Computing in the Year

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Evolution and Revolution

"But what ... is it good for?"
Engineer at the Advanced Computing Systems Division of IBM, 1968, commenting on the microchip.

The progress of the human species has been dominated by evolution. Evolution happens in two ways: passive evolution and active revolution. Passive evolution is usually un-noticeable, affects a lot of people and changes our lives to some extent. Active revolution, on the other hand, is a seismic shift in the way we lead our lives. It is a change so great and has such a huge impact that it affects our entire lives.

Previous transitions include the Industrial Revolution, when we changed the way we produce everyday goods. We were suddenly in a position to make more goods, faster and cheaper. We could mass-produce goods which led to increased trade. Another such transition was the Transport Revolution, when we invented such marvels as the steam train, the metalled road and the internal combustion engine. Surely there was also a similar revolution when the caveman began to build a more permanent home, in the form of a house. There have been a large number of revolutions in the lifetime of the human species.

"The problem with the future is that it keeps arriving far too early."
New Scientist

However, most of the shifts are of such immense proportions, that we cannot envisage them before we have experienced them. The Catholic Church teaches us that there is life after death but there is no way we can know what heaven and hell are like until we have gone there (when it is too late). It is like this with these seismic shifts. Until we have died and gone to heaven, there is no way we can even begin to imagine what lies ahead.

When the Technological Revolution began in the 50s with the invention of the Transistor and the Integrated Circuit, there was no way the people involved could have foreseen the world of computers as it is today. They were just working on a new project, an electrical project of seemingly little importance. What started in a small laboratory in Bell Labs, has exploded into a science that grips every part of our lives. Computers are everywhere, in kitchen appliances, in cars, in phones as well as in the ubiquitous beige box. They do the vast majority of our boring or complex work for us, from playing games to controlling flight plans. They manage the accounts of a million taxpayers and they beep at every checkout in every shop in the developed world. Yet there was no way any of this could have even been dreamed of before the invention of the computer.

Even after the invention of the computer (in its most humble form), the people using it never imagined just how widespread it would become. They saw computers as a nice (if expensive) way of testing mathematical proofs and of calculating long and complicated mathematical equations, things most normal people balk at the thought of.

The same applies to the Internet and the World Wide Web. When the military at ARPA and Tim Berners-Lee were working on their respective projects, one to transport military data around and the other to transport physics data to other physicists, they could never have imagined what the internet and the web would become. They probably would have laughed if someone had suggested it would quickly become a massively-popular resource, where people meet, discuss, send email, put up or surf web sites, buy goods, rent services as well as many other things. Although the military still have their MilNET and there is still a wealth of physics data on the Internet, they are but a small subset of the information out there.

This is a perfect example of a revolution, linked to another revolution. There is no way the latter could ever have come about without the first having happened. I believe that it is the first of many evolutions that will come about as a result of the technological revolution. Some will be passive, some will be active and some, like the Internet, will be paradigm shifts that we can't even imagine.

Here are some of the areas that I think will be affected by computers in the year 2050.

Communications

In the last few years, the main area in which computers have developed has been communication. Not just the passing of information across the world, but the interaction between friends, family members, business people, lovers and anyone else who wants to meet others. In the past this meant email and that meant longhaired teenagers or white-haired physicists. In more recent times email has been extended so that it is used by almost everyone who has a computer. It can convey information in the form or words – extended by the ubiquitous smiley – and also sound, video, animation or any other format that you can put into a computer.

Video conferencing is becoming popular but it is still limited to rich people or people with high-bandwidth connections. This is one area that will definitely become popular. The ability to talk to people who might not be close to you, while still keeping all the human attachments intact. These include facial expressions and hand gestures that make conversation much more than just the sum of its words. At first this will be useful for business people. Why take time off work to travel across the sea to the European continent or to America to organise a business meeting or sale, when you could conference from your own office? Companies will save millions in travel expenses and lost work. Employees will spend less time away from home. Another area is family contact. As every Irish person knows, emigration and death used to be almost synonymous. With the reduction in both phone and flight costs, this is not the case. However there can still be long periods of time when a brother or son, sister or daughter can be out of contact. Even phone calls cannot replace actually seeing and talking to them. Video conferencing will alleviate this to some extent.

