INFORMATION TECHNOLOGY AN INFORMATIVE INTRODUCTION

Asoka S. Karunananda
Dept. of Mathematics
The Open University of Sri Lanka.

This paper elaborates on the development and evolution of both computer and communication technologies. The current and the future trends in information technology are also discussed. The social aspects of the development of information technology are discussed briefly. Sri Lanka should immediately go beyond the level of mere use of IT but join the global research and development process.

The area of Information Technology, IT, emerged as an integration of communication and computer technology. The birth of communication technology is as old as the beginning of human civilization. However, digital computer technology is just fifty years old. It is evident that computer technology has dominated not only the development of IT, but also the whole development of the modern world. Sri Lanka should immediately go beyond the level of mere use of IT but join the global research and development process.

Introduction

Information Technology or IT has been a buzzword in the modern world. The current trends in the modern world are dominated by IT. In simple terms IT can be considered as a contribution to the development of communication technology with the support of other areas including computer technology. Without doubt, communication is a fundamental activity of every living being. From the dawn of human civilization, attempts have been made to improve techniques of communication. Perhaps, the elementary means of communication can be treated as forms of languages. There is evidence that even animals communicate in terms of some languages. According to literature, the use of human languages dates back to 35,000BC. As humans invented various forms of new knowledge, mere verbal language was not sufficient for communication. In this vein, the second major means for communication, that is, writing emerged in 4000BC. The idea of writing is in fact a development of the use of languages. Having emerged as a method of communication various forms of writing techniques developed. The evolution of communication techniques has a long history as that of the mankind. However, the most remarkable development in communication was reported in the recent centuries.

In particular, the latter part of this century has witnessed a remarkable development of communication technology. An interesting question is why such a rapid development in communication technology could take place in this century. Undoubtedly, everybody knows the answer. It is the impact of rapid development of computer technology. Stated in another way, the merger of communication and computer technologies has made rapid development in communication technology possible. IT is generally considered as an integration of computer technology and communication technology. To a large extent modern development is attributed to modern computer technology. The modern computer technology is powered by what is known as digital technology. The evolution of digital technology is known to be very fast. The digital technology is also the cheapest technology todate. We are living in a digital world and computer is just one usage of this technology. The microprocessor concept in digital technology has brought the computer to ordinary people. In the modern world, whole development including IT is dominated by the computer technology.

This paper elaborates on the development and evolution of both computer and communication technologies. The current and the future trends in information technology are also discussed. The social aspects of the development of information technology are discussed briefly. In order to present the above in context the rest of the paper is organized as follows. Section 2 discusses the evolution of communication technology. Section 3 is a detailed discussion on the development in computer technology. Section 4 describes IT and our society with particular emphasis on how Sri Lankans cope with IT in the near future. Section 5 attempts to project the future direction of IT and the modern world.

Overview: Evolution of Communication technology

The origin of communication technology dates back to 35,000BC. The first reported instance in the history was that people thought of languages for communication. As the next step in the evolution of communication technology the concept of writing emerged. It was reported as far back as 4000BC. Once the concept of writing emerged various forms of writing were developed. It was a long time since then, printing emerged in 600BC as a remarkable development of writing concept. Despite, the fact that the Chinese invented the art of book printing, the first book was printed in Europe in 1453AD. Following the development of printing technology, newspapers, magazines and books emerged as powerful media for communication. The use of the first printing press was recorded in North America in 1639.

Subsequently, there were several developments in communication technology in the 17th century. Some of these developments include photography, Morse telegraphy and high speed printing. During this era people became very much interested in remote communication.

In 1876, the invention of the telephone emerged as a breakthrough in communication technology. It made the first and the biggest impact on the idea of remote communication or telecommunication. After the invention of the telephone, the concept of telecommunication began to evolve. In the early days of inventions of communication technology, its evolution was considerably slower. However, during 1888 to 1895 (just seven years) radio waves, movie projector and radio and motion picture camera were invented. The invention of radio waves made a significant impact on telecommunication. It should be noted that there was a big demand for motion pictures ideas in early 20th century.

In 1928, the first black and white television was demonstrated. Ten years later the commercial TV broadcasting was begun. The first colour TV was demonstrated (in 1946) almost twenty years after the invention of the black and white television.

During mid 1940s, there was another breakthrough in communication technology . It was the invention of the *transistor.* That is the basis for all modern digital technology. In fact, even the computer techniques would have not been developed so much if the transistor was not invented. The invention of transistor led to many developments such as transistor radio (1952), satellite (1957), push button telephone (1961), portable video recorder (1968) and digital computer. Since then technology was dominated by 3D televisions, cellular phones, fax, CD-Roms (Compact Disk-Read only memory). At present, communication is totally multimedia based. That is communication technology has evolved upto a stage in which people can exchange text, pictures, moving pictures and sounds within a fraction of a second.

In a broad sense, evolution of communication technology can be seen in three areas:

- Communication media.
- Network communication
- Invention of sending, receiving and recording devices.

Communication media

The evaluation of communication media basically falls under two categories; wire or cable connection and wireless connections. Wire or cable connection includes twisted pairs, coaxial cable and fibre-optics. In contrast, wireless connection refers to the use of radio waves and microwaves. Twisted pair is used for short distance communication. The coaxial cable can support communication over large area. However, both media are susceptible to be affected by lightening. Fibre optic is used for long distance communication and is also free from lightning hazzard. Radio waves and microwaves are used for country wide and international telecommunication. The development of communication media was very much influenced by theory in subjects like physics.

