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Blue Brain Using Artificial Intelligence

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ABSTRACT

Today scientists are in research to create an artificial brain that can think, respond, take decisions, and keep anything in memory. The main aim is to upload the human brain into a machine. So that man can think, take decisions without any effort. After the death of the body, the virtual brain will act as the man. So, even after the death of a person we will not lose the knowledge, intelligence, personalities, feelings and memories of that man, that can be used for the development of the human society. Technology is growing faster than everything. IBM is now in research to create a virtual brain, called "Blue brain". If possible, this would be the first virtual brain of the world. IBM, in partnership with scientists at Switzerland's Ecole Polytechnique Federal de Lausanne's (EPFL) Brain and Mind Institute will begin simulating the brain's biological systems and output the data as a working 3-dimensional model that will recreate the high-speed electro-chemical interactions that take place within the brain's interior. This review paper consists of detailed information about the comparison of natural and simulated brain, implementation of artificial brain and various steps in creating simulated brain using Artificial Intelligence.

Keywords: Synthetic Brain, Supercomputer, IBM Blue gene, Nanomachines, Virtual environment, Neural Simulation, Artificial Intelligence.

I. INTRODUCTION

Human brain is the complex organ that controls thought, memory, emotion, touch, motor skills, vision, breathing, temperature, hunger and every process that regulates our body. The brain translates the information delivered by the impulses, which then enables the person to react.

This project was begun by a scientist at EPEL, Switzerland named Henry Markram. In 2005, IBM [International Business Machines] and EPEL [Ecole polytechnique federale] launched this project.

The primary machine for this project is the supercomputer engineered by IBM named 'Blue Gene'; hence the project was named Blue Brain. Michael Hine's NEURON, along with other custom-built components is used as simulation software, But we lose the knowledge of a brain when the body is destroyed after the death of man. That knowledge might have been used for the development of human society. What happens if we create a brain and upload the contents of the natural brain into it?

Need of Blue Brain?

Intelligence is associated with nursing inborn quality, which cannot be created and stored for future use. After death, all our intelligence is destroyed and we often have problems of remembering some important dates, people's name, and
Historical facts and so on. Virtual brain could be a smart answer to the problem where someone needs to live within a PC as a program so that it might be simple to recollect all the facts in such a busy era.

Aim of this project:

The main intention of this Blue Brain project is to review the purposeful principles of the brain moreover as its construction in supercomputers and enables quick treatment of brain related diseases.

Possibility:

Fig 2. Nanobot

Could it be possible to create an artificial brain and stimulate it to think, feel and experience the world as like a normal human brain? Yes, it is possible. Raymond Kurzweil, an American inventor, in his paper narrated the full details about the invasive and non-invasive methods using Nanobots which are terribly little and are needed to travel around the spine and brain to provide the structure and activity of Central Neural System (CNS). A Supercomputer with giant space for sorting and processing power is required to process the collected information. These Supercomputers are Nanorobots as shown in figure 2 can provide an interface with the human mind.

Natural Brain and Stimulated Brain:

Before getting to know about the building and functions of the Blue Brain, it is important to grasp information regarding the working of the human brain. The human ability to observe, clarify and respond is controlled by nervous system. The nervous system is quite a magical one which works through electric impulses from the human brain.

