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A Survey Paper on Blue Brain Technology

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Abstract: ***Human brain is the most valuable creation of God. The man is intelligent because of the brain. "Blue brain" is the name of the world's first virtual brain. That means a machine can function as human brain. Today scientists are in research to create an artificial brain that can think, response, take decision, and keep anything in memory. The main aim is to upload human brain into machine. So that man can think, take decision 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.***

Keywords: Nanobotes, Neurons, Sensory System, Blue Brain, skeleton.

I. INTRODUCTION

Human brain the most valuable creation of god. The man is called intelligent because of the brain. But we loss the knowledge of a brain when is destroyed after the death .It would be the world first virtual brain. Within 30 years. We will be able to san in to the computers. When man does not have a device called computer, it was a big question for all. But today it is possible due to the technology. Technology is growing faster than everything. It is called "**Blue brain** ".If possible, this would be the first virtual brain of the world. The Blue Brain System is an attempt to reverse engineer the human brain and recreate it at the cellular level inside a computer simulation. The project was founded in May 2005 by Henry Markram at the EPFL in Lausanne, Switzerland. Goals of the project are to gain a complete understanding of the brain and to enable better and faster development of brain disease treatments. The research involves studying slices of living brain tissue using microscopes and patch clamp electrodes. Data is collected about all the many different neuron types. This data is used to build biologically realistic models of neurons and networks of neurons in the cerebral cortex. The simulations are carried out on a Blue Gene supercomputer built by IBM, hence the name "Blue Brain". The simulation software is based on Michael Hines's NEURON, together with other custom-built components. As of August 2012 the largest simulations are of micro circuits containing around 100 cortical columns such simulations involve approximately 1 million neurons and 1 billion synapses. This is about the same scale as that of a honey bee brain. It is hoped that a rat brain neocortical simulation (~21 million neurons) will be achieved by the end of 2014. A full human brain simulation (86 billion neurons) should be possible by 2023 provided sufficient funding is received.

II. WHAT IS BLUE BRAIN?

The IBM is now developing a virtual brain known as the Blue brain. It would be the world's first virtual brain. Within 30 years, we will be able to scan ourselves into the computers. We can say it as Virtual Brain i.e. an artificial brain, which is not actually a natural brain, but can act as a brain. It can think like brain, take decisions based on the past experience, and respond as a natural brain. It is possible by using a super computer, with a huge amount of storage capacity, processing power and an interface between the human brain and artificial one. Through this interface the data stored in the natural brain can be up loaded into the computer. So the brain and the knowledge, intelligence of anyone can be kept and used for ever, even after the death of the person.

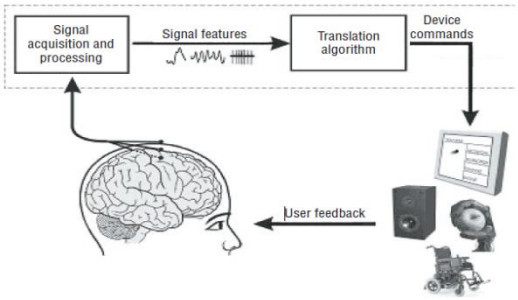

Fig. 1 Diagram of blue brain system

The Blue Brain Project is an attempt to create a synthetic brain by reverse-engineering the mammalian brain down to the molecular level. The aim of the project, founded in May 2005 by the Brain and Mind Institute of the École Polytechnique Fédérale de Lausanne (EPFL) in Switzerland, is to study the brain's architectural and functional principles. Goals of the project are to gain a complete understanding of the brain and to enable better and faster development of brain disease treatments. The project is headed by the founding director Henry Markram and co-directed by Felix Schürmann and Sean Hill. The research involves studying slices of living brain tissue. Data is collected about all the many different neuron types. This data is used to build biologically realistic models of neurons and networks of neurons in the cerebral cortex. The simulations are carried out on a Blue Gene running Michael Hines's NEURON software, supercomputer built by IBM. Hence the name Blue Brain. Virtual brain is an artificial brain, which does not actually the natural brain, but can act as the natural brain. It can think like brain, take decisions based on the past experience, and response as the natural brain. It is possible by using a super computer, with a huge amount of storage capacity, high processing power and an interface between the human brain and this artificial one .Through this interface the data stored in the natural brain can be up loaded into the computer. So the knowledge, intelligence of anyone can be kept and used for ever, even after the death of the person.

