Machine.Doc

As cutting-edge technology pervades the field of medicine, computers are proving to be the best assistant a doctor can ask for

Sunil Srinivasan

As you go about the affair of living, you put your life in the hands of numerous doctors, nurses, physicians, surgeons, computers...computers? Does that surprise you? It shouldn't.

Technology has added a whole new dimension to the world of medicine, whether it is in the form of digital imaging, telemedicine and biosensors or the latest innovations in genetic therapy and micro-miniaturised devices. Tasks such as diagnosing, documenting, monitoring and operating, which were once handled by humans, are today being handled efficiently by computers.

More intelligence first

Artificial intelligence is not a new phenomenon. As early as the mid-1950s, expert systems based on artificial intelligence have been used in the field of medicine. These knowledge-based systems would query the physician about the patient's symptoms, and based on the information that was fed into them, the machines would generate a diagnosis. Such systems were highly popular, but they faded out in the 1960s and 70s as they involved the collection of extensive information and organisation of data on a large scale, which was almost impossible at that time.

Advancements in technology have solved this problem to a great extent and the use of artificial intelligence in medicine has made a comeback in the form of Decision Support Systems (DSS). These powerful computers analyse the condition of a patient and recommend precautionary steps. These devices are being used in universities to teach medical students. This technology has also been adopted by doctors in many areas including cardiac monitoring, automated ECG, clinical laboratory analysis and administration of anaesthesia.

Some general DSS applications are 'alerting systems' that monitor and alert the doctor when changes occur in a patient's condition. Such systems can also scan and evaluate laboratory test results and send reminders and warnings through e-mail. Another emerging DSS technology is image recognition and interpretation. This allows analysis of medical images from X-rays to complex imaging resources such as angiograms and CT/MRI scans. Here, the DSS will be able to identify abnormal images when compared to the normal expected scans. DSS is expected to reduce false alarms or unnecessary hospitalisations to a great extent.

Genes and computers

Artificial intelligence isn't the only diagnostic method generating hype. The medical community around the world is keenly following the development of micro- and nano-array diagnostic technologies. Successes in molecular biology and micro-fabrication technology are helping in the creation of the genetic chip, also called the DNA chip.

The Human Genome Project (HGP), funded by the US government, aims to discover most of the human genes (about 1,00,000 of them) and sequence about 3 billion DNA sub-units, and make them accessible for further studies in the form of the DNA chip. Computers are being used for the sequencing process, which is of utmost importance and has to be automated to identify genetic sequences using gene probes (*See figures 1 to 4*).

