Microchip explodes the horizon

by Md Asadullah Khan

LAST CENTURY'S INVENTIONS like steam engine, automobile and gunpowder changed the face of the world accomplishing things faster and more efficiently than the humans could do alone, or in a group. Microprocessor, this century's key invention has brought about a breakthrough in all walks of life. By managing electrical impulses to mimic the logic of the brain—on or off, one or zero, yes or no—the microprocessor is an extension not of strength, but of intelligence. Prior to this, the microprocessor's forerunner, computer could be tapped only by a fortunate few. But what engineers at Intel Corp. did in 1971 was to shrink those great boxes of transistors and wires down to a more manageable size by etching circuitry and logic gates in miniature or an inexpensive mass producible silicon wafer — the stuff of ordinary sand. Chips have set in motion a virtuous cycle of technological advancement. Intel founder Gordon Moore in a now-famous observation that came to be known as "Moore's Law" estimated that microprocessors double in power (or become 50 per cent cheaper) every 18 months.

The microprocessor is constantly being adapted to new uses, saturating every aspect of daily life. Coupled with wireless communications, chip-based information appliances will, within the next several years, make it possible for people to receive digital data—stock quotes, grocery prices Internet sites, corporate sale reports, restaurant reviews, sports, weather and traffic on demand anywhere on earth. Language barriers will fall with the advent of gadgets capable of translating sentences as they are spoken. At home, smart oven will unerringly cook food, entertainment units that know your preferences will retrieve favourite programmes automatically or by voice command, while other digital assistants will eliminate daily drudgery. Automobiles that know where you are and can direct you to your destination, that warn you of treacherous road conditions and impending collisions, that can even take over the wheel in emergencies are already under development. Smart cards-credit card sized pieces of plastic with embedded microprocessors—portend a cashless society where individuals carry electronic wallets containing all identification and means of payment in digital form. Use of digital cash will become widely accepted once consumers are confident in the security of transactions and are able to use the virtual money for even the smallest purchases. Affordable computer workstations capable of manipulating massive amounts of data are helping to unravel nature's more elusive secrets.

Because of the microprocessor, previously "Herculean projects" such as the Human Genome Project, an international efforts to map the three billion DNA sequences that determine the human genetic makeup are being completed ahead of schedule. In a word, the power of microchip is gradually becoming something astounding. The silicon chip itself, may ultimately be relegated to a museum by another nascent technology called quantum computing. Through subatomic engineering, scientists hope to knit together groups of crystalline molecules, which can store electrical charges into impossibly small devices that perform like silicon chips. So says James Heath, a chemistry professor at the University of California at Los Angeles and head of a quantum computing research team, "We can potentially get the computational power of 100 workstations on the size of a grain of a sand."

Voting through computers

Democratic government and democratic practices can only be ushered in the any country, either Bangladesh or elsewhere through fair voting. Because of the volatile nature of politics and intra-party feuds and conflicts, voting exercise is far from clean. So governments in many countries are now considering computerised voting. Evidently, its convenience is bound to boost the votes cast in an election. In North America, people are already registering to vote by computer. US-based Election Systems and Software Inc says that besides Internet voting, people will eventually be casting ballots by telephone and interactive TV.

Such new technologies can also be used to conduct electronic referendums on key issues.

But some problems remain to be ironed out notably authenticating ballots and maintaining confidentiality. Maybe a special pin number could be used for each individual or "Smart Cards" issued with a magnetically encoded strip or hologram. There has been talk about using biometrics for authentication, including fingerprints, voice and eye scans. These things would come up in this millennium.