Network communication

Communication ranges from communication between two people to communication among groups of people. The latter is based on the idea of network for communication. In fact the communication network idea evolved with the support of computer technology. This is because computers are very powerful nodes in a communication network. There are three main systems of networks, namely, Local Area Networks (LAN), Metropolitan Area Network (MAN) and Wide Area Network (WAN).

LAN is a type of communication network spread over a small geographical area such as a building. However, MAN is larger than local area networks and they can spread over a region like a big city. The WAN is even much bigger and can cover an area like a country or even the whole world. The Internet, most powerful communication achievement todate, is an example of wide area network. Section 4 discusses the Internet in detail.

Communication devices

Numerous devices have been invented to promote communication. These devices include Cellular phones, Fax machines, CD-Roms and modems. In this context computer technology has also given a new dimension to devices of communication. For example, the devices like routers, hubs, modems and network cards are types of devices for enhancing the idea of communication with the support of computers. It is impossible to discuss the development of communication technology without referring to the contribution of computer technology. Therefore, in the next section we elaborate on the evaluation of computer technology. Without computer technology, communication technology cannot move any further.

Overview: Evolution of computer technology

The birth of computer technology dates back to the invention of *Abacus.*(counting bead frame) in

3000BC. Clearly, the computer technology began long after communication technology. However, the pace of evolution rate of computer technology was much slower than that of communication technology at the beginning. Only in 1642AD, Pascal developed the first adding machine. Two centuries later, in 1832, a mathematician by the name of Charles Babbage developed the first computer. The first computer was named as Babbage's *analytical engine*. It was an analogue computer. Just ten years later Ada Lovelace introduced the idea of computer program and wrote the world's first computer program.

In 1890, the computer adopted the technique of using punched cards. Data and programs were represented using punch cards. The idea of having a hole or not having hole is used as the alphabet of punch card language. This duality sense later gave birth to the digital computer. The general theory of electronic computers was considered in 1930. In 1946 the first digital electronic computer, ENIAC, was invented in the United States. In the early days, computers were very large. However, in 1970s the *microprocessor* was developed and it established the basis for small computers. Soon after the birth of microprocessor the pocket calculator was developed in 1971.

The invention of the first personal computer by Apple Macintosh in 1977 was a breakthrough and it had a single microprocessor. In 1981 IBM introduced their first personal computer. Although IBM computers were born after Macintosh, it is evident that IBM computers and IBM compatibles dominate the modern personal computer world. The concept of desktop publishing emerged during 1984-1993. It was also first introduced by Macintosh and is now dominated by IBM. The idea of desktop publishing introduced the computer based super quality and high speed printing widely. A personal computer, scanner and a printer together have replaced massive printing presses.

The current trends in computer technology are very much dynamic. At the beginning, computer was considered as a machine for mathematical calculations. Since then it evolved as a device for data processing which goes beyond the mere use for calculation. Nowadays, computer is multimedia machine and is a versatile one. It is not a single machine but it is a combination of machines.

The latter part of this century can be reckoned as the golden era of the history of computer technology. The idea of intelligent machines emerged during this period. Machines or artifacts are generally used to make physical activities easy for man. Further, all these artifacts are products of human ingenuity. Hence, the development of artifacts can make human intellectual activities easy, too. Perhaps this can be the ultimate goal of invention of artifacts. The challenge of developing intelligent machines was accepted by mankind in the latter part of this century.

Intelligent machines

In responding to the need for developing intelligent artifacts, the area called Artificial Intelligence (AI) emerged in 1956. The aim of AI can be simply interpreted as emulation of models of natural intelligence on the artifact called computer. It should be noted that in the current trends, AI does not talk of an artificial form of intelligence. The power of AI is embedded in the fact of what we know of natural human intelligence. Since AI looks for models of natural intelligence, it basically draws from models of intelligence from different areas where the theme, intelligence has been studied. For example AI develops *learning systems* by exploiting theories of learning in education. Further, a biological model of the human brain is used to develop artificial neural networks.

The most important impact of AI is that it makes computer to behave as an intelligent machine. Computers now tend to emulate various models of human intelligence. Thus the modern world is moving towards the development of intelligent artifacts. The idea of intelligent machines has thus grown beyond recognition. Modern development is very much dominated by various intelligent computer systems such as expert systems, robotics, language processing systems, automated reasoning systems, neural networks and genetic algorithms.

How computers work

In this section we discuss in layman's term, how computers work. Computers are electric devices such as television, radio and cassette recorders. However, computer is different from other electric devices as it can be programmed or instructed to do various activities. Stated in another way, electronic circuits in computers are programable. Since the modern computers work on electrical signals, one can talk to computers using language with the alphabet "0" and "1". Here "1" represents availability of current while "0" represents non-availability of current. As far as one instructs the computer using "1" and "0" the computer can understand it. Today user friendly languages like English or Sinhala are developed to instruct computers and these languages are eventually presented using "1" and "0" without the user knowing how it happens.