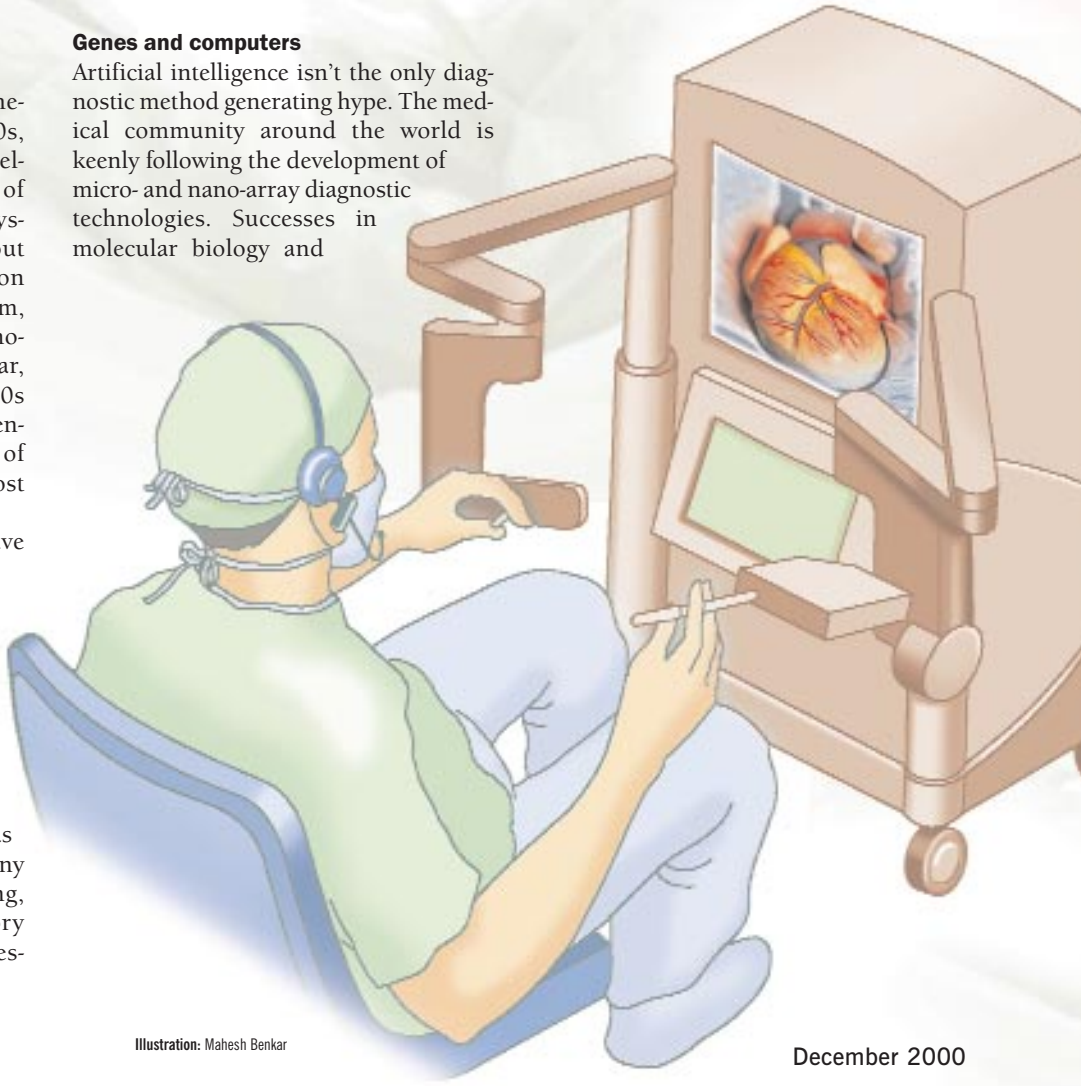
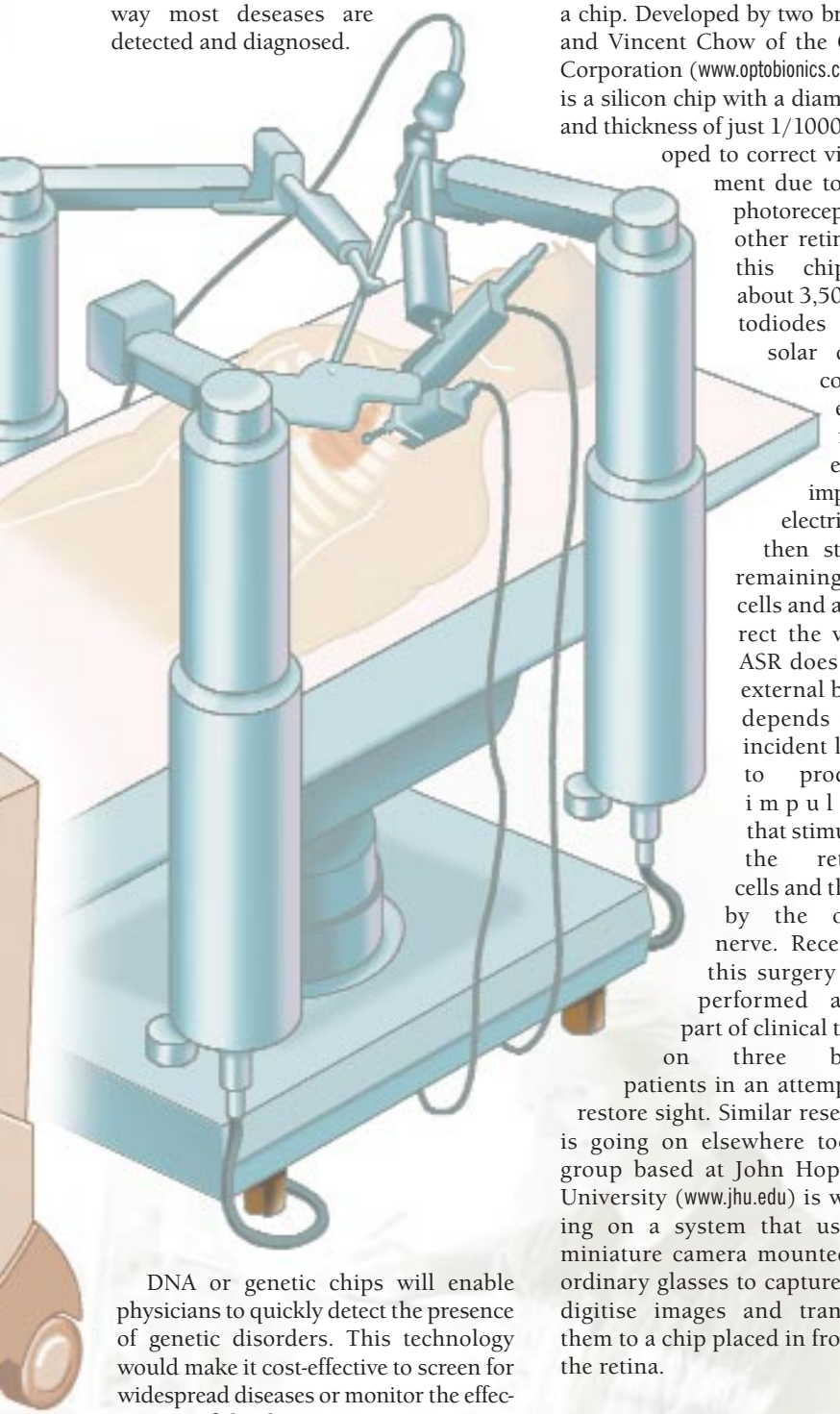


Illustration: Mahesh Benkar

While DNA chip-based testing will not reach laboratories before 2003 due to the high costs and regulatory requirements, once implemented they would change the way most deseases are detected and diagnosed.



DNA or genetic chips will enable physicians to quickly detect the presence of genetic disorders. This technology would make it cost-effective to screen for widespread diseases or monitor the effectiveness of the therapies.

Improvements in the field of micro- and nano-scale fabrication techniques have made the implantation of organic structures on substrates of inorganic materials possible. These fabrication techniques are similar to that of chip fabrication.

