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Reports and Surveys

AUTOMATION AND ROBOTICS REPORTS

1. UK Automation and Control Systems industry analysis
According to the financial analysists Plimsoll Publishing* some 44% of the Automation and Control Systems industry improved their company's performance last year.

The analysis, covering 315 companies offers a comprehensive look at each organisation. One of the new features offered in this new publication awards each company with one of three 'mood' indicators or faces to represent improvement or decline in performance. It provides an innovative and effective way of assessing the general mood of the industry.

The analysis summarizes their grading system as:

> "The indicators are calculated on the overall "score" of the company's individual performance over the last 12 months. It is a combination of 5 key ratios. The basis of these ratios is simple as any fall is a decline in financial performance and an increase is an improvement.
>
> 116 companies are showing a decline in their financial performance and are warranting a "bad" mood. Whilst not all of these companies are in serious difficulties, 65 or 56% of companies are showing two consecutive "sad" face years indicating difficulties caused by competitive markets or poor management of their affairs. These companies are showing these early signs of financial difficulties that can lead to the failure of the company.
>
> Remarkably, 111 companies analysed showed an improvement in performance. "Most might see this as amazing. Yet the irony here is how so many in the industry can be seen as smiling when there is so much poor economic and business news about. We believe this figure proves that management are in control in these companies."

Comments one of the compilers of the analysis:

> "The Plimsoll analysis is aimed at managers, directors and decision makers wanting to be better informed on competitor behaviour and yet who do not have the time or skills to fully understand how to analyse a competitor's performance."

2. Range of Pre-engineered solutions
Automation specialist Festo† has introduced a range of standardised system solutions to reduce installation and commissioning times and maximise ease of use, it claims, for its customers. Their first off the pre-engineered line is, what they say, a comprehensive solution for handling problems.

The company outlines their new system and their perceived advantages to their customers as:

- Single part number ordering for a complete handling solution;
- All wiring and piping for the pneumatic and automation components are already in place and thereby eliminating the most common source of installation errors;
- The packages include full documentation, CAD drawings and 3D illustrations ready to be dropped into machine designs and technical files.

The company say that they supply:

> "The entire package, from a simple handling axis to a multi-axis system complete with control system utilising touchscreen industrial PC and bus technology. All the user needs to do is bolt down the handling system to their machine, connect mains voltage, and watch it run!" The term 'Festo Plug and Work®' to highlight the ease and speed with which applications can now be built has been registered.
>
> The new Plug and Work pre-engineered handling solutions consist of pick and place gantries and cantilever designs across a range of sizes and movements. Customers simply select the mass of the component, the required cycle time and the movement required for their application.
>
> The new handling system solutions include free consultancy to advise on appropriate equipment configurations. Typical pre-engineered solutions cover loads from 150 g to 150 kg in single or multi-axis formats with accuracies down to 0.01 mm. A broad selection of pneumatic and servo-electric drives complete the package to address all positioning possibilities.
>
> Along with tested designs, proven performance, fixed costs and Festo Plug and Work® functionality, users will also benefit from access to specialist automation expertise, applications support and advanced software solutions including the latest PALM programming software free of charge (for use with Palm and Handspring PDAs) for the handling system PLC controllers."

One of the obvious advantages of pre-engineering is that it is possible to have proven standardised solutions up and running in days at a fraction of the cost of in-house design and build. But of course, as with all such systems they have to be both carefully chosen and costed. In this case the company does offer a range of over 16,000 products that are available to modify any chosen package to suit special requirements. Potential users of such system solutions are well advised to monitor the products market in the usual way (see Plate 1 on next page).

* Plimsoll Publishing Ltd: New Analysis, 2nd Edition, 363 pp. (2002). Tel: (01642) 626400. E-mail: plimsoll@dial.pipex.com
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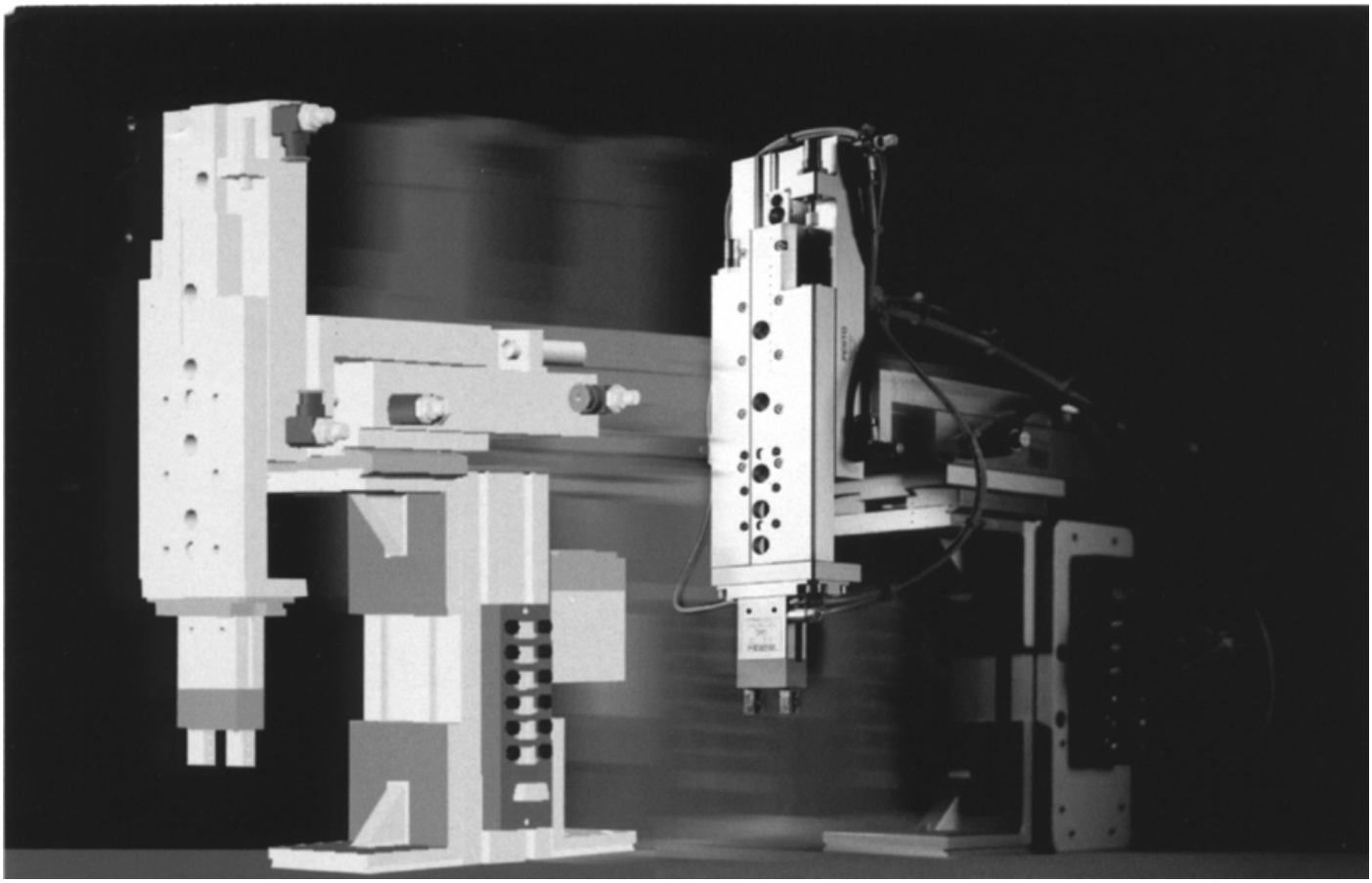


