

Blue Brain Technology to Preserve Intelligence

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Abstract -- It took us thousands of centuries to evolve from Unicellular Organism to this complex biological form. Our Brain and Intelligence were the center of all the evolution we've been through. Human brain is a pool of intelligence, which will be of no use after the death. But with the help of this new technology, it becomes possible human intelligence can virtually exist after the death of an individual. "BLUE BRAIN" is a technology, in which we upload the human brain recorded structure and signals in the Super Computer to make a simulation of how intelligence works. Uploaded human brain recorded structure in computer would work as Virtual Brain. Even after the death of an individual, his brain will be alive virtually. For this we are going to use Nanobots to record the structural neuron transmitting signals and also the response given by the brain on the stimuli of the body using the neurons. These neurons act as an interface between the brain and the body. We will upload all the recorded data of the brain functioning in the super computer with a huge amount of storage capacity and processing power. We will discuss the working of the Blue Brain Technology and would focus on its advantages, drawbacks and the way to utilize less memory and the brain based chip technology as well as its future expected applications.

Key Words: Nanobots, Neocortex, Neurons, Blue Brain Project (BBP), Sensory Cell

1. INTRODUCTION

HUMAN BRAIN, the most powerful machine in the world that GOD has created, which has the power to think and utilize its knowledge to create something new that will be beneficial for the human species. The knowledge that has the ability to create something that will help the human to grow to a higher level. We lose such knowledge after the death [1], but what if we create an artificial brain that has all the characteristic and thinking power same as the natural brain. In May 2005, Blue Brain project was founded by Henry Markram at EPFL at Lausanne, Switzerland [1]. The goal of this project was to better understand the working of the brain how it transmits the signal to the various parts of the body and receive the signal transferred through the neurons so that react for the particular condition. The project involves the studying of the small part of brain tissue

through microscopes and patch clamp electrodes [1]. These methods are used to study the working of the human brain how the signals are transferred from one neuron to another neuron throughout the body.

1.1 BLUE BRAIN- Description

Blue Brain, it would be the world's first artificial brain [1]. IBM with collaboration with *École polytechnique fédérale de Lausanne (EPFL)* is developing an artificial brain which is a virtual brain but it would act as a natural brain. It would think, take its own decision on the basis of its past experiences and the knowledge it have and respond as the natural brain [2]. It is possible by using blue gene super computer with a large amount of storage capacity, processing power and an interface between the human brain and the super computer [1]. This interface will be useful to transfer or copy the human recorded structure to the super computer that will create a virtual brain that would have the ability to think and respond to the condition.

1.2 NEED OF BLUE BRAIN

Human species always need such an intelligence that will grow and develop something that will be beneficial for all the living things, but we lose such intelligence after the death. The Virtual Brain (Blue Brain) is the solution for it that will be able to store the intelligence and the human recorded structure even after the death. We also face some difficulty in remembering things for this virtual brain is key to remember all the things in the memory that we can use even after the death.

2. HOW NATURAL BRAIN FUNCTIONS

The 3 simple function through which brain receives the signal and respond to the condition are: -

2.1 SENSORY INPUT

When our eyes see something or our hands sense something by touching the any warm surface, the sensory cells known as neurons, send some message to the brain depending on the sense [1]. This way of gaining information from the outer environment is known as sensory input [1].

This will help our brain to gain the information from the outer environment that will be useful in taking decision.

2.2 INTEGRATION

Integration is also known as interpretation of information or the signals that brain had received from the neurons [1]. After receiving signals from neurons, brain process on the information and signal.

2.3 MOTOR OUTPUT

After processing on the information brain sends a message through neurons to effector cell, gland cell, that will respond to the information gained from the environment and perform some task on accordingly on the environment [1].

3. COMPARISON BETWEEN NATURAL AND VIRTUAL BRAIN

3.1 INPUT

In natural brain neurons are responsible for transferring information from the sensory inputs to the brain that help brain in processing the information and also storing the information that it has gained through sensing [1].

In virtual brain same operation is done with the help of artificial neurons or we can say the silicon chips that will work as the artificial neuron for the virtual brain [1]. These chips are tested by the scientist such that it can receive electric pulses from the sensory cells.

3.2 INTERPRETATION

In natural brain, electric impulses received from the neurons are interpreted [1]. This interpretation is done with the help of certain states of the neurons which stores the current state. Some neurons are fixed for only storing the state that will be useful in taking decision.

In virtual brain, interpretation of electric impulses is done with the help of different registers, these registers are used to store different state [1]. These registers will be helpful in taking decision.

3.3 OUTPUT

In natural brain, according to the state of the neurons brain sends the output pulses to the respected sensory cell with the help of artificial neurons [1]. That will perform the task according to the output pulses that will be reflected by

the muscular cell to the outer environment.