There is no reason to limit this to PC-to-PC calls. Video conferencing will take place anywhere, through a computer, a TV, a mirror, even a mobile phone or watch! Holographic imaging could be used to generate an image of the person you are talking with. This might seem a strange idea - talking to a projection of a person. However, consider the current mobile phone craze. If you walk down any street in Dublin at the moment you can see people walking along, apparently talking to themselves. Hands-free sets make this look even stranger. We have grown used to this behaviour so there is no reason to believe we couldn't accept holographic imagery as easily.

Despite all the possibilities that lie ahead of us in this area, there is one major limitation facing the communication industry. This problem is so major that it could stop the industry dead in its tracks. That problem is that people are inherently social creatures. We crave (and need) social interaction. It gives us a reason to live and keeps a part of our brain alive. There is only so far we can go with electronic communication before humans begin to reject it in favour of actual in-person chat. Maybe we will begin to just talk to people around us instead of using electronic communication to talk to those people we would prefer to talk to. While I don't believe that we will ever abandon e-communication completely, I do think that there is a limit on how far we can go down that road.

Medicine

Another area, which has so far been relatively slow to embrace computers, is medicine. Patients' records are still held at various locations and in different forms, mostly on paper. There may be many different analyses of patients, held on paper form in doctors' clinics and hospital records. Given some doctors handwriting, it might be nigh on impossible to concatenate these records, as well as being an arduous and long-winded job.

In the future, patients records could be held on a central server, possibly run by the Irish Medical Organisation, or the Department of Health. Doctors would add comments, analyses and drug reports to this database. If you went to any doctor in the country, they will be able to view this (or as much as you want them to see). Symptoms, which might not be noticeable under normal conditions, should be much easier to spot. Mistakes relating to drugs and prescriptions will be less likely, because doctors will know what drugs you are already taking, what drugs have been revealed not to work for you and what drugs you are allergic to. The only outcome of this is better service for the patient.

But what about if you fall sick while abroad. Without some means for foreign doctors to see your report, all the E111 forms in the world won't help. It should be relatively simple to have an international network of these databases, with an artificial intelligence driven programme translating your report into the necessary language.

Taking this even further, it has been suggested that a small chip, located just under the skin, could hold all this information. Thus the information stored on it is accessible all the time, wherever you are and will not be subject to the irregularities of international (or even national) telecommunications. It could output the data held on it in any language necessary to any qualified doctor or medical officer. One advantage of this is privacy. People are still very wary about information held about them somewhere else. They are likely to be even more wary of private medical data held about them. If this data was held under your skin, only readable with your permission, security should be no problem.

Implementing the technology a step further, it should become feasible to have the chip monitor certain parts of the body. It could be a silent, invisible nurse, always checking to see if you are about to get sick. For instance, it could monitor the body's core and skin temperature to see if they differ too much or if they are fluctuating. Electrical impulses in the brain could be monitored to spot epilepsy. These are just two examples of a wealth of information that this device could monitor.

Then again, how many people are likely to accept a government programme of shoving chips inside the populace? While the prospect may seem scary, most people have little or no qualms about pacemakers that are used to regulate the heartbeat. What about some of the cures that are being proposed to cure epilepsy that involve hooking wires up to peoples brains and sending electrical impulses into the nerves whenever necessary? Surely none of these are less scary or less intrusive than a small chip that doesn't actually control any part of the body.

Human-Computer Interface

"Computers in the future may weigh no more than 1.5 tons."
Popular Mechanics, forecasting the relentless march of science, 1949

Perhaps computers themselves will undergo the most dramatic change. There will be two major changes to computers.

