Blue Brain

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Abstract: One of the most complex creation of the universe is a Human Brain. A human being is known for efficiently using his brain. The human intelligence can be stored in a virtual brain which is widely known as "Blue Brain". That means machines can also replace human brains. The main motto is that, the ultimate source of information and innovation must be preserved. Clearly speaking, a normal human being will not be alive forever but the knowledge of the brain should be used even after his death. The main goal of neuroscience is understanding the biologically related mechanisms that are responsible for mental activity of human brain. In focus, the study of cerebral cortex is the most challenging task for science in near future. Presently scientists are researching to create an artificial brain that can accomplish the tasks like thinking, responding, taking up decisions and keeping everything in memory. So that after a human's death the virtualized brain contains his intelligence, knowledge, personalities, feelings and memories of that man which can be used for developing the society.

Keywords: Blue Brain Project (BBP), Cerebral cortex, Neuron, Blue Gene.

I. INTRODUCTION

None have ever understood the complexity of human brain it a detailed manner. What if we could have an opportunity to store a special brain's intelligence even after the body is no more, this is the biggest motivation to carry out this survey. Blue Brain is one such concept which provides an interface between the human brain and the computer where a detailed simulations of neurons of the real brains are observed and artificial neurons are recreated which work similar to the natural neurons. This way of super-computer based constructions and simulations provide a wide new way to study the detailed structure of the brain.

Memorizing millions of events can be done by human brain, decision is made according to the situations, and a real-time response to an action can be made. The invention of artificial brain by Blue Brain Project happened through reverse-engineering process where a super computer is used to store this huge amount of data while running NEURON simulation software which not only consists artificial neural network but also includes a biologically realistic model of neurons. Nanobots are small components which reside inside the human body and traverse through the brain and spine circulatory system [1].

The nanobots are responsible for continuously monitoring the brain and giving updates to the computer which will be stored in the registers. The purpose of nanobots is studying every minute concept related to brain, including the interconnection of neuron. This work will study the activity of nervous system as well as its structure, and also analyse the structure of brain[4]. This technology is also useful in medical field to help the neurologically disordered people and also help the deaf people by providing them the information via direct nerve stimulation. The intelligence can be preserved even after the death of human with this technology, by stimulating the characteristics and the structure of the human intellect (brain) in the super computer..[3]

II. LITERATURE SURVEY

Blue Brain Project focuses on building biologically detailed equipments and simulations of the rats, and ultimately the human brain. The supercomputer-based constructions and simulations provides a radically new way to understand the detailed structure and process of the brain. The project's strategy exploit interdependencies in the experiment's data to access dense maps of the brain, without measuring every element of its multiple levels of association. This strategy allows the project to build digital remodelling of the brain at an unprecedented level of biological detail [1]. The working of human brain basically has three sub processes, they are: Sensory Input, When we see something or our touch a warm surface, the sensory cells or Neurons, convey a piece of information straight to the brain. Integration, is also known as the interpretation of things we have sensed, tasted and touched with our sense organs, into responses that the body identifies[2].

Many neurons work together and understand the environment to accomplish this process in the brain. Motor output, Once our brain has interpreted everything then it conveys a message through neurons to effecter cells, muscle or gland cells, which essentially work to perform our requests and act upon our environment[3].

The brain transfer technology is executed by two techniques namely, Copy and transfer and Slow and relentless substitution of neurons. In the past, it is accomplished by doing with the following 3 steps Firstly examining, controlling and differentiating the cerebrum components. And secondly, duplicating, moving, storing data into computer [4].

Now human brain is altered into the humanoid robots or in an organic body. According to the author, we see that the focus is on the simulation method of the collected data. It is basically divided into two parts, simulation speed and simulation workflow. Simulation speed: Simulations of every cortical column execute about two hundred times slower than actual time. For one second of simulation time 5 minutes of actual time is taken. After understanding biologically important factors for a given effect it might be possible to crop constituents that don't finance in order to progress with performance. Simulation workflow: Algorithms and constraints are modified according to the disease stage of the animal being simulated, age and species. Every protein is simulated where there are millions of proteins in one cell [5].

Taking forward the IBM tradition the Blue Gene evolved in the new era of high-performance computing[6]. A brand new complicated multi-level schema and function of the human brain is provided by BBP[7].