In the computer world, electronics circuits related to computer devices are called hardware. Further programs that instruct the hardware are called software. In this sense the computer can be defined as a machine with two layers called hardware and software. The simple working principle of computers is that software operates on hardware.

It should be noted that computer technology has been evolved in the direction of both hardware and software. Theoretically it is also possible to develop a software program as a corresponding piece of hardware. The technology for this conversion is also emerging.

Software is of two types: the system software and application software. The system software interacts with the user's programs and the hardware of the computer. The users talk to the hardware through the system software using application software. Figure I illustrates the interaction between user and the computer.

In today's world the user of computers are directly connected with application software while hardware is not visible to users. Software is cheap and can be written by ordinary people. Computer software tradition ranges from programming, wordprocessing, use of packages, simulation, design and modeling. In fact the notion of intelligent machines can also be demonstrated by means of software. That means computer can be made intelligent by writing software programs that emulate some characteristics of human intelligence. For example, we can write a program to model the software to behave as a teacher. Furthermore expert systems, neural networks, genetic algorithm, fuzzy logic are such intelligent software programs.

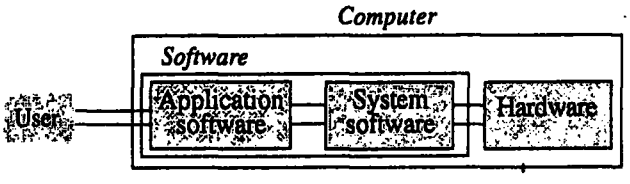

Figure I: Computer user Interaction

Philosophy behind Computers

A question that is often asked is whether computer field can be treated as an empirical science such as physics or biology. As we all know, empirical sciences like physics are based on observation and use inductive reasoning for conclusions. In the computer world the area of software can be tested by observation and it also draws conclusions inductively. Thus a part of computer field is scientific. So one cannot totally deny the scientific basis of computer field and its distinct existence as Computer Science. We should also remember that scientific theories are generally liable to be disproved (or rejected), so is software in the computer world.

Further, hardware field in a computer is based on nice mathematical structure called Boolean algebra. Mathematics can never be falsified. So hardware field of computers can be guaranted to be accurate at all the time. Since software programs can generally be converted as hardware pieces, computer can also become a fully mathematical device. It will also entirely remove the risk of using software.

Some characteristics of computers

There are various types of computers todate. Depending on these types, the characteristics of computers differ. However, there are several characteristics, which are very common features of all computers. It is important to know these characteristics to acquire a basic understanding of computers and evolution of computer technology. A brief description of such characteristics and an explanation why computers possess them are given below.

Speed

Without doubt, the computer is attractive to many people due to its speed. The computer is also a machine. However, it differs from other machines as it has a very special device, called *memory*. It was the idea of Charles Babbage that a machine can be made to work very *fast* if a machine is coupled with an additional storage. This is because having storage close by means that materials for processing can be provided without a delay. Babbage's suggestion for storage or memory for machine is known as *mill and store* concept. The inspiration for this idea came from observing the working pace of factories in Europe after the industrial revolution. All the capabilities a computer holds are attributed to existence of a memory. If it does not hold memory, the computer itself is just an electronic device like a television.

Since, a computer possesses memory it gives us a very special facility. That means, a computer can be programmed or instructed to do various things as its memory stores these instructions. The commonly known major characteristics of a computer, speed, is a result of it having a component called memory . Despite different technologies emerging in the computer world, the concept of memory remains unchanged and is kept as a separate device in a computer system.

In broader sense, the idea of computer memory can also be seen as a revolutionary paradigm in information storage. This is because, sophisticated computer based storage devices, such as hard disks, floppy disks and CD-Roms are also several methods of information storage. In the computer world, memories are twofold, namely, temporary storages and permanent storage. In technical terms they are called primary storage and secondary storage respectively. The primary storage is used for loading programs on a temporary basis to run with the support of main processing unit of a computer, called Central Processing Unit (CPU). We will discuss the CPU later in this paper. The secondary storage is considered as permanent and retained in large storage devices such as hard disks, floppy disks, tapes and CD-Roms.

Versatility

Computers are versatile machines. That means computers can work as several machines. For example, computers can operate as TV tuners, CD players and radios. Versatility of computer as a machine dominates its applicability every where in the world. More importantly, in recent times,

computer has shown its ability to support communication, thereby, making the whole world a global village.

An interesting question is: why and how computer becomes a versatile machine. The answer is very simple. The computer is structured with a main circuit board to which you can plug small circuit boards doing various tasks such as CD playing, and receiving TV signals. In the computer world, the main circuit board mentioned above is known as *motherboard* or *systemboard*. The small cards which are connected to the system board are called *expansion board* or *controller cards*. The sockets connecting motherboard and expansion cards are called slots. In general terms, a computer can be used to work as any given machine. Further, a computer can also control a machine that is connected to a computer using a suitable port.

The idea of controlling mechanical devices using computer (digital technology) emerged remarkably in the early 1970. This tradition was called *mechatronics*, an acronym for integration of mechanics and elctronics. It later leads to the area called robotics. With the emergence of AI, people are now interested in intelligent robots and intelligent controls using computers. It should also be noted that the concept of computer controlled machine leads to another dimension of automated systems. Compared with other machines, computer is very much automated. Thus we can drastically reduce the human intervention in a process, if computers are used.