Plate 1. New 'Festo Plug and Work®' pre-engineered handling solutions consist of pick and place gantries and cantilever designs across a range of sizes and movements.

AUTONOMOUS CLEANERS

1. New robots for the domestic scene

In November 2001 Electrolux claimed it had launched the world's first 'autonomous floor cleaner' about a hundred years after Hubert Cecil Booth invented the first successful vacuum cleaner. In March 2002, however, Matsushita announced its rival product, also billed as 'the world's first robotic vacuum;' no doubt there are other manufacturers with similar claims. But what is of most importance is that robots designed for the domestic market are being developed and marketed. Of those recently publicised in these reports it is of significance to note that they are of the 'single function' variety. These are robots that are designed to perform a simple and necessary operation. These are the ones that carry out one task and do it well. The range now available for the home market include robots for tasks in the garden which are singletasked such as the robot lawn mower. The robot engineer Hans Moravec is reported as believing that:

> "There was a lot of optimism in the beginning when robots first appeared on the scene. But some of us began to realise there was a major miscalculation in building robots – and that had to do with the belief that complicated programming was involved.
>
> The best robots today are those that are the simplest in what they do. These are the ones that have one task and do it well. Any time you try and build one that does a multitude of things, like a robot that can do everything at home, you inevitably fail because there are too many ways in which something can go wrong."

We report on two robot cleaners in the next sections.

2. Trilobite – first robot cleaner?

Electrolux's Trilobite is claimed to be the first vacuum cleaner to go on sale with the promise that it will perform the most tedious of domestic tasks better than humans. It immediately was criticised by its rivals as being 'little more than a motorised carpet sweeper.' The company, on the other hand, believe their device is the first autonomous floor cleaner to be brought onto the market.

It is 13 inches wide and is said to be able to vacuum some 95% of the area to be cleaned and could slip under such low furniture as coffee tables much more easily than the conventional ones. It has already been on sale in Sweden with the United Kingdom next in line as a marketing venue. The company say it will cost about £1000, which in the UK is about six times the cost of an ordinary vacuum cleaner. We are told that the device does not negotiate steps and that it requires a magnetic strip hidden under the carpet to

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prevent it leaving the target area. Electrolux research has indicated, it is reported, that with the 3.6 million vacuum cleaners sold in the UK in a year some 180,000 homes could be prepared to pay more to make the chore a little easier. No technical details are currently available but presumably the designers have harnessed a suction motor and sensors to a carriage that is sufficiently mobile to navigate walls, furniture and other obstacles. Many of the developers' rivals who have been attempting to produce robot vacuum cleaners suggest that it only uses 90 watts of power when conventional cleaners need 800–1,600 watts. In developing such devices much of the available power has to be utilised to beat the carpet, suck up debris and manoeuvre the machine around the room. Any shortage of power would result in the vacuum having reduced suction the rival developers say. They even claim that a robot vacuum with an adequate suction power would required either heavy batteries or run for only short periods. We will see how the competing developers of such robot devices fare in the coming months.

3. Matsushitals robotic cleaner

Developed by the Japanese electronics giant Matsushita the robot cleaner is slightly bigger than a football and apparently has the intelligence to avoid falling down stairs, or hitting walls. Not a great deal of technical data is available, for obvious commercial reasons; we are told, however, that it is fitted with 50 sonic and infra-red sensors and that it can work for up to an hour on a single battery charge after using its sensors to measure the size of each room that needs to be cleaned. Some £1 million has been spent on its development and when the current trials are completed a full market launch will be made. This has been provisionally set for mid-2002.

The company, who also own Panasonic, have been researching automation in relation to domestic chores for some time and believe that robots could be developed for many household tasks. They cite guarding the house against fire or burglary in homes whilst the occupants are asleep or away as a likely project.The renewed interest in robots in domestic environments will undoubtedly see new ranges of personal robots being made available for the consumer market.

COMPUTERS TO WEAR

1. Developing the 'wearable computer'

In industrial applications computer devices are often carried around on the production floor. In that sense they are hardly new or exciting. At first it was only a matter of envisaging something the size of a backpack, now, however we have the problem of defining what is meant by such a device. The trouble is that computer systems vary so much in size that, for example, a wearable computer could be the size of the smallest chip or indeed the size of suitcase. The other question to be considered in framing any definition of such devices is whether they are to be worn outside or inside the body. We all know that for many applications computing devices have been implanted in the body or fixed onto the skin. With the current rate of advance in this form of technology it is better to take an extremely loose description of such computers rather than aim at a precise definition. Consider then some of the possible categories recently reported to us.