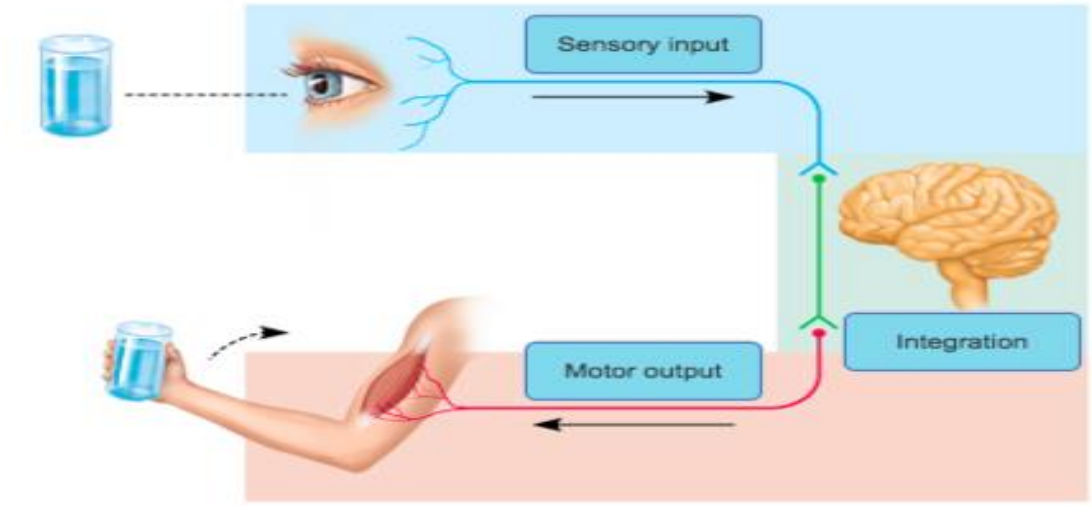

Fig 3. Working of Natural Brain

As seen in above figure 3, the following are the steps of working of the natural brain. The brain and intelli-gence will live even after death. We often face difficulties in remembering things such as people's names, their birthdays, and the spellings of words, proper grammar, important dates, history, facts etc... In the busy life everyone wants to be relaxed. Can't we use any machine to assist with all these? Virtual brain may be the solution to it.

- **Input**: The process of gathering information from the environment through sensory neurons is referred

to as sensory input. For instance, when the human eye perceives an object or when the hands feel a texture, the corresponding sensory neurons transmit signals to the brain.

- **Interpretation/Integration:** The process of comprehending the received sensory input with the assistance of the brain is known as interpretation. This involves the coordinated activity of billions of neurons to recognize and make sense of the surrounding environment.
- **Output:** Once the sensory input is processed, the brain sends signals through neurons to effector cells, such as muscles or glands, which carry out responses to the environment.
- **Processing:** Arithmetic and logical computations carried out in neural circuits enable decision-making. This process involves utilizing both previous experiences stored in the brain and current sensory inputs to arrive at decisions.
- **Memory:** Specific neurons in the brain facilitate our ability to form and recall memories.