Intelligence

The question whether computers are intelligent is a common one. Of course we do not know how to define the term intelligence. However, we have some understanding of human intelligence by referring to some activities in which intelligence is required. For example, learning ability, teaching ability, mathematical problem solving ability and explaining ability are coupled with human intelligence. It is extremely interesting to know that computers can be programmed to exhibit their capability with regard to at least some form of intelligence. Stated in another way, although computers are not intelligent by nature, they can be made to be so by writing programs that emulate some known intelligent characteristics. The computer is the only machine which has the ability to emulate at least some forms of intelligence. Other machines are not only not intelligent by nature, but also cannot be emulated to behave as if they are intelligent.

Until recently, people generally held the view that computers are not creative, at least to some extent. As we all know, creativity is another aspect of intelligence. Some argue that computers cannot generate something more than what is known to the programmers. However, there is now evidence that computers can also generate things which were not seen by the programmer at the time he/she wrote the program. An engineer engaged in building construction, may know all theories, rules and principles for constructing a bridge, and he may have written that knowledge into a computer program. Of course, just because the engineer wrote the program he may not be aware all of possible designs that can be had using his knowledge. In contrast, if the conditions are given the program can generate all possible designs including those which the engineer never saw before. This is a fairly old example cited by Professor Marvin Minsky, who is a founder member of Artificial Intelligence. Besides, there is also recent evidence of creativity of computers. For example, new research area called *datamining* aims at generating previously unseen relations among data entries in very large databases.

Reporting of characteristics of computer is an extremely lengthy theme. Thus far we have elaborated only on some essential characteristics. Next we discuss the essential architecture of a computer.

Architecture of Computers

This section discusses the essential architecture of a computer. Every machine has a processing unit. Stated in another way all machines are processors. As we have already mentioned, computers process with the support of memory. Further every machine also has a means for input and output. Thus necessary components of a computer can be termed as *processor, memory, input* and *output*. Nowadays, input and output units are collectively named as peripherals. In this sense, Figure 2 shows the basic architecture of a computer.

Figure 2 Basic Architecture of a computer

As shown in the diagram peripherals are supposed to get access to memory only via processor. The line connecting memory and processor is called *memory bus* while the line connecting processor and peripherals is called *peripheral bus*.

When computer technology evolves the technology of all these aspects; memory, buses, processors and peripherals also develops . In the modern computer, memories, processors and buses are found in the form of integrated circuits or chips. Peripherals can be seen as a combination of both electronics and mechanical devices.

Since memory, processors, bus technologies and peripherals are the key aspects of modern computers, it is necessary to explain briefly the development of these technologies.

Memories

As we mentioned earlier, computers possess two main types of memories namely, primary storage or main memory and secondary storage such as hard disks. The primary memory has two parts: RAM or random access memory and ROM or read only memory. The speed of modern computers is mainly determined by the size

of RAM. All programs written to a computer are run by loading those into the RAM. In recent times, memory has become very cheap. In this sense the minimum RAM for ordinary computer, at present, is 32 Mega bytes (32 MB). Over the last few decades, RAM technology has been evolved in many directions including invention of Static RAM (SRAM) and Dynamic RAM (DRAM).

In contrast ROM is used as a storage of essential instruction for booting and functioning of a computer. It is permanently fixed onto the motherboard in the form of chips. Users cannot write to ROMs but manufacturers write to ROMs using various techniques. The number of forms of ROM depends on how one writes to ROMs.

With the passage of time , the secondary storage devices such as floppy disks, hard disks and CD-Roms are also becoming very cheap. Their storage capacities are also expanding very rapidly. For example, now harddisks with 3.2 Gega Bytes (3.2GB) are available at relatively cheaper price. High capacity CD-Rom devices such as DVD (Digital Video Drive) are also now available in the market. Three dimensional storage devices such as holograms are also being developed. In general, secondary storage devices are considered under peripherals. Lastly it should be noted here that computer technology has assumed a new dimension for very high storage capacities in a reliable manner using a small physical space. The storage technology is also becoming very cheap.

Processors

The concept of processors in computers has been used in discussions on computers. For example, in the world of personal computers, you would have heard of terms like 386, 486, Pentium, Pentium II, Pentium pro, 686, etc. which refer to different technologies and versions of processors of computers. The speed of a computer is now usually expressed in terms of the technology of processor . Higher the number on the processor, the speed and the technology become more advanced. From, Intel company, the recent processor can be seen as Pentium II. However, technology evolves very fast.

Ordinary personal computers use a small single processor called microprocessor. These computers are therefore called microcomputers. Bigger computers possess several microprocessors. Section 3.7 discusses different types of computers. In general terms, in the world of personal computers, another name in use for microprocessor is CPU or central processing unit.

In the early days CPU was said to have two major units in it. These units are called Arithmetic & Logic Unit (ALU) and Control unit. However, CPUs in modern computers are capable of handling many functions other than arithmetic/logical calculations and controlling computer-wide services. For example most of the modern CPUs are capable of handling multimedia (sounds, pictures, moving pictures, etc.). Those computers are supplied with complex CPUs. The MMX technology of microprocessors provides the capability of handling multimedia.

