A Review on Blue Brain "The future Artificial Brain"

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Abstract— Human brain is the most valuable creation of God. Understanding the human brain is one of the greatest challenges facing 21st century science. The man is intelligent because of the brain. "Blue brain" is the name of the world's first virtual brain which means, a machine that can function as human brain. The Blue Brain Project is the first made comprehensive attempt to reverse-engineer the brain of mammalian, so that through detailed simulations the function of brain can be understood. IBM's Blue Gene supercomputer allows a quantum leap in the level of detail at which the brain can be modeled. The main aim is to upload human brain into machine. After the death of the body, the virtual brain will act as the man. In this paper, we present the complete research work on concepts of Blue Brain and its requirements.
Key words: Human brain, Blue Brain, Artificial Brain

I. INTRODUCTION

No one has ever understood the complexity of human brain. It is complex than any other circuits in the world. So, question may arise "Is it really possible to create a human brain?" The answer is "Yes". Because, whatever man has created today, he has always followed the nature. 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. It's very clear by reading the general overview of what Blue brain is. Blue brain is a concept which allows to copy or to transfer all the contents of a human brain into a virtual brain that resides inside a Super computer. The Super computer used in this is Blue Gene as of the current information revealed. It is like uploading a mind in a computer. Mind uploading can probably be achieved by either of two methods: 1.Copy and Transfer or 2.Slow and steady replacement of neurons.

II. ARTIFICIAL BRAIN OVERVIEW

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.

Artificial brain is a term commonly used in the media to describe research that aims to develop software and hardware with cognitive abilities similar to those of the animal or human brain. Research investigating "artificial brains" plays three important roles in science

- A study called cognitive neuroscience, which helps neuroscientists to make an on-going attempt to understand how human brain works.
- A thought experiment in the philosophy of artificial intelligence (AI), which demonstrates that it is actually possible to create a machine that has all the capabilities of a human being in theory
- A serious long term project to create machines capable of general intelligent action or Artificial General Intelligence. This idea has been popularised by Ray Kurzweil as strong AI

A. Description of the Standard Genetic Algorithm

The standard GA (Genetic Algorithm) used to help calculate the speed up factor consisted of the following steps.

1) Randomly generate 100 bit string chromosomes of length N2(p+1). Over the years we have used values, N = 16, p = 8, so our chromosomes (bit strings) were 2304 bits long.*

2) Decode the chromosome into the N2 signed binary fraction weights, and build the neural network for each chromosome.

3) Perform the fitness measurements for the task concerned. For details, see the next section.

4) Rank the fitnesses from best to worst.

B. Evolving Neural Network Modules on a PC and on the Celoxica Board

The aim of the experiment described in this section is to evolve a "GenNet", i.e. a Genetically Programmed Neural Net that outputs a desired signal. The experiment was conducted both on a PC and on the Celoxica board. Based on the two evolution times of the GenNet using the two methods, a comparison was made to see how great a speed-up of the evolution can be achieved by using the Celoxica Board compared to using a software based evolution on the PC. The GenNet evolution program that was run on the PC was written in the "C" language, whereas the program run on the Celoxica board was written using the "Handel-C" language.

Fig. 1: the Celoxica Board

C. Blue Brain Project

Rosen Industries created the prototype for the Blue Brain. The report is in Do Androids Dream of Electric Sheep, which obviously inspired Markram's Blue Brain Project in

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Lausanne to reverse-engineer the mammalian brain, creating a complete virtual brain within IBM's BlueGene/L supercomputer. The Blue Brain project proposes a fantastic voyage.2 the first phase of this project succeeded in simulating a rat cortical column. It claims to use more realistic models of neurons than most neural net models.3 It has spawned several ancillary projects around the globe, such as the Cajal Blue Brain in Madrid.

