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Blue Brain

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Abstract: Scientists, today, are researching to create an artificial brain that has the capability to mimic the actions of a natural brain like thinking, responding, making decisions and keeping memory. Intelligence is something inborn and not something that can be bought or produced synthetically. Few people in the world have insane IQ level, which the normal person cannot match. Human brain is an invaluable creation, but the value of this creation diminishes when a man reaches his last stage. Blue brain is a project that aims to upload the human brain into a machine. This machine will be the virtual brain that will act like a man after the death of his body. Thus, even after his death, he won't lose the person, his feelings, emotions and most importantly his knowledge and his life experiences and their memories. Scientists have begun simulating brain's biological system, recreating the high speed electrochemical interactions that take place within the brain including the cognitive functions like language, perception, memory and learning, and output the data as the working 3-dimensional model.

Keywords: Nanobots, Silicon Chips, Neural networks, registers to store the state, Artificial Intelligence.

I. INTRODUCTION

Human Brain is the most complex circuitry in the world. Man's intelligence comes from his brain. A person is able to react to stimuli generated due to information delivered to the brain by impulses. But the intelligence of a person becomes useless after his death. Thus an attempt has been made to create a virtual brain, a machine that can function as a human brain and is being called "Blue Brain."^[1]

A. Blue Brain

- 1) **Meaning:** The process of scanning one's brain into the computer so as to extract the complete information of the person including his/her memories, intelligence, emotions is termed as "Blue Brain". Assisting man in making logical and reasonable decisions based on previous experiences of other knowledgeable men is the primary objective behind developing a virtual brain.
- 2) **Virtual Brain:** Virtual brain can be defined as the artificial brain. So it is not the natural brain but functions somewhat similar to it. Once it is created it can be used to think like the brain and take decisions based on the past experience. This can be possibly achieved with the help of the supercomputer which has a large amount of storage capacity, blistering speed and immense power. This will require massive interface between the human brain and the artificial brain allowing the data from natural brain to be uploaded into the machine
- 3) **The need for a Virtual Brain:** Intelligence plays a vital role in development of the person. So we need to find a solution so as to store the intelligence of the man after his death. It is quite difficult to remember the spelling of words, proper grammar, important dates etc. What if we have a program corresponding to all of these so as to make life less stressful? Virtual brain is the solution for all of this.^[2]
- 4) **Making virtual brain possible:**



Figure. 1 Wired connection to the cortex.

We can develop a virtual brain by using Nanobots which are robots, small enough to travel throughout the circulatory system. These robots will travel into the spine and brain which will help to monitor the structure of the Central Nervous System, providing the complete details of the connections between neurons. These robots will record the current state of the brain. Or we can wire the cortex of human brain the way it has been done for cats before by scientists in their experiments and send live information to a computer.^[3] Once we enter this information into the computer, it will start working similar to the human brain.

B. Working Of Human Brain

The nervous system is one of the most organized electron mechanisms, which is not less than a miracle because we are not able to see it but it is working via electrical pulses in our body. The ability to see, hear, feel and smell are controlled like the calculations taking place in the computer. The three simple function of the brain are sensory input, integration and motor output.

- 1) *Sensory Input:* Sensory input is a stimuli that man perceives using one's own senses. Message is passed to the brain about the surrounding activities through the sensory cells, known as neurons
- 2) *Integration:* Integration refers to how the brain regions work together to process information and effect responses. This process takes place where the cluster of neurons fire together.
- 3) *Motor Output* Once the brain has understood all that we have learned through our senses, then it sends the message through the neurons to the effector, muscle or gland cells, which will work to perform our request and then act upon it.

C. Brain Simulation

- 1) *Input:* In the human brain the neurons are responsible for passing the message to the central nervous system. The body receives the input from the sensory cells which produce electrical impulses received by the neurons and then transfers these impulses to the brain. This can be achieved by creating a virtual nervous system. Scientists have found a solution to this by creating Silicon Chips in place of neurons which can receive the input from the sensory cells and can be sent to the supercomputer for interpretation.
- 2) *Interpretation:* Human brain receives the electrical impulses from the neuron and then interprets it. Interpretation depends on the state of many neurons. Set of registers can be used to interpret the electrical impulses received by the artificial neuron. Different states of the brain will be represented by different values of registers.
- 3) *Output:* According to the state of the neurons the brain sends the electrical impulses, which represent the responses, to the sensory cells of the body.
- 4) *Memory:* Certain neurons in the brain represent certain states permanently. Now, whenever we want to remember the past things or some serious matter these states of neurons are interpreted by the brain. In a similar way certain states of the registers can be stored permanently and they can be accessed whenever require
- 5) *Processing:* Thinking about something, taking decisions involves logical and arithmetic calculations being done in the neural circuitry. So the state of certain neurons is changed to get the output.
Decision making can be done by the computer, by using some stored states and received input.