III. PROPOSED SYSTEM

A. Need for Blue Brain

Today we are urbanized because of our intelligence. Intelligence is the inborn feature that can't be created. Some people have this ability, so that their thinking capacity can think up to such an extent where others can't reach. Such intelligence is always needed by the human society. But the intelligence is lost along with the body following death. The virtual brain is a answer to it. The brain and intelligence will live even after the death. We often face problems in recalling things such a person's name, born dates, the spellings of difficult words, appropriate grammar, special dates, past history, facts etc. In this busy life every one want to be hassle-free. Can't we use any machine to aid all these? Virtual brain may be the key to it. What if we upload ourselves in a computer, what if we could live in a computer as a program? The solution for all these queries is a development of Blue Brain.

B. Working of Human Brain

The brain is termed as the central nervous system of a human body weighing around 3 pounds and likely serves as an information processing centre. The function of the brain is to receive signals from sensory neurons and respond back with new signals instructing corresponding parts of the body to react accordingly. It rises perception and consciousness by integrating signals received from body along with the signals from adjacent areas of the brain. The working of nervous system is magical because it cannot be seen but it is working through electric impulses throughout our body. Nervous system is termed as one of the world's most "intricately organized" electron mechanism. The three main functions to understand the working of this system is: sensory input, integration & motor output.

- **Sensory Input:** When one sees something or touches a warm surface, the sensory cells, which are also known as Neurons, convey a piece of information straight to the brain. Since it is getting information from your surroundings and feeding things in your brain by one's senses, it is called sensory input because.
- **Integration:** It is also known as the interpretation of things one has sensed, felt the taste, and touched with the sensory cells or neurons, into the body identifiable responses. This process is accomplished in the brain where many neurons work together to understand the environment.
- **Motor output:** Once our brain has interpreted everything one has learned, either by sensing through touch, felt through taste, or using any other sense organs, then our brain conveys a piece of information through neurons to responsive cells, muscle or gland cells, that are essential to work and perform our requests and act upon the environment.

C. Working of Blue Brain

The working of blue brain is mainly divided into three steps which explain the complete functioning of blue brain, They are: Data collection, Data simulation and Visualization.

Step 1: Data collection/acquisition: It consists of diagnosing slices of brain under a microscope, observing its shape and electrical behavior of neurons individually. The method of studying the neurons is familiar and hence neurons are captured by density, shape, physiological and electrical activity and the site within the cerebral cortex. All the above observed study is converted to a precise algorithm which defines the function, process and positioning methods of neurons. Finally these algorithms are used to recreate biologically similar looking virtual neurons ready for simulation.

Step 2: Data simulation: The main aim is to use various algorithms to create a virtual cell that will describe and define a real neuron. Constraints and algorithms are selected according to age, species and disease stage of object being simulated. 'Blue brain project-software development kit', a set of APIs allows to audit prototypes and simulations. The BBP-SDK as shown in Fig. 1, is a C++ library that is wrapped in Java and Python. Neuron is the primary software used for neural

simulation. The process of data simulation consists of five sub processes namely: Input, Interpretation, Output, Memory and Processing.

- Input:- Neurons are responsible for passing message in our body. Input is conveyed by the sensory cells to our body. Electric impulses are formed by sensory cells which are received by the neurons. Then electric impulses which are passed through the silicon chips of artificial neurons are further sent to the brain by neurons.
- Interpretation:- Brain receives the electric impulses from the neurons which are developed by means of registers. Different values of the registers are accomplished by various states of brain.
- Output:- Depending on the states of the registers, the electrified impulses are sent by the central system called brain representing the responses which are further received by the sensory cells to respond .The part of the body of whose sensory cells are going to receive that, depends on the state of the neurons in the brain at that particular time.
- Memory:- Information can be permanently stored in our brain by some specific neurons. According to our requirements, the brain interprets those states and thus past things can be recalled. Neurons are demanded to do so and also to continuously display the accurate vision of state of the brain.
- Processing:- By using some of the stored states, estimation will be performed by the computer. Neural circuitry does the arithmetic and logical computations. To generate the output stored, past experiences and current input received are used.
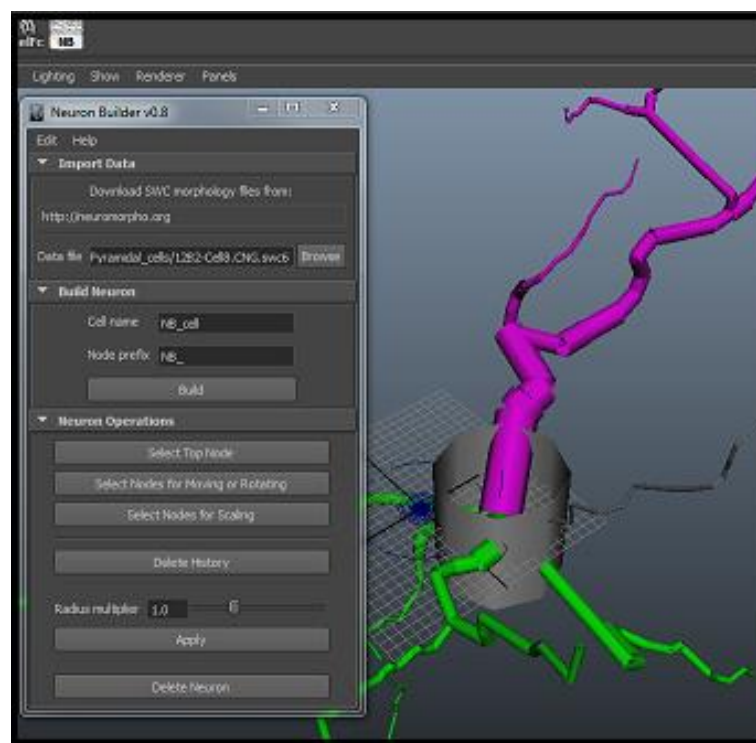

