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Computer and its application in the emerging world

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Abstract

Computer is an electronic device which is very useful today in every aspect of life. It has made our life so easier. It is most important tool in the process of research. They allow work to be done faster than human beings in a better and systematic way. The main advantage include that it can store large amount of information confidentially. They are being used in different fields such as education, banking sector, artificial intelligence, simulation studies etc. The paper mainly focuses on the history of computers and their application in various fields.

Introduction

The word computer is derived from word 'Compute' which means to calculate. A computer is an electronic machine which is used to process store and retrieve data. It can perform any task within seconds and can store large amount of data. The use of computers has reduced the paper work. They are being used in each and every field from education to research. It allows us to do the work in more effective manner in a short duration of time. It is basically a device which take instructions from the programmer and perform the operations as required. [1]

Charles Babbage is known as the father of computer. The history of computer is very old. The invention of calculating machine by Blaise pascal in 1642 started the use of machine in industry. The computers were invented not only for purpose of entertainment, they were basically designed to solve the serious problems and make the work to be done in an easier and cost-effective manner. [13]

History of computers

The use of computers was first started by United states in 1880 for easily calculating US census results because otherwise it used to take years to calculate results. For this government developed Punch card-based computers which covered entire room space. The invention of computer involved following series of events:

- In 1623, first mechanical calculator was developed by Wilhelm Schickard which was a working calculator.
- In 1673, digital mechanical calculator was developed by Gottfried Leibniz which was known as Stepped Reckoner. He was also the first computer scientist to document the binary number system.

- In 1801, looms were developed by Joseph Marie which used wooden cards for fabrication in France. The computers also used punch cards.
- In 1820, First mechanical calculator industry was established by Thomas de Colmar which could be used easily in office on daily basis.
- In 1822, Charles Babbage, known as the father of computer built first computer.
- In 1843, an algorithm for computation of Bernoulli numbers was written by Ada Lovelace. It was the first algorithm published for computer implementation.
- In 1885, tabulator was invented by Herman Hollerith in which punch cards were used for the processing of statistical information. This also became the part of IBM company.
- In 1890, punch card system was designed for calculation of 1880 census by Herman Hollerith which save the 5million dollar of government and help in completing the task just in three years.
- In 1936, Alan Turing developed Turing machine which can calculate anything which is computable.
- In 1937, first computer was developed without gears, belts, shafts and cams by J.V. Atanasoff at Iowa state university.
- In 1941, a computer was designed by Atanasoff and his student Clifford Berry which can solve simultaneously 29 equations and was able to store the information in memory.
- During 1943-1944, John Mauchly and J. Presper Eckert developed ENIAC (Electronic Numerical Integrator and Calculator) which had 18000 vacuum tubes and was known as grandfather of digital computers.
- In 1946, funding was provided by Census bureau to Mauchly and Presper for building UNIVAC which can be used for business and government purpose.
- In 1947, transistor was developed by John Bardeen, Walter Brattain and William Shockley for making electric switch.
- In 1953, first computer language COBOL was developed by Grace Hopper.
- In 1954, a programming language, FORTRAN was developed by John Backus and his programming team.
- In 1958, a computer chip, called as integrated circuit was developed by Jack Kilby and Robert Noyce for which Kilby received a novel prize in physics in 2000.
- In 1964, a prototype of modern computer was developed by Douglas Engelbart along with Graphical user interface (GUI) and mouse. It allows the easy access of computers to general public.
- In 1969, an operating system, UNIX was developed by Bell labs which was written in C programming language. It was not

useful in-home PCs, only useful in mainframe computers used by large companies.