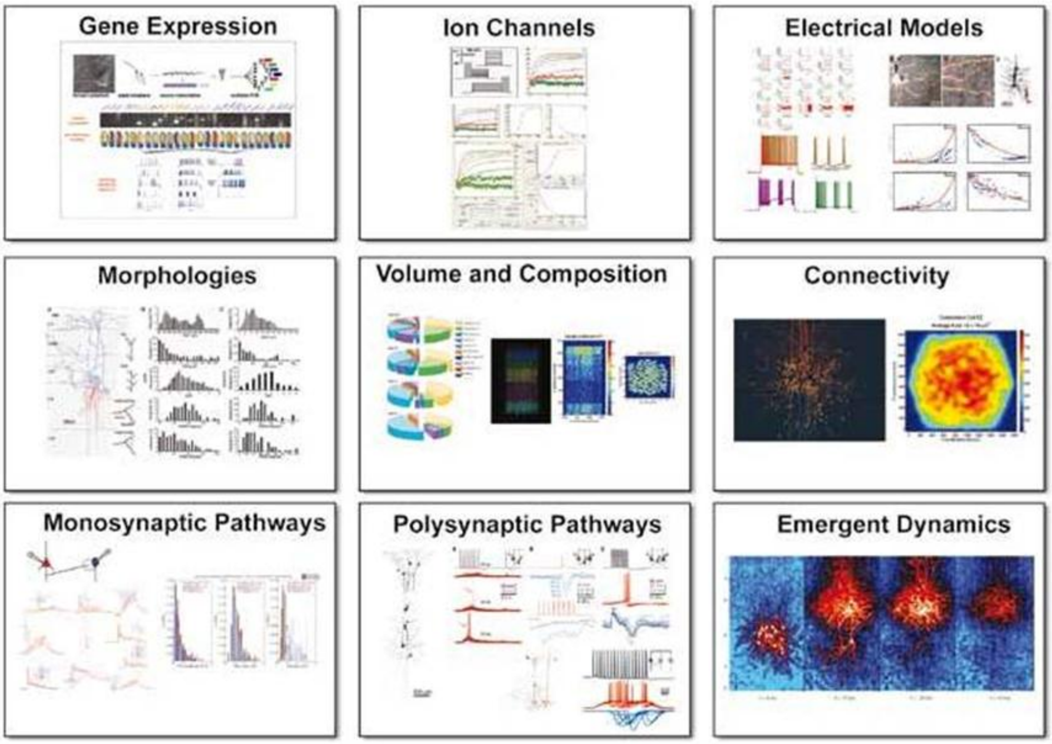
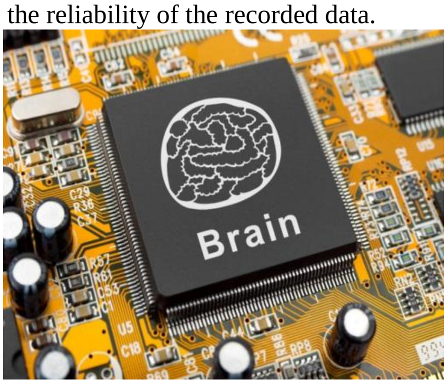


Fig. 2: Brain Chip

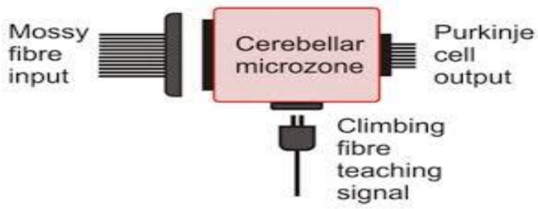
D. Brain Chip

Matthew Nagle's brain chip was designed to provide a balance between safety, durability, and functionality. The chip had to be small enough to not hinder normal brain function and no disruptive to neural communication to avoid brain damage. Nagle's chip recorded brain signals using integrated CMOS circuitry, which is an array of recording electrodes. Just like repeating an experiment ensures statistically significant results, using multiple electrodes improved the reliability of the recorded data.



