A Comparative Study of Early V/S Modern Computers

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Abstract- We knows that day by day advancement in technology is under growth. A lot of latest devices are discovered who play a vast role in development of technology. In this paper emphasis has been given on the gradual and continuous advancement of computers. A simple device like computer has witnessed many significant changes in its manufacturing and development. By and large, the changes are conceptual, manufacturing and in ever increasing applications. This paper gives the view of all computing devices

Keywords: computer, abacus, napier bones, punched cards, analytic engine, vacuum tubes.

I.   INTRODUCTION

It is quite apparent and significant that in our daily life, we need to keep written records what we have done in the past, basically in the form of numerals to increase productivity, growth and efficiency. In last years a man has to work hard for performing any task like table, logarithmic table and trigonometric. From the history of computational work done in the past, man has observed the following demerit in the manual computational work. The demerits include:
•   It is difficult to work for a person for a long period.
•   short memory problems
•   repetitive task is boredom
•   There are so many errors in results
•   It is not efficient for scientific calculation. In order to find the solution of the above problems, man has been continuously searching and inventing machine to replace man with machines to get the desired and accurate result. So in this paper, some of the early but significant achievements of man in the field of computing have been enumerated as under[1].

II.   DEFINITION

a) Computer in the past The term 'computer' is derived from the Latin word "computare" meaning to calculate. In the past, computer is restricted only to arithmetic calculations.
b) Computer in modern form Computer is defined as an advanced electronic device that takes raw data as input from the user and process these data under the control of set of instructions called program and gives the result called output and saves output for the future use[1].

III.   EARLY COMPUTERS

a) Computers before 300BC Men/Women- During this period, the word computer was used to describe human beings. Their primary job was to perform the repetitive calculations like navigational tables, tide charts and planetary positions for astronomical almanacs. Therefore, we can say that a group of intelligent women were first computers.
i. Disadvantages of human computer
• Repetitive job is boring
• Carelessness leads to error
• Not good and efficient for longer period of time
• Accuracy problem
• Team work
• A lot of space needed to set up laboratory/office
• Time consuming
These problems forced man to search for a new method, device, technique or a mechanism to solve real world problems quickly, accurately and efficiently[1].
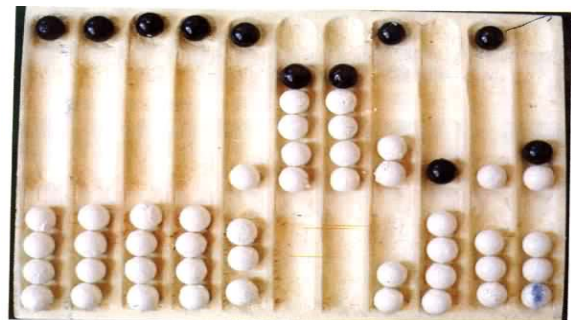b) Computers at 300BC

Figure 1. A very old Abacus
To get rid of human errors, man had developed a calculating machine called ABACUS. It was first developed, invented and used by the Babylonians. i. Salient features of Abacus
• Abacus aids the memory of the human performing the calculation.
• Addition and subtraction can be done efficient Accurate results can be obtained The Abacus is still in use today, but multiplication and division are slower.

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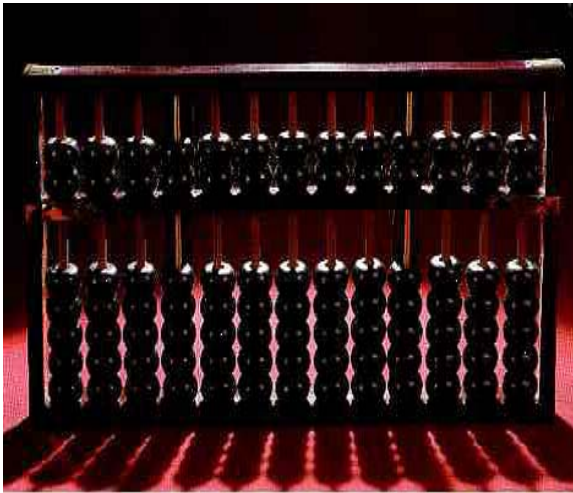Guru Nanak College Budhlada, Punjab India