III. History of the Blue Brain

The aim of the project, founded in May 2005 by the Brain and Mind Institute of *the École Polytechnique Fédérale de Lausanne* (Switzerland) is to study the brain's architectural and functional principles. The project is headed by the Institute's director, Henry Markram. Using a Blue Gene supercomputer running Michael Hines's NEURON software, the simulation does not consist simply of an artificial neural network, but involves a biologically realistic model of neurons. It is hoped that it will eventually shed light on the nature of consciousness. There are a number of sub-projects, including the Cajal Blue Brain, coordinated by the supercomputing and Visualization Center of Madrid (CeSViMa), and others run by universities and independent laboratories.

Goals

I. Neocortical column modeling

The initial goal of the project, completed in December 2006, was the simulation of a rat neocortical column, which can be considered the smallest functional unit of the neocortex (the part of the brain thought to be responsible for higher function such as conscious thought). Such a column is about 2 mm tall, has a diameter of 0.5 mm and contains about 60,000 neurons in humans; rat neocortical columns are very similar in structure but contain only 10,000 neurons (and 108 synapses). Between 1995 and 2005, Markram mapped the types of neurons and their connections in such a column.

II. Whole brain simulation

A longer term goal is to build a detailed, functional simulation of the physiological processes in the human brain: "It is not impossible to build a human brain and we can do it in 10 years," Henry Markram, director of the Blue Brain Project said in 2009 at the TED conference in Oxford. In a BBC World Service interview he said: "If we build it correctly it should speak and have intelligence and behave very much as a human does."

III. Progress

In November 2007, the project reported the end of the first phase, delivering a data-driven process for creating, validating, and researching the neocortical column. By 2005 the first single cellular model was completed. The first artificial cellular neocortical column of 10,000 cells was built by 2008. By July 2011 a cellular microcircuit of 100 neocortical columns with a million cells in total was built. A cellular rat brain is planned for 2014 with 100 microcircuits totaling a hundred million cells. Finally a cellular human brain is predicted possible by 2023 equivalent to 1000 rat brains with a total of a hundred billion cells. Now that the column is finished, the project is currently busying itself with the publishing of initial results in scientific literature, and pursuing two separate goals: construction of a simulation on the *molecular level*, which is desirable since it allows studying the effects of gene expression; simplification of the column simulation to allow for parallel simulation of large numbers of connected columns, with the ultimate goal of simulating a whole neocortex (which in humans consists of about 1 million cortical columns).

IV. Uploading Human Brain

First, it is helpful to describe the basic manners in which a person may be uploaded into a computer. Raymond Kurzweil recently provided an interesting paper on this topic. In it, he describes both invasive and non invasive techniques. The most promising is the use of very small robots, **or** nanobots**.** These robots will be small enough to travel throughout our circulatory systems. Travelling 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 between each neuron. They would also record the current state of the brain. This information**,** when entered into a computer, could then continue to function as us. All that is required is a computer with large enough storage space and processing power. Is the pattern and state of neuron connections in our brain truly all that makes up our conscious selves? Many people believe firmly those we possess a soul, while some very technical people believe that quantum forces contribute to our awareness. But we have to now think technically. Note, however, that we need not know how the brain actually functions, to transfer it to a computer. We need only know the media and contents. The actual mystery of how we achieved consciousness in the first place, or how we maintain it, is a separate discuss.

IV. NEED OF VIRTUAL BLUE BRAIN

Today we are developed because of our intelligence. Intelligence is the inborn quality that cannot be created. Some people have this quality, so that they can think up to such an extent where other cannot reach. Human society is always in need of such intelligence and such an intelligent brain to have with. But the intelligence is lost along with the body after the death. The virtual brain is a solution to it. The brain and intelligence will be alive even after the death. We often face difficulties in remembering things such as people names, their birthdays, and the spellings of words, proper grammar, important dates, history facts, and etcetera. In the busy life everyone wants to be relaxed. Can't we use any machine to assist for all these? Virtual brain may be a better solution for it. What will happen if we upload ourselves into computer, we were simply aware of a computer, or maybe, what will happen if we lived in computer as a program?

V. HOW IT IS POSSIBLE?

First, it is helpful to describe the basic manners in which a person may be uploaded into a computer. Raymond Kurzweil recently provided an interesting paper on this topic. In it, he describes both invasive and noninvasive techniques. The most promising is the use of very small robots, or nanobots. These robots will be small enough to travel throughout our circulatory systems. 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

between each neuron. They would also record the current state of the brain. This information, when entered into a computer, could then continue to function like us. All that is required is a computer with large enough storage space and processing power.