Effect of Consumerism

A computer these days gives the average person the power to do things in a week that al. the mathematicians who ever lived until 30 years ago couldn't do in years. The explosion of scientific innovations has brought in its wake western – style consumerism. Sadly true, we have been deceived by illusory growth figures. The growth rate may benefit the multinational corporations and somewhat the top 20 per cent of the populations. But consumerism is making people to spend more than they earn. All these consumers are heavily in debt. The poor get nothing and are getting desperate. People having no means of ostensible income and no standing in the society are being corrupted by consumerism. Most people have now air conditioners, television and provocative videos that ultimately leads to sexual abuse. Consumerism at its height has brought in its wake drug menace and drug trafficking around the world. In most under developed countries, especially tender-aged citizens are being slowly poisoned. The largest, richest and most deadly criminal enterprise in history—drug trafficking—is penetrating deeply into the civic structures that make democracy a mockery. Computer knowledge is now essential in landing jobs. To have an edge in job search in any country in the earlier days, it used to be enough to be well educated. Now, say the experts, it's critical to be digital. Employees who are adept at technology earn roughly 40 to 50 per cent higher pay. Now every business either in America or elsewhere in the world requires some computer knowledge. Companies and industries are even modelling their cash register after Nintendo controls. But the "haves", says the Harvard Business School Professor, will be able to communicate around the globe. The "have-nots" will be consigned to the "rural back water of the information society". But advanced countries are trying to bridge the gap but the fact is technology is advancing so fast and at such huge costs that it's nearly impossible for cash-strapped people in the country to catch up.

New ideas and programmes for the schools are being announced every now and then. The 90s populist slogan in America is no longer "A chicken in every pot" but "A computer on every desk".

Computers and video networks can provide long-distance healthcare. It may sound unbelievable and strange in our country but throughout rural America, patients are discovering that the big city medical centre is just a mouse-chick away. Once dismissed as gimmickry "telemedicine" networks could soon link" every big medical centre and physician's office in the US. Since 1990, the number of US networks has jumped from three to at least thirty and virtually every state in the US is developing one.

Reports have it that when 60-year-old Virdia showed up at Dodge County Hospital in rural Eastman, in the recent past, she had a persistent fever and the oozing black lesion on her leg was so painful she couldn't walk. The emergency physician guessed she had been bitten by a spider. Yet no one could really say–even her internist Dr. Monroe–what it was. Until recently getting a diagnosis would have required harrowing journey to Atlanta to see a dermatologist. But Monroe flipped on a computer-linked, interactive video system, and in effect beamed a specialist onto the scene. From an office in the Medical College of Georgia, Dr. Jack Lecher interviewed Underwood on the screen while examining her lesion on another. What she had, he quickly realised was not a spider bite but a staph infection, that was rotting her flesh. She had to spend 12 days in the hospital, receiving intravenous antibiotics, but thanks to the quick diagnosis that was all it took to save her leg. The new millennium holds so much promise. A typical telemedicine network includes a dozen more facilities—doctors' offices, nursing home, even prisons— each one linked to regional medical centre through computers, cameras and video monitors. One camera has a zoom lens that can pan a whole examining room or focus on a single skin pore. A second may transmit images of records and test results, while a third attaches to scopes that can be used to inspect the colon, the stomach or the inside of someone's ears. By activating the system a faraway specialist can discern almost anything that a physical examination would reveal—and he can do it in seconds rather than hours.

The benefits of virtual medicine or so to say millennium medicine aren't confined to emergency care alone. You would hardly find an oncologist or psychiatrist or neurologist in a suburban town or rural surrounding because few rural communities generate enough business to attract such a specialist. But electronics could change all that. Report have it that from his well-wired office in Kansas city Dr. Gary Dolittle is now preparing to launch twice-weekly oncology clinic for cancer patients all over north-central Kansas.

And Dr. Ace Allen, director of the state's Telemedicine Research and Evaluation Programme, says other specialists will soon follow suit. While Kansas dreams of electronic clinics, health officials in Georgia are taking the same idea a step further. In the not-too-distant future, they say, anyone with a special TV may be able to conjure medical assistance without leaving the living room. Researchers from the US Army and the Medical college at Georgia in recent times are installing computer linked Cable TVs in some Augusta homes inaugurating what they call the electronic house call. The computers have ports for several diagnostic instruments. By holding, say, the stethoscope to his chest and clicking the appropriate icon on the computer screen the user will be able to send readings to doctors while talking to them on TV monitor.