Chip health

Chips can also be used for other purposes. How about inserting them in your eye? The Artifical Silicon Retina (ASR) is such a chip. Developed by two brothers, Alan and Vincent Chow of the OptoBionics Corporation (www.optobionics.com), the ASR is a silicon chip with a diameter of 2mm and thickness of just 1/1000 inch. Developed to correct visual impairment due to the loss of photoreceptor cells and other retinal diseases, this chip contains about 3,500 microphotodiodes (a type of solar cell). These convert light energy from images into electrical impulses. These electrical impulses then stimulate the remaining functional cells and and thus correct the vision. The ASR does not require external batteries and depends only on the incident light upon it to produce impulses that stimulate the retinal cells and thereby the optic nerve. Recently, this surgery was performed as a part of clinical trials on three blind patients in an attempt to restore sight. Similar research is going on elsewhere too. A group based at John Hopkins University (www.jhu.edu) is working on a system that uses a miniature camera mounted on ordinary glasses to capture and digitise images and transmit them to a chip placed in front of the retina.

The Web of medicine

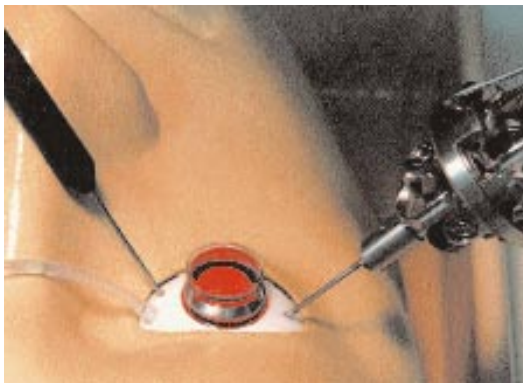
Electronic documentation of patient records, access to medical literature on the Net and sites that offer counselling advice—all these make possible a new way of looking at healthcare.

For instance, CareGroup Healthcare System, consisting of six hospitals, lets its physicians and patients use the Internet to gather information and put it up on its own Web site. So if a patient has to undergo surgery, he can log on to the Web site and watch a video of a similar surgery to get an idea of what the procedure will be like. The doctors can also use the Web site to check patient records that are stored online and decide upon their next move accordingly. On the flip side, health information present on the Web may not be all that reliable and trustworthy, and it's easy to be misled by the incorrect information.

Telemedicine

However, the Internet, in a different role, may change the way surgeries are done in tomorrow's world. A technology called telemedicine has the ability to make use of virtual reality so surgeons can operate on patients in remote locations using a virtual environment.

The biological program of Advanced Research Projects Agency (ARPA), a US research agency, has demonstrated the feasibility of robotic surgeries using wireless transmission technology, with the operation site being located a kilometre away from where the doctor is.



Simulated eye microsurgery using slave robots

Dual-arm telerobotic microsurgery workstation developed in 1997

The Making of a Genetic Chip

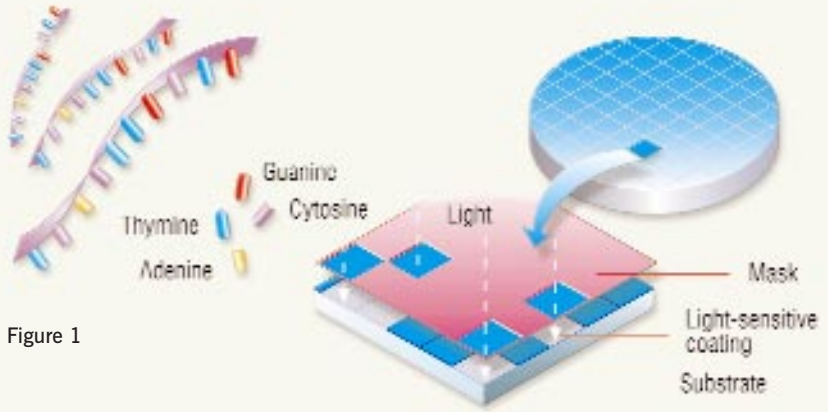


Figure 1

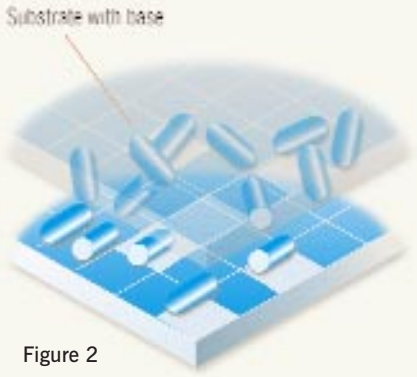


Figure 2

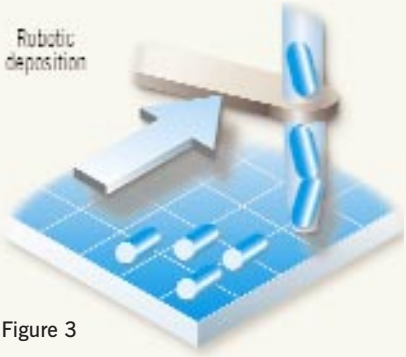


Figure 3

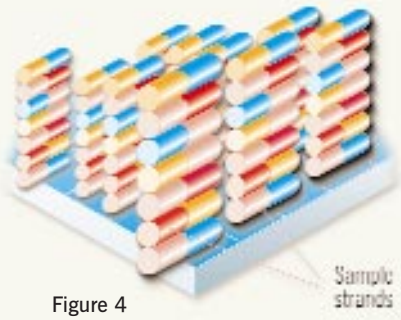


Figure 4

Using conventional techniques such as biochemical synthesis, strands of identified DNA are made and purified (*fig 1*). Then, using photolithography and other micro- and nano-fabrication techniques, plastic wafers are fabricated into containers for DNA probes (*fig 2*). Techniques such as electrophoretic bonding and robotic deposition are used to make the genetic material stick to the substrate. It is essential that you have a clean environment during this process (*fig 3*). Finally, the DNA chips are made and checked for quality before they are sent to the researchers. Usually, with the help of phosphorescent tags, researchers try and identify the components (*fig 4*).