The CPUs are also becoming very cheap. It should also be noted that CPU couldn't achieve to the speed of a computer without the support of substantial amount of RAMs. A latest Pentium processor with small RAM is just like an elephant without a trunk!

Buses

The concept of bus provides a means for information flowing between peripheral to CPU and CPU to memory. The bus concept in computer world also has a meaning similar to that of bus in real world. The most important analogy is that wider the bus lane between above components more information can flow faster. Bus width is an essential attribute to the speed of modern computers. The bus width is measured in terms of bits. There are bus technologies supporting a sequence of widths such as 8-bits, 16-bits 32-bits and 64bits. Bus technology has been evolved in many steps by improving the width and the performance of buses. Some of the technologies which have emerged are known as ISA (Industry Standard Architecture), MCA (Micro Channel Architecture), EISA (Extended Industry Standard Architecture), VESA (Video Electronics Standard Association) Local Bus and PCI (Peripheral Components). It is important to mention here that one major factor for development of bus technology was the desire to handle graphics on the computer. Since graphics include many data users wanted faster buses.

The latest and mostly available bus technology todate can be seen as 64-bits PCI. As the name implies it gives a novel way for connecting peripherals. So it's a type of peripheral bus rather than a memory bus. It is quite natural that as time goes, sophisticated bus architecture for peripherals is required. This is because the development of computer technology is heavily dominated by invention of new peripherals. Day after day computers connect more and more peripherals.

Peripherals

Since the computer is a versatile machine, it can in principle work with any machine. Stated in another way, there may be a large number of peripherals for computers. It is generally noted that 80% of the cost of a computer is for peripherals. As we mentioned earlier, functionally there are two peripherals, namely, input devices and output devices. There are also some devices, which can work as both input and output devices. For example, monitor of a computer can be considered to be such a device.

It is difficult to provide an exhaustive list of peripherals for computers. However, the following peripherals are commonly cited. They are: keyboard, mouse, light pens, digitizers, scanners, fax machines, bar-code readers, monitors, printers, modems, video phones, plotters and risograph.

It is important to refer here to the impact of peripherals on computers. Clearly, peripherals make computers more and more versatile. This causes the industry to invent new technology for development of computer technology too. For example, when computer wants to support multimedia devices such as sound cards, CD-Roms, video phones, etc. development of the computer technology appeared even at the CPU level. New idea for the development of memories was also inspired by the need for attaching more and more peripherals. New attempts to develop voice input and voice output peripherals have also influenced the development of computer technology.

Trends in computer technology

The rapid development of computer technology is seen everywhere. What has really happened with the development of computer technology? There are five major angles from which one can look at the evolution of computer technology. They are

- Physical size of computers
- Price of computers
- Reliability
- Speed
- Versatility

Size: As technology evolves the physical size of computers becomes smaller. In the early days of development of computers, they were really very big in size. Now the size of a computer has reduced to the level at which one can hold a computer on his/her palm. The new concepts such as Net PCs and mobile or nomadic PCs are examples of development of small computers. Without doubt, in the future computer will necessarily be portable.

Price: Computer technology is becoming very cheap day by day. It is correct to say that there is no commodity, the price of which has been falling at a rate as fast as the computer does. The price of a newly introduced processor cannot remain steady for more than six months, and the arrival of the next technology reduces the prices. At present a powerful personal computer can be bought for fifty thousand rupees. There has also been a decline of price of storage devices (memories) over last many years. However, in the past, memories were even more expensive than processors. Peripheral devices are also becoming very cheap. As the prices of computer and its accessories continue to fall there is a tendency now to hire computers rather than buy them for personal use.

Reliability: Reliability of computers has also gone up in line with the evolution of computer technology. In particular, information storage techniques have been developed remarkably. When memories become cheap it is possible to have bigger RAMs in modern computers. This increases the reliability of running bigger programs. With the ability to perform sophisticated mathematics, computers are capable of giving more accurate answers. With enhanced reliability of computer networks, there is little risk of losing information. It provides the means for multiple backup storage if necessary. Despite the fact that computer software is generally not trustworthy, techniques have also been developed for justifying the accuracy and reliability of large programs.

Speed: More notably, as computer technology evolves, the processing speed of computers has remarkably gone up. As we mentioned earlier, the speed of computers is dependent on the type of computers. In this respect supercomputers are known as the fastest computers todate. They have ability to perform trillions of instruction per second. As in ordinary usage, the concepts like kilo, mega and pico are no longer sufficient for describing the processing speed of even an ordinary personal computer.

Versatility: By definition, computers are versatile machines. Successive versions of computers are becoming more versatile. Generally a computer can be used by itself or coupled with any machine. Furthermore, computers have also established another dimension for human inventions, *viz* intelligent machines. It is evident that computer has the potential to be programmed as if it is intelligent. Computer intelligence can be achieved by means of software technology, which makes it accessible to every ordinary person. No doubt that versatility of computers is unlimited.

Types of Computers

There are different types of computers. They differ in accordance with processing power, physical size, technology, usage, etc. This section briefly discusses four major types of computers. They are microcomputers, minicomputers, mainframe and supercomputers.