2. Microchip implanted

Professor Kevin Warwick, the cybernetics expert of Reading University (UK) and a fearless experimentor recently had a microchip implanted into his arm. By anyone's definition he became, as far as we know, the world's first cyborg. There is, no doubt, that he is a pioneer in this research and we have described his endeavours on many occasions. He is investigating whether data can be transmitted between human and machine; he wants to know the extent to which it is possible to capture data signals which, on the one hand, would include commands for movement say, and on the other, physical emotions such as pain or pleasure, and in each case be able to transmit them to other humans or, maybe devices. The operation was recently televised and screened worldwide so that even if it produces no positive results it has publicised such initiatives and Professor Warwick has to be admired for his pioneering endeavour.

3. Developing the new wearable computers

We are not sure who initiated the concept of wearing and not carrying computers, but Dr. Mark Weiser of the Xerox's Palo Alto Research Centre (USA), has been given the credit for the idea. In 1991 he is said to have proposed that computers could be made so small thay could be worn as jewellery or as clothing. Other computer researchers have made claims for producing the idea and, of course, there are now many manufacturers and research agencies who are exploiting the concept. We now have the hightech backpack in many different forms so that it can be worn by cameraman, production worker or warehouse operator.

You can wear a web-cam and microphone for real-time interactions that can happen online. Cyberhelmets are popular so that you can view information of your choice at any time. There are watches that can be worn to give you full computing power or just as or, in addition to serve as a cellphone. All the devices that are wearable come with the possibility of having the latest interface systems whether it be voice-dialing, or any other advanced input/output facility.

4. Introduction of new systems

Many new systems are being introduced to the target user who is usually the user who has got everything or is merely technologically hungry. In most cases the devices on offer have been produced with a very serious purpose in view and have very real applications in science, industry and business.

Many new systems are being launched this year. The WIA-100NB Wearable Internet Appliance is being launched by Hitachi in Japan and by Xybernaut in the US. This machine is slim, silver and palm-sized unit that hooks on to your belt or sits in a pocket. Most innovative in its design is that it does not possess the conventional screen, but instead

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a tiny display sits just in front of your eye, attached to a headband. It is claimed that the laser optics used make a virtual notebook-sized screen appear to float in front of you. Xbernaut has been involved with developing devices of this sort since the beginning of the l990s. This new machine, which is called Poma, is the first to enter the market.

This machine and others that will, no doubt, follow in its wake are aimed at the new breed of wearable computer users, this is someone, they believe, who is keen to compute whilst on the move, surfing the internet, retrieving personal information, playing online games all anywhere and at any time.

MIT has decided that wearable computers should, in fact, be clothes, just as Weiser's original concept declaimed. Their latest project called MIThril literally wraps one in computer power. It consists of putting input/output systems, wireless networking and all that goes with it in a sleeveless fleece. No doubt, other researchers will follow this trend and we will soon see some exotic garments implanted with the latest computer and communications facilities.

5. Future Predictions

A recent report suggests that by the end of this decade 40% of adults and 75% of teenagers will be wearing computers. This is bound to happen as manufacturers produce miniaturised systems that carry more powerful processors, they would contain full voice recognition systems, advanced wireless communications and all the new fashionable devices that are currently too large to wear. Many of these systems will have tracking facilities using global positioning, others will allow one to use them without having to take one's eyes off the task in hand. Already Xybernaut have a wearable product called Mobile Assistant which is in use in Tennessee, the company say, where the Tenessee Department of Transport has equipped its staff. It allows their workers to view and to update information, even when they are driving.

Those of us, it seems, who have researched into the information age that is already with us will not be surprised at this trend. The popularity of mobile telephones indicates how quickly the applications of advanced technology are absorbed by the public at large; it could well be that carrying any sort of technological device will become a thing of the past and wearing our technology will be the reality.

6. Wearables in the real world

Unfortunately, being in the real world of wearable computers can create personal problems. It is reported in *Technology News* (March, 2002) that Professor Steve Mann of the University of Toronto (Canada) was stopped boarding a flight at St. John's Newfoundland after a strip search revealed he was wearing computerised glasses, headgear and an electronic body suit. He is reported as saying that he needed the gear for medical reasons. Professor Mann is a specialist in wearable computers and has worn full cyborg equipment for some 20 years, we are told. More stringent searches by security conscious airlines may well create problems for passengers with wearable computers Professor Warwick with his implanted chip may well cause a rethink of current security vetting at airports, particularly if they become more commonplace in the future.

INTERNET USE AND ABUSE

1. Internet statistics of usage

Everyone knows that the very nature of the Internet has revolutionised the way in which organisations and individuals acquire and distribute information. The International Date Group has, however, surprised even the most ardent net surfer by indicating that the number of people on the internet will reach 320 million by 2002 (Needle, 1999).[1] It is also recorded that in the USA alone, e-commerce will account for approximately USD $325 billion by 2002. These are some of the statistics that Murugan Anandarajan of the Department Of Management at Drexel University (US), quotes in his article 'Internet Abuse in the Workplace' (Anandarajan, 2002).[2]

2. Internet abuse in the workplace

Amandarajan makes the point that, in addition to being a channel for commercial exchange, the web also provides employees access to the world's biggest playground. The Aberdeen Research Group Report (Yasin, 1999)[3] indicates that employees in the US squander anywhere from 30 minutes to three hours a day on non-work-related activity. This is Internet abuse, Anandara writes. A definition is presented which, the article says, covers this activity:

> "Internet abuse is any voluntary act of employees using their companies Internet access during office hours to surf nonwork-related Web sites for nonwork purposes."

Many employers and employees would challenge this definition or at least ask for a discussion about what is for example, 'work' in the modern workplace. Using the internet for apparently nonwork purposes may well make for a better employee. Many interesting questions arise and these should be considered before the word 'abuse' is bandied about.