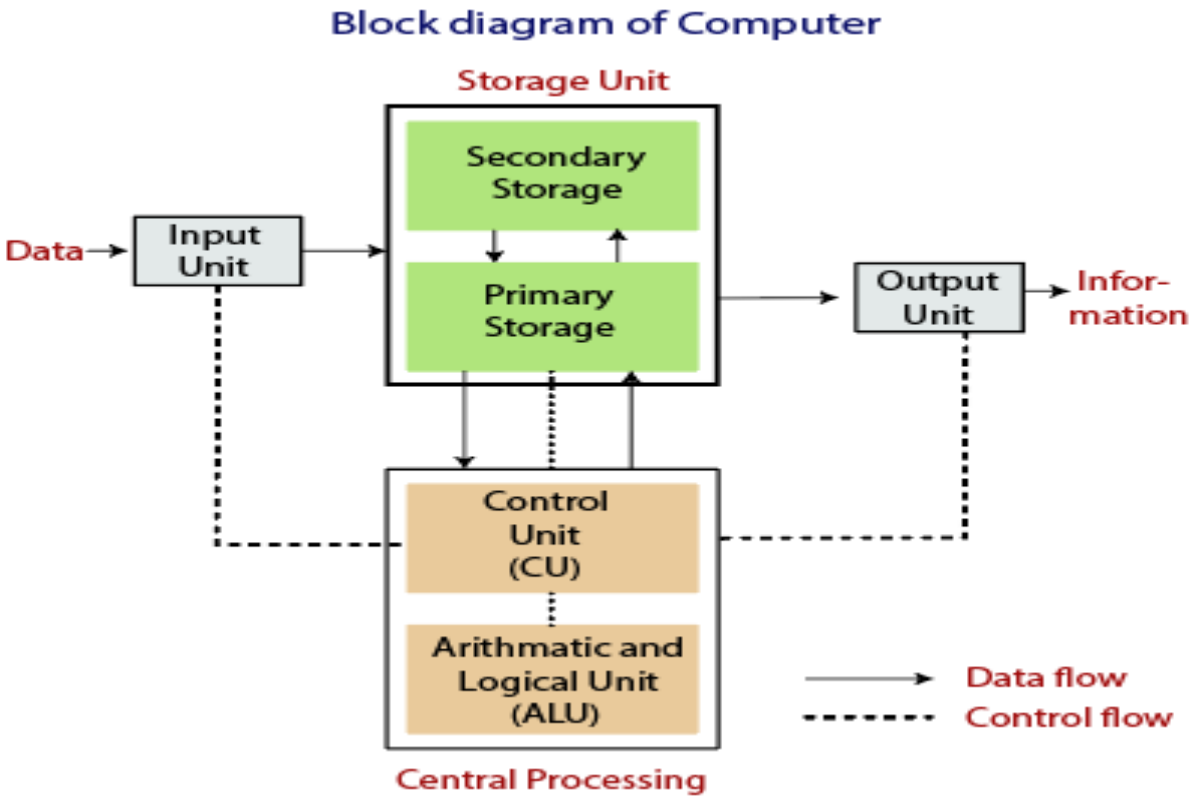

Fig.4. Working of a Simulated brain.

Functions of Simulated Brain:

As seen in above figure 4, the following are the steps of working of simulated brain

- **Input:** The scientists have created artificial neurons with silicon chips in the similar manner as actual neurons. These artificial neurons will receive input from secondary cells and also the electrical impulses from secondary cells are sent to supercomputers via artificial neurons for interpretation.
- **Interpretation:** The electric impulses that are obtained from synthetic neurons are interpreted by the way of a set of registers. The various values in the register represent different states of the brain.
- **Output:** After being interpreted, the output signals are given to sensory cells present within the artificial neuron.

- **Memory:** It is possible to store the records permanently with the help of secondary memory [Hardware]. By this way, the sets of registers will be stored permanently and the information in it could be retrieved and used when it is needed.

- **Processing:** The processing is done by computer by some stored information and by the inputs received. Artificial brain will perform some arithmetic and logical calculations as performed by our human brain using the concept of artificial intelligence.

TABLE 2. Comparison between Natural and Simulated

Parameters	Natural Brain	Stimulated Brain
INPUT	By means of neurons.	Electronic circuits containing artificial neurons made up of silicon.
INTEGRATION	Activity of Neurons	Through the use of binary code stored in the register.
OUTPUT	By means of neurons.	Electronic circuits containing artificial neurons made up of silicon.
MEMORY	The lasting configuration or activity pattern of neuron/cell.	Non-Volatile memory.
PROCESSING	Performing mathematical and logical operations through the connections and activity of neurons.	Performing mathematical and logical operations with the aid of AI techniques.

Project Description

The steps for creating a simulation of virtual brain are divided into 3 major sections:

- Data collection.
- Data simulation.
- Visualization of results.

[1]. **Data Collection**:

Data collection is a process of collecting individual slices of the brain and analyzing the electrical activity and the shape of neurons under a microscope [12]. Neurons are captured consistent with their structure, position in cortex, populous density and electrophysiological behavior. From figure 5, the topology of structural brain networks at micro-, meso- and macro-scales can be seen.

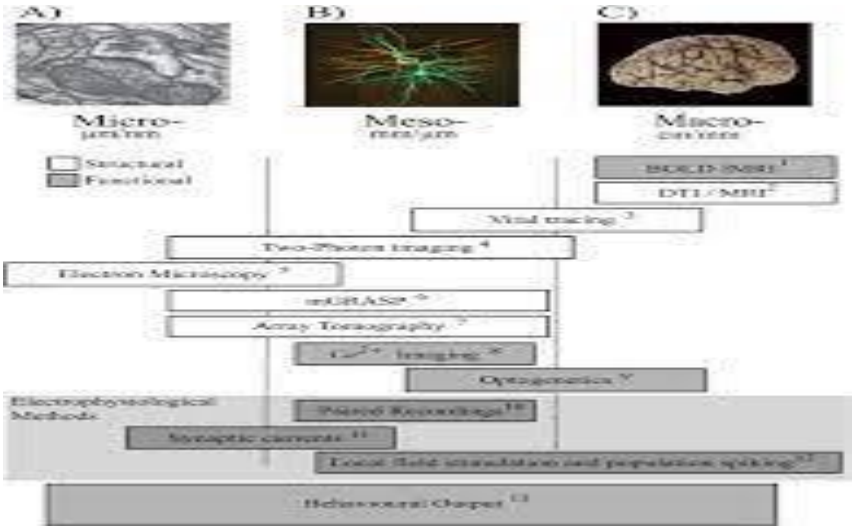

Fig 5. Neurons in Brain

The electrophysiological behavior of neurons is studied in a 12-patch clamp as shown in figure 6 especially designed for this Blue Brain project. Twelve numbers of living neurons are synchronously patched and their electrical activities are recorded.