In virtual brain, it will also send the output pulses to the sensory cell based on the state of the register, this impulse will be transferred to the sensory cell with help of artificial neurons. According to this signal the sensory cell will react to the outer environment that means the response of the brain is reflected by the sensory cell.

3.4 MEMORY

In natural brain, it uses some neurons which are only used for storing the current state [1]. These neurons will be used in remembering thing, since those neurons are dedicated to store a fix state. If we want to remember something brain will force the neuron to show the state of that neuron so that we could remember the thing.

In virtual brain, in this it is possible to store the data in the secondary memory permanently so for this we use the register to store the state that will be useful in retrieving the data when we require it.

3.5 PROCESSING

In natural brain, when we think about something, logical & arithmetic computation is done in the neural circuitry [1]. The past experience stored and the current inputs received are used in sending the appropriate output pulse to perform some action.

In virtual brain, the computation is done with help of previous data stored and the current input received from the artificial neurons. It will perform some arithmetic & logical operation [1].

4. STUDY OF NEURONS

There are mainly 3 steps involved in the study of neurons that are: -

- a. Data Collection
- b. Data Simulation
- c. Visualization

4.1 DATA COLLECTION

In this small brain tissue is collected, then with the help of microscope or patch clamping method shape and electrical behavior of the individual neuron is gathered [2]. The neurons are collected on the basis of their shape, electrical and physiological behavior [2], which are present within the cerebral cortex. These observations are translated into algorithm describe the process, function, and their

positioning methods of neurons [2]. This collection of data will provide the researchers all the information they needed to create a 3D model of the neuron to study it completely.

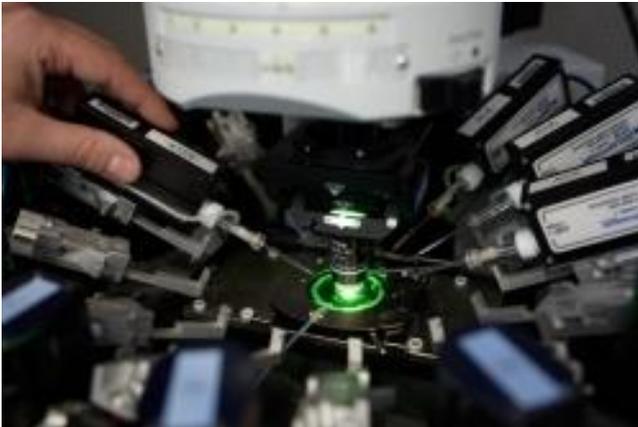


Fig-1: The 12 Patch Clamp

Fig-1 shows the patch clamp technique used to gather the data of the neurons from a particular cell separated using this technique information is collected like no. of neurons, no. of synapses, connection between the neurons and the synapses [2]. After gathering all the information, it is provided to some algorithms that will process it further so that researchers could utilize that information to create a 3D model of the neurons that will be useful in the study of the neuron and synapses. In the given figure it is using 12 patch clamp to collect all the information related to the neurons and synapses.

4.2 DATA SIMULATION

In this main aim is to make virtual cell using different algorithms that will define & describe the real neurons [2]. The algorithms are adapted depending upon the age, species, disease stage of the human being simulated.

4.2.1 BBP-SDK

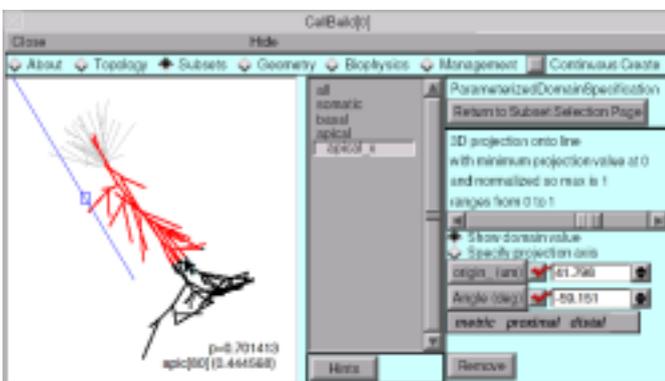


Fig-2: Neuron Cell Builder

BBP-SDK stands for “Blue Brain Project-Software

Development Kit”. It is a set of API (Application Programming Interface) which allows the researchers to use and audit virtual cell prototype and simulation [2]. It is a C++ library wrapped up in Python and Java. Primary software used for the neural simulations is “NEURON” [2]. In the starting of 1990’s Michael Hines of Yale University and John Moore at Duke University developed this. It is an Open source software.