VI. FUNCTIONING OF HUMAN BRAIN

The human ability to feel, interpret and even see is controlled, in computer like calculations, by the magical nervous system. Yes, the nervous system is quite like magic because we can't see it, but its working through electric impulses through your body. One of the world's most "intricately organized" electron mechanisms is the nervous system. Not even engineers have come close for making circuit boards and computers as delicate and precise as the nervous system. To understand this system, one has to know the three simple functions that it puts into action: sensory input, integration, motor output.

A. Sensory input:

When our eyes see something or our hands touch a warm surface, the sensory cells, also known as Neurons, send a message straight to your brain. This action of getting information from your surrounding environment is called sensory input because we are putting things in your brain by way of your senses.

B. Integration:

Integration is best known as the interpretation of things we have felt, tasted, and touched with our sensory cells, also known as neurons, into responses that the body recognizes. This process is all accomplished in the brain where many neurons work together to understand the environment.

C. Motor Output:

Once our brain has interpreted all that we have learned, either by touching, tasting, or using any other sense, then our brain sends a message through neurons to effecter cells, muscle or gland cells, which actually work to perform our requests and act upon the environment. How we see, hear, feel, smell, and take decision.

VII. BRAIN SIMULATION

Comparison between natural and simulated brain Table.1

TABLE I

Natural Brain	Simulated Brain
INPUT In the nervous system in our body the neurons are responsible for the message passing. The body receives the input by sensory cells. This sensory cell produces electric impulses which are received by neurons. The neurons transfer these electric impulses to the brain.	INPUT In a similar way the artificial nervous system can be created. The scientist has created 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. So, the electric impulses from the sensor cells can be received through these artificial neurons.
INTERPRETATION The electric impulses received by the brain from neurons are interpreted in the brain. The interpretation in the brain is accomplished by means of certain states of many neurons	INTERPRETATION The interpretation of the electric impulses received by the artificial neuron can be done by means of registers. The different values in these register will represent different states of brain.
OUTPUT Based on the states of the neurons the brain sends the electric impulses representing the responses which are further received by sensory cell of our body to respond neurons in the brain at that time.	OUTPUT Similarly 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.

Natural Brain	Simulated Brain
MEMORY There are certain neurons in our brain which represent certain states permanently. When required, this state is represented by our brain and we can remember the past things. To remember things we force the neurons to represent certain states of the brain permanently or for any interesting or serious matter this is happened implicitly.	MEMORY It is not impossible to store the data permanently by using the secondary memory. In the similar way the required states of the registers can be stored permanently and when required these information can be received and used. be received and used.
PROCESSING When we take decision, think about something, or make any computation, logical and arithmetic computations are done in our neural circuitry. The past experience stored and the current inputs received are used and the states of certain neurons are changed to give the output.	PROCESSING In the similar way the decision making can be done by the computer by using some stored states and the received input and the performing some arithmetic and logical calculations.

VIII. STEPS OF BUILDING A BLUE BRAIN

1. Data collection

2. Data simulation

3. Visualization

1. Data collection:

It involves collecting brain portions, taking them under a microscope, and gauging the shape and electrical behavior of neurons individually. This method of studying and cataloguing neurons is very familiar and worldwide. The neurons are captured by their shape, electrical and physiological activity, site within the cerebral cortex, and their population density. These observations are translated into precise algorithms which describe the process, function, an positioning methods of neurons. Then, the algorithms are used to generate biologically-real looking virtual neurons ready for simulation.

2. Data simulation:

It concerns with two major aspects:

a. Simulation speed

b. Simulation workflow

Simulation speed:

Simulations of one cortical column (more than 10,100 neurons) run about two hundred times slower than real time. It takes about five minutes to complete one second of stimulated time. The simulations display unevenly line scaling. Presently the major seek is biological soundness rather than presentation. After understanding biologically significant factors for a given effect it might be feasible to crop constituents that don't subsidize in order to advance performance.

Simulation overflow:

Making virtual cells using the algorithms, written to define and describe real neurons, is the major seek of this step.

Algorithms and constraints are adapted according to the age, species, and disease stage of the animal being simulated. Each one of the protein is simulated.

