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Review on The Human Brain Project

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Abstract: *Human Brain Projectis developed to integrate a strategy for understanding the human brain by gathering all existing data and knowledge that can be acquired about the structure and function of the brain and use it to develop a virtual brain structureby using latesttechnologies. Thishelps in understanding new fundamentals of the human brain and its reactions to various diseases and drugs, as well as brain-like computing technologies. This project has incredibly unlimited applications such as, medical, drugs designing, computer technologies, etc…*

Keywords: *Blue Brain, Super Computer, Simulation, Brain Model, NEURON, PyNN, Blue Gene.*

I. Introduction

The Human Brain Projectwas first brought up by Henry Markham, at the École Polytechnique Fédérale de Lausannel, located at Switzerland on the date, 1st of October 2013 in a European Commission Future and Emerging Technologies Flagship. Due to its amazing and vast prospects of its insights, it has got many funding from the European Union and other research institutions thathopes on the collaboration of this project.Scientists with a neuroscientific brain, a philosophical brainalso those brains that are specialized in computer science were also included in this supernatural project. The objective of this projectvery simple.First to collect all empirical data related to human brain and its structure and all those data are used to map the virtual brainand to develop simulations algorithms. This project has planned to use all those data and make available for research all over the world. More than 117institutions in 19 countries has partnered in this project. All these institutional teams are well coordinated so that the project will become successful on their moto until by 2025. The director of this project has also initiated many other such project like a piece of puzzles. One of such is the BLUE BRAIN PROJECT, initiated in 2005, which aims on creating a virtualmodel of the brain by reverse-engineering human brain neurons and their connectivity.The heart of this project is a Blue Gene supercomputer which runs through the softwareNEURON, the software models an single neuron and allows us to program it in our own way. Initially, the project was started by taking a rat's brain as a test subject. The Brain of the rat is similar to the brain of humans except that it does make some difference in the quantity of neurons. In humans, each columns are 2 mm length and has a diameter of 0.5 mm and contains about 60,000 neurons where as in rats, each columns are very similar in structure but contain only 10,000 neurons. The first brain model of rat's brain with columns of 10,000 cells was built by 2008. Scientists say that the modelling of human brain is possible by 2025.TheBlue Brain Project releases the first digital 3D brain cell model. HBP scientists collect allavailable data and develop brain models based on these quantitative data obtained. The natural human brain is can process many information and perform multiple actions in the same instant so that the normal computer is hard to simulate even a fraction of the human brain. So, to perform huge multiple operations at the same time, supercomputers are being employed.These supercomputers are capable of performing huge and multiple operations in a second and have their capacity measured in quadrillions of bytes.The Human Brain Project not only makes this hardware available to the scientists, but also develops software that supports scientists in other parts of their research also.

II. Hardware And Software

The Hardware and Software used for collecting data, mapping, simulations are listed as follows;

- **Supercomputer:**

The primary machine used by Brain Projectsare a Blue Gene supercomputer built by IBM. The machine is installed on the EPFL campus in Lausanne and is managed by CADMOS (Center for Advanced Modeling Science). The computer is used by a number of different research groups as well as by the Brain Project research. In 2012 the BBP was consuming about 20% of the compute time. But now it has be improved to a great extend as the technologies are glooming.

Fig: Supercomputer

Blue Gene Supercomputer's technical specifications are;

- 4,096 quad-core nodes
- Each core is a PowerPC 450, 850 MHz
- Total: 56 teraflops, 16 terabytes of memory
- 4 racks, one row, wired as a 16x16x16 3D torus
- 1 PB of disk space
- Operating system: Linux

This machine has emerged a the top computing computer and has been used by space and other complex applicaations.