Besides telemedicine, another type of virtual environment that can make use of robots is endoscopic surgery. Here, the operation takes place locally but the surgeon uses instruments looking at a television monitor. Such virtual environments are used to create simulations for training medical students and young doctors.

According to Richard M. Satava, program manager, Advanced Biomedical Technology Program (a division of ARPA), five elements are required for the use of virtual environments—high-resolution graphics, display of organ properties, display of organ reactions, interactivity between objects such as surgical instruments and organs and sensory feedback. The elements that are needed for such a virtual environment are a head-mounted display, which is basically a helmet with a pair of wide-angled television screens placed in front of the eyes, and speakers placed over the ears.

The input device is a DataGlove, which has a similar function to that of a joystick and looks like a glove. Using the DataGlove, a surgeon can move through the virtual environment by pointing in the direction he wishes to move in. He can also pick up and manipulate objects. At the other end, a robot replicates his actions and movements to perform the actual surgery.

Telemedicine is not just about virtual reality—there's an entire network that has to be set up to power the whole process. Obviously, the video streaming involved requires high bandwidth.

Different network technologies are evolving to support such bandwidth demands, though mainstream use of such technologies may take another five-10 years.

Stitching it up

IBM announced in 1999 that it would build the world's fastest supercomputer—Blue Gene—to understand diseases and find their cures. Such innovative studies will have a trmendous impact on medical technology in the days to come.

Not too long ago, heart transplants were considered a novelty. Today, with 'artificial' hearts and digital imaging, the search for the right heart is totally eliminated. As computers get smarter and newer devices emerge, the use of technology in medicine will continue to grow. So don't be too surprised if there comes a time when a machine doubles up as your 'family doctor'!

Make Way for the Robots

Robots are major contributors in the field of medicine. Robots can improve the way clinical procedures are conducted and prevent the blemishes that may occur in case of human-operated surgeries. The Center for Medical Robotics and Computer Assisted Surgery at Pittsburgh in the US was the first to use computer-based surgical assistants that helped surgeons plan and perform hip implantation accurately. Its sister organisation, the Center for Orthopedic Research, used a robot called ROBODOC to perform a clinical trial. Robots are the enabling technology for telemedicine, and their contribution can in no way be underestimated.

dazzling displays

Aliasagar

Fed up with the increasingly distorted displays on your monitor? See the world in a different light with some of these display units

▲ MicroOptical Clipon display—*For your eyes only*

This wearable display is designed to be attached to the user's spectacles. The kit contains an invisible clip-on monitor-information display, which includes within it the see around display optics, a converter for VGA and NTSC and an articulating-mounting arm, which helps in adjusting the small display attached to the glasses. These are housed within a casing separated from the display by a 4-foot cable.

Web site: www.microopticalcorp.com

MicroOptical Integrated Eyeglass Display— ▼ *Sharply focussed*

This particular unit weighs 62 grams and comes along with the spectacle, with the required electronics attached on the left side and the reflector on the glass itself. The image is generated through an electronic signal sent to the microdisplay when the display is turned on and is relayed to the eyes of the user through the reflector in the form of light rays. The focus can be adjusted up to 2 feet as per the user's convenience. The unit offers a resolution of 320x240 with 16-bit colour and a 60 Hz refresh rate.

Web site: www.microopticalcorp.com

◀ TekGear M1 HMD
—Hands off!

This is a wearable, hands-free device from Tekgear that offers a resolution of 320x240 in a grey scale display and works with both VGA and NTSC standards. The device has a 2-watt power consumption, making it appropriate for laptops as well and includes a head mount display with a belt pack drive electronics assembly. Users can view the display on the existing computer using a regular 15-pin D-sub connector.

Web site: www.tekgear.ca

▲ Neovo M-15 Panel Display
—Angular viewing

The Neovo M-15 is a 15-inch TFT monitor which has excellent tilting function for extra comfort. It also ships with speakers for your viewing and listening pleasure. The monitor is also known for its PC and Mac compatibility. Its hard-coated anti-glare screen makes it a monitor on everyone's wish list.

www.neovo.com

▲ Apple 15-inch Flat Panel Studio Display*—Stunning and sensitive*

This particular flat panel display unit from Apple has stunning good looks and sports a USB interface. The unit has touch sensitive buttons and a 1600x1024 resolution that allows for display of two full pages of text or viewing DVD movies in full format. The display incorporates an advance technology which sends the original image data to the display directly, thus eliminating the need for a display card and resulting in a no-distortion image. The display also produces 16.7 million colours and has a 160-degree view angle, thus providing accurate colour display at wide angles.

Web site: www.apple.com

▲ Apple 17-inch Studio Display*—The home theatre*

This display incorporates the most highly advanced CRT technology—the natural flat diamondtron with an ultra fine aperture grille pitch which provides bright, vibrant imaging with very little distortion. One of the most attractive features of this display is the theatre mode which brightens the screen automatically and provides enhanced viewing.