Fig. 1 Neuron Cell Builder with BBP-SDK

Step 3: Visualization: An application called RTNeuron software is used by Blue brain project to visualize the neural simulations. This software was developed internally by the BB team. Here a 3D model of neuron is designed which can be used by the researchers to cram the structure and operation of a neuron. RT Neuron is an ad-hoc application unlike other simulations which is written in C++ and openGL. The output from neuron is fetched by RT Neuron and displays them in 3D which helps the researchers to observe the activation potential propagation through among neurons. It also helps to interact with the 3D model by altering the animations in terms of zooming, stopping, resuming. The RT Neuron allows the visualization to render individual neuron as well as a complete cortical column.
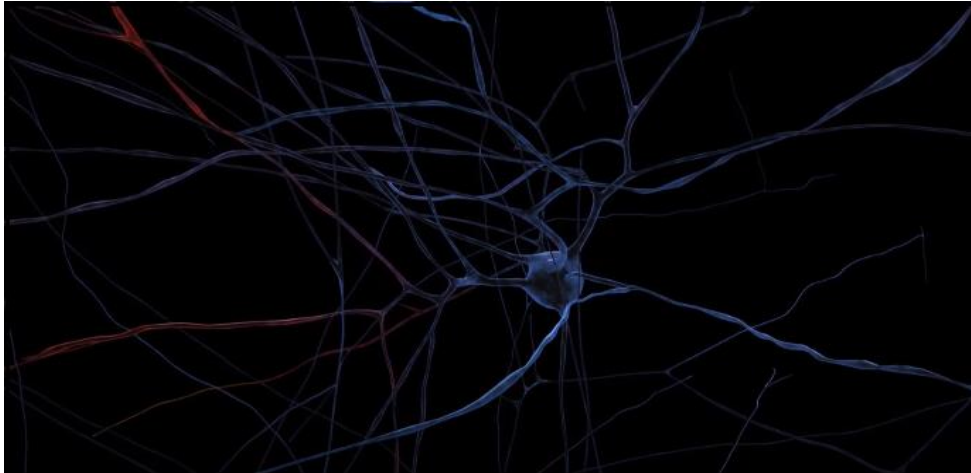
Fig. 2 3D Visualization of neuron simulation

D.   Uploading Human Brain

Very small robots called Nanobots are the most promising factor for uploading. Modern technology is developing machines or robots whose components are nearly close to the range of a nanometre. These nanoids are so tiny that it can travel throughout our circulatory element. To attain these uploading, miniature robots named nanobots are used.
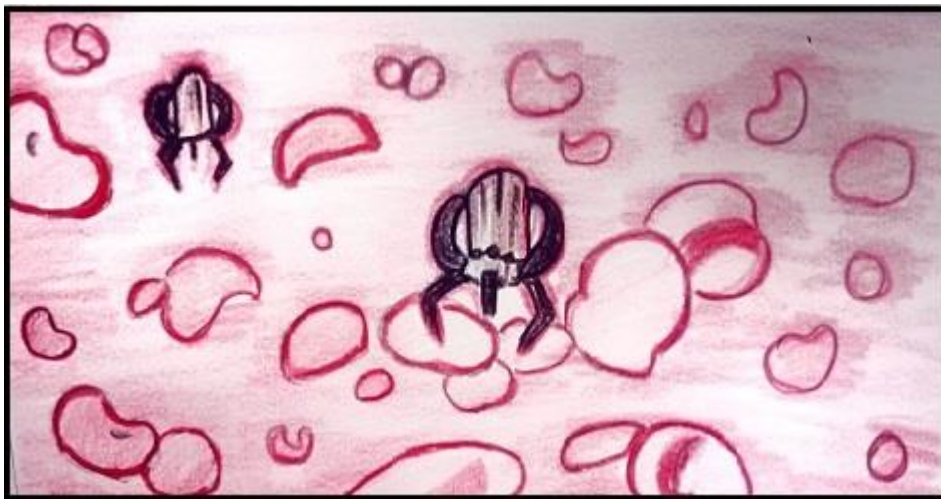

