

Blue Brain Technology

Princy Joy

Asst. Professor, Dept. of Computer Science, Teresian College, Siddarthanagar, Mysuru, Karnataka, India

Abstract: *Human brain is the most complicated and intelligent circuit among all the creation in the world. Human being is intelligent and smart because of the brain. The human brain converts the information conveyed by the impulses that enable a person to respond. All of the inventions of the world came from man's brain. Every human brain is a pool of knowledge and intelligence, but with our death it ends. But in this digital era it becomes possible with the help of a new technology to preserve the human brain virtually after one's death. This new technology is known as blue brain technology. This blue brain project's main objective is to upload human brain to a super computer to simulate how intelligence works. Uploaded human brain recorded structure works in the computer as Virtual Brain. Hence, even after an individual's death, his brain will be virtually alive in the machine. Using Blue Brain we will be able to scan ourselves into the computers. Blue Brain will allow to preserve the personality, intelligence, and feelings etc for a long time after the death of a person. BLUE BRAIN is the name of the first virtual brain in the world that means a machine capable of functioning as a human brain. Today, scientists are in research to create an artificial brain that can think, respond, take decision, and store anything in memory. So, even after a person's death, we won't lose that man's knowledge, intelligence, personalities, feelings and memories that can be used for the development of the human society.*

Index Terms— Blue brain, Natural Brain, Neurons, Nanobots.

I. INTRODUCTION

The Blue Brain System is an attempt within a computer simulation to recreate the human brain at the cellular level. The Blue Brain technology is a science and technology project that is new and innovative. It is the first ever virtual brain in the world. The artificial brain which performs similar tasks of human brain. The purpose of Blue Brain technology is to upload the complete information that exists in the brain to a computer. With this technology, even after the death of human body, we can preserve the knowledge and intelligence. Blue brain technology provides comprehensive simulation with the external artificial intelligence network of the essential internal connectivity of cerebral parts. This technology shows the new path in the artificial intelligence field.

In May 2005, Blue Brain project was founded by the Brain and Mind institute by founding director Henry Markram at EPFL (Ecole Poly technique Federal de Lausanne) at Lausanne, Switzerland [1]. The aim of this project was the better understanding of the functioning of the brain as it transmits the signal to the different parts of the body and receive the signal transmitted through the neurons in order to react to the specific condition and create a biologically detailed digital reconstruction of a human brain inside a computer. If this is achieved, human knowledge can be preserved even after the death for a long time. The simulations are performed on a super computer built by IBM called Blue Gene, hence the name Blue Brain [1]. The project involves the study of the small portion of brain tissue through microscopes and patch clamp electrodes. These methods are used to study the functioning of the human brain as the signals are transferred throughout the body from one neuron to another.

II. FUNCTIONING OF NATURAL BRAIN

Human beings have various capabilities such as the ability to see, interact, sense, etc. All these are our central nervous system's work. We can't see our central nervous system, but it works through electrical impulses inside our body. One of the most "intricately organized" electron mechanisms in the world is the nervous system. Even engineers aren't even close to creating something precise like the nervous system.

To understand this system there are three simple functions.

- Sensory Input
- Integration
- Motor Output

2.1 Sensory Input

The sensory cells, also called as Neurons, send a message directly to our brain when we touch something hot or our eyes see something. This action of receiving information from our surrounding environment is called Sensory Input [2].

2.2 Integration

Integration can be defined as interpreting the things we have felt, tasted, touched, etc. with our sensory cell into responses that the body identifies. This process is all done in the brain where many neurons work together to know the environment [4].

2.3 Motor Input

Once our brain interprets everything we have either by touching, seeing or any other sense, our brain sends a message through neurons to cells, muscle or gland cells that actually work to fulfill our requests and act on the environment[2].

III. WHAT IS BLUE BRAIN?

Blue Brain is an artificial and virtual brain but it would act as a natural brain. Based on its past experiences and the knowledge, it would think, take its own decision, and respond as the natural brain. It is possible by using a blue gene super computer with a large amount of storage capacity, processing power and an interface between the human brain and the super computer. This interface will be useful for transferring or copying the human recorded structure to the super computer that will create a virtual brain with the ability to think and respond to the condition. So everybody's brain and knowledge, intelligence can be kept and used for ever, even after the person's death [3]. What could have been the face of the earth today if we could still communicate with great scientists who contributed everything they could to a better society?