- In 1970, the first dynamic access memory chip, Intel 1103 was developed.
- In 1971, floppy disk was invented by Alan Shugart and a team of IBM engineers which was used to share data between computers.
- In 1973, Ethernet was developed by Robert Metcalfe for setting connection between different computers and hardware.
- During 1974-1977, a large number of personal computers entered into market which included IBM 5100, Mark -8 Altair etc. In 1975, first minicomputer Altair 8080 was developed for which Paul Allen and Bill Gates wrote a software using new BASIC (Beginners All Purpose Symbolic Instruction Code) language. Two childhood friends started a company 'Microsoft' on April 4th. In 1976, Apple computers were started by Steve Jobs and Steve Wozniak.
- In 1978, a computerized spreadsheet program, VisiCalc was developed.
- In 1979, a word processing tool WordStar was developed for adding margins and word wrapping.
- In 1981, the first IBM personal computer was developed which was based on MS-DOS operating system. It consists of two floppy disks, intel chip and colored monitor.
- In 1983, first personal computer Apple's Lisa was developed which uses Graphical User Interface (GUI). Also, the first portable computer Gavilan SC was developed and was marketed as laptop.
- In 1985, windows came into use which has audio and video accessibility.
- In 1986, Deskpro 386 came into market by Compaq.
- In 1990, HTML (Hypertext Markup language) was developed Tim Berners-Lee which led to rise of world wide web.
- During 1993 and 1994, the use of games, music and graphics was accessible on PCs.
- In 1996, Google search engine was developed at Stanford University by Sergey Brin and Larry Page.
- In 1999, users connected computer without wires and Wi-Fi term came into force.
- In 2001, Mac OS X was provided by apple which provided multi-tasking benefits. Later on, windows XP came into use.
- In 2004, Microsoft internet explorer was challenged by Mozilla Firefox and Facebook was developed.
- In 2005, YouTube was founded and Android, Linux based mobile phone operating system was developed.

- In 2009, Windows 7 was developed by Microsoft which has other advanced features.
- Later on, Windows 10 was launched by Microsoft in 2015.
- In 2017, Molecular informatics program was developed by DARPA (Defense Advanced Research projects Agency) to use molecules as large number of molecules exist which possess different atomic structures in a 3D form. [6]
- In 2019, Google claims that it has developed quantum supremacy in which computers have advanced functions which can solve quantum problems that cannot be solved by normal classical computers which are being used. [8]
- Currently work is being done on development of these quantum computers which will use biomolecular technology and spintronics. [9]
- The history of computers includes five generations as follows:
  a) First generation of Computer (1937-1946) – In this first digital computer was built by Dr. John V. Atanasoff and Clifford Berry. The first digital general-purpose computer ENIAC was also developed during this generation. [14]
  b) Second generation of computer (1947-1962) – It allowed the use of transistors instead of vacuum tubes. In 1951, UNIVAC 1 (Universal automatic Computer) was introduced. In 1953, International Business Machine IBM 650 and 700 series computers were introduced.
  c) Third generation of computer (1963-1975) – Integrated circuit were invented which decreased the size of computers and allowed to run multiple programs at one time.
  d) Fourth generation of computer (PC 1975-Current) – Microprocessors were developed by Intel. It contained large number of transistors which could perform all functions of central processing unit.
  e) Fifth generation of computer (Present and Beyond) – It is based on Artificial Intelligence and include various applications such as thumb print, recognition of voice etc. which are used today. [15,16]

Uses of computers in various fields [7]

1) Use of computers in Simulation –

It is used to study behavior of a particular system on computer. It is basically simulation of any process or system. In this a model is designed which simulates the system. It is used in various fields like engineering, pharmacy, economics etc. [28]

In pharmacy, computer simulation plays an important role. It helps in simulating complex

system like human body which help in understanding this complex system and its functioning so that safe and effective medicines can be developed easily. [1] It basically uses placebo drug for determining the effectiveness of active drug. [29] The use of computers in pharmacy was started around 25yrs ago. It involves series of steps as:

a) Formation of model of real system.
b) Perform simulation study.
c) Obtaining simulation results.
d) Comparison of these simulation results with real system. [1]

For computer simulation in pharmacy, various softwares are used such as Minitab, Design expert etc.

History of computers in pharmacy

Before 25yrs ago, the use of computers by scientists and various pharmaceutical companies can't be think of but today they are the essential part which are used for generating, managing and transmitting information. Max M. Marsh was the first person to use computers for drug designing in pharmaceutical industry. He first started an industrial research program to use computer for drug designing. Their use was first presented at Don Boyd's third annual CICCCL-3 at Eli Lilly & company on 18 Dec. 1997.