Fig. 3 Nanobots in circulatory system

As shown in figure 1 the nanobots monitor the functions and structure of our central nervous system by moving into the spine and the brain. Watchfully scanning the structure of the brain is the extra function of the nanobots which provides a detailed readout of the connections. Further, these details help the machine to function as the humans function. Ultimately, by using nanobots, the data stored in the entire brain will be uploaded into the computer.

E.   Tools and Technologies

•   A super computer with a large storing capacity and very high processing speed

•   A very wide network

•   A program that has the capability to convert the electric impulses from the human brain to an input signal, which has to be received by the computers, and vice versa

•   Nanobots - a powerful robot that can act as an interface between the human brain and the computer

Benefits and challenges of Blue Brain

Benefits

- Understanding the processing of human brain is very complicated, therefore Blue Brain provides a platform to know the internal working of human brain and also how the information will be transported through the neural networks
- Blue brain helps to store and efficiently utilize human intelligence and knowledge present in the mind even after the physical body is no more.
- Hearing impaired defects of an individual can be cured by sending the information via direct nerve stimulation.
- Decisions can be made in the absence of a person, thinking of an animal or human can be known easily.
- This is an establishment to discover a wide variety of neurological and psychiatric diseases which depends upon the flow of different elements and pathways of the neocortical column and also implement suitable drug for the disease.

Challenges

- The risk of human dependency on Blue Brain would drastically increase when it will be introduced into the world, also the technical knowledge can be used against the same person.
- Brain simulation of huge number of neuron and trillions of connections consumes a large amount of power and hence dissipation of heat takes place
- Today, a outsized supercomputer consists of thousands of processes, but a human brain cortex has billions of neurons and trillions of cortex, the cortex scale is very far and unclear

IV. CONCLUSION

To conclude the work, saying that humans can be transformed into computers to some extent can be proved true. The opinion against this result is one among the two, either dependent on simple minded or a strong call for upgrading the technology.   The survey of BBP technology, various methodologies and the equipments used in the execution of this project that is required 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 the deaf by providing them all the information via direct nerve stimulation. Simulating the characteristics and the structure of the human intellect (brain) in the super computer can benefit humans to a greater extent.

Since trillions of simulations and connections is to be stored and processes in the supercomputer during the simulation phase, a huge storage, processing speed and power is required and hence dissipation of heat takes place. This becomes the major drawback of the system. The reliable solution is, rather storing every simulation of the neuron only the simulations which help in decision making or which are essential for the case study can be recreated. This would save a considerable amount of memory as well as help store much of necessary information of the human brain.

REFERENCES

[1]. Iyer Mili Venkat, Sachin Gala, Ruchik Thakkar, Manan Mehta, Yash Bhawre, "Blue Brain: Bringing a Virtual Brain to Life", International Journal on Recent and Innovation Trends in Computing and Communication, ISSN: 2321-8169 Volume: 4, January 2018.
[2]. Kavya Priya G.V and Monika Sruthi.J, "A Review on Blue Brain Technology", International Journal of Trend in Research and Development, Volume 3(6), ISSN: 2394-9333, Nov-Dec 2019
[3]. Nakul Ghimire and Fahad Iqbal, "Blue Brain", International Research Journal of Engineering and Technology International Journal of Engineering & Technology.
[4]. Vijay Prakash Tiwari, Yash Khare, Prof. U. C. Patkar, "Blue Brain Technology to Preserve Intelligence", International Research Journal of Engineering and Technology, India, e-ISSN: 2395 -0056 Volume: 03, Apr-2016.
[5]. https://www.humanbrainproject.eu/faq/neuroscience
[6]. BlueGene: http://www.research.ibm.com/bluegene
[7]. "Project Milestones". Blue Brain. http://bluebrain.epfl.ch/Jahia/site/bluebrain/op/edit/pid/19085
[8]. http://research.ibm.com/bluebrain.
[9]. L. McKinney. (July 24, 2009). "Firing Up the Blue Brain - We Are 10 Years Away From A Functional Artificial Brain", The DailyGalaxy.
[10]. http://thebeutifulbrain.com/2010/02/bluebrain-film-preview/ Henry Mark ram, "The Blue Brain Project", Nature Reviews Neuroscience
[11]. http://bluebrainproject.epfl.ch