Web site: www.apple.com

◀ TekGear M2*—Space saver*

This is an 800x600 full colour display device that has replaced CRTs (Cathode Ray Tubes) and has a low power consumption. Its lightweight design gives you lots of flexibility and is a huge space saver. The kit consists of a viewing device and a belt pack drive electronics assembly.

Web site: www.tekgear.ca

Quick Take

Digital video editing offers an exciting, though demanding, career opportunity. But before you join the nearest institute offering training in DVE, read ahead for a low-down on what it takes to get ahead in this field

Location Courtesy: Graftech Studios & Video World, Mumbai

Nilesh Kakade

If you are looking for a career that will give you a chance to flaunt your creativity and give you a shot at becoming famous in the celluloid world, then digital video editing (DVE) might just be the field for you. Of course, you will have to put in a good amount of hard work and make some friends in the industry if you want to make it to the big league. But once you get there, the recognition and the huge pay packet will more than make up for your efforts. Interested? Then read on to learn more about how to get started.

So what exactly is digital video editing? To understand that, you need to know what digital video (DV) is. DV is a high-resolution video format that treats video and audio as digital information. In this format, data can be stored, manipulated and relayed just like any other computer data. Projects can be shot in DV, edited on your home computer using a low-cost DV editing system and then distributed on videotape, DVD, or even the Internet.

The term 'digital video' encompasses applications of sequenced pictures (television, motion pictures, video, animations and sometimes even still photography). This can include both naturally created content such as photography and synthetically (or artificially) prepared content such as digital imaging. The fine point is that digital video can readily support linking to a vast array of other information resources. There are many different aspects to the digital world now—digitisation of moving pictures is opening new vistas of communication. Another realm of possibilities for active participation is in the form of interactive video. Video hyperlinking is also starting to make its mark.

On the editing table

Editing literally means preparing for publication. DVE therefore refers to the making of a concise, visually aesthetic digital product, cleansed of all unwanted elements and depicted in an easy-to-understand manner. In video editing, a video editor will go about his job of selecting, editing and re-recording the good footage, eliminating the bad scenes/portions from the video/film, and bringing out a digital product. This whole process is known as post-production (since a video editor's work only starts after all the scenes have been shot). The job of the video editor also includes titling, special effects, sound effects, etc.

Simple editing can be learnt by just about anyone with a little patience and knowledge of software. Beginners shouldn't find it difficult to make a simple production with titles, graphics, fades, wipes and a few special effects. A digital camera or camcorder would be enough to try out such things, but when it comes to professional work, there's a steep learning curve involved. High-end editing equipment is involved as also the use of software that allows you to create just about any effect you want.

Photograph: Ashesh Shah, Imaging: Neeta Wadiker

The linear/non-linear game

DVE includes both linear editing as well as non-linear editing. Linear editing is basically mechanical in nature, in that it employs the use of camcorders, VCRs, edit controllers, titlers and mixers to perform the edit functions. Linear video editing mostly refers to the process of editing video tapes by way of controlling (with an edit controller) wherein the editor cuts and pastes film sequences from one tape to another, using two or more VCRs. The list of equipment can grow as the complexity of the setup increases. Moreover, it is time-consuming and might not give the desired effect. This editing technique is performed in linear steps, one cut at a time (or a series of programmed cuts), and thus the name.

Non-linear video editing (NLE), on the other hand, is the process of manipulating audio and video content on a computer in the same manner that you would manipulate text in a word processing application. It involves cutting and pasting of sequences in a movie, making changes by altering bandwidth and adding special effects and sound to make the movie interactive and visually appealing. Audio and video content is entered into the computer by digitising source material from a VCR, DVD player or camcorder. Once the source material exists inside the computer in a digital format, non-linear editing software is used to manipulate the audio and video content.

The demand for NLE is growing as there are many video editing software available today that sport the popular Windows menu, are very user-friendly and offer a host of features. The current software programs that are predominant and widely used in the industry are Media 100, Avid and Edit, to name a few. These deliver pretty good, high-quality work. "Over the last eight-10 years, Avid has established itself as the most popular NLE in the world. Adobe Premiere has also established itself as a cost-effective editing tool for starters and multimedia producers. Apple's Final Cut (originally developed by Macromedia) seems to be hot stuff at the low entry price point," says Nick Tay, lecturer/manager, Digital Media Authoring Studio Centre for Film and Media Studies, NgeeAnn Polytechnic, Singapore (www.dmasdvd.com).

The learning curve

Given the technicalities involved in DVE, certain basic aptitudes are essential before you think of a career in this field. For starters, some knowledge of lighting and camera will come in handy. DVE also involves some concepts of physics and mathematics, especially when it comes to high-end special effects. And it goes without saying that you should have a design sense. You also need to put in lots of hard work, have patience and be creative. "I select my students carefully and only after screening them do I admit them to the course. Also, I see to it that the students have a basic understanding of the visual media and a keen interest in computer graphics-related software," says Hemraj Shetty, course coordinator, Xavier Institute of communications (XIC), Mumbai (www.xaviercomm.org).

The training houses

As in most fields, there are two basic methods of learning DVE. You can join a

training institute that covers this subject or start as an apprentice with some production house. The course at XIC, for instance, covers the fundamentals of digital video and non-linear editing techniques using software such as Media 100 and Adobe After Effects. Also, there are other electives to choose from such as 3D modelling and animation in SoftImage.