The history of computers in pharmaceutical field include following phases-

1) The Germination phase- The 1960s
2) Gaining a foothold- The 1970s
3) Growth phase- The 1980s
4) Fruition phase- The 1990s

The Germination phase- The 1960s

In 1960, 100% of computational chemists were in academic not industry and were called as theoretical or quantum chemist instead of computational chemist. The students from academics were hired for drug discovery using computers by industries. The X-ray crystallographers were also educated for the use of computers. In 1960s, the computers were kept in locked room and was only accessible to engineers and programming consultants instead of ordinary users. The largest computer which was used by crystallographers and theoretical chemists was IBM 7094. These IBM cards were manufactured in different colors and was used to store data containing no backspace or delete key. In 1962, Quantum Chemistry program exchange software was discovered which was initially used for exchanging programs and electronic structured calculations. There were several other companies working for drug discovery like Abbott, Upjohn etc.

Gaining a foothold- The 1970s

In this phase, some of the companies backout due to lack of management support. Merck& Smith Kline and French was another company who entered this field and hired chemists which

were trained in organic chemistry and computers. At Eli Lilly, IBM3278 and Dec writer II was used by computational chemistry group. In 1973, a program name Gaussian 70 was invented and later on Gaussian 76 and 80 were made commercialized. A software named MMI was invented which was used for molecular mechanics. Then, two other computer-based resources were developed by pharmaceutical companies – a) Cambridge structural database b) Protein data bank supported by American taxpayers.

Growth phase – The 1980s

In this phase various softwares were developed ChemDraw, MOPAC, CLOG P, TOPKAT, CADD, QSAR etc for various purposes. First computer VAX 11/780 was developed by digital equipment corporation in 1979. Then in 1986, chem draw software was developed for drawing 2D structures. In 1978, Prof. Todd Wipke with his coworkers founded a company which marketed a program called MACCS for database management. Then, a software named MOPAC was developed for optimizing geometry of molecules. In 1980, CLOG P was developed by prof. Al Leo for determining lipophilicity of molecules. TOPKAT was developed by Dr. Kurt Enslein for measuring toxicity of molecules. SBDD (Structure based Drug Designing) was developed in 1960. Then, QSAR (Quantitative structure activity relationship) was used for discovering Norfloxacin in 1982 and X-PLOR was developed for determining protein crystallography by Dr. Axel Brunger. Later on, in 1980s, super computers were developed. [10,11]

Fruition phase – The 1990s

In this phase many chemical entities reached the market place which were developed by different softwares. In this phase supercomputers were also brought to market by a pharmaceutical industry Cray by collaborating with Eli Lilly company. Some of the drug molecules are: [12]

S.No.	Generic name	Brand name	Approval year	Software used for discovery	Pharmacological activity
1	Losartan	Cozaar	1994	CADD	Antihypertensive
2	Lopinavir	Aluviran	2000	SBDD	Antiviral
3	Norfloxacin	Noroxin	1983	QSAR	Antibacterial
4	Dorzolamide	Trusorpt	1995	CADD/SBDD	Antiglaucoma

QSAR- Quantitative structure activity relationship; SBDD- Structure based drug designing; CADD – Computer aided drug designing.

The use of computer simulation in other fields are:

1) Used in weather forecasting in which computer models are used for predicting. [27]
2) Used for giving training to pilots.
3) Help in testing safety of new vehicles.
4) For designing of robots and robot control algorithms, robot simulators are used. [30]

2) Use of computers in Artificial Intelligence –

It is an important tool of computer science. It helps in developing machines which have human like intelligence. [17] It has expert system and neural network. An expert system provides advice for solving problems which otherwise require human expert. Neural network helps in processing information in a similar way the brain processes and analyze the results and situations which may occur. Various expert systems are:

a) Puff: It is used for diagnosis of pulmonary diseases.
b) Dendral: It help in identification of structure of chemical compound by using mass spectroscopy data and its constituent elements.
c) Mycin: It helps in diagnosis of various blood diseases and provide suitable therapy for patient. [2]

3) Use of computers in medical field:

It helps doctors to store information of patients like their medical history, current status of health etc. and can be accessed anytime, anywhere easily. In case of emergency, doctors can assist other doctors through video conferencing and also contact patient. They are used in hospitals for performing diagnostic tests like MRI, CT scan etc. [23] The important applications are:

a) In computer assisted surgery, computer technology is used planning surgery which provide guidance to doctors to perform surgical operations easily and effectively.
b) In the field of radiology, it helps the doctors in interpretation of various medical images obtained in ultrasound, MRI, CT scan in a very short duration of time. [3]