IV. WHY WE NEED BLUE BRAIN?

Intelligence is the inborn quality that can't be created [4]. After a person's death, virtual brain will act as a person so that we will not lose that man's knowledge, intelligence, personalities, feelings, and memories that can be used for the development of human society. Some super brains like Steve Jobs or Stephen Hawking could be interfaced with computers to develop new inventions [6].

V. INTERFACING METHODOLOGY WITH BLUE BRAIN TECHNOLOGY

Interfacing is possible only when the nanobots are inserted by capsule or injection by the medicine into the human blood. Nanobots are nothing but small robots, which are in the size of 10-9meter. They are used to collect neuron data and are transmitted to the outside device. These nanobots start circulating in the blood and take the information between the neurons with the electric impulse. Because neurons are communicated with each other by the electric impulses in our body, during the data transformation from one neurons to another neurons, these nanobots will theft the information from the neurons and sent outside with the help of electrodes or the signal transmitters. To take signals that are generated from the nanobots and brain neurons simulations the electrodes are connected to the human brain which can collect the information from the neurons simulations. These signals are basically analog in nature; to convert these signals into digital, these signals are sent to a high resolution analog to digital converter technology which can convert the analog signal into machine understandable language [6].

VI. STEPS FOR BUILDING A BLUE BRAIN

6.1 Data collection/ Data Acquisition

Data Acquisition contains taking individual brain slices and placing them under microscope for observation purposes to measure the electrical activity and shape of the individual neurons. The neurons are captured accordingly by their morphology or shape, cortex location, population density, and electrophysiological behavior. The observations are then translated into mathematical algorithms that describe the neuron's function, positioning, and form. The algorithms are then used to generate virtual neurons that are biologically realistic and ready for the simulation phase.

6.2 Data simulation

Simulation refers to the use of a mathematical model to recreate a situation so that the likelihood of different outcomes can be estimated more accurately. The main focus for virtual brain development is on the neurons and the primary software used for neural simulation is a package called NEURON.

The data simulation itself consists of three main parts, namely:

- BBP-SDK
- Simulation Speed
- Simulation Workflow

6.2.1 BBP-SDK

The Blue Brain Project - Software Development Kit, is a set of Application Programming Interfaces allows the researchers to use and audit prototypes and simulations. The Blue Brain Project-SDK is C++ library wrapped in Java and Python. The primary software used for neural simulations is NEURON. Michael Hines of Yale University and John Moore at Duke University developed this in the starting of the 1990s. It uses C, C++, and FORTRAN. It is a freely available open source software. In 2005, Michael Hines carried the package into the massive and parallel Blue Gene in cooperation with the BBP team.

6.2.2 Simulation Speed

Simulations of one cortical column (more than 10,200 neurons) run at about 300 times slower than real time. Which means it takes about five minutes to complete one second of simulated time. The simulation displays uneven line scaling (which indicates that doubling the size of the neural network doubles the time it takes to simulate). The primary goal at present is biological validity rather than performance.

6.2.3 Simulation Workflow

It involves the synthesis of virtual cells using the algorithms found to describe the actual neurons. The algorithms and parameters are adjusted for the species, the animal's disease stage being simulated and the age. Every single protein is simulated (and there are about one billion of them in a single cell).

Steps: First, a network skeleton is built from all the synthesized neurons. After that, the cells are connected together (based on the rules that are found experimentally). The neurons are finally functionalized and the simulation is brought to life. Using visualizing software, the blueprint of emerging behavior is visualized.

6.3 Visualization of results

RT Neuron is the main application used by Blue Brain Project to visualize neural simulations. This software was developed internally by the BBP team. It is coded using both C++ and OpenGL. RT Neuron is ad-hoc software written specifically for neural simulations, i.e. it cannot generalize to other types of simulation. RT Neuron takes the output from Hodgkin-Huxley simulations as input in NEURON and delivers them in 3D. This allows the programmers and researchers to view as activation potentials propagate through or between neurons. The animations can be paused, stopped, started and zoomed, hence allowing the researchers to interact with the model [5].

VII. UPLOADING HUMAN BRAIN

Small robots called Nanobots are used to upload a person into a computer. These robots are going to be small enough to travel through our circulatory systems. Traveling to the spine and brain, they will be able to monitor the activity and structure of our central nervous system. Nanobots could also scan our brain structure carefully, providing a complete overview of the connections between each neuron. They would also record the brain's current state. When entered into a computer, this information could then continue to function as us. Entire brain data will be uploaded to the computer. All that is required is a computer with large enough storage space and processing power [7].