Besides XIC, there are other training centres too where one can learn these courses. There are also companies such as Tata Elxsi that sell you the high-end software and then provide training on how to use it. Microcell Multimedia, with centres in Mumbai, Ahmedabad, Pune and Bangalore, specialises in video imaging and special effects. It uses a Silicon Graphics Inc (SGI) machine for training its students. The course syllabus insists that students build a professional portfolio from scratch, inclusive of scripting, storyboard design and final animation. "Our training programme is totally hands-on and the course is structured so that the students get professional experience," says Shakuntala Israni, general manager, Microcell, Mumbai (www.microcellindia.com).

Even the Indian government has got into the act. The Centre for Electronics Design and Technology of India (www.mit.gov.in/cedti.htm) is keen on promoting digital video editing and movie making and has introduced a four-week course. Also in line is the course offered by the Centre for Development in Advanced Computing (CDAC) as part of its multimedia training programmes (www.cdacindia.com/html/nmrc/sources/training.htm).

However, remember that not all training institutes can offer what you want. Given the kind of high-end and highly priced software involved, as also the digitising equipment, most institutes are not able to offer hands-on or real-life training. For a person to learn DVE, "the learning aspect has to be a real-time environment wherein a person gets to learn the finer aspects of this trade from day one," says Shetty.

More often than not, courses on digital imaging are passed off as video editing. Do remember that learning about GIF animations is not the same as learning motion sequencing. Training institutes don't have that much industry recognition because of the feeling that most training institutes teach very little. "Normally, I check out a person first, otherwise I don't believe so much in the courses offered by the training institutes," says Rahul Zaveri, director, Indosan Technologies (www.indosantechnologies.com), Mumbai, which provides turnkey solutions in broadcast video, post production, etc. Adds Sushil Deshpande from C-News Channel, a private cable channel in Mumbai, "For recruitment purpose, I first give a hands-on test to the person and check whether he is well-versed with the latest technology, whether he can conceive and conceptualise and whether he has a creative mind."

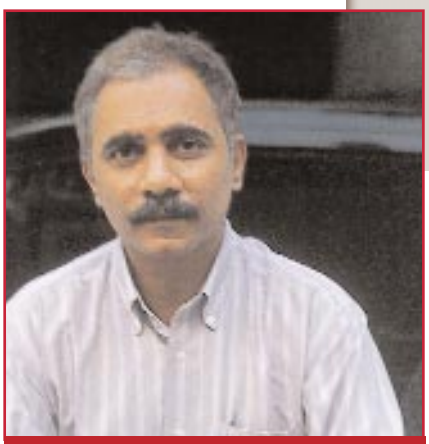
So, before you spend your money on institutes, do check out the placement opportunities. Preferably, talk to some ex-students and find out where they have been placed and also find out whether the institute is using licensed software.

Of course, there's nothing to beat learning directly from a senior editor at some production house. With the plethora of satellite channels and independent producers making serials, you can try your luck with any of them. You might need some contacts to get in, but it does give you a better perspective and learning opportunity than any training institute.

The avenues

Given the vast application of DVE there are many aspects you can learn. If you are planning a foray into multimedia applications, then it might be worthwhile to learn about certain technical aspects such as compression. Knowledge of graphics also helps you to be creative, and if you know how to make buttons, icons or windows, you can add interactivity to your presentation and make it more effective. For serials involving minimal post-production work, knowledge of linear editing might be a good starting point.

> "A person who wants to make a career in this field must be able to take the rigorous work schedule, and try to learn as much as possible"



Rahul Zaveri
DIRECTOR, INDOSAN TECHNOLOGIES

Work in advertising agencies requires you to be highly creative and good at animations and special effects, and also requires knowledge of the equipment. In addition, as Shetty says, "You should know the aesthetics of editing. You should be very particular about judging colours, for instance, skin tones. You should know things such as telecine, colour correction, and a bit about audio."

Adds Zaveri: "You also need to have a proper concept of time. The duration of an ad film is normally 10-60 seconds or so, and you have to communicate the key purpose of the film in the most effective way in this short time. Apart from being able to operate the editing system skillfully, the editor must be able to cut a comfortable pace for the audience to see and grasp the film. This sense of editing can be cultivated without going to film school if one gets the opportunity to work with acclaimed/experienced editors and film makers from whom these qualities can be imbibed."

But when it comes to feature films, you'd better know everything!

Also, there's quite a lot of software to

DVE Training Guidelines

Before you join a training institute, ensure that it covers the following topics:

- ✔ Machine control—the institute should have a VTR (video tape recorder) so that students can learn machine control
- ✔ Adobe Premiere
- ✔ Adobe After Effects
- ✔ Hands-on exposure to 3D Max
- ✔ Concepts of 2D and 3D geometry
- ✔ Concepts of non-linear editing software
- ✔ How to 'capture to frame' and how to 'output to tape'

learn from, as Zaveri explains: "There are various application software packages available for editing and complementing the editing process. These tools allow for 2D/3D graphics and animation, video compositing, image processing, special effects, etc. Many films may have 'unseen' effects, where the effect is there, but the audience cannot see it. Final Cut Pro from Apple is a very useful tool as it incorporates unique features from Media 100, Avid, Edit and even from Smoke, a Discreet product. Adobe After Effects is also a very good product, but it is up to the user as to how effectively he can use the system to derive maximum productivity."

Adds Shetty, "The core fundamentals of all software within a particular category (NLE, image processing, compositing, etc) remains the same. It is mostly the features, menu structures, windows, etc which might be different. Some might have more features some less or some times they are put in a different way. For example, in one NLE software the process of converting analog to digital may be known as digitising while the same thing is known as capturing in another NLE software.