Computers are used in the hospital for storing information of patient like their billing, discharge, registration records. For analysis of data in the medical field various softwares are used like biomedical computer package, Genstat etc. [20] Epi-Info is a software which is used by WHO (World Health Organization) for studying epidemiology. A tool called computer assisted decision making help the doctors in making clinical decisions. [19,21,22]

4) Use of computers in the field of management:

Computers play a key role in our daily life which help to perform any task easily and quickly. They are used in banks for maintain accounts and record of their customers. Mainframe is the backbone of any bank which performs various operations simultaneously like as keeping record of various interests and earnings of banks, perform analysis of financial markets and can easily contact with other branches of bank within the world. ATMs which have computer units allow the customer to withdraw cash, deposit cash, check account balance anytime easily. They all are connected to mainframe of the bank

where all the data is stored. There are teller computer terminals which allow customers to easy access to their business and personal overseas accounts and make payments easily.

Computers also play an important role in the field of e-commerce which allow the business partners to connect to each other through computer network. It allows people to conduct meetings online without being present at the place physically. It also allows users to buy, sell and exchange products using computer network. [4,18]

5) Use of computers in the field of Education:

The gaining of knowledge using computers is a part of modern teaching which allow students to obtain information and gain knowledge using internet on computers. It is the storehouse of information and also the information can be easily stored and obtained easily whenever needed. It allows distance learning which has removed the limitation to only physical classrooms and labs. The various softwares on computer allow providing information in a effective manner by using animations, making presentations. [1] It can act as a helpful tool for students who cannot afford expensive books. It helps in doing research work and submitting the thesis and projects work online using e-mails and different academic links. It helps in connecting with the world and getting day to day knowledge. The introduction of computers has replaced traditional blackboard with electronic whiteboard. [24,25]

6) Use of computers in the field of Defence

In the field of defence, they can be used to track the missiles and destroy them to save country. In this field military computers are used which must comply with the FIPS (Federal Information Processing Standards) 140 standards. The use of computers in ships and planes allowed to attack the enemy easily and diagnose and control the problems. They can be used to maintain records which can be retrieved easily after years also. They are also used in Intercontinental Ballistic Missiles (ICBMs) which uses GPS system. [5, 26]

7) Use of computers in Transport

By the use of computers or mobiles, everyone is able to book tickets, can check the status of train or flights by using different softwares like where is my train, NTES, Rail connect etc. Now a day, trains are fully electronic. [31]

8) Use of computers in Institutes and Offices

Computers are the major part of human's life. Computer is used in institute, factories and offices for the biometric purpose like for thumb impression, face recognition. For various other things like Aadhar card, pan card, bank account,

thumb impression and face recognition is required. [32]

9) Use of computers in 3D printing:

3D printing also known as additive manufacturing is a process off producing an object by successive layering. This technique was first started by Hull. The term 3D printer was patented by Michael Cima and Emanuel Sachs in 1993 for the manufacturing of plastic, metal and ceramic parts using 3D printer. Now this technology is used widely for manufacturing of medicines and different human scaffolds. In this technique, Computer aided design program is used which convert file into .stl format and 3D model of object is produced by 3D printer. [33]

10) Use of computer in the field of bioinformatics:

In the field of biology, large amount of variable data is available. The use of new screening, statistical and computer-based techniques has made work easy and reliable. Molecular computing and bioinformatics play important role in study of molecules using computer by developing softwares. Now molecular genetic analysis has become easier. Due to development of new generation sequencing technology, the biological data of DNA, RNA and protein scaling has increased widely. As a result, bioinformatics tool has led to development of new drugs, understanding mechanism of disease, diagnosis and treatment faster using different software packages developed. By combining biology and computer programming, different softwares have been developed such as MEGA7.0, BLAST (Basic Local Alignment Search Tool), GSDS2.0 etc. [34,35]

Conclusion

The above applications of computer show that it has made our life easier. The use of computer simulation helped in saving the money and time which is required for development of new molecules. It has led to increased research in the field of pharmacy. The use of artificial intelligence has caused development of new machines with required characteristics in short duration of time. The use of internets on computer has led to e-learning which was not possible earlier. So, it depicts computer as an essential tool of our daily life.

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