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Figure2. Modern Abacus

In 1623 a new calculating device is discovered.
Calculating clock: It is the first gear driven calculating machine[3]. It is invented by the German professor Wilhelm Schickard.
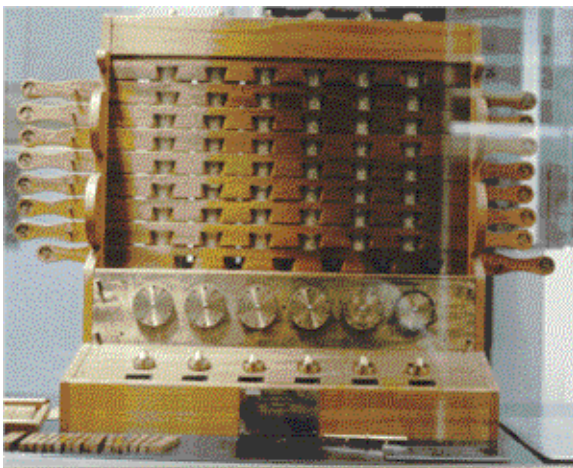

Figure3. Calculating Machine

After this a new calculating machine is discovered In 1642 Blaise Pascal invented the gear driven Pascaline to add numbers[1].
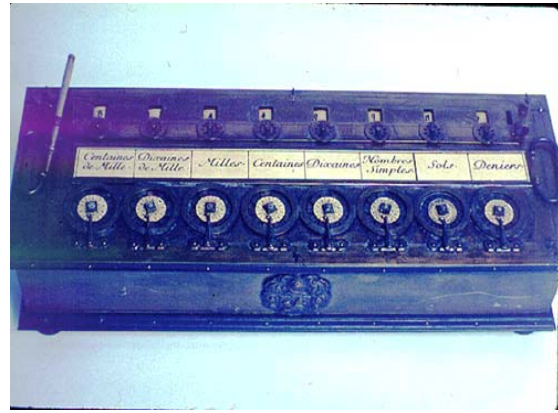

Figure 4.Pascal's Pascaline

In 1801 Joseph Marie Jacquard: A Frenchman who invented a power loom. This invention paved the path for inventing punched card. The invention of punched is considered as the major contribution and development in the development of advanced computer[2].

Figure5. Punched card

In 1822 Charles Babbage: The English mathematician proposed a stream driven calculating machine called Jacquard's power Loom with punched card[4].
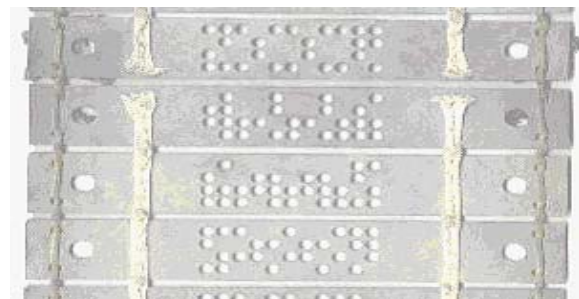

Figure 6. Jacquard's power Loom with punched card
The development of the Analytic engine with the idea of "store" and "Mill" is considered as the major breakthrough in

computer history because in a modern computer the same kind of parts are called the memory unit and the central processing unit (CPU).Due to this reason only, he is called the father of modern computer[1].

h) 1890

Hollerith: He had the insight to convert punched card to what is today called a read/write technology. Hollerith built a company[5], the tabulating machine company which after a few buyouts eventually became International Business

Figure 7.Babbage's Difference Engine

machines, known today as IBM Difference engine. The machine would be able to compute tables of numbers, such as logarithmic table. But unfortunately the project of Difference Engine failed due to over expense. Soon after Babbage had introduced a new machine called Analytic Engine powered by six steam [7] engines. In this project Babbage had used punched card to store numbers for future use and a mechanism to get result. Charles Babbage had divided Analytic Engine into two parts the "store" and the "Mill". The term "store" indicates the place where numbers are held and the "Mill" indicates the place where numbers are processed to give new results.

IV. SOME APPLICATION OF MECHANICAL COMPUTER

• Efficient in arithmetic calculations like addition, subtraction, multiplication and division[6].