The original developers of networks had little idea of the consequences of allowing an information system with the facilities of the Internet to be freely available to employees, whatever their corporate status. The debate could open with the view of Boisot (Boisot, 1999)[4] who discusses a line of acceptable user behaviour. Boisot argues that:

> ". . . both individuals and organisations can be viewed as productive factors generating output levels."

In consequence, technical progress, such as the Internet, acts to reduce the quantities of input required to produce a given output. Technical progress, however, also pushes towards more changes and complexity. There is a drive then, to blend complexity reduction with complexity absorption. What results then, we are informed, is a zone of comfort, or a balance between complexity reduction and complexity absorption, that represents the best usage of the internet. It would seem therefore that we are being told that Internet abuse could exist above this zone in terms of excessive

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freedom to employees and below the zone in terms of excessive control by the organisation involved. The question asked is where is the line drawn between productive and nonproductive work? The layman who is the employer in many cases will be the first to acknowledge that it may be productive for an employee to experiment with such a new technology to his advantage. A certain amount of playful activity, we are told, can lead to learning that will be of use to the organisation. Indeed, one study has already suggested that frequent internet users are often happy and productive workers.

Social theorists will already have considered this problem to be one that should involve social contact theory. That is a theory that suggests individuals have evolved ways of dealing with other individuals, with groups and within organisations. It becomes a question, we are told, of the exchange of perceived benefits, i.e. to the individual and to the organisation.

3. Discussing the consequences

There is no doubt that resolving this problem is of great importance and the cost researchers say, of ignoring it is enormous. A recent study of 'Internet Abuse in the Workplace' highlights the difficulties encountered in firstly, understanding the problem and secondly, in devising methods for controlling it. It provides a great deal of information on the subject with studies that include: Company profile of the frequent user; constructive approaches to internet recreation in the workplace; Abuse or learning?; Does Electronic Monitoring of Employee Internet usage work?; Monitoring for Pornography and sexual harassment. The problems are complex and the studies of Internet usage in the workplace comparatively new. Obviously, more research will be initiated and it is to be hoped that it will be communicated to organisations with some speed to the benefit of both employees and employers.

References

1. D. Needle, "Surprise: E-commerce will drive net growth," *PC World* (15 September 1999).
2. R. Yasin, "Web Slackers put on notice," *Internet Week* (15 October 1999).
3. M. H. Baisot, *Knowledge Assets* (Oxford University Press, 1999).
4. M. Anandarajan, "Internet abuse in the workplace," *Communications of the ACM*, **45**, No. 1, 53–54 (2002).

RESEARCH REPORT

1. Finding out how our visual systems and brains work

A report from Newcastle University (UK) gives details of the role of binocular eye movements in the perception of motion in depth by human observers. The report says that:

> "When objects move in the natural world, we usually try to follow them with our eyes. The Newcastle team is currently testing how well and how often people make binocular-following eye movements, and to what extent these eye movements help, or hinder, the visual system when detecting how objects move in depth.
>
> Recent research has shown that motion in depth is detected poorly when compared with the detection of lateral motion (when the eyes are fixed). But it is not known whether the results of such work can be generalised to situations when the eyes move, or when the observer moves to intercept an object.
>
> The team's next series of experiments will test whether binocular eye movements can improve the detection of motion in depth. Then, it will test whether such movements allow observers to make more accurate estimates of motion in depth, and whether they help people interact with moving objects."

The work of the Newcastle University research team was written by Dr Julie Harris who can be contacted on email: jbharris@ncl.ac.uk

2. Novel Laser Techniques to manipulate chromosomes

A multidisciplinary team of researchers at the University of St. Andrews, Scotland (UK) is developing novel laser techniques to manipulate chromosomes with unprecedented precision.The aim the team reports, is to provide biologists with a powerful tool to study the fundamental mechanisms of how chromosomes become damaged.

The research is being led by Dr Kishan Dholakia of the lasers and optics group in the university's School of Physics,in collaboration with Professor Wilson Sibbet and Dr Peter Bryant also of the university. The programme of research is funded by the UK's Life Science Interface Programme.

> "The genetic material of all organisms is constantly subjected to attack by environmental factors such as toxins or radiation. If damage does occur, special enzymes are despatched to effect a repair. However, occasionally a break in the strand of DNA can then manifest itself as a break in the chromosome as a whole. It is thought that at least one type of 'chromatid' break results from a rearrangement (involving cutting and rejoining sections of the chromosome) of the chromosomal material around the break site, which the cell carries out in response to the original DNA damage. If this rearrangement process is incomplete when the cell divides, a break will be observed when the chromosomes are viewed under the microscope.
>
> To study this phenomenon biologists need to isolate damaged chromosomes and then excise the small portion containing the fracture for further analysis. This is a difficult manipulation and it is here that the optical physicists believe they can help."

The researchers say that most biologists currently use thin glass needles to cut small sections from the chromosomes under the microscope. They believe that this is not very sensitive and requires some quite complex mechanical instrumentation. The St. Andrews team is developing a way of using laser light in the form of optical tweezers to move and cut the chromosomes. They say light has a small but definable momentum, and the high power per unit area of a laser beam is capable of producing a force of the order of pico Newtons. Dr Dholakia says that "these optical tweezers

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make it possible to pick up and move micron-sized particles."

The researchers reports that:

> "The wavelength of the light must be selected with care so that the object is not damaged by the intense beam. Once the chromosome of interest has been isolated by the optical tweezer it is necessary to cut around the break to enable that region to be analysed. To do this we hope to use a second, pulsed, laser with a different wavelength to act as an optical knife. By manoeuvring this laser around the region of the break we should be able to isolate that region and then tweeze it out."

The St. Andrews researchers also say that they are developing ways of making chromosomes more mobile, and that they have succeeded in manipulating whole chromosomes with the optical tweezing system. Further experimentation with different configurations of laser light to find the most efficient tweezing geometry is being pursued. The researchers believe that once their system has been shown to work for chromosomes they would expect it to be applicable in many varied research areas providing 'spin-offs' for the use of this powerful tool.