The first is that they will almost disappear. The beige box that insults most well decorated living rooms will transform to look more like the rest of the home entertainment systems. For years the makers of games consoles have realised that, in order to achieve their aim of a games console in every home, they had to look as nice as the rest of the entertainment systems. That means black or silver, not beige. It also means small, discreet and rounded, not big and boxy. It also means that they must be easy to use and hard to break. PC manufacturers have been aiming mainly at the business market, so they have ignored these concerns. Computers, where they do make their way into the home, are either consigned to the bedroom or hidden away in a corner of the living room. At the moment they are beige boxy machines with a maze of wires and flashing lights. Any attempt at design is either weak or ugly. They are also relatively hard to get up and running, compared to new TV's and video recorders. They have a high failure rate and are expensive to fix, unless you know a friend or neighbour who "does" computers.

Computers in the future must address these concerns. They must be black (or at least nice to look at) and fit into the furniture, rather than the furnishings fitting round them. Wires should be kept to a minimum and Bluetooth, which allows wireless communication, is helping here already. They must be easy to start and keep running and fix themselves if a minor problem occurs. They must also be fast to turn on and off. How many people would buy a TV that took three minutes before they could be used?

In recent years there has been a massive drive towards faster processor speeds, faster hard drives, faster ram and faster Internet access. For some people – physicians and mathematicians, animators and space control engineers - this has actually meant that they work faster. They can perform their number crunching, graphical generation and simulations much faster than before. For the rest of us, this speed has gone into the extra instructions that make computers easier to use: Windows, for example. This trend must continue into the future. Computers should be so simple that even an adult can use them – I say this because at the moment children are comfortable with both computers and video recorders and it is adults that have the problems. Computers created this embarrassing situation and they should fix it, to restore the respect that primary school teachers need.

However, all this is a stop-gap. Computers, I think, will become an integral part of everything we use in life. Sun's C.E.O. tells us that future cars will become nothing more than "a Java technology-enabled browser with tires." Already we have new cars fitted with GPS Navigation systems, but fuel injection and anti-lock brakes are already standard computer-controlled parts of cars. However, this will continue. It has been predicted, and

the French X-10 Corporation have already started, that the entire house will be networked together. X-10's system integrated security, care for the elderly, automation and remote control of house appliances under one standard system, which can be controlled using main wires travelling round the house. Bill Gate's new house is an extreme example of how this technology can be implemented. A central computer will control each house, but, vitally, this computer is never seen. It is controlled (and controls) via wires, buttons and voice activation units throughout the house. This is a vital part to the evolution of computers. If they are to be integrated into houses, they must fit into our way of thinking and working. People shouldn't have to learn a new interface or programming language to use the TV or fridge. The computer should be merely a useful aid to using those devices.

An example of this, which is available already, is the TiVo system, which is making its way here from the States. It is a video-recorder with a CPU at its heart. It can be used as a normal video recorder via its front panel or a normal remote control. However, the CPU inside watches what you are doing. It watches what programmes you like, what advertisements you don't and it learns. Then it goes off and tapes those programmes for you. If you aren't using the device, it can record random programmes of genres that you like. If you switch on a programme in the middle, it allows you to watch it from the start, while it records the rest. The important thing is you don't know you're using a computer and you don't have to learn anything new to use it.

This policy will be extended to cover anything in the house; blinds will automatically roll up or down, depending on what you normally do. Fridges will watch the use-by date on food and tell you what food you need to buy, replace or throw out. Crucially, you won't need Java, C or grounding in basic Windows to use them.

Perhaps the part of computers that has confounded computer people for so long is verbal communication. At the moment, interaction – if you could call it that – is really limited to keyboard, mouse and monitor, none of which are exceptionally natural, intuitive ways of working. If you could speak to your computer and it could understand what you want it to do and talk back to you, this would be a much more intuitive system. As processors grow faster, the latter is becoming more realistic and less like a bad imitation of a Dr. Who-style Dalek. However, the vagaries of human conversation make speech-interpretation very difficult. The range and contrast of human conversation make it very difficult to programme a system to understand every possibility. However, this is one area that artificial intelligence will help.

When we can interact with a computer without talking in or listening to stilted speech, we will have eliminated a huge barrier in human-computer interaction.

Artificial Intelligence

AI has long been the dream of computer engineers. It was once believed that the human brain was no more than just a complex set of instructions and that if we could ever map and mimic them all, we could successfully create a mock human brain on a computer chip. We have since learned that it's not quite that simple.