The millennium promise in medicine will work wonders. Detecting a tumour is one thing treating it quite another. Even if telemedicine does revolutionise diagnostics, surely surgery will still require direct contact between patients and doctors. No, it will not.

Several engineering teams are now perfecting "robot-assisted microsurgery" system that could reach the market by the end of the decade. These devices which carry out commands issued on an electric console, promise both to extend surgeons' reach and to enhance their performance.

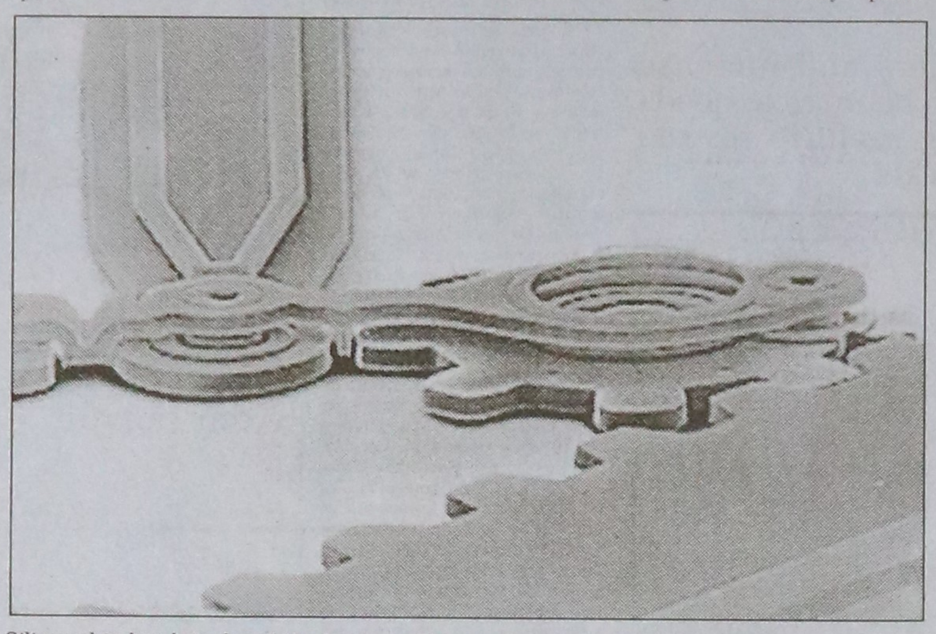
One of the pioneers in virtual surgery is Dr. Steven, a California eye surgeon who has long wished for a better way to treat the ocular damage caused by diabetes and high blood pressure. A surgeon can sometimes stem the loss of vision by cauterising injured blood vessels in the retina, but the vessels are too small to mend with any finesse. So Charles and engineers at NASA's Jet Propulsion Laboratory have developed a robotic arm that mimics anything the surgeon does with an electronic pointer, but at less than a fifth of the original scale. Human tests are just beginning but the device could give surgeons unprecedented access to remote regions of the eye, ear, spine and brain.

Biotechnology to the aid of over populated world

No problem can be more threatening to the earth's environment than the proliferation of the human species. Today, the planet holds six billion people. During the next century, world population will double with 90 per cent of that growth occurring in poorer, developing countries. But in the poorest countries, growth rates are outstripping the national ability to provide the basic necessities—housing, fuel and food with grasslands overgrazed and croplands over-ploughed by desperate farmers. Horrifying images of starvation in parts of Africa, Asia and North Korea at least have captured the attention of the world. In such a desperate and hopeless situation, biotechnology or genetic engineering promises to transform agriculture increasing farm yields to sustain the growing number of population. Encouragingly, in our neighbouring country India, half of the crops grown germinate from hybrid seeds. Combined with irrigation, mechanisation, pest control management and use of fertilisers, the superior strains helped, launch the so- called Green Revolution that has made the nation of 980 million people self-sufficient in food. In 1967, India harvested 74 millions tonnes of grain. Thirty years later, production topped a record of 199 million tonnes, a jump of 169 per cent — although land under cultivation expanded only eight per cent. In the next five to seven years, say India will need 240 million tonnes of food to feed its accelerating growth of population 2.1 per cent) vis-à-vis China's 1.2 per cent and the answer lies with Monsanto.