ROBOTICS WORLDWIDE

1. Netherlands

A report from Eindhoven (The Netherlands) from Nyquist Industrial Control gives details of a prototype PC-based robot control system.

The company's developers say that it (Plate 2):

> ". . . uses standard drives to connect to existing, dedicated motors and encoders. High-level software calculates the exact motion profile in 3D, synchronizing the movement of the axes to make the desired path. The system demonstrates how easy it is to upgrade the control systems of existing proprietary robots by using open PC-based software and standard drives, rather than having to develop expensive, customized schemes. The project, achieved through close collaboration with the Dutch robot system integrator Morotech Robottechniek of Hoorn, demonstrates that Nyquist's PC-based motion control systems, commonly used in sophisticated high-end robotics, are suitable for the most rugged industrial applications.
>
> Using the manipulator, a DR-4000, provided by welding robot manufacturer DAIHEN Corporation of

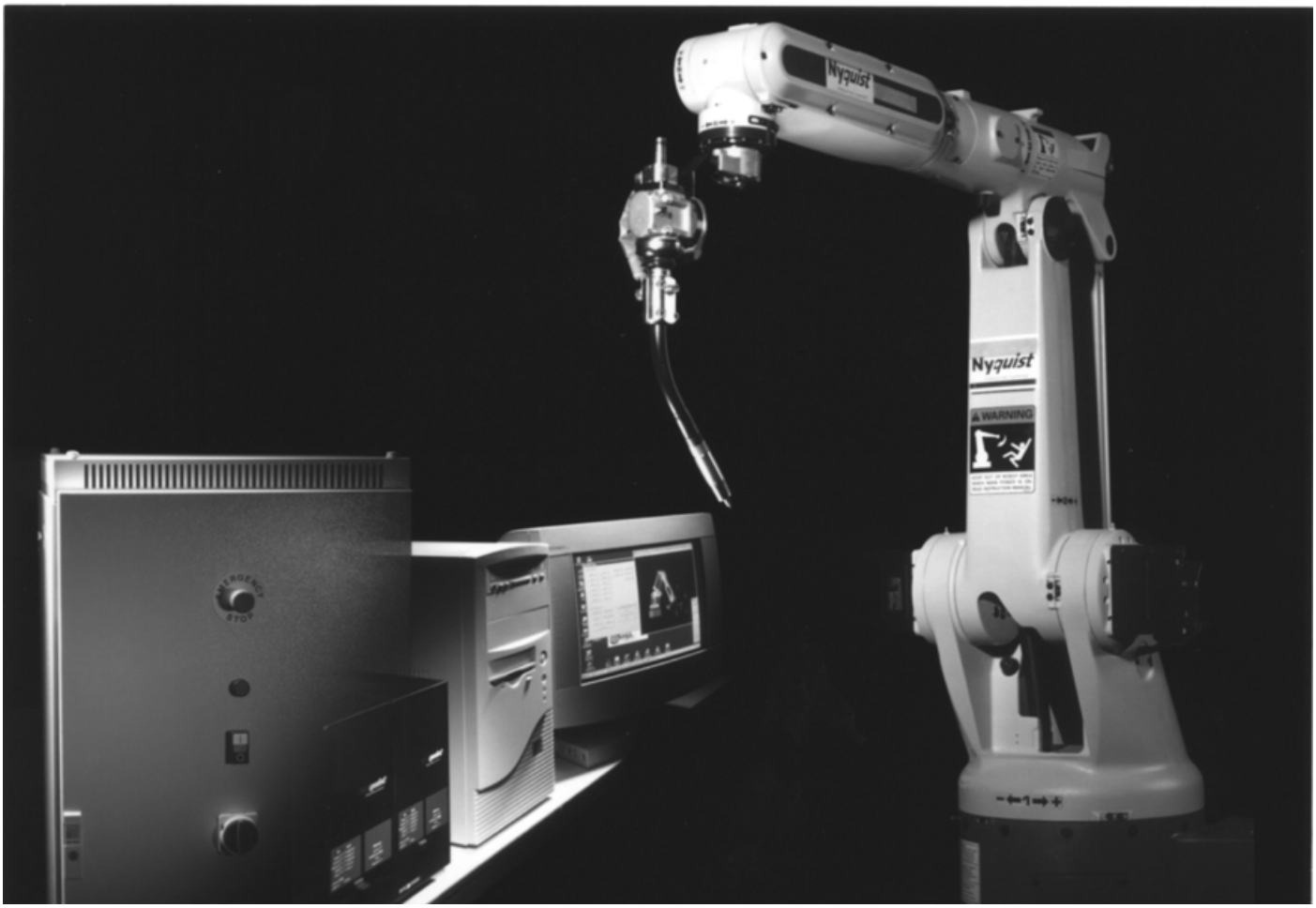


Plate 2. Prototype PC-based robot control system from Nyquist Industrial Control.

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Osaka (Japan), Nyquist's prototype system retains the existing robot mechanics, motors, and cabling between robot and control cabinet. Electrical connections too, are compatible with the current proprietary controller. Connection is a matter of disconnecting the cable from the existing control cabinet and hooking it up to the new prototype, with no modifirations. The prototype systems based on Nyquist's NYCe3000 PC-based plafform, with its open and versatile four-layer software.

Unlike common proprietary controllers, the system can easily be adapted to different requirements. With the open Nyquist system, it is a relatively simple task to change a few software parameters to make configuration changes. Besides quickly adapting to different configuration changes, this even adapts to different applications.

It is also easy to add a large number of interpolated or synchronized axes using the open PC-based software and, in principle, to link to systems like ERP, office automation, and even CAD. It will be possible to import product data into the robot controller and use it for programming. All this goes towards creating intelligent combinations of multiple robots, conveyer systems and positioning equipment. In fact, it means a transformation from simple to high-end applications, like laser welding, multiple handling or similar applications with advanced product assembly and manipulation.

Nyquist's open motion control approach is based on accepted industry standards like standard PCs, Ethernet, FireWire (IEEE-1394) and the Microsoft Windows NT and NT Embedded operating systems and drivers. FireWire is ideal for connecting the I/O modules, motion and vision components that typically make up an industrial control system. It offers 400 Mbit/s transmission speeds, along with the guaranteed response times that are essential to motion control applications."