Newer AI systems no longer depend on a long sequence of recursive if…. else statements. They are built on massive databases of information that the system can 'learn' and use. However, one of the major stumbling blocks is the time taken to navigate and find information in these databases. The larger they are, the more human a system can seem. However, the larger they are the more lag there is in processing the data to product a result.

This is another area of computers that depends on the continual multiplication of processor power. Maybe sometime a processor will be invented that can rival the human brain in data retrieval and processing. Whether will we see this in 50 years, though, is doubtful.

When we can carry on a conversation with a computer and not know that we are not dealing with a computer, we will have solved a lot of problems (and created a lot more moral questions).

Perhaps an unusual idea, which has been mooted before, is the idea of 'consciousness uploading'. This could take one of two forms. The first, is one where someone's entire brain (their 'self') would be uploaded into a free-form database and stored. If that person died and a suitable replacement body could be found or grown, that person could be transposed into it and they could continue their lives. While this might be an interesting idea, it is both technically unfeasible at the moment and not very practical from a human point of view. The person would have to adjust to the new brain, the new body and whatever other baggage is brought with the new body. Also the idea of not dying is very unchristian. Lastly, and perhaps most important, if nobody died, there would be a massive population explosion. There would be no place for people to live and the earth could not support the demands this population put on it.

The second form of consciousness uploading is more inhumane. It involves the persons' brain being uploaded into a network of free-form databases. The person would abandon their human body and live the rest of their life inside the network. They could interface with other uploaded people through the network, and with the 'real' world, through monitors, video cameras and speakers/microphones.

Non-semiconductor based computers

Ever since the beginnings of computers, we have built them based on a piece of metal with strange properties. Electrons fly along this metal, sometimes fast and sometimes slow. Sometimes they don't move at all. Every computer is based on this principle. The faster we can convince these electrons to move, the faster the computer works and the happier we all are.

"Research into areas such as molecular nanotechnology, optical or photonic computing, quantum computing, DNA computing, chaotic computing, and other seemingly esoteric areas of research may prove fruitful, changing totally the way we design and manufacture microprocessors or perform computations." PC Magazine

The major flaw with electrons is that they are physical objects. They have a maximum possible speed, which limits the speed of a computer. In the future, it might be possible to manipulate beams of light to perform computer logic, by controlling one beam of light with another beam of light. When two beams of light, which can move much faster than electrons, hit a non-linear optical medium they interact. Depending on their entry points and their properties, they can land at specific points which represent AND or OR logic gates. It would be possible to make a switch that can switch in the femtosecond range, as opposed to electron-based gates, which switch in the nanosecond range.

"*Photons have advantages over electrons because light travels considerably faster than electrons in a circuit, and therefore, can carry more information in less time*." Cyber Dyne Computer Corporation

However, we have to keep in mind that no-matter how fast your liquid-nitrogen-cooled dual Pentium 3 1Ghz processor moves, it can't rival Mother Nature. Things happen in nature in ways we can't understand, never mind copy. It is this realisation that has brought forward the idea of organic computing. This type of computer would use natural logic and would be built from some kind of organic material. It would be self-healing if something went wrong. It should also be self-teaching, i.e. it should adapt to suit its surroundings. If such a self-teaching unit could be built (or grown as the case may be), then the same unit could be built the world over and it would adapt to suit its designated job. There would be no wastage because they could be re-used easily. There would be huge economies of scale, because no specialisation is necessary. Our consumption of precious metals such as germanium and of plastic, which is inherently bad for the environment – would be cut, which can only help our world. However, of all the ideas expressed here, this is the furthest off. It is not even in theory stage, because no one can visualise it at all. No-one knows how to go about starting such a process.

Conclusion

In this essay I have given some of my ideas of what computing will be like in the year 2050. However, these are things that have been suggested already – either in scientific papers or journals or in science-fiction movies. The things that will really affect the future are the things that occur to people when they least expect it. The bright spark of invention is one that can never be predicted, but once it has been lit, it can never be extinguished.