Scientists now believe that growing scenario of food gap and population explosion can only be bridged by the marriage of biotechnology and agriculture. In scores of experiments, scientists are changing the genetic endowments of plants and animals and the results could spawn a revolution in farm fields, feedlots and dairy barns. Only recently, the US Department of Agriculture has approved nearly 100 test plantings of crops that have been genetically altered to give them traits such as pest resistance and tolerance to weed killers. More ambitious projects are envisioned, among them adding protein to staples like corn and changing the type of oil produced by soybeans. Pigs that grow faster and leaner and cows that manufacture medicine in their milk are other goals.

Genetic modification has since now been done on at least 50 species of fruits. Calgene, a biotech firm in Davis, California, has developed a tomato that does not rot as fast as normal varieties. Since 1993, Bio Technica International of Cambridge, Massachusetts has carried out first genetic alteration of corn, the No. 1 crop in the US. In the past desirable properties were introduced into plants and animals through simple crossbreeding but for the most part scientists merely reshuffled genes within a particular species. Corns could not be crossed with soybeans, nor cows with pigs. But now plants as diverse as tomatoes and cotton have been equipped with genes that scientists have borrowed from bacteria. Shrimp may soon be given disease-fighting genes taken from sea urchins. Eventually, crops and farm animals may be raised to produce not just food and clothing but also a wide array of chemical compounds and human proteins like insulin.



Silicon chip has broadened the horizon of human hopes

While research on plants has taken the lead, work with farm animals does not lag far behind. Only in the recent past the Baylor College of Medicine and Houston-based Granada Biosciences succeeded in transplanting growth-promoter genes into cattle embryos.

Industry enthusiasts say bio-engineered animals and plants could become commercially available within the next five years. But the question now looms up: Are GM (genetically modified) crops safe for consumption? Many scientists say the risks are being over-stated because DNA—in any food—is destroyed during digestion. But some critics insist that GM foods could contain ingredients that cause serious food allergies not normally present. There is now growing demand, especially in Europe, for all GM products to be labelled, something biotechnology companies are loath to do in case it sparks consumer panic and blights the fledgling GM industry. Despite the perceived dangers, GM food will proliferate over the coming decades—driven by agribusiness's appetite for profit and pressure of population.

Scientists even say that food will be produced at the molecular level—chicken breasts grown in a Petri-dish, say. The meal in a pill has been predicted since at least the 1950s.

The workaholics may save time by popping capsules containing all the elements of balanced meal plus mood enhancers that mimic the joy of eating. The argument that bio-engineering of farm animals and plants poses risk can hardly be ruled out. With plants, however, there is always the possibility that few traits could be accidentally transferred to wild relatives of domestic species. Theoretically, experiments with genes that confer resistance to disease or herbicides could create hardier weeds.

Food safety is another legitimate concern. Products from genetically altered crops and livestock will require rigorous testing to ensure that they are harmless. On balance, however, as the scientists predict, bioengineering is likely to be more a benefit than a bane. In the case of cotton which is heavily sprayed with chemical insecticides, the addition of a bacterial gene that poisons budworms and bull-worms could help farmers and the environment alike. Similarly, the discovery that plants can be "vaccinated" against disease by equipping them with viral genes ought to reduce reliance on chemical insecticides. Currently farmers battle such diseases by spraying that carry them. Genetic engineering could also be used to give livestock more resistance to bacteria, reducing the need to feed antibiotic to farm animals. Most importantly, it is to the hungry Third World that biotechnology offers the greatest hope. Washington University plant pathologist Rogar Beachy is working on introducing genes for disease resistance into Cassava, a critical food source for much of Africa.