II. CURRENT RESEARCH WORK

A. What is Blue Gene?

An IBM project - Blue Gene, is aimed to design supercomputers which can reach tremendous operating speed in the range of petaFLOPS, along with minimal power consumption. IBM collaborated with scientists at Switzerland's Ecole Polytechnique Fédérale de Lausanne (EPFL), where they began to simulate biological system of the brain and output was the 3-dimensional working model which recreates the high speed electrochemical interactions taking place in the interior of the brain itself. Cognitive functions viz memory, learning, language and perception were also included. Some psychiatric disorders such as depression and autism were also considered. It is thereby assumed that modeling will spread through the other regions of the brain and if this is achieved, it will also improve its relationship with molecular, cognitive functions and genetic of the brain.



Figure. 2 Blue Brain project at IBM.

B. Various Blue Gene Projects

There were a total of 3 Blue Gene Projects.

- 1) *Blue Gene/L*: Blue Gene/L is the first computer in the Blue Gene series. In 1999, IBM engineers and scientists from Lawrence Livermore National Laboratory(LLNL) collaborated to develop the prototype for the Blue Gene/L. Each Blue Gene/L unit has two 700 MegaHertz PowerPC 400 embedded processors along with double pipeline, double precision Floating Point Unit(FPU). Dual FPUs were proposed just to give each Blue Gene/L node a top notch performance of 5.6 gigaFLOPS.^[4]
- 2) *Blue Gene/P*: Blue Gene/P is the second computer in the Blue Gene series. In June 2007, IBM came up with specifications where each Blue Gene/P chip contained four POWERPC 450 processor cores, running at 850 megaHertz. Each compute card contained a Blue Gene/P chip along with 2 or 4 GB DRAM which also had a compute node. Each compute node is bound to have a top notch performance of 13.6 GFLOPS. 32 such compute nodes are inserted into an air cooled node board and each rack containing 32 node boards.^[5]
- 3) *Blue Gene/Q*: Blue Gene/Q is the third computer in the Blue Gene series. In June 2012, IBM engineers proposed Blue Gene/Q which has a top notch performance of 20 PetaFLOPS. Each Blue Gene/Q compute chip has 18 core chips. The 64 bit A2 processor cores are 4 way simultaneously multithreaded which run at 1.6 GigaHertz. In June 2012, TOP500 list had 20 Blue Gene/Q installations of ½ rack containing 512 nodes, 8192 processor cores, 86.35 TFLOPS Linpack.^[6]

C. Advantages And Limitations

1) Advantages

- a) Intelligence of the person can be saved for a thousand years.
- b) Remembering things easily without any efforts.
- c) It can avail the interference between human beings and animals.
- d) Intelligence of the person can be used even after his death.
- e) Decisions can be made without the presence of the person.
- f) The blue brain permits the deaf to hear via direct nerve stimulation.
- g) In case of psychological disorders, one can download the contents of the brain that was uploaded, and overcome them.

2) Limitations

- a) We will get more dependent on the computer.
- b) Information may get disclosed to an unauthorized person.
- c) Another fear is with respect to human cloning.
- d) Increase in computer viruses, possess a threat.
- e) Regaining the memory back is an expensive procedure.

D. Hardware And Software Requirements

- 1) A super computer with high processing speed.
- 2) Program to convert the electrical impulses from the brain to input signals.
- 3) Powerful nanobots, to act as an interface between natural brain and the computer.
- 4) Linux and C++ software.
- 5) 256MB to 512MB memory per processor.
- 6) 100 kilowatts power consumption.

III. CONCLUSION

The blue brain project is the advancement in biological and digital technology. Through this technology at some point, a human can be transferred into the computer. By adapting the methodology of nanobots, there will be a decrease in development time and better performance is expected. The limitations in this technology are easy to overcome. Once it is established, we will require approximately five or more than five years to complete the blue brain project. Thus, with the advancement in the technology, the blue brain can be implemented in a better way.

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