Note: there are hundreds of millions of proteins in one cell.

a. First a network skeleton is built from all the different kinds of synthesized neurons.

b. b. After this, the cells are joined according to the experimentally found rules.

c. c. Finally the neurons are functionalized and the simulation brought to life.

d. The blueprints of emerging behavior are watched with visualization software.

BBP-SDK

The Blue Brain Project - Software Development Kit, a set of Application Programming Interfaces allows the researchers to use and audit prototypes and simulations. The Blue Brain Project-SDK is a C++ library wrapped in Java and Python. The primary software used by this 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 freely available open source software. The website makes everything available including the code and the binary data freely. Michael Hines in cooperation with BBP team in 2005 ported the package into the massive and parallel Blue Gene.

3. Visualization:

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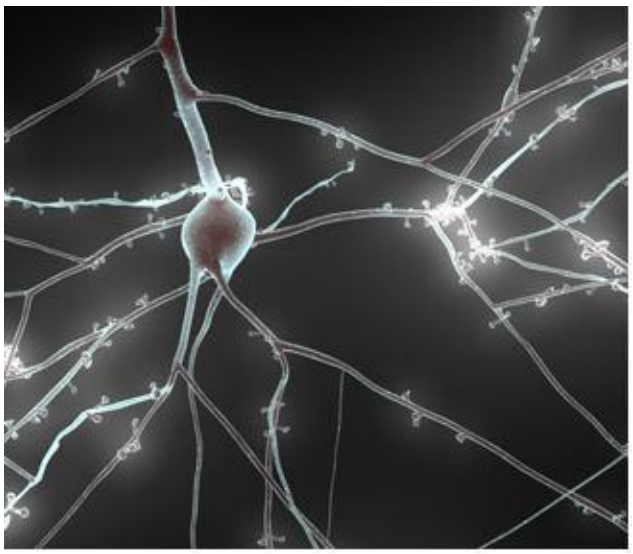

Fig. 2 Visualization results of rt neuron

RT Neuron is the main application that Blue Brain Project uses for visualization of neural simulations. The BBP team developed this software internally. It is coded using C++ and OpenGL. RT Neuron is an ad-hoc software written specifically for neural simulations, i.e. it can't generalized to other kinds 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. The visualizations are multi-scale (they can render individual neurons or a whole cortical column).

IX. Hardware and Software Requirement

- A Blue-Gene super computer running Michael Hines's NEURON software.
- Memory with a large storing capacity.
- Processor with a high processing power.
- 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 to act as the interface between the natural brain and the computer.

X. APPLICATIONS

- Gathering and Testing 100 Years of Data.
- Cracking the Neural Code.
- Understanding Neocortical Information Processing.
- A Novel Tool for Drug Discovery for Brain Disorders..
- A Global Facility.
- A Foundation for Whole Brain Simulations.
- A Foundation for Molecular Modeling of Brain Function.

XI. ADVANTAGES OF BLUE BRAIN

- Blue brain is an approach to store and utilize human intelligence and information present in the mind even after human demise.
- It is an important move towards self-decision making by the computer or machine that holds a Blue brain.
- Business analysis, attending conferences, reporting, etc. are very significant functions that an intelligent machine can do consistently.
- It can be used as an interface between human and animal minds. The BBP has become successful in rat and some other animals which is a sign of success.

XII. DISADVANTAGES OF BLUE BRAIN

- It increases the risk of human dependency on Blue Brain every time.
- Once a Blue Brain related to a particular person's neural schema is hacked, the brain could be used against the very.
- Against human (like we have been watching in the movies like Terminator, Universal soldier, etc.)

XIII. FUTURE WORK

Blue Brain project was progressing faster than expected. "Consciousness is just a massive amount of information being exchanged by trillions of the brain cells human." Some proponents of strong AI speculate that the computers in connection with Blue Brain and Soul Catcher may exceed human intellectual capacity by around 2015, and that it is likely that we will be able to download the human brain at sometime around 2025.

XIV. CONCLUSION

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. While the road ahead is long, already researches have been gaining great insights from their model. Using the Blue Gene supercomputers, up to 100 cortical columns, 1 million neurons, and 1 billion synapses can be simulated at once. This is roughly equivalent to the brain power of a honey bee. Humans, by contrast, have about 2 million columns in their cortices. Despite the sheer complexity of such an endeavor, it is predicted that the project will be capable of this by the year 2025.

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