Scientists at the International Potato Centre in Peru and the International Rice Research Institute in the Philippines are applying the tools of genetic engineering to improve the major crops of South America and Asia. Before the middle of the next century, experts warn, world population may reach 10 billion and agriculture had better keep up. By that time, the planet's crop and livestock growers will probably have new environmental challenge to meet, among them a changing climate and increasingly salty soils. So, asserts Beachy, "Some argue that it is irresponsible to use biotechnology. To me, it seems irresponsible not to use it." Gene therapy people have started bidding farewell to the century of physics, the one in which we split the atom and turned silicon into computing power. It is now time to ring in the century of biotechnology meaning the gene therapy that offers promises of replacing faulty genes with defective ones offering hopes for treating diseases from cystic fibrosis to cancer.

Just as the discovery of electron in 1897 was a seminal event for the 20th century, the seeds for the 21st century were spawned in 1953, when James Watson blurted out to Francis Crick how four nucleic acid could pair to form the self-copying code of DNA molecule.

Before this century, medicine consisted mainly amputation saws, morphine and crude remedies. People by now know that flu epidemic of 1918 killed more than 20 million people in just a few months as perished in four years of World War I. Since then, antibiotics and vaccines have allowed us to vanquish entire classes of diseases. As a result life expectancy in the US jumped from about 47 years at the beginning of the century to 76 now. The next medical revolution will change so much, because genetic engineering has the potential to conquer cancer, grow new blood cells in the heart, create new organs from stem cells and perhaps even reset the primeval genetic coding that causes cells to age.

Our children, in the new millennium, may be able to choose their kid's traits, to select their gender and eye colour, perhaps even tinker with their IQs, personalities and athletic abilities. They could clone themselves, or one of their kids or a celebrity they admire or may be even us after we've died.

In the five million years since apes separated from human species our DNA has evolved less than two per cent. But in the next century, we'll be able to alter our DNA radically, encoding our visions and vanities, while concocting new life form. But moralists and bioethicists warn us that we should draw a line that would permit using genetic engineering to cure diseases and disabilities (cystic fibrosis, muscular dystrophy) but not to change personal attributes that make someone an individual (IQ, physical appearance, gender and sexuality).

The world is getting ready for the breakthrough that could come at the end of the next century, as predicted by the scientists, and is comparable to mapping our genes: plotting the 10 billion or more neurons of our brain. With that information, we might someday be able to create artificial intelligences that think and experience consciousness in ways that are indistinguishable from a human brain. Eventually we might be able to replicate our own minds in a machine, so that we could live on without a biological brain and body.

Presumably, the 20th century's revolution in "Info-technology" will thereby merge with the 21st century's revolution in biotechnology. Genetic engineering for Designer babies Until just a few years ago making a boy or baby girl was pretty much a hit or miss affair.

But not any more. Parents who have access to the latest genetic testing technique can now predetermine there baby's sex with great accuracy—as Monique and Scott Collins of Virginia, US learned to their delight two years ago, when their long-wished for daughter Jessica was born after genetic prescreening at a fertility clinic in Fairfax, Virginia. And baby Jessica is just the beginning. Within a decade or two, it may be possible to screen kids almost before conception for an enormous range of attributes, such as how tall they're likely to be, what body type they will have, their hair and eye colour, what sort of illnesses they will be naturally resistant to, and even conceivably, their IQ personality type.

In fact, if gene therapy lives up to its promises, parents may someday be able to go beyond weeding out undesirable traits and start actually inserting the genes they want.

Before the new millennium is many years old, parents may be going to fertility clinics and picking from a list of options, the way the car buyers order air conditioning and other facilities in their car.

"It's the ultimate shopping experience, designing your baby," says biotechnology critic Jeremy Rifkin, who is appalled by the prospect.

The prospect of designer babies, like many of the ethical conundrums posed by the genetic revolution is confronting the world so rapidly that doctors, ethicists, religious leaders and politicians are just starting to grapple with the implications. Aside from gender, the only traits that can now be identified at the earliest stages of development are about a dozen of the most serious genetic diseases. Gene therapy in embryo is at least a few years away. And the gene or combination of genes responsible for most of our physical and mental attributes has not even been identified yet. Besides, say clinicians, even if the techniques for making designer babies are perfected within the next decade, they should be applied in the service of disease prevention, not improving on nature.