"At a very basic level the students should know software such as Adobe Premiere which will help them to know about NLE, Adobe After Effects and Adobe Photoshop for the knowledge of compositing and software such as Cleaner 5 to create streaming videos for the Internet. They should also know the various Codec standards."

The career graph

Once you manage to get into the video editing industry, then if you have the talent and perseverance, there's no stopping you. However, do not expect a cushy job from day one, as there is no fixed nine-to-five routine. Starting salaries in this field are often quite a pittance. You might get as low as Rs 3,000 per month, but as the level of expertise increases, the salary range really shoots up. And after that, the sky is the limit.

"The initial grind of three months to about six months down the line would determine your career prospects in this field," informs Shetty. "A person who wants to make a career in this field must be able to take the rigorous work schedule, and try to learn as much as possible on the job. Only after that can he become a true professional and demand a huge salary. Also, a person well versed in his field can freelance and work on multiple projects. A project well executed is your passport to fame and recognition in the celluloid world," adds Zaveri.

The digital scope

Digital video technology cuts across many industries, including content providers, information service providers, network service providers, suppliers of information appliances, and users of information. Several industry-driven workshops have been held to discuss the convergence of these industries.

The digital revolution seems likely to change the economics of the entertainment industry in general and the film industry in particular. And with the Indian government promoting DTH (direct-to-home) services, it is a boon for video professionals as they will now have to cater to the growing market of new channels, interactive content, video on demand, digital media servers, high-bandwidth file systems, etc. This is one market buzzing with activity.

As Tay puts it, "With more and more demand for content—be it Web-based, broadband, cable, or DVDs—there will be greater demand for skills in digital NLE video post production."

Photograph: Rahul Sharma, Imaging: Neeta Wadiker

It's a woman's world!

Creativity, leadership, business acumen, technical skills…women have it all and are using these assets to make their presence felt in the IT industry

Nilesh Kakade

As we cruise along the information superhighway, computers have now infiltrated just about every aspect of our society. You find them in offices, homes, classrooms and even at the local grocery store. And with this ever-expanding reach of computer technology, you also find more and more people making a name for themselves in this field.

Yet, one stereotype that continues to exist in most people's mind is that computing, like any other technology-related field, is an area unsuitable for women. However, in reality, women no longer stay away from subjects such as mathematics and engineering, or computer science for that matter. With many a school imparting education in computer fundamentals, little girls are growing up to be as proficient in computing as little boys. And the Internet has opened up new vistas for women to try and explore their talents and be successful.

Though there are relatively few women out there in corporate boardrooms discussing technology with their peers and bosses, this percentage is increasing. Women hold some of the key positions in the computing world and more and more are joining the fray.

Breaking stereotypes

Another stereotype that is set to be shattered is that women gravitate only towards 'feminine' careers even in computing–jobs that utilise their 'natural creativity', such as Web designing, fashion designing, interior decoration and 3D modelling.

Today, women the world over have infiltrated all areas of the IT industry. Women head some of the world's largest and most successful IT companies, such as Carly Fiorina, CEO of Hewlett-Packard. Companies that have (or have recently had) women CIOs (Chief Information Officers) include Novell, Toyota Motor Sales USA, Xerox and DuPont, to name just a few. And the women heading their respective organisations are role models for many budding entrepreneurs.

Location Courtesy: Graftech Studios & Video World, Mumbai

In terms of skills, women are at par with men. They figure in all aspects of the IT work environment–from programming and technical support to sales and marketing. And there are plenty of jobs available for women with the necessary qualifications.

Says Purnima Lamba, CEO of Soulkurry.com, "There are openings in all fields of computing such as strategy, administration, content, marketing, programming, designing, business development and customer service." She adds, "SoulKurry has an all-woman team handling the entire portal and we are thriving. There are half a dozen sites that thrive on this model!"

Though the traditional barriers in terms of mindset and working hours exist in every career, this is changing in the IT field. "I used to work in Tata Infotech before I started SoulKurry.com. The team ratios used to be 70:30 at worst. I think these ratios are very healthy compared with industries such as finance or manufacturing," says Lamba.

Adds Ananta Ahluwalia, a software engineer with Webforia, Bellevue, USA, "I think women are bringing as many needed skills to the IT industry as the men are. I see us as equals in this model. I have seen some excellent project management and development roles being played by women in this industry."

As for biases in favour or against women in the IT field, the feeling of most women holding key positions in this industry is that generally speaking, they are employed on the basis of their skills and experience.

This is true even in India. As Meghna Walia, staff scientist at the National Centre for Software Technology, Mumbai, says, "I have never felt discriminated against as a woman in my field. I have always been evaluated on my performance like any other employee and have been appreciated for my efforts. Perhaps such a feeling might be reported by people who are competing for key management roles but as a developer/ software engineer I have never heard of gender-bias in my circle of contact."

Purnima Lamba
CEO, SOULKURRY.COM

At home in the IT world

Another age-old issue is whether a woman can find the right balance between her career and her family. "Stringent deadlines and erratic working hours seem to be the only constraints in IT that can make a woman opt out of the field," says Meghna Walia. "But the exciting career opportunities and changing social structure have been incentives that are strong enough to overlook these hurdles and encourage women to take up IT as a career option. It's hard work that pays well."