VIII. COMPARISON BETWEEN NATURAL BRAIN AND SIMULATED BRAIN**8.1 Natural Brain****8.1.1 Input**

In our body's nervous system, the neurons are responsible for passing the message. The body is receiving the input from the sensory cells. This sensory cell produces electric impulses that neurons receive. The neurons transfer these electric impulses to the brain.

8.1.2 Interpretation

The electric impulses received by the brain from the neurons are interpreted in the brain. Brain interpretation is accomplished through several neuron states.

8.1.3 Output

Based on the neuron states, the brain sends electric impulses representing the responses further received by our body's sensory cell to respond to neurons in the brain at that time.

8.1.4 Memory

There are certain neurons in our brain that permanently represent certain states. This state is represented by our brain when required and we can remember the things of the past. To remember things we force the neurons to represent certain brain states always or for any interesting or serious matter, this happens implicitly.

8.1.5 Processing

When we make a decision, think about something, or make any computation, our neural circuitry performs logical and arithmetic computations. The past experiences stored and the current inputs received are used and the conditions of certain neurons are changed to give the output.

8.2 Simulated Brain**8.2.1 Input**

The scientist has made artificial neurons by replacing them with the silicon chip. It has also been tested that these neurons can receive the input from the sensory cells. Through these artificial neurons, the electrical impulses from the sensory cells can be received.

8.2.2 Interpretation

The interpretation of the electric impulses received by the artificial neuron can be done by means of registers. The various values in these register will denote various states of the brain.

8.2.3 Output

Based on the states of the register the output signal can be given to the artificial neurons in the body which will be received by the sensory cell.

8.2.4 Memory

By using the secondary memory, it is easy to store the data permanently. Similarly, the required register states can be permanently stored and this information can be received and used when required.

8.2.5 Processing

The computer can make the decision by using some stored state and received input and performing some arithmetic and logical calculations [4].

IX. ADVANTAGES / MERITS OF BLUE BRAIN

- After the death of a person knowledge can be preserved long and can be used for further development.
 - Deaf people can be helped with direct nerve simulation process.
 - It is possible to take fast decisions.
 - Without much effort things from the past can be remembered.
 - By interpreting the electric impulse from the brain of animals, their behavior can be understood.
- So it can be used as an interface between human and animal minds [5].

X. DISADVANTAGES / DEMERITS OF BLUE BRAIN

- Because Blue Brain is a computer technology, it will always be susceptible to hacking. Once a Blue Brain related to a particular person's neural schema is hacked, the brain could be used against the person.
- Human will become dependent on Computer Systems.
- Large amount of power is required for powering the machine. The brain consumes about 20W of power whereas supercomputers may use as much as 1MW [7].

XI. HARDWARE AND SOFTWARE REQUIREMENT

- A super computer
- Memory with a very large storing capacity
- Processor with a very high processing power
- A very wide network.
- 100 kilowatts power consumption.
- A program to convert the electric impulses from the brain to input signal, which is to be received by the computer, and vice versa.
- Very powerful Nanobots [5].

XII. APPLICATIONS

- Novel Tool for Drug Discovery for Brain Disorders.
- Foundation for Whole Brain Simulations.
- Data of 100 years can be tested and implemented.
- Neural code can be cracked and modified as per the conveyance.
- Complete brain and human body can be studied.
- Diseases can be identified and curried easily [3].

XIII. CONCLUSION

The blue brain project is the development in biological and digital technologies. Through this technology at some point a human can be transferred into computer. The limitations and arguments in this technology are easy to overcome. The Blue Brain is an attempt to create artificial brain by reverse engineering. Human brain is a most valuable creation. The brain translates the information delivered by impulses which enables the person to act and react. In future we will be able to turn ourselves in to computers. Virtual brain that will be able to take its own decisions and use the intelligence even after the death. This technology is also useful in medical field to help the neurological disordered people and also help the people who are deaf by providing him/her all the information via direct nerve stimulation. This technology will simulate the characteristic and the structure of human brain in the super computer that will preserve the intelligence of the human even after the death. The BBP has become successful in rat and some other animals which is a sign of success. To transfer ourselves in to a super computer it will take few more years.

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