Microcomputers: As we have already noted, the concept of microprocessor established a new direction for computer industry. Microprocessor can simply be seen as an integrated single chip of ALU and control unit of a processing unit of a computer. Microcomputers are now heavily used as personal computers. However, modern microcomputers are even strong enough to operate as workstation, ie. a computer that can be connected to several other computers. Microcomputers include desktop, laptop, notebooks and palmtop. The price of the microcomputers is rapidly going down now while their performance is rising. They are popular in houses and offices .

Minicomputers: Minicomputers are bigger than microcomputers in terms of price, size, and performance. The history of minicomputers is also older than microcomputers. The minicomputers are used to computerize systems which are widely distributed. Therefore, minicomputers have the ability to provide service for a large number of clients at the same time. Most of middle range banks, offices, and insurance agencies use minicomputers for networking their institutes. In order to enhance processing power, minicomputers are supplied with more than one microprocessor.

Mainframe: Mainframe computers are much more powerful than minicomputers. These computers are capable of responding to several millions of instructions per second. Mainframe

computers are also very popular for networking large organisations. Main frames are now as abundant as mini-computers.

Supercomputers: Until recently, the computer world was discussing only micro, mini and mainframe computers. However, the idea of supercomputers became popular in the early 1980s. At that time, there were no more than five supercomputers in the world. Now some of our neighbouring countries too have supercomputers. The processing power of supercomputers is extremely high. The speed of super computers cannot be measured using time units such as even nano and pico seconds. The speed of supercomputers is expressed using a unit call Giga Flops. While microcomputers have single processor, supercomputers consist of ten thousand of processors.

Modern computers

Modern development of information technology has led to the development of new types of computers too. In this connection the idea of Internet has made an immense impact on the development of new computers. This is discussed in the next section. Here we discuss the types of computers that emerged from the Internet technology. There are two types of computers, namely, Network computers and Nomadic computers, which emerged from the Internet technology.

Network computers: Network computers are designed to be connected to the Internet directly. The whole idea of network computers is to develop a computer with minimal peripherals and use the resources on the Internet. Therefore even software packages are used from the Internet by logging to the appropriate Internet site. This method of using computers is known as *application server-based* computing. Network computers do not have hard disks type of secondary storage for storing software packages. Another interesting feature of network computers is that they have special type of operating systems that can run on any computer. This operating system is developed using a language called Java which is fixed to the computer in the form of a chip.

Nomadic computers: Nomadic computer is another name for mobile computer. As the name implies these computers can be taken with you while you travel. They can also be connected to the Internet either via cables or wireless connections with the support of a device called the modem. A limited number of these computers are also now available in Sri Lanka .

In the future one will find at least a few Internet sockets just like additional power sockets we find today in our homes, offices and hotels. In the near future we will also be able to connect to any point in 'the world from anywhere else in the world. When you travel, you do not need to bring every thing with you, but only your mobile computer, which provides the means for contacting people you want.

Computer and Communication

In the previous section we discussed the impact of Internet technology on new types of computers. In the modern world the idea of Internet dominates the whole advancement of Information Technology. While computer has taken the place of a universal machine, Internet has become a global channel for communication. This section describes what Internet is; the importance of Internet and how we get connected to the Internet. It is clear that without a description of the Internet, an article on IT will be incomplete.

Computer networks

The Internet can be seen as a product of integration of communication and computer technologies. Stated in another way, the idea of Internet is proof of the capability of computers to work as a machine for communication. The fundamental concept of the Internet is the functioning of computer networks. Some important aspects of computer networks are explained below.

Computer networks provide a means for sharing resource thereby saving resource, time and effort. Connecting of computers into a network is effected by using special devices called network cards. The connection can be established using media such as co-axial cables, twisted pair, fibre optics, radio waves and satellites. All these media have their own potentials and limitations of transmitting data. For example, a normal telephone line or a twisted pair is capable of transmitting only the analogue form of signals. Other media can generally transmit data in the form of digital signals, which are generated by modern computers. Therefore, when we use twisted pair as the communication media, we need additional computer device for analogue to digital conversion and *vise versa*. This device is called a *modem*. The word modem is a common term of the home Internet users. Without a modem one cannot communicate with the Internet via normal telephone lines.

What is the Internet?

The Internet is the world's biggest Wide Area Network. It consists of thousands of computer networks and millions of computers. The Internet is full of resources which are available to users who are connected to the Internet. There is no super owner of the Internet except the fact that one can have one's own regulations for people who wish to access your computer over the Internet. Every computer connected to the Internet has a unique address.

The earliest version of the Internet is known as ARPAnet and was developed in the United State in the early 1970s. The aim of the ARPAnet at that time was to share research information among the American Defense Department and the Research Institutes like universities. In the late 1980s, the Internet had spread to several countries in Europe. Sri Lanka was connected to the Internet in 1995. It was initiated by the university community in Sri Lanka. Later, the Sri Lanka

Telecom and some private sector operators have become involved in the Internet activities.

Services of the Internet

The Internet is a huge collection of information. It can be seen as the world's biggest library. It is also important to mention that the Internet can be used to access the most up to date information immediately. The Internet thus provides the latest information at a very high speed. Furthermore, the Internet has become so attractive to people due to one major reason. It is due to the media used on the Internet. Every communication has a medium such as text, graphics, moving pictures or sound. The specialty of the Internet is that it provides a multimedia communication system. Stated in another way, information on the internet can be received in all forms such as sounds, texts, graphics and moving pictures even in three dimensional perspectives. The multimedia support in the Internet is highly inter connected. You can navigate over the computers connected to the Internet within few minutes using various multimedia supports.

