsidiary, Motoman Inc., and some 60 controllers a month in Sweden.

Another reason is that the growing demand has seen growth to double figures in the US in the past few years and in Europe, Yaskawa's exports have been shown recently to have been growing at 10–15 per cent a year. This is in itself a good argument for the company to make robots there.

Kawasaki Heavy Industries, which is ranked fifth amongst its sales competitors, now has a sales agency in Germany. This is to establish a footing for manufacturing there and to decide which robots to sell and market. There is no doubt that Japanese companies do find it hard to establish a presence in some regions, notably in Europe which has been traditionally dominated by Germany and other local manufacturers.

Shipments of industrial robots. It has, however, been estimated that the shipments of industrial robots from Japan overseas is increasing. The Japanese Industrial Robot Association has reported shipments amounting to 315.2 billion yen during the calender year 1995 which was up 24.5% on the previous year. This figure included domestic shipments of 142.8 billion yen, a rise of 15.5% and exports of 172.9 billion, a rise of 33%. It was interesting to note that shipments of assembly robots was up 22.4%, welding robots some 17.8% and resin forming robots were up to 10.9%.

5. United Kingdom

Computer Systems that crash. For many years, since the beginning of the so-called computer revolution, the government and corporate institutions have attempted to computerise their activities. Many computer scientists have seen the same mistakes being repeated in the new and replacement computer systems installed to provide greater efficiency; a problem hardly confined to Britain, but one which continues to be reported on worldwide. By repeating the same basic mistakes bureaucrats continue to waste both the taxpayers and the shareholders money. Where, it is now asked, are the auditing systems that would ensure that lessons are learnt and mistakes not repeated.

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To attack this problem a UK Computer journalist has published a new book: *Crash*: *Ten Easy Ways to Avoid a Computer Disaster* (published by Simon and Schuster, price £20). The author is Tony Collins, who, it is reported, has worked on the book since 1992 in an attempt to draw attention to what is described as 'the shambles being created by Government departments as they waste billions of pounds on new computer systems which fail to work''. As a journalist he has reported in the UKs *Computer Weekly* for many years on the failure of many such prestigious installations that have failed to meet their target requirements. He has highlighted such computer systems as those installed to make the London Ambulance Service more efficient and the Wessex Health Authority system for the National Health Service. He believes that in many such designed systems the same pattern of operation has emerged, that of hiring expensive consultants to design ludicrously complex, over-ambitious, one-off systems which fail to allow for the requirements and capacities of its users; an overtight schedule; an almost psychotic reluctance to admit things have gone wrong. Finally, the pattern always seems to indicate that when the system crashes, no one is found to be accountable and no one is concerned to learn why it went wrong. What he sees as worrying is that new systems are even now being planned, costing billions of pounds, yet are poised to repeat exactly the same mistakes. Is this situtaion confined to the United Kingdom alone? Are scientists reluctant to kill the goose that lays the golden eggs because crashed systems can mean more 'tweaking', more development and consultancy? On the other hand, these reports may merely illustrate the lack of established operational strategies and accountability.

Exposure to Electro-magnetic fields. The problems that may be encountered by exposure to electro-magnetic fields has again been highlighted in the United Kingdom by a report from the government funded *National Radiological Protection Board* (*NRPB*). The problems concern people who live or work near the sources of such fields. These locations can range from those who sit in front of computers to those people who live near overhead electricity pylons. The UK press reports quote Dr Zenon Sienkiewicz, a senior scientist at the NRPB as saying that:

''. . . mice exposed to the fields learnt new information more slowly than animals used as a control, although they were eventually able to acquire the same amount of knowledge. Information learnt before the exposure was not affected.

He believes that it was difficult to extrapolate the findings to people, but there should be replicated trials on humans to discover whether the results were the same. Humans may, he said, be affected in the same way, as what happens to mice is generally applicable to humans. He also added that although the levels of exposure used in the experiment were far higher than those affecting humans in the environment, it was not known what the extent of the long-term lower exposure could be. Details of his research findings are published in the *Bio Electro-Magnetics,* a journal published in the U.S.

Such reports have, of course, to be approached with caution. There has also been a widespread debate in the U.K. about whether such fields from electricity pylons can cause cancer. Dr. Sienkiewicz has been careful to point out that there was insufficient evidence to suggest that humans may be affected like mice and that there should be tests so that guidelines could be drawn.

NANOTRANSISTORS OPEN UP NEW WORLDS

1. Progress in nanotechnology

We all know now that nanotechnology deals with very small measures, with 'small' meaning dimensions of a billionth of a metre. Machines using this technology are measured in molecules. Much ahs been written about the future potential of making in miniature so many devices that are essential to our way of living. In the UK it has already been estimated that in the early 2000s nanotechnology could produce a £80 billion worldwide market. The race is on to produce what are described as nanomachines and in the USA, at the Massachusetts Institute of Technology (MIT), scientists have reported that by building the world's first atom laser, using a 'Bose-Einstein condensate', which is an unusual form of matter predicted by Einstein, they have moved closer to the goal. This device, that has been produced at MIT, emitted a confined beam of atoms in a single quantum state: the matter equivalent of a laser. This it is claimed has produced the 'ultimate' control you can have over atoms.