Readers will appreciate that for robot manufacturers the transition from closed to open systems means that key technologies no longer need to be re-invented in-house, but can be out-sourced as necessary.

Companies can then adopt if they wish, streamlined top-down process using ready-made, open subsystems that are easy to combine. This can result in the release of designers to concentrate on their specialist application knowledge, such as the design of the highest performance equipment for laser welding, multiple material handling and the many other high-speed tasks in automation that face modern industry.

Nyquist Industrial Control can be contacted by e-mail: contact-us@nyquist.com.

2. Switzerland

At a technology day held at the ABB Group R&D laboratory (ABB Group R&D Laboratory, Dartwil, Switzerland), the ABB President and CEO Jorgen and the Chief Technology office, Marrkus Bayegan outlined the company's new research and development strategy. They said that:

"ABB, the global power and automation technology group is streamlining its research and development to focus on technologies that increase productivity and sustainability for utility and industry customers, especially growth areas linked to its broad initiative called industrial information technology, patented as Industrial IT.

Our business is focused on helping utilities and industry enhance their productivity and sustainability through power and automation technologies. Our research and development efforts must closely reflect that focus, with Industrial IT, we are developing a common architecture allowing customers to link our generic and branch-specific offerings, and third-party products, into more efficient manufacturing and business operations. This is an ambitious effort, which is key to our future.

The new R&D strategy entails shifting some research resources in the ABB Group R&D laboratories from mature technologies into Industrial IT and emerging technologies, such as wireless communications in industrial plants, industrial software developments and advanced sensors – aiming to make ABB's traditional and mature products Industrial IT-compatible.

As a part of this process, we are creating four global virtual laboratories: Industrial Processes and Automation; Power Technologies; Engineering and Manufacturing Technologies; and Oil and Gas Technologies. This means linking our researchers up with one another, universities we collaborate with and partner organisations in a fully networked, online environment. It's a natural step in today's more open world, with IT providing for efficient communications between researchers and collaborators.

ABB spent around 3% of revenues, or US$700 million (£486 million), on R&D in the year 2000. Some 6,000 scientists and technology specialists work in ABB Group R&D laboratories and divisional R&D centres around the world. In Europe, the shift in focus is coupled with a decrease from 760 to 550 scientists in Group R&D labs. In the United States and Asia, Group R&D staffing will grow from 25 to 100 scientists in the new technology areas. This means a net decrease of 135 scientists in Group R&D centres.

Industrial IT is ABB's architecture for ensuring that the products, installations and software systems in a factory or an electrical utility grid – to take two examples – are built to a shared information standard, and can communicate as integral parts in an operational platform that allowsonline optimisation in real-time. Industrial IT-enabled products range from high- and low-voltage electrical equipment to motors, drives, and sophisticated operations management systems in plants."

3. UK's Engineering Physical Science Research Council

The UKs Engineering Physical Sciences Research Council (EPSRC), in association with the IEE, the British Computer Society and the Royal Society sponsored an international review of UK research in Computer Science. Under the Chairmanship of Professor Fred B. Schneider of Cornell University (USA), a panel of some of the world's leading computer scientists from both industry and academia conducted the review. The panel undertook a week long

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study to effectively evaluate the standing and potential of computer science research in the UK. The Report* was published in February 2002 and provides, the Chief Executive of EPSRC says:

> ". . . a very clear exposition of the nature of research in Computer Science and it's importance to Science and Society as a whole."

The report identifies that this research has significant strengths in many areas, and acknowledges that a number of the foundations of the discipline were established by the UK science base. Among the particular areas of strength in which the UK has a leading position are:

- Semantics;
- Logic;
- Programming Languages;
- Formal Methods.

Many other areas of internationally competitive research include:

- Real-time systems;
- Dependability;
- Software Engineering;
- Speech Recognition and Computational Linguistics;
- Machine learning;
- Human computer interaction;
- Bioinfomatics.

The report also pointed out some of the imbalances in the research capacity within computer research in the UK. Examples, such as algorithms and complexity, in which the UK has never exhibited great strengths, experimental systems, which is seen as an area in decline, and the need to encourage more explicit engagement of computer science in high performance computing applications were given.

In addition, a number of suggestions are made regarding the levels of funding for UK Computer Science compared with other countries and the organisational arrangements within EPRSC for raising the profile of computer science within the EPSRC portfolio. The published report is now available for comment by the community, including such cognate disciplines as mathematics, electronics, and electrical engineering and psychology, which interface with computer science.

SOFTWARE REPORTS

1. Automating data management

A Glasgow University, Scotland (UK) team has created a system for improving computer programming productivity. The research team is led by Professor Malcolm Atkinson. No one can deny the need for not only improving programming as we know it but also the productivity of those engaged in the activity. A report on Professor Atkinson's research and development in this area has said that:

> "Today's modern business now operating in a much more competitive, and usually global market, needs a seemingly ever increasing array of Information Technology (IT) – such as airline booking, stock control and ordering, process management and administration, and cooperative design environments – for it to operate efficiently as well as satisfy the diverse needs of its customers. There has never been a time when corporate IT has been placed under such intense pressure to 'perform' for its business leaders and customers as such systems grow in sophistication and size. IT is now expected not just to be more efficient but also more cost-effective as development gains pace to match a cornpany's constantly changing operational needs.
>
> Many companies have become wholly reliant on the effective management of their IT to survive, yet IT budgets have become squeezed and IT teams have been expected to deliver more and more functionality and flexibility from their corporate systems.
>
> The demand for skilled application developers is therefore overwhelming, but the UK is currently suffering from a death of programming expertise. It is therefore imperative to improve the effectiveness and productivity of application developers."

Professor Atkinson and his team at Glasgow University's Computing Science Department have developed a way of automating data management for large and complex software applications. He says that:

> "This is a problem I've been addressing for many years – that for complex applications it's really very difficult for the average programming to manage their own data over the long term."