The programs that run on a computer in the US can be accessed and one can see them as if they run on one's computer. One can also consult one's medical specialist over the Internet and let him examine one's medical reports on the Internet. This concept has led to the idea of Telemedicine, which is now becoming very popular. Nowadays people can advertise their business and requirements on the Internet. Most journals, newspapers and magazines and even marriage proposals are now being advertised on the Internet. There is no need now to wait until an expert arrives to teach about something one do not know. It is just a matter of connecting to the Internet and searching for the information one needs. Within a fraction of a second the Internet can show you a list of sites (or computers connected to the Internet) from where one can learn what one wants. The Internet is supplied with very handy searching mechanisms over the Internet.

In a broader sense, the traditional teaching is no longer required. The Internet now provides a fast and effective open learning strategy in the mode of distance learning. However, you never feel a distance between you and the knowledge source when you use the Internet. The Internet has reduced the communication gap to zero.

The Internet has also promoted business deals on the Internet. This is known as electronics commerce and it emerged in mid 1990s. Using this concept you can do shopping while you are at home. It is called Internet shopping. Latest technology called Virtual mall even allows you to bargain while you do Internet shopping.

Over the last few years the Internet technology has been capable of bringing all communication aspects on to the Internet. For example, radio and television broadcastings are now added to the Internet. This makes it possible for everyone to listen to the radio or watch television programs over the Internet. You no longer need a radio and television at your home if our broadcasting services are made available on the Internet. In the future there will be no need for many different machines at home. Instead a single computer would suffice.

The number of services available on the Internet increases exponentially. However, there are some popularly cited facilities, namely, E-mail, Telnet, Usenet, FTP and WWW (world wide web). The following is a brief description of these services.

E-mail: Electronic mail or E-mail is the most elementary and oldest facility using the Internet. The electronic mail operates in a same manner as normal mail but electronically. E-mail is much faster and cheaper than ordinary mails. In sending Emails you just need to know the email address of the recipient of the mail. Email is basically a method for transferring text-based documents. However, these days the idea of voice-mail is also emerging.

Telnet: Telnet is a service provided by the Internet for logging to a remote computer. One can use the Telnet command followed by the Internet address of a particular computer to be logged on. If the remote computer has no access restriction you may login to the computer without any trouble. If they have any access restrictions, we need to get a user name and a password from owners of the remote computer. Once you log in to a remote computer you then actually work with the remote computer.

Usenet: The Usenet facility is used to communicate among people who belong to a particular group. In contrast to E-mail, Usenet provides a means of getting responses on line. So you can discuss as if members of the group are seated together. There are various groups using the Usenet facility on the Internet. The recent development of the IRC or Internet relay chat is an improved facility available to Usenet idea.

FTP: The FTP or File Transfer Protocol is a facility on the Internet for exchanging files between two computers. This facility is very much used by research community for receiving and sending journal articles to various places using the Internet. This saves a lot of time and money required for sending and getting a document over the ordinary post. FTP can be used for exchanging documents with both text and even complicated graphics.

WWW: The World Wide Web is a fascinating technology on the Internet. It provides a graphical user interface for interacting with the Internet. The multimedia power of the Internet is embed in the WWW technology. Using WWW, the texts, graphics and other media on the Internet are linked all over the Internet sites by means of a technology called *hypertext*. The WWW technology allows us to navigate over the Internet sites all over the world using multimedia supports. The web technology was added to the Internet in early 1990. Since then the Internet has become very popular and user friendly. Most of the recent

advancements of the Internet are very much attributed to the WWW technology.

Connecting to the Internet

Although there is no owner of the Internet one cannot directly connect to the Internet. This is because the Internet media such as cable, waves and satellites are not free of charge. In every country one finds agencies that will connect one to the Internet. These agencies are called Internet Service Providers (ISP). In Sri Lanka there are at least ten ISPs. One can get the Internet services via these people by paying some amount of money which is generally dependent on the type of service they provide. This method of connecting to the Internet is called dial-up Internet. Once you get the connection from an ISP you can connect your home computer to the Internet, through ordinary telephone lines, using a modem. Thereafter you will dial your ISP and get connected to the Internet, use it and later pay your telephone bills for connecting you to ISP.

If one has the means to invest like in a big company (or a university) one may get a dedicated line for connecting one to the Internet. Since others do not use one's dedicated line one can connect to the Internet at any time without waiting for a free connection. However, it should be noted that the dial-up Internet connections are much cheaper than dedicated line connections.

IT and Our Society

It is evident that the IT dominates the development of the whole world. Undoubtedly, IT has given an additional boost for the developed countries. However, if IT does not spread to the poor countries in a systematic manner, the gap between the developed countries and the third-world countries becomes even bigger. This section discusses how IT development should be treated in a country like Sri Lanka.

A resource such as the Internet is an essential technology for a country like Sri Lanka. It has special relevance as it has on other natural resources such as petroleum, mineral, metals, etc. Its strength and future is very much dependent on education. We need to have therefore a sufficient exposure to the modern world, and IT is a must.