2. The Leeds Nanotransistor

In Leeds (UK) it is claimed that the world's first nanotransistors are opening up new worlds for the communications and computer systems of tomorrow. At the Department of Electrical and Electronic Engineering in it reported that they have built a nanotransistor for the 21st Century. Professor Christoper Snowden of the Department says that:

''The device is so small that you could lose it underneath the common cold virus . . . The smallest transistor could be about 10 atoms in dimension – about as small as you could get.''

It opens up the vision, it is claimed, that devices of tomorrow would be driven by a transistor that is so small that beside it bacterium would appear colossal, and a virus merely huge. In fact, a computer could be produced that was so minute that no optical microscope could see it at all.

Reporting on this new development of nanotransistors, Tim Radford writes in th UK's *Guardian Newspaper* (30 January, 1997), that:

''Because it is so small, the wave length at which the nanotransistor operates is very small, and therefore the hertz number of frequency of cycles per second is very large. The Leeds nanotransistor is in the terahertz range and this means more bandwidth. If todays bandwidth is a kind of Dover Strait (English channel with France) through which all communications traffic must jostle, then the Leeds team have just opened up an ocean of wavespace.''

This analogy certainly gives us an idea of the implications of using such a small device and Professor Snowden clarifies the concepts even further when he says that:

''If people want to send more and more information using faster communications systems they need more and more bandwidth . . . So this type of transistor represents the future of communications systems for the next century. To put this in context mobile telephones work at 900 MHz. All the work we do in our group starts at one gigahertz, which is just above that frequency, and runs all the way through to two terahertz; a terahertz is 1,000 GHz, or a million megahertz, which is very high frequency indeed. We have opened up bandwidths by factors of thousands.''

It has to be appreciated that the smallness of the transistor does not limit its transmission capacity; it widens it. As a result there are many research areas that are crying out to be exploited. One being television where cameras are required to roam around without being connected by cable.

The report from Leeds says that the researchers are working on combinations of indium gallium arsenide and a new material called indium phosphide which will permit the construction of smaller computing machines with higher frequencies. The new Supercomputers are currently based on gallium arsenide.

At Leeds the researchers say that smallness counts and they justify this by saying:

''. . . information has to move through those 10 atoms, so that

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the fewer atoms you are able to move the information through, the faster it will go. You may argue the limit would be one atom, and indeed there is some work being done in Japan on what are called single electron memories, which are a more abstract aspect: it is an absolute limit and it is a long way off . . .''

In the real world of building computing machines it would be possible to take the Leeds technology now and start using it, but there would be some delay as manufacturers learn how to handle transistors that are only 10 atoms across. Other important problems have to be solved, such as the heat dissipation from such small devices and the measurement of currents and voltages at the frequencies that have been achieved. The Leeds team believe that they have solved some of these difficulties.

Currently, it appears that this research is being funded from the USA with British companies not showing much enthusiasm. This can soon change as the potential of nanotechnology is driven home to industry by the continual breakthroughs that are being publicised. Pictures of nanoscale repair robots traversing the human arteries and the possibilities of computer processor speeds some 10,000 to 100,000 times higher than todays Pentium processors working at up to 200 MHz can achieve, must surely excite the interest of any forward looking industrial nation.

ROBONURSES

A new robot has been developed by Toshiba in Japan that can recognise a face, respond to verbal instructions and shake your hand. A spokesperson for Toshiba claims that it has the capability of providing nursing care to the sick and elderly.

Described as a 'human and friendly' robot the developers say that it has a coming role at a time when there are fewer and fewer young people in a society that has more and more who are elderly. The resulting situation, it fears, will be one where manpower will be in short supply and high technology will not only be used for the more sophisticated medical applications but also will be harnessed for routine care.

The Japanese electronics group has been congratulated on its product and the government's research initiative for welfare and medical apparatus has a development programme which recognises the need for technological solutions to the impending social problems of the future. One of this programme's projects is a six-year plan which is to run in conjunction with a number of electrical manufacturing companies such as Fujitsu and Toshiba, for the development of suitable robot systems. Specifically, one of these projects is for a robot capable of carrying and clearing food trays in a hospital or in an environment where older people are catered for. The robot would be equipped with a navigational unit to direct it from bed to bed together with a monitor to inform patients what is on the menu, and a mechanical arm to lift and remove trays. The designers believe that such a system with thse basic functions would be a considerable aid to nurses and others involved so that they could spend more time on actually caring for their charges.