• Using these computer man has succeeded in preparing logarithmic table and trigonometric table.
• The computers were restricted only to scientific use.

A. Parts of Early computer

• Human Brain-(Human Intelligence) - Before 300BC
• Abacus-Rings, Rods, Pebbles
• Napier Bones - Ivory sticks carved with numbers
• Calculating Clock - iron gear driven calculating machine
• Pascaline - gears and cylinders
• Leibniz stepped reckoner - ten flutes drum
• Jacquard power loom (punched card)- punched wooden cards
• Difference engine/Analytic engine -steam engines and punched cards
• Hollerith desk ---- holes cards, a gear driven mechanism
• Mark 1---- switches, relays, rotating shaft and clutches and electric motor
• Vacuum tubes----- three legged arrangement to

Transistors----- Germanium, paper clips and razor blades
• IC (Integrated Circuit) ---- transistors
• DRAM ---- capacitor (To store data in the form of electric charge)
• ENIAC ------ vacuum tubes, card readers, patch cords
• UNIVAC ------- magnetic tapes
• Drum memory------ metal cylinder coated with recordable ferromagnetic material
• Magnetic core memory ----- ferrite core memory, magnetic ceramic rings

V. DEVELOPMENT AND INVENTION OF ELECTRONIC DEVICE/COMPUTER

A. 1943 ENIAC--- (Electronic Numerical Integrator and Calculator).It was the first electronic digital computer, built at the university of Pennsylvania between 1943 and 1945 by two professors John Mauchly and J.Presper Eckert. ENIAC requires 20 by 40 foot room, weighed 30 tons, and used more than 18000 vacuum tubes.

1944

Harvard's Mark1: He built partnership with IBM and developed the first programmable digital computer in USA. But it was not a purely electronic computer. He had used switches, relays, rotating shafts and clutches. The Mark1 was capable to operate on numbers that were 23 digits wide.

B. 1947

William Shockley, John Bardeen and Walter Brattain: They successfully build the first transistor at Bell Labs. In 1950 William Shockley develops the bipolar junction transistor, the device most commonly referred to as a transistor by today's standard. The invention of transistor in 1947 is considered as a revolution because in digital computer like ENIAC it quickly replaced the

traditional vacuum tubes. Strong reasons for the replacement are as under:
• Transistors amplify current much more quickly than vacuum tubes.

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International Conference on
Recent Trends in Computer Science & Information Technology (RTCSIT-2016)
21st August 2016
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• Transistors do not generate lot of heat whereas vacuum tubes generate lot of heat.

• Transistors size is very small and light weight in comparison to vacuum tubes. So transistors helped a lot in making small size computer.

• Transistors do not generally burn whereas vacuum tube has a tendency to burn. So vacuum tubes are not cost effective, reliable and safe. For instance, the first digital computer ENIAC used around 18000 vacuum tubes that constantly burned out, making it very unreliable, problematic, unsafe and erroneous.

C. 1958

The development and invention of IC (Integrated circuit) took place in the year 1958 by twogreat engineers Jack Kilby and Robert Noyce. The development was the result of the microelectronics

revolution started in 1947. In an IC millions of transistors can be created and interconnected. All the elements on the IC are fabricated simultaneously via a small number (may be 12) of optical masks that define the geometry of each layer. The development of IC speeds up the Importance of IC in modern computer development The impact of this tiny chip has been far reaching. The chip virtually created the modern computer industry, transforming past room size

machines into today's array of mainframes, minicomputers and personal computers.

VI.   DEVELOPMENT   OF MODERN/FOURTH GENERATION COMPUTERS

a) 1970—1972

Invention of RAM: Between 1970 and 1972 computer memory on an IC or chip was developed. This memory was named as random Access Memory (RAM). It allowed data to be accessed randomly, not just in the sequence it was recorded. DRAM (Dynamic Random Access Memory) is the most common kind of RAM for personal computers. Intel released the 1103 chip, the first generally available DRAM memory chip. The introduction of 1103 DRAM was considered as a turning point in the history of IC. For the first time, significant amount of information could be stored on a single chip.