➢ **Nanobots:**

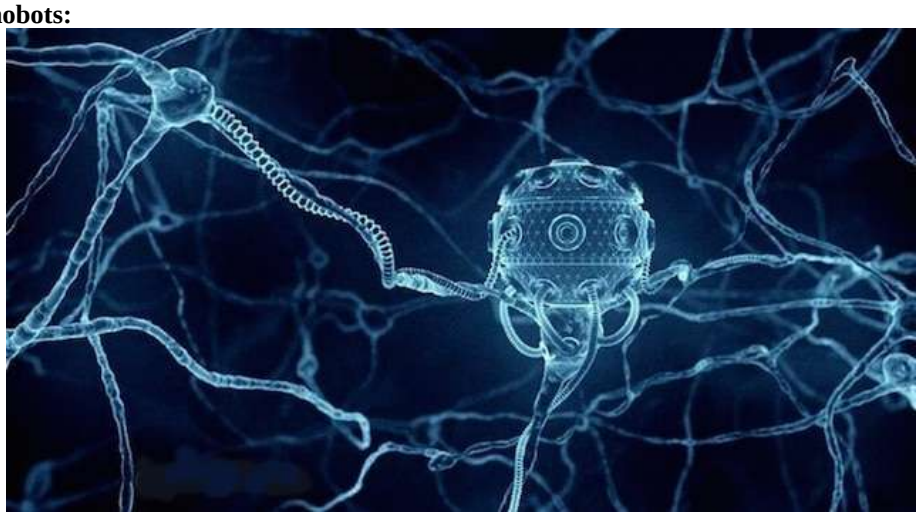

Fig: Nanobot

NanobotsThe uploading is possible by the use of small robots known as the Nanobots .These robots are small enough to travel throughout our circulatory system. Traveling into the spine and brain, they will be able to monitor the activity and structure of our central nervous system. They will be able to provide an interface with computers that is as close as our mind can be while we still reside in our biological form. Nanobots could also carefully scan the structure of our brain, providing a complete readout of the connections. This information, when entered into a computer, could then continue to function as us. Thus the data stored in the entire brain will be uploaded into the computer. IBM, in partnership with scientists at Switzerland's Ecole Polytechnique Federale 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. These include cognitive functions such as language, learning, perception and memory in addition to brain malfunction such as psychiatric disorders like depression and autism. From there, the modeling will expand to other regions of the brain and, if successful, shed light on the relationships between genetic, molecular and cognitive functions of the brain.The model brain can accurately

echo the song of a South American sparrow. The bird sing by forcing air from their lungs past folds of tissue in the voice box. The electric impulses from the brain that force the lungs had been recorded and when the equivalent impulses were passed to the computer model of the lungs of the bird it begins to sing like the bird. In conclusion, we will be able to transfer ourselves into computers at some point. Most arguments against this outcome are seemingly easy to circumvent. They are either simple minded, or simply require further time for technology to increase. The only serious threats raised are also overcome as we note the combination of biological and digital technologies.

- **PyNN:**

A Python package for simulator-independent specification of neuronal network models. The PyNN API aims to support modelling at a high-level of abstraction (populations of neurons, layers, columns and the connections between them) while still allowing access to the details of individual neurons and synapses when required. PyNN provides a library of standard neuron, synapse and synaptic plasticity models, which have been verified to work the same on the different supported simulators. PyNN also provides a set of commonly-used connectivity algorithms (e.g. all-to-all, random, distance-dependent, small-world) but makes it easy to provide your own connectivity in a simulator-independent way, either using the Connection Set Algebra (Djurfeldt, 2010) or by writing your own Python code. The other thing that is required to write a model once and run it on multiple simulators is standard cell models. PyNN can able to translate cellmodel name and parameter name to simulator-specific name, which can become usefull for maping and modelling. In this case, you can use any neuron or synapse model supported by your simulator, and are not restricted to the standard models.

- **BBP-SDK:**

The Blue Brain Project - Software Development Kit, is a set of Application Programming Interface that allows the scientists to use and model prototypes and run simulations. The Blue Brain ProjectSDK is simply C++ library wrapped in Java or Python. The primary software used by this for neural simulations is named as NEURON. Michael Hines of Yale University and John Moore at Duke University developed this software. It is an open source software.

III. Merits And Demerits

There are countless advantages and application that can tremendously improve the way we look on the fields of computing, medicine, etc.… [12] Some of the mentionable merits include;

- Remembering things without any effort is possible.
- We can make decisions without the physical existence of a person
- Usage of the intelligence of a person after his/her death
- The actions of animals can be understood easily
- Via direct nerve stimulation, the deaf is able to hear

Depending on the way we use all the technologies that humans create, all technologies have both good and bad effects which we should be accept and make use of those technologies on the good and improving way. Some of the demerits include;

- We will more rely on computer
- Technical knowledge can be used against us
- There are more power constraints as the supercomputers may use large power for computing
- Human Cloning is also possible.

IV. Conclusion

Hence, we can say that with some improvement in today's technology, the Blue Brain can be implemented in future and transferring ourselves into computer would be possible. The intelligence of human brain will be stored even after the death for betterment of society. We can make decisions without the actual presence of a person. But it is also true that we will depend on the computer. It will bring both positive and negative effects to human society.These supercomputers are capable of performing huge and multiple operations in a second and have their capacity measured in quadrillions of bytes.The Human Brain Project not only makes this hardware available to the scientists, but also develops software that supports scientists in other parts of their research also. This technology will be accepted all over the world widely very soon.

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