The collected observations are then converted into algorithms that narrate the function, positioning and type of neurons. These algorithms will be used to generate synthetic virtual neurons that are prepared for consequent phases.

Fig 6. Patch clamp instrument.

B. **Data Simulation:**

Blue Brain Project-Software Development Kit [BBP-SDK]:

The main software employed by this Blue Brain project for neural simulation is a software package known as NEURON which was developed in the 1990s by Michael Hines [Yale University] and John Moore [Duke University].

This software is written in C, C++, and FORTRAN programming language [8].It is an open-source network (i.e.) the codes and binary are freely offered within the website. It is a C++ library wrapped in JAVA and PYTHON.

In 2005, Michael Hines and the BBP [Blue Brain Project] team collaborated to port the bundle to the massively parallel Blue genetic Supercomputer.

Data Simulation is bothered with 2 major aspects.

- Simulation Speed.
- Simulation Workflow.

Simulation Speed:

Simulation of one cortical column [around 10,200 neurons] runs approximately at 200xs very slower than the original time [24]. The simulation doesn't show even line scaling. It exhibits doubling of the dimensions of the neural network, which doubles the time it takes for simulation. The initial intent is to supply biological accuracy.

Simulation Workflow:

Simulation workflow includes virtual cell synthesizing using algorithms that were found to explain real neurons. There are millions of proteins in a single cell and each single protein is simulated.

The algorithms are customized on the basis of their lifetime, species and unhealthiness stage of the simulated animal [25]. The cells are connected with one another according to the experimental rules. The behavior of nerve cells is envisioned by Visualization software.

The basic unit of the cerebral cortex is the cortical column. There is an idea to couple the brain simulations with avatars that live within the virtual surroundings and additionally with the robots that are interacting with the actual world.

The primary target is to grasp the information and reproduce the human consciousness.

C**. Visualization of Neurons:**

RT Neuron: RT Neuron is the primary application employed by BBP to envision neural simulation. The RT Neuron package is written in C++ and openGL programming language which is developed by the BBP team. It uses ad-hoc software specially designed for neural simulation (i.e.) it cannot be used for additional kinds of simulations. The input is given as Hodgkin-Huxley simulations in Neuron and also the output is created as 3D.A Silicon Graphics Inc [SGI] with 300 GB shared memory is employed for visualizing the results. The visualizations are multi-scale [single neuron or whole cortical column]. The animations are paused, zoomed and so the researchers can interact with the model shown in figure 7.

Fig 7. Visualization of RT Neurons.

Requirement:

- A large amount of memory (i.e.) 16 terabytes [26] is required as there are billions and billions of neurons. The storage needed for such a massive simulation is terribly huge.
- A high-speed processor [256 MB to 512 MB memory [per processor] to simulate billions of neurons.

- A program that converts the electric impulses from the brain into an input signal to be obtained by the Supercomputer and vice versa.

- A nanorobot to act as the interface medium between the supercomputer and natural brain.

REFERENCES

1. Saurav Poonia: A Study on Blue Brain Modeling, Applications and its Challenges - International Journal of Research in Engineering, Science and Management Volume-2, Issue-2, February (2019).

2. Ojaswini Ghodkhande, Gajanan Patle: REVIEW ON BLUE BRAIN: AN ARTIFICIAL BRAIN- International Journal of Advanced Computational Engineering and Networking, ISSN: 2320-2106, Volume-3, Issue-12, and Dec (2015).

3. Priyanka Ingle, M. U. Karande: The Blue Brain -The Survey of Paper Blue Brain- International Research Journal of Engineering and Technology- Volume: 05 Issue: 05 | May- (2018).

4. Shruti Ganji and Kamala Nayana: Upgrading Human Brain to Blue Brain- Journal of Nanomedicine & Nanotechnology- Volume 6 - Issue 3.