Solutions are also available in the form of flexible working hours, and working from home, more so with the advent of the Internet. "Women are being given the opportunity to work 'flexitime' and work from home, which opens a whole new window for many," says Lamba. "The soft skills that a woman brings to an organisation have always been acclaimed by management gurus as the need of the hour, but now the multitasking capabilities of women are also being given a chance to flourish.

"I think that computer engineering and in particular, Web-related careers are especially suited to Indian women who need the option to work from home after marriage and children."

Adds Ananta Ahluwalia, "I don't see any barrier for women in technology. There is a vast canvas of possibilities and as an individual there is no limit to what one can achieve. Be it a man or a woman, where there is a will, there is a way."

Women all the way

So why should a woman prefer a career in IT? As Dianne Grunkelee, marketing director (APAC region), Interact Commerce Corporation (erstwhile SalesLogix Corporation), says, "People in general, not just women, are attracted to a career in IT because this industry, more so than others at

> "There are openings (for women) in all fields of computing such as strategy, administration, content, marketing, programming, designing, business development and customer service"

PADMASREE WARRIOR
Vice President & Assistant Director, Digital DNA Laboratories, Motorola

Padmasree Warrior is in charge of Motorola's Digital DNA project, the technology that is creating waves in the field of embedded computing. She is also responsible for driving the process technology platforms and plays a key role in transforming her company's technology innovations into customer-focused solutions.

SONIA BHANOT
President and CEO, Verano

An engineering graduate from Punjab University, Sonia Bhanot is the president and CEO of Verano, a company that specialises in making e-business portal software. She is responsible for leading Verano's corporate growth and business development activities. Prior to this she was vice president of sales and marketing at CuraSoft, a leading vendor of event management software for IT professionals. She has also held senior business-planning, marketing and channel development positions at Hewlett-Packard.

this point in time, is growing and moving ahead at an incredible pace. Because of this dynamic growth, companies are spending more money on continuing development of software and hardware which continues to fuel growth."

Often less ga-ga than their male counterparts over the latest gee-whiz features, women IT leaders want to know what is going to make their jobs easier and more efficient, and they have strong opinions about how IT needs to deliver services that make a difference in day-to-day life. Says Grunkelee, "Most people today are affected in some way by technology and this will continue to grow. Most people want to be involved with something that is going to affect, or already affects, their lives."

With more women entering the world of computing, social attitudes regarding the sort of careers that they are suited for are undergoing a change. Women are no doubt an under-utilised source of talent that can help lead the high-tech economy and we can certainly expect to see more women at the helm of affairs as the IT sector reaches newer heights. Ada Lovelace, the world's first woman programmer, would definitely be proud of this development.

The Pioneers

From Ada Lovelace, the first woman programmer in the world, to the new divas of modern computing, women have definitely come a long way and their tribe is increasing.

Ada Lovelace edited a pamphlet on Charles Babbage's Analytical Engine and developed a program for it to calculate Bernoulli numbers (a sequence of numbers used in number theory and calculus). By doing so, she became the first technical writer and computer programmer in the world.

Edith Clarke was a *computor* assistant (skilled mathematician) at AT&T. She was so interested in the computing work that she did not return to her studies, but instead stayed on at AT&T to train and direct a group of *computors*. From *computor* to electrical engineer—Edith Clarke was a pioneer in both engineering and computing. In 1921 she filed a patent for a 'graphical calculator' to be used in solving problems related to electric power transmission lines.

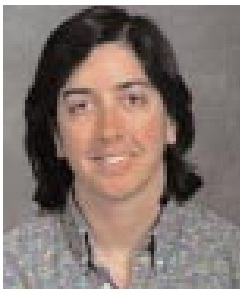
Kay McNulty was one of the first women to have worked with ENIAC (Electronic Numerical Integrator and Computer). Her job involved making calculations for firing and bombing trajectories as part of the war effort in the early 1940s. The need to perform the calculations more quickly prompted the development of the first electronic computer in the world. .

Grace Brewster Murray Hopper invented the earliest programming languages in the 1950s for the MARK I and the UNIVAC I, and also invented the earliest compilers. Along with Charles Phillips, she is often referred to as the person who was instrumental in the development of COBOL.

Joan Margaret Winters began working in Computer Services at Cornell University in 1970. There she designed and implemented SPINDEX II applications for the Department of Manuscripts and University Archives. She is one of the pioneers in the field of computing who dedicated herself to teaching the importance of human factors in the design of computer hardware and software, leading to much of the human-computer interface we have today.

Evelyn Boyd Granville, one of the first African-American women to obtain a PhD in mathematics, she developed the computer projects that were used for trajectory analysis in the Mercury Project (first manned space mission) and the Apollo Project (first mission to the moon).

Erna Schneider Hoover invented a computerised switching system for telephone traffic, to replace the existing hard-wired, mechanical switching equipment. At Bell Labs, she became the first woman supervisor of a technical department.



DEB AGARWAL
Computer Scientist, Lawrence Berkeley National Lab

Deb Agarwal holds a PhD in Electrical and Computer Engineering from the University of California. She is now working at Lawrence Berkeley serving the high-profile Comprehensive Nuclear Test-ban Treaty Organization.

Currently she is working on the Distributed Collaboratories Project which aims at researching technologies needed to advance distributed collaboratory environments.

She has also worked with the Robotics Department at the General Motors technical centre where she developed a knowledge-based diagnostic expert system for robotic work cells. She was instrumental in laying out and verifying advanced robot work cell concepts for departmental and divisional applications.