Another system that will contribute to this programme of research is one which has been designed to keep track of patients. Researchers at the Tochigi Prefecture Technology Centre have been developing for nearly three years, such a system that makes use of satellite tracking. It uses the same design of technology that is currently used in vehicle navigation systems. The system is already in use to keep track of elderly patients who may be suffering from senile dementia and getting lost. It allows a pocket-sized transmitter to be attached to each patient and the system can then trace them, providing the information for their carers.

These systems are to be marketed at a suggested price of about £250 each for the devices. This is to be a subsidised price so that its true marketing costs are not revealed.

Although these developments are initially aimed at the Japanese market, where some 15% of the population are over 65 years of age, and with a fertility rate of less than 1.5 children per couple, there is worldwide interest in their progress. Although the Japanese statistics reveal probably the worst scenario in the world, since its birthrate is the lowest and its life expectancy rate (at almost 80 years) is the highest, it is, unlike so many other nations, using new technology in its solution to the problems.

By the year 2025 it has been estimated that Japan will have the oldest population in the world with 32 million people, that is more than a quarter of the total being over 65 years of age. It therefore has every incentive to develop technological programmes to produce human and friendly robotic devices to ease the problems the future will bring.

SOFTWARE ANNOUNCEMENTS

1. CAD Software

TurboCAD is offered as an easy-to-use desktop CAD software for users who need to create, edit and view precision drawings. It is used, its author say, by over a million world-wide users in all areas of design; these include all aspects of engineering as well as architecture and construction.

The software, is described by its developers as delivering comprehensive CAD functionality, flexibility, and expandability for the technical professional, as well as easy access to CAD technology for the inexperienced user. It is claimed that *TurboCAD* adheres to the International Microcomputer Software Inc., (IMSI). Office usability standards and is compatible with the industry-standard CAD file formats; it is completely programmable by third-party solution vendors. This, it is beblieved, makes it suitable for any existing, new or expanding design environment.

The current releases (June, 1997) are of *TurboCad v4* and *TurboCad v4 Professional.* An analysis of the software shows that it has: usability enhancements, AutoCAD compatibility and raster-to-Vector conversion. It also has Internet features, which the product UK spokesperson says, allows 'the use of the Internet to maintain a close, two-way relationship with customers and allow them a bigger voice in shaping the future of a development'. The Professional version of *TurboCAD* includes an internal database engine which tracks and summarises and presents data from within a drawing. Symbol enhancements are catered for with over 12,000 pre-drawn symbols in *TurboCAD v4* and some 16,000 symbols from over 23 industry-specific categories in the *Professional* version. The developers also have specified its object-oriented programming environment as follows:

Scripting and programming support is provided in both new versions through *Enable Basic* (similar to *Visual Basic*), which includes interactive user input, variables, control commands, operators, external stream input and an advanced debugger. In *TurboCAD v4 Professional,* the power of its engine is exposed through a *S*oftware *D*evelopment *K*it (*SDK*) which provides access to hundreds of API functions and an OLE Automation class library. It can be run standalone, or as an in-process (DLL) server, allowing developers to either extend the functionality of *TurboCAD* or develop entirely new applications. All the popular Windows development environments are supported, including *Visual Basic, C++, Delphi* and *Java.*

IMSI is known as an important developer and publisher of productivity and educational software for business and home use. Its products include: – *TurboCAD®, TurboProject®, MasterClips®, FormTool®, FloorPlan Plus 3D®, WinDelete™, NetAccelerator™* and *Graphics Converter™.* (Contact: For the latest product information, developments and case studies, visit IMSI's web sites at *www.imsiuk.co.uk* and *www.imsisoft.com*).

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2. Software Users Year Book

The latest edition of the *Software Users Year Book,* the directory guide to the UK software industry, has been published by Learned Information.*

The directory consists of two volumes. One volume contains 12,500 software products which enables users to discover what software is available in a particular area, e.g. finance. Users are able to compare prices of similar products through quick references tables and discover what software works on their platform.

The second volume is of 3,200 software companies. This is a list of company profiles which includes a listing of 1,200 software developers classed by tools used or applications developed. The profiles of the companies in this volume include full contact details (including e-mail where available), named contacts, number of staff, turnover, target markets and manufacturer accreditations.

The *Software Users Year Book* provides an overview of the software industry in the UK. The directory is used as a guide to finding and buying software and as a source of contact details for, among others, IT companies, marketing departments and telemarketing companies.

* Learned Information Europe Ltd, part of the multinational VNU publishing group, produces an IT industry database of over 13,000 manufacturers, distributors, dealer and VARs and over 20,000 products. Key publications include *The Software Users Year Book, The Computer Users Year Book,* The Computer Software & Services CD-ROM and Datasite CD-ROM. For further details contact Learned Information Europe Ltd on +44 (0)1865 388057; Web site at www.learned.co.uk).

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