A.   Generations of Electronic Computer

Major technological changes in the development of modern electronic computer are referred to as generations of computer. The technological changes in the development of computer resulted in smaller, cheaper, more powerful, more energy efficient, low maintenance, good performance and fast computer. The development of electronic computer has witnessed the following five generations.

a) First Generation of computer (1940-1956)

• The first electronic computer used vacuum tubes for circuitry and magnetic drums for memory.

• Dependent on machine language.

• The first generation computers are UNIVAC and ENIAC.

b) Second Generation of Computer (1956-1963)

• Transistors replaced vacuum tubes. This allowed computers to become smaller, faster, cheaper, more energy efficient and reliable than first generation of computers.

• Second generations of computer used punched cards for input and printouts for output.

• Assembly language was used instead of machine language.

• Magnetic core technology was used for memory instead of magnetic drums.

c) Third Generation of Computer (1964-1971)

• Integrated circuit (IC) replaced transistors. Transistors were miniaturised and placed on silicon chips called semiconductors which drastically increased the speed and efficiency of computers.

• Keyboards, monitors and operating system were introduced in this generation.

• Computers become accessible to a mass audience.

d) Fourth Generation of Computer (1971-2005)

• Microprocessors replaced IC. Example Intel 4004 chip.

VII.   ADVANCEMENT   IN   FIFTH GENERATION COMPUTING

The fifth generation computing is totally a new concept of developing computers. It does not match with the past or early developments of computer. In this generation of computer man is trying to incorporate the human characteristics or features like outstanding problem solving ability, high level deliberative reasoning, and pattern recognition. The approach definitely remove the demerits of fourth generation computer and will prove to be a more reliable and versatile machine ever made by mankind. The new techniques used to achieve the above target are Artificial Intelligence (AI), voice

recognition, quantum computation and Nanotechnology. Here, we first try to understand the following terms one by one.

•   Artificial Intelligence (AI)

It is a branch of science that believes in making computers or machines that can find solutions to

complex problems in a more human like fashion. Research on AI has focussed chiefly on the following components of intelligence: learning, reasoning, problem solving, perception and human language understanding.

•   Applications of Artificial Intelligence (AI)

• Advance computer game playing and robotics pets.

• Speech recognition by a computer

• Understanding natural language by a computer

• Identifying 3 dimensional objects by a computer

• Developing expert system in medical science by a computer

•   Voice recognition

Voice recognition refers to the ability of a machine to receive and interpret dictation, words or phrases spoken by humans. It is the technology by which sounds, words, phrases and sentences spoken by humans are converted into electrical

signals, and these signals are transformed into coding patterns to which meaning has been assigned. Efforts have been made to speak a word or phrase into a microphone, then the electrical signal from the microphone is digitized by an "analog to digital (A/D) converter" and is stored in memory. Here the spoken words are considered as an input to a computer program. This technology will definitely eliminate peripherals like keyboard and mouse from computer system.

• Quantum computing

It is the area of study focussed on developing computer technology based on the principles of quantum theory, which explains the nature and behaviour of energy and matter on the quantum (atomic and subatomic) level. Development of a quantum computer would mark a leap forward in computing capability far greater than that from the Abacus to a modern day super computer, with performance gains in the billion fold realm and beyond. The quantum computer, following the laws of quantum physics, would gain enormous processing power through the ability to be in multiple states, and to perform tasks using all possible permutations simultaneously. The concept and an approach to quantum computing is still under research and development.

• Nanotechnology

Nanotechnology refers to the engineering of functional systems at the molecular scale. It is the projected ability or technique to construct/make complete high performance very small products. The molecular scale nanotechnology is considered as the fourth generation of nanotechnology from 2010 to 2020. It is based on molecular devices by design and atomic design. The program is still under research and development.

E. Applications of Nanotechnology

• Scientists are trying to build machines on the scale of molecules. For instance, a few nanometre wide

VIII. CONCLUSION

This paper describes the need and emergence of a machine like computer. Efforts have been made to describe the different stages of development of computer right from since time immemorial to 2012 and beyond. With the passage of time man has witnessed different forms of computer with much more improved capability. Development of computer has witnessed major technological changes and more sophisticated techniques have been employed to present a much better computer than the past. This paper also laid emphasis on the role played by the major contributors in the development of a more advanced, sophisticated and portable machine.

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