But ironically, what doctors intend is not necessarily what's going to happen. Indeed, the technology that permitted the Collins family to pick the sex of their child was first used to select for health, not gender per se.

The first couple to use this technique was looking to escape a deadly disease known as X-linked hydrocephalus, or water on the brain, which almost always affect boys. But while the technique is ideal for weeding out this and other X-linked disorders, including haemophilia, Duchenne muscular dystrophy and Fragile X-syndrome, most patients treated at Genetics IVF want to even out their families. Our view at the moment, so says Dr. Zev Rosenwaks, director of the Centre for Reproductive Medicine and Infertility at Cornell Medical Centre in New York city, is that these technique should be used for medical indications, not family balancing.

Cloning may be the way out when conservation fails

Since Scottish researchers successfully cloned Dolly the sheep in 1997, it was hardly expected how this awesome science would open the door to human cloning. And the biggest profit in medicine will come from cloning fetal cells, not adult ones. But doubts about the science and ethics of cloning need to be resolved before business can market its planned products—pharmaceuticals, and later organ transplants from pigs. New health care products will be created from a combination of genetic engineering and cloning science. In the first place, scientist alter the DNA of animal cells and embryos by adding human codes then they duplicate the newly created DNA to breed genetically identical flocks. Altered genes should mean that "engineered" animals produce milk containing specific proteins for medicines or have particular organs that will not be rejected after transplants.

We must recall that the birth of Dolly the sheep, an exact replica of its mother, sparked a worldwide debate over the moral and medical applications of cloning. To put it precisely, cloning may have something to contribute to human, medicine, but the world must use it cautiously. Several European countries and US states have banned the cloning of human beings.

Prospects on the Horizon

Other then gene therapy and gene based drugs that could come to the benefit of humans, there will be others including new kinds of vaccines, new sources of transplant tissue, even techniques doctors may someday use to stave off the ageing process. Stem cells have such potentials and could be a terrific boon to medicine. Most diseases involve the death of healthy cells—brain cells in Alzheimer's, cardiac cells in heart disease, pancreatic cells in diabetes, to name a few. If doctors could isolate stem cells, as they hope now, then direct their growth, they might be able to furnish patients with healthy replacement tissue.

Doctors have been constantly urging us to eat fruit and vegetables for maintaining good health. But within the next decade we could be eating broccoli not to make our parents happy but also as a way to deliver drugs that stave off infectious diseases or that treat various chronic conditions.

"The idea of vaccinating people with edible plants is very new," says Dwayne Kirk of the Boyce Thompson Institute for Plant Research in Ithaca, New York. "But it's a lot friendlier than injections."

Because their cells naturally produce large quantities of protein, tomatoes and potatoes seem for now to be the most efficient vehicles for new approach. Instead of mixing viral or bacterial DNA in a formula for injection, for example, scientists could insert it into soil bacteria. When the bacteria are taken up by the plant, therapeutic DNA material are stitched into the plant's genome.

Plant-based vaccines are particularly attractive for Third World countries, where storage and distribution of drugs are a problem. Eventually people in these areas may inoculate themselves against diseases simply by growing a rop of genetically engineered fruits or vegetables and eating a few several times a year. The technique may not, however, be limited to infectious diseases only. It may even be useful for condition such as Type-I diabetes, in which patient's immune system destroys essential insulin producing cells in the pancreas.

> The silicon chip itself, may ultimately be relegated to a museum by another nascent technology called quantum computing. Through subatomic engineering, scientists hope to knit together groups of crystalline molecules, which can store electrical charges into impossibly small devices that perform like silicon chips. So says James Heath, a chemistry professor at the University of California at Los Angeles and head of a quantum computing research team, "We can potentially get the computational power of 100 workstations on the size of a grain of a sand."