4.3 VISUALIZATION

In the visualization the 3D model of the neurons is created such that the researchers can use this to study the structure and working of neuron. For this scientist uses a software known as RT Neuron [2]. This software was created by BBP development team. This software is very useful for the researchers to study the functioning of the neurons and synapses. One of the example of the visualization software is RT Neuron.

4.3.1 RT NEURON

RT NEURON is the application used by Blue Brain project for visualization of the neural simulations [2]. It is coded using in C++ and OpenGL by the BBP team internally [2]. It is an ad-hoc software developed specially for neuron simulation. RT Neuron takes output of Hodgkin-Huxley simulations as an input in NEURONS and delivers them in 3D. this also helps researchers & programmer to view as activation potentials propagate between neurons. This 3D model can be stopped, paused & start to completely study the neurons [2].

5. COMPUTER HARDWARE

5.1. BLUE GENE



Fig-3: Blue gene super computer at EPFL

Blue gene is the primary hardware used in the Blue Brain Project built by IBM. On June 2005 IBM agreed to supply the blue gene super computer to EPFL [1]. It is installed in EPFL at Lausanne and managed by CADMOS (Centre for Advanced Modeling Science) [2].

This super computer is used by number of research group for computing and brain simulation. The brain simulation is done one day per week and the rest of the day the data is gathered and cells are studied so that new things could be found out that would help in their research and also in analyzing all the data gathered.

5.2 SILICON GRAPHICS

Silicon Graphics Inc. (SGI) 32 bit-processor with 300 Gb of shared memory is used in visualization of results. It helps in studying the working of the neurons [2]. It is also used in storing the state so that it could be used to remember things. It acts as an artificial neuron in the blue brain technology.

6. UPLOADING HUMAN BRAIN

The uploading is now possible with the help small bots known as Nanobots. These Nanobots are very small in size such that it can travel throughout our circulatory system [1]. By travelling into the brain and spine, Nanobots will be able to monitor the structure and activity of our central nervous system [1]. Nanobots will act as an interface between the human brain and the super computer [1]. Nanobots will also be able to carefully scan or record the structure of the human brain, providing a complete readout of the structure and the connections through which signals are transferred from the sensory cell to brain and the response signal send by the brain to sensory cell for performing some action in response of the signal it interpreted. All this information is then uploaded in the super computer that will create a virtual brain that will perform function as the human brain. This recorded structure is stored in the secondary memory such that it will not lose any information means the data gathered will be stored permanently.

7. CURRENT ACHIEVEMENTS

In current achievements, The EPFL scientist had completed their first draft of computer reconstruction of a piece of neocortex. Neocortex is that part of brain where different type of neurons is located having different functionalities like storing, transferring, sensing and etc. these neurons are useful for researchers to study the behavior of the brain and also the flow of the signals through the neurons from brain to sensory cell and vice versa.

The electrical behavior of the virtual brain tissue was simulated on supercomputer and found to match the no of behavior in the human brain.

The researchers performed tens of thousands of experiments on neurons and synapses in the neocortex of young rat and collected and studied each type of neurons and synapses

present in the neocortex.

8. MERITS

- Without any effort we can remember things.
- Intelligence of a man can be used even after the death.
- It is useful in self decision making by the super computer.
- Blue brain is an approach to store and analyze the data.
- BBP can be act as an interface between humans and the animals.
- It is a good cure for human disability.

9. DEMERITS

- The main demerit is that we became totally dependent on the computer.
- Since the neural schema of the human is hacked when BBP is related to the brain.
- Computer viruses are risky of this that could corrupt the data.
- This requires a large amount of memory and processing power to create a virtual brain that could act as a natural.

10. FUTURE SCOPE

In future this technology is very useful for the human species. If blue brain technology integrated with the robotics, then it would be the beginning of a new era that will be able to utilize the intelligence of a person at a completely different level even after the death.

In future this technology will be useful in diagnosis of malfunction of human brain as well as development of treatments for neurological disorders [1]. Since this technology is useful to study the flow of the signals transferred from brain to the sensory cell and from sensory cell to brain. So that it could be easy to diagnose the problem and find a solution for it that would help the researchers and scientist to find the accurate problem faced by the person and could find a solution for that.

Since blue brain technology takes a lot memory to store the information and the state that will be helpful in remembering the state to take decisions. In future this problem can be solved by the new technology that would take less space and store the large amount of data that will be useful in remembering and taking decisions. One of the technique that we think about is the brain based chip or the DNA based chip that has the capability to store a very large amount of memory.

11. CONCLUSION

We surveyed the field of virtual brain or blue brain technology and different techniques and the hardware used in the implementation of this technology that will be useful in creating a 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 all the information via direct nerve stimulation. This technology will stimulate the characteristic and the structure of the human brain in the super computer that will preserve the intelligence of the human even after the death.



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