5. Pranay V. Ahirekar, Piyush P. Sonawane, Rahul S. Singh Bhatti, Saurabh J. Bhamre: Blue Brain: A Subway to Artificial Intelligence- International Journal of Interdisciplinary Innovative Research & Development (IJIIRD) ISSN: 2456-236X- Vol. 02 Special Issue 05 | (2018).

6. Preeti Patel, Rakesh Patel, Ekta Agrawal: Study on Blue Brain with its Application- INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY- 3(12): December, (2014).

7. Remya Vinayakumar, Deepthi Varghese, Vince Paul: The Blue Brain Technology Using Wetware Technology and Fuzzy Logic-International Journal of Computer Science and Information Technologies, Vol. 6 (1), 61-68, (2015).

8. Surya Verma, Bhumika Kohli: Blue Brain- International Journal of Scientific and Research Publications-Vol 5/Issue 10- Oct (2015).

9. Iyer Mili Venkat, Sachin Gala, Ruchik Thakkar, Manan Mehta, and 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.

10. Kiran Ahuja, Harsh Sekhawat, Shilpi Mishra, Pradeep Jha (2021). Machine Learning in Artificial Intelligence: Towards a Common Understanding. Turkish Online Journal of Qualitative Inquiry, 12(8):1143-1152

11. H. Arora, M. Kumar, T. Rasool and P. Panchal (2022) Facial and Emotional Identification using Artificial Intelligence. 2022 6th International Conference on Trends in Electronics and Informatics (ICOEI), 1025-1030.

12. Dr. Himanshu Aora, Kiran Ahuja, Himanshu Sharma, Kartik Goyal, Gyanendra Kumar (2021). Artificial Intelligence and Machine Learning in Game Development. Turkish Online Journal of Qualitative Inquiry (TOJQI), 12(8):1153-1158.

13. Abhinav Agarwal, Himanshu Arora, Shilpi Mishra, Gayatri Rawat, Rishika Gupta, Nomisha Rajawat, Khushbu Agarwal (2023). Security and Privacy in Social Network. Sentiment Analysis and Deep Learning. Advances in Intelligent Systems and Computing 1432:569577.

14. S. Mishra, M. Kumar, N. Singh and S. Dwivedi (2022). A Survey on AWS Cloud Computing Security Challenges & Solutions. IEEE 6th International Conference on Intelligent Computing and Control Systems (ICICCS), 614-617.

15. Shweta Pachauri, Deeksha Sharma, Dr. Rahul Misra (2022). Role of Computer Education in Indian Schools. International Journal of Recent Research and Review, XV(3), 15-18.

16. A. Dhoka, S. Pachauri, C. Nigam and S. Chouhan (2023). Machine Learning and Speech Analysis Framework for Protecting Children against Harmful Online Content. IEEE 2023 Second International Conference on Electronics and Renewable Systems (ICEARS), 1420-1424.

17. Rahul Misra, Dr. Ramkrishan Sahay (2018). Evaluation of Student

Performance Prediction Models with TwoClass Using Data Mining Approach. International Journal of Recent Research and Review, XI(1): 71-79.

18. Rahul Misra, Dr. Ramkrishan Sahay (2018). Evaluation of Five-Class Student Model based on Hybrid Feature Subsets. International Journal of Recent Research and Review, XI(1):80-86.

19. S. Sharma, D. Arora, G. Shankar, P. Sharma and V. Motwani (2023). House Price Prediction using Machine Learning Algorithm. IEEE 7th International Conference on Computing Methodologies and Communication (ICCMC), 982-986.

20. Dr. Himanshu Arora, Gaurav Kumar soni, Deepti Arora (2018). Analysis and Performance Overview of RSA Algorithm. International Journal of Emerging Technology and Advanced Engineering. 8(4), 10-12.

21. Vipin Singh, Manish Choubisa, Gaurav Kumar Soni (2020). Enhanced Image Steganography Technique for Hiding Multiple Images in an Image Using LSB Technique. TEST Engineering & Management 83, 30561 -30565.

22. Shilpi Mishra, Divyapratap Singh, Divyansh Pant, Akash Rawat (2022). Secure Data Communication Using Information Hiding and Encryption Algorithms. IEEE 2022 Second International Conference on Artificial Intelligence and Smart Energy (ICAIS), 1448-1452.