E. Cerebellar Chip

The discovery of learning neurons confirmed the existence of the biological counterpart of Perceptron, an artificial neuron in the field of neural net The concept of cerebellar learning was further refined by the identification of a physiologic biological functional unit, namely, the cerebellar chip The chip is organized around a single output neuron, the Purkinje cell. Information reaching the cerebellum is first processed by many, so termed, pre-processing neurons such as granular cells. The output of these pre-processing neurons reaches the Purkinje cells via the parallel fibers which form synaptic connections with dendrites of the Purkinje cells. Transmission efficacy of the synapses between parallel fibers and the Purkinje cells is modifiable, forming the basis of synaptic plasticity, and provides the biologic substrate of the cerebellar learning processes.



The cerebral cortex exhibits a basic neural architecture similar to the cerebellum. The logical cerebral counterparts of cerebellar Purkinje cells are the pyramidal cells. The cerebral cortex exhibits a basic neural architecture similar to the cerebellum.

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F. Neurorobotics

The brain evolved to control the body as it interacts with its environment, interactions that many researchers in robotics have attempted to replicate. In most cases, however, the models and robots they have used have been distant from biology.

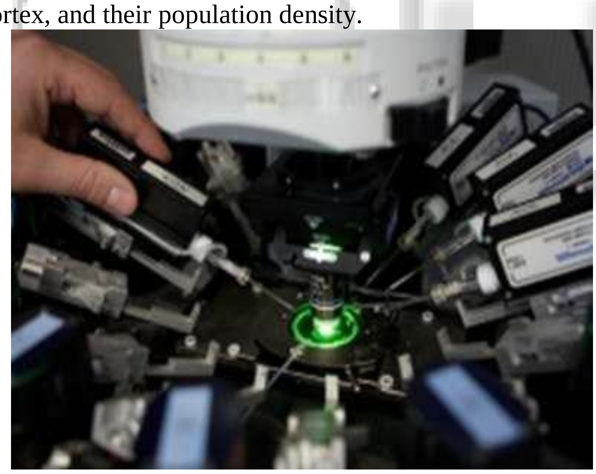
The HBP Neurorobotics Platform would allow them to interface a detailed brain model to a simulated body with an appropriate set of actuators and sensors, place the body in a simulated environment, and train it to acquire a certain capability or set of capabilities, and compare its performance against results from human or animal experiments.

III. Steps to Building a Blue Brain

- Data collection
- Data simulation
- Visualization

A. Data Collection:

It involves collecting brain portions, taking them under a microscope, and gauging the shape and electrical behavior of neurons individually. These observations are translated into precise algorithms which describe the process, function, and positioning methods of neurons 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.



B. Data Simulation

It concerns with two major aspects:

- Simulation speed
- Simulation workflow

1) 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.

2) 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.

IV. Need of Virtual 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.

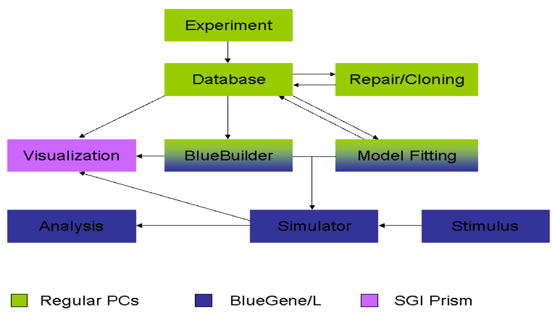
V. Goals

A. Neocortical column modelling

The initial goal of the project was the simulation of a rat neocortical column, which is considered by some researchers to be the smallest functional unit of the neocortex. 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 Markram mapped the types of neurons and their connections in such a column.

B. Whole-brain simulations

The main limitations for digital computers in the simulation of biological processes are the extreme temporal and spatial resolution demanded by some biological processes, and the limitations of the algorithms that are used to model biological processes. If each atomic collision is simulated, the most powerful supercomputers still take days to simulate a microsecond of protein folding, so it is, of course, not possible to simulate complex biological systems at the atomic scale. However, models at higher levels, such as the molecular or cellular levels, can capture lower-level processes and allow complex large-scale simulations of biological processes. However, simulating neurons embedded in microcircuits, microcircuits embedded in brain regions, and brain regions embedded in the whole brain as part of the process of understanding the emergence of complex behaviours of animals is an inevitable progression in understanding brain function and dysfunction, and the question is whether whole-brain simulations are at all possible. Computational power needs to increase about 1-million-fold before we will be able to simulate the human brain, with 100 billion neurons, at the same level of detail as the Blue Column.