Acknowledgement is also made by the team to Sun Microsystems for their 'thriving collaboration' and for supplying the research hardware and software environment and investment of a significant amount of its developers' time in the project.

We are also told that:

> "The company also plans to use the fruits of this research to help in the development of its own family of network-related software (CASE) tools. Currently, application programmers usually have to contend with and co-ordinate operating system, programme language and database themselves, mapping every data structure either to the file or database system they happen to be working with."

It would appear that with simple business application structures, this process works easily, but with complex structures, such as those found in geographic information systems (GIS), engineering applications, and many of the scientific applications there is still a lot of work to be done mapping the program data to the database structure. Professor Atkinson continues in the report by saying that:

* See http://www.iee.org/Policy/CSreport/ for the full version of the report.

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> "However, building on the platform neutrality of *Java*, we have developed an integrated approach that presents the as one coherent facility."

In the same way that the *Java* programming environment automates main memory management, which increases developer productivity, the Glasgow team, it would seem, has sought to automate long-term data management with the view of again increasing developer productivity.
The researchers say that:

> "We've achieved this by automatically preserving any data, structure you can declare in *Java*, and making it available for subsequent program executions. This is seamlessly integrated with storing it in the hard disk. This procedure has been done before for academic languages, which are relatively simple. *Java* however is a much more complex language.
>
> There are a number of technical difficulties associated with capturing the state of those data structures and preserving them. There are also a number of conceptual dfficulties to contend with, because some structures are not preservable.
>
> In other words, they are 'intrinsically transient' (i.e. if you're communicating with a user at a screen, the user may not be there when your program restarts) our environment acts as a convenient mechanism for developers to handle this intrinsically transient data.
>
> We think that this is very important for large scale enterprise applications in general, and our working demonstration of how this works in practice has been very successful. We already have 150 registered sites using the system but what like to do is make the environment more widely available so the new generation of object oriented databases can benefit from this breakthrough."

For futher information contact: Professor Malcolm Atkinson on 0141 330 4359 (mpa@dcs.glasgow.ac.uk), or visit the web site at: www.dcs.gla.ac.uk.

2. Virtual Modelling Package

Modelling is now so sophisticated that very few applications have not been considered and supplied with adequate suites of software.

It is no surprise, therefore, to read that a US company called *Lands' End* is now using what it describes as an 'unique mail and Internet' package for modelling oneself. The unique tool is called My Virtual Model™ which is designed to create a virtual version of oneself and, in consequence, use it obtain the best fitting for your clothes or, indeed, to view oneself in as many outfits as you like. The software allows one to create one's own model in about ten minutes and the system enables you to save it and access it at anytime when one logs on to the appropriate website. Users have been creating their own model in what is described as a 'reasonable' time with the facility, then to try on different clothes. Obviously, the speed of the operation will depend on the Internet link that is used. The developers of the software have been careful to make some of the personal information that has to be input as data for your model to be held confidentally and to be protected by a password. This company currently offered some 700 outfits that could be tried on. Users say that at the click of a button it it is possible to view oneself in some chosen combination and, if unsure, can call or e-mail a 'helpdesk' and have a split screen style conference, with an advisor who can also look at the generated virtual version.

Other mail-order companies have graphics software but for the time being are not able to offer this type of facility. More retailers, *Lands' End* say are likely to follow this initiative. We are also told that the current version of the package is being updated so, the company say, an even more realistic model of oneself can be created, dressed and rotated to order. This is yet another useful application made possible by software innovators.

3. 'Text Miner' to check CVs.

SAS, a US company has developed a program called *Text Miner* which, it says, uses 'smart technology' to detect suspicious statements made in a Curriculum Vitae (CV).

The program works by examining text patterns and numbers that can change when a lie or exaggeration is detected. The company says that:

> "The language used in the CV wilI also be studied so that the writers' descriptions of their previous posts can be examined. This is done so that the style of the text can be analysed to see whether it accurately reflects the job description. It can also check to see if academic institutions mentioned in a CV actually existed and if they offered the courses named at the time the candidate claims to have taken them."

In the United Kingdom recently there have been a number of cases where false claims have been made in CVs. One case in which false references were used some £4 million was stolen from two banks. In other cases life-threatening situations arose because false medical qualifications were claimed in CVs by candidates who were then appointed to senior medical posts!

The program developers say that:

> "Some things might be an honest mistake, but it will all add up and in the end you may get a degree of uncertainty that will be investigated further."

Text Miner, we are told, will also be able to pick up telltale patterns that show whether a candidate used a computer program to draw up several CVs and covering letters at once.

In the UK the company *Experian* has already set up a web based system called CV Verifier that automatically checks any GV input to it. This system and similar ones worldwide rely on accessing databases so that, for example, academic records can be checked, court records and the standing of submitted referees verified.

Software in the USA is even more advanced and such enquiries are regarded as commonplace. More advanced checking systems are now being employed there as a result of the present world situation. Lie-detector machines are now commonly used in situations where previously it was considered essential to respect a candidates 'human rights.'

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It is now apparent from the media that the UK and other countries are following the US; a UK consultancy group, *Control Risks Group* say that this trend is just something that is becoming part of the business culture. This Group believes that about one in four CVs contains lies and that is a figure which is more likely to increase in the future.

4. Computer Program for language Translation

Producing algorithms for language translation may have multi-uses. The online journal of the British Computer Society (2002) has given details of a new computer program called *Brutus* which can translate Latin into English. It has been developed by Dr. Paul Bowden of the Department of Computing at Nottingham Trent University (UK). It has been designed intially to help children learn the classical language and for teachers to mark translations. Language translation has become very sophisticated since the early days of 1968 when language professionals became interested in applying computers for teaching purposes and to assist in the translation of languages for business, industrial and social purposes. There are a number of differing techniques that can be applied to the problem, and in this project of Latin to English we are told that the simplest one has been utilised. This involves taking one word at a time, with the first translations being refined in a series of subsequent operations.