It should also be noted that IT has made the people in the third world countries intellectual laborers for the developed countries. They have been working as good programmers or software users. Unfortunately, we have forgotten the need for going beyond just being users. In the modern IT world, we are lagging very much behind in research activities. Therefore we have fully relied on the technology invented by developed countries. If the country does not concentrate at the level of research development in IT, we will be in trouble in the future as a result of our not keeping pace with modern development in IT. It is sad to say that the current practice of IT in Sri Lanka is very much limited to the use of software invented by the developed countries. We should not forget that developed countries continue to work intensively in research and development while we are just users of their inventions. To cite an example: Intel has announced that they no longer produce MMX 200 microprocessor. In this situation can we afford to lose our computer with MMX 200 processor if it needs repair. It is true that world is moving along with the development of IT. Does that really imply that all are equally benefited? The role of most of computer literate people in Sri Lanka now is only local advertising of IT inventions by the developed countries. This is sad.

Questions are raised by some about ethics and social effects of development of IT. Since IT has broadly opened the channels of communication, it is natural that both socially good and bad values spread equally. Viewing impartially, the fault is with humans, but not with IT. It should be noted that whether we invent new IT or not, elsewhere the world would continue doing so. Therefore, we should join the research development process and compete by inventing new technologies with others. This will help us at least to protect our social values. Otherwise we have to get IT consultancies from developed countries to protect our heritage! It is indeed an irony that we do not invent anything but criticize others that their inventions are a threat to mankind. It is very difficult to believe that Sri Lankans generally do not venture into research since the inventions can be harmful to the mankind!

Internet issues such as security, privacy and virus hackers are of common concern in countries like Sri Lanka as we are now just users of the Internet. Are we suggesting that other people in the world should invent peaceful technologies for mankind while we just relax? With the development of IT, the need for connecting us to the world research development is very important. *There is no social threat and danger other than the lack of knowledge and dependence on others' inventions.*

Future of the IT

The Internet: IT dominates development in the modern world. In this situation computer has been a versatile machine with numerous capabilities. With the help of computer technology, the communication gap between two physical points has become insignificant. The Internet technology has the potential to promote various dimensions of the modern development. In the near future the Internet will be the most potent means of communication. It is evident that computer technology itself has been developed in the direction of network computers and nomadic computers. Furthermore, Internet technology has given rise to development in the software technology too. For example, software concepts like agent, intelligent agent and multi-agents have emerged due to the usage of the Internet and the influence of Artificial Intelligence. The traditional education methods will be replaced by the Internet technology to a greater extent. The whole world may evolve towards a global village.

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Intelligent machines: The idea of Intelligent machines has a great potential to grow up and integrate with the communication technology. The tradition of intelligent software has influenced all software industry. In the future we may be talking of a form of Intelligent Information Technology. Without doubt, the ultimate aim of inventing artifacts should lead to the development of intelligent machines. This is because all these inventions are products of human intelligence.

AI has already drawn from biological inventions such as models of human brain and genetics for developing intelligent systems such as: neural networks and genetic algorithms respectively. In the future Genome project will have a potential to contribute to the development of Artificial Intelligence in new directions. In the philosophical sense one can notice three information realms, namely, genetics, culture and artifacts. While computer dominates the artifactual aspect of information technology, other realms of information are also being developed rapidly. In this sense there will be lot of merging of different disciplines in the future. There will be a decline of sustainability of disciplines in isolation in the future.

Concept of time: Ever since the civilization of mankind, the concepts of time and space have influenced most of the advance development. The way people look at the concept of time has shown new direction of development. For example, during the last decade of the previous century, different views on the concept of time emerged. As a result of these, most influential sciences such as quantum theory and relativity emerged. If these two theories were not developed during this century, there would not have been development of IT of this nature, today. It should be noted that IT is driven entirely by digital technology. Digital circuits are made with semiconductors and the behaviour of semiconductors is explained using modern quantum theory. How the concept of time may be influential in the development of the next century is discussed below.

As we are approaching the year 2000, computer industry and whole of IT or the whole world is going to face a problem known as the *millenium bug*. It leads to problems of handling of time in computers in an unexpected manner. The cause for this problem was that in the early days of computers, storage (memory) was very expensive. Therefore people decided to use only the last two digits for representing a year. For example, 1995 is referred to as 95 by the computer. Now, imagine year 2000, which in the last two digits is referred to as year 00. The calculation related to date and time will give you negative or strange values. In the year 2000, one's age will be a negative number.

Although people are talking of the millenium bug, nobody really knows the real issues that we are going to face in the year 2000. We also do not know how to resolve this issue. There is also no clear understanding of where the problem resides. Some say that the issue is embeded in three levels, hardware, operating systems and application software. If the problem is there, the software can be rectified. However, you cannot do so easily if the problem is in the operating systems. If the issue is with the hardware you may have to throw away your computer. However, debugging must be done everywhere. Otherwise there will be numerous conflicts.

In view of this an interesting feature can be seen behind the millenium bug. That is, it may give new experiences about how the concept of time makes the whole world complicated. Novel ways of looking at the concept of time have always led to the development of new theories. Perhaps, the millenium bug will be a blessing with regard to the development in the next century.