Algorithmic and simulation efficiency could reduce this requirement by two to three orders of magnitude. Simulating the NCC could also act as a test-bed to refine algorithms required to simulate brain function, which can be

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used to produce field programmable gate array (FPGA)-based chips. FPGAs could increase computational speeds by as much as two orders of magnitude.

The FPGAs could, in turn, provide the testing ground for the production of specialized NEURON solver application-specific integrated circuits (ASICs) that could further increase computational speed by another one to two orders of magnitude. It could therefore be possible, in principle, to simulate the human brain even with current technology.

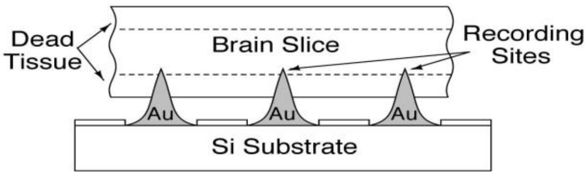
C. Uploading Human Brain

First, it is helpful to describe the basic manners in which a person may be uploaded into a computer. 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.

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.

D. Finding a Cure for Paralysis

The human brain is the command center of the nervous system. It is composed of 100 billion highly specialized cells called neurons. Through the complex networking of these cells, the brain sends and receives signals that manage biological processes within the body and direct voluntary movement. In a healthy person, sensory neurons carry signals from the body through the spinal cord to the brain, while motor neurons carry signals from the brain through the spinal cord to all other parts of the body. Nagle's severed spinal cord effectively disconnected his brain from his limbs. Currently, there are no cures for paralyzed people. However, research concerning the development of brain-computer interfaces (BCIs) presents a potential solution. Successful trials using BCIs in subjects, such as Nagle, provide hope that brain chip technology will one day enable paralyzed people to control computers, wheelchairs, and even their own limbs.



(a)

(b)

VI. BRAIN GATE

The principle behind the Brain Gate system is that, signals are generated in the motor cortex and they cannot be sent directly to the arms, hands and legs due to spinal cord injury, stroke or other condition. The Brain Gate Neural Interface System is grounded on Cybernetics podium technology to sense, transmit, analyse and apply the language of neurons. The System consists of a sensor that is entrenched on the motor cortex of the brain and examines brain signals. The brain signals are construed and translated into cursor movements, offering the user a substitute pathway via the Brain Gate System to control a computer simply by thinking, in the same way as individuals who have the ability to move a computer mouse using their hands.

A. Challenges Faced By Brain Gate:

- It is very luxurious.
- Curb in information transform rate. The latest technology is 20 bits/min.
- Difficulty in adaptation and learning.

VII. APPLICATIONS

- The Brain Gate System is designed to restore functionality for severely motor-impaired individuals.
- In classification of EEG signal.
- It may be able to provide an individual with the ability to control devices that allow breathing, bladder and bowel movements.
- The Brain Gate Neural Interface System is a new medical device that is being developed to improve the quality of life for physically disabled people by allowing them to quickly and reliably control a wide range of devices.

A. Merits of blue brain

- We can Use the intelligence of a person after his/herdeath.
- We can remember things without any effort.
- Understanding the activities of animals is possible.
- Making decision without the presence of a person is possible.

B. Demerits of blue brain

- Others may use technical knowledge against us.
- We become dependent on the Computer.
- Another fear is found today with respect to human Cloning.

VIII. CONCLUSION

The whole idea is that mental illness, memory and perception triggered by neurons and electric signals could be soon treated with a supercomputer that models all the 1,000,000 million synapses of brain. There are good reasons to believe that, regardless of implementation strategy, the predictions of realizing artificial brains in the near future are optimistic. Using this system the patient can read e-mail, play videogames, turn lights on or off and change channels or adjust the volume of a television set. The results are remarkable and almost unbelievable.

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