Dr. Bowden says that:

> "As far as I am aware there is no other program like it. I used my old school textbook to program Brutus and it turns out that it can translate about ten Latin sentences per second from the schoolbook exercises. I remember it took rather longer when I did those very same exercises at the age of 12."

It may be that this approach to language translation is particularly suitable for a structured language such as Latin but the success of the basic algorithm should encourage others and is likely to lead advances in other applications.

TECHNOLOGY AND SPORT

Researchers at (UK's) Edinburgh University's Department of Materials Science and Engineering, led by Dr. Jane Blackford were only too glad to assist in preparing the British Olympic Curling Team for the recent Winter Olympic Games. Central to the success of the team, which, of course won Britains's first gold medal for l8 years, was a pioneering 'sweep ergometer' developed by the Edinburgh scientists.

The device, which uses sensors embedded in the curlers' brushes to send data to a computer, was used to perfect the British team's sweeping technique, which is one of the most important aspects of the game.

During their preparations for the games the team took part in a series of experiments to simulate match play, when players sweep in front of the moving stone with various degrees of force to melt the ice and make the curling stone travel straighter and faster. The experiments involved having the brushing strokes analysed by the computer program to create the perfect sweep.

In addition, the team was backed by another project that used computer systems for a 'notational analysis' to dissect shots and to improve tactics. Every stone played by the women's team was filmed and relayed to the computers to give them an instant breakdown of their play. The researchers at Edinburgh University who invented the sweep ergometer say that they:

> "dismantled a conventional brush and fitted an accelerometer in the brush head to measure to speed and the direction in which the brush was moving. Between the brush head and the shaft they fitted a strain gauge load cell, which measured the horizontal and vertical force the sweeper was applying.
>
> The measurements were downloaded to electronically through a wire connected to the broom shaft and relayed to a computer. Over two days' work with the women's team, the data was converted into graphs and the scientists, curlers and the team coach, went over the results.
>
> They looked at the consistency with which each sweeper kept her brush head moving for the 25 seconds the stone was in motion. On average, a sweeper could keep her broom moving at a frequency of four times a second. They looked at the pressure each sweeper applied and whether it varied. The results allowed each member to build up a picture of her technique."

This research was assisted by a machine developed by a Canadian University that can fire a curling stone with the same force each time Researchers now plan to continue their innovative programme to measure which type of sweeping is the most effective. Using the Canadian machine they can vary the direction of travel and the speed of the stone over the ice. It has been suggested that at the next Olympic games and indeed at lesser events, there should be awards for the scientists who provide the expertise needed to win.

THOUGHT TRANSLATION DEVICE (TTD)

It is reported that a 'Thought Translarion Device (TTD)' has been developed by Professor Niels Birbaumer of Tuebingen University, in Germany. This is, of course, not the first thought translation system that has been described in chese reports and surveys. Many have been heralded as 'break throughs' and then nothing more has been heard of them; others, however, have resulted in viable marketable systems. In this case the developers of TTD are at pains to admit that their device is still in its infancy although it is at a stage where it enables its users to focus their minds onto moving icons on a computer screen. This is, indeed, progress and as a result it is said that when it becomes more refined it will be possible for the brain of the human user to carry out some of the tasks described as 'opening a window,' 'flicking a light switch,' and even, which seems more ambitious than most other similar projects, order the food supplies and initiate other such operations.

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At present, however, the basic version is a device that consists of six electrodes that are linked to a standard desktop computer via a small control box.

The research and development is being carried out at the Institute of Medical Psychology and Behavioural Sciences at the university, where the researchers described the 'box' linking the electrodes to the computer as the standard electroencephalograph (EEG) which is able to record the signals from the brain. These electrical signals are transmitted to the computer which has been programmed to respond to certain subconscious thoughts when they are detected. The device in its present state of development is said to cost some £3,000 to £5,000, although the developers predict that it could sell for as little as £150 if it was marketed as a mass-produced unit.

Demonstrations of the machine have been held for the media. One such exercise involved electrodes being connected to the brain so that the frontal lobe, which is used for planning and many high level cognitive activities, could be used to control a ball that was displayed on a computer screen. It formed the basis of an experiment that simulated a football match and the screen was setup with two goals and marked-out pitch the aim being to control the movement of the ball with one's mind so that goals could be scored. Currently, we are informed a 'thought' instruction is obeyed correctly in eight attempts out of ten.

When the basic operations are mastered by the machine's user higher levels can be reached, as in so many computer games. One remarkable demonstration is that of the use of the machine by a handicapped user who is a patient with 'locked-in syndrome.' He has learned, we are told, how to use the machine at this higher level so that he can operate a word processing system, giving him, once again, the ability to write. Many other applications, particularly in the medical field are being carried out or initiated at the project-level. They involve, Professor Birbaumer says, work with, stroke victims, epileptics, hyperactive children and many other conditions.

1. Future Developments

Research in this area is, of course, being carried out at other institutions, and several companies are marketing simple devices. Researchers at Tuebingen are, however, planning more advanced versions. One using a magnetoencephalograph (MEG) is a device that costs £l.2 million and is capable of providing more detailed readings by using magnetic fields instead of electric currents.

The software used in the system is also being further enhanced so that when the word processing system is controlled by TTD words can be completed after only a few letters have been selected by the user. One main thrust of their development is to produce a device that will allow patients to control medical aids and household appliances. Professor Birbaumer sums up the state of the research by saying that:

> "The technology is still slow but now that we have crossed the border and been able to interpret thoughts we have the ability to use TTD for many other operations-switching on the oven, ordering groceries or making phone calls. Some patients can already open doors or switch on the TV."

Finally, he believes that it is only a matter of time before thoughts can be interpreted as words. This will then lead to many more applications that will cover a wide range of activities. The main criterion however, is that a truly effective system can be produced which has a high reliability and an acceptable 'hit rate' for 'thought collection' and 'thought evaluation.' Then the device can be commanded to carry out efficiency are amongst the many groups who will realise the importance of a Human-Machine Interactive Interface developed on this concept. It is, however, obviously not a short-term project but there should be intermediate 'spin-offs' from its various levels of progress.

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