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A Study on Artificial Intelligence- The Blue Brain

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ABSTRACT: IBM has researched to create a virtual brain, called "Blue Brain". The main aim of this research is to upload human brain into machine. This 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 and it can 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. In this paper, we present the complete research work which explains the concept, procedures to build the blue brain and goals with conclusion.

KEYWORDS*:* Blue Brain; Knowledge Sharing; Artificial Brain; Neurons Sensory System.

I. INTRODUCTION

No one has ever understood the complexity of human brain. It is complex than any other circuits in the world. When man does not have a device called computer, it was a big question for all if it is really possible to design a computer. But today it is possible due to the technology. This **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 (Ecole Polytechnique Federale De Lausanne) 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.

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II. RELATED WORK

In [1] 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, which can be used for the development of the human society. In [2] BLUE BRAIN is the name of the world's first virtual brain which means, a machine that can function as human brain. Today, scientists are in research to create an artificial brain that can think, respond, take decision, and store anything in memory. The main aim of this research is to upload human brain into machine. So that man can think and take decision without any effort. In In [6] 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 issue using microscopes and patch clamp electrodes. [8] 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 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".

III. ARTIFICIAL BRAIN OVERVIEW

Research investigating "**Artificial Brains**" plays three important roles in science.

- A study called cognitive neuroscience, which helps neuroscientists to make an ongoing 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 popularized by Ray Kurzweil as strong AI (taken to mean a machine as intelligent as a human being).

IV. STEP TO BUILD A BLUE BRAIN

There are three main steps to build the virtual Brain

- Data Acquisition.
- Simulation.
- Visualization of Results.

A. Data Acquisition: Under data acquisition, the brain slices are placed under microscope and the shape as well electrical activities of individual neurons are measured. The neurons are examined by their shape called as *morphology*. These observations are translated into mathematical algorithms which describe the form, functions and position of neurons. The algorithms are then used to generate biologically-realistic virtual neurons ready for simulation to study the electrophysiological behavior of the neurons; the main tool required is 12 patch clamps. It allows twelve living neurons to be concurrently patched.

B. Simulation

Simulation refers to the use of a mathematical model to recreate a situation, so that the likelihood of various outcomes can be more accurately estimated. The main focus for the creation of virtual brain is on the neurons and the primary software used for neural simulation is a package called NEURON which was developed in 1990 by Michael Hines and John Morey. It is written in C, C++ and FORTRAN and is free, open source software. Neural simulation is basically used for building and using computational models of neurons and network of neurons. For blue brain, the current version of neuron which is being used is 7.2. The main factors on which the simulation depends are:

1. Simulation Speed: The simulations show approximately linear scaling. The simulation time step for the numerical integrations is 0.025ms and the time step for writing the output to disk is 0.1ms.

2. Workflow: The simulation step involves synthesizing virtual cells using the algorithms

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C. Visualizations of results:

RTNeuron is the primary application and the software was developed internally by the BBP team. It is written in C++ and OpenGL.

V. EVOLUTION OF BLUEBRAIN

A. Blue gene Supercomputer:

The primary machine used by the Blue Brain Project is a Blue Gene supercomputer built by IBM.

1) BLUE GENE/L: IBM agreed in June 2005 to supply EPFL with a Blue Gene/L as a "technology demonstrator". The IBM press release did not disclose the terms of the deal.
2) BLUEGENE/P: In June 2010 this machine was upgraded to a Blue Gene/P. The machine is installed on the EPFL campus in Lausanne and is managed by

Blue Gene/P technical specifications

1) 4,096 quad-core nodes
2) Each core is a PowerPC 450, 850 MHz
3) Total: 56 teraflops, 16 terabytes of memory
4) 4 racks, one row, wired as a 16x16x16 3D torus
5) 1 PB of disk space, GPFS parallel file system
6) Operating system: Linux SUSE SLES10
7) Silicon Graphics: A 32-processor Silicon Graphics Inc. (SGI) system with 300 GB of shared memory is used for visualization of results.
8) Commodity PC clusters: Clusters of commodity

PCs have been used for visualization tasks with the RTNeuron software.

B. Blue Gene/Q: JUQUEEN is an IBM Blue Gene/Q supercomputer that was installed at the JULICH Research Center in Germany in May 2012. It currently performs at 1.6 pet flops and was ranked the world's 8th fastest supercomputer in June 2012. It's likely that this machine will be used for BBP simulations starting in 2013 provided funding is granted via the Human Brain Project. This aims to develop a three-dimensional, realistic model of the human brain.

C. 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.

VI. GOALS

A. 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 functions 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.

B. 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.

C. 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, it 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

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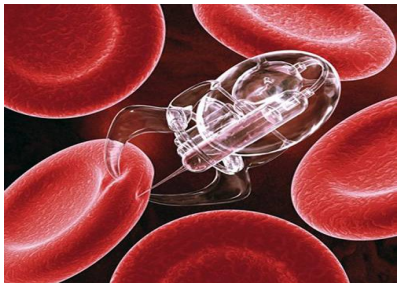
our circulatory systems. Travelling into the spine and brain, they will be able to monitor the activity and structure of our central nervous system. They will be able to provide an interface with computers that is as close as our mind can be while we still reside in our biological form.



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.

VII. MERITS AND DEMERITS

Merits

With the blue brain project the things can be remembered without any effort, decisions can be made without the presence of a person. Even after the death of a man his intelligence can be used. The activity of different animals can be understood. That means by interpretation of the electric impulses from the brain of the animals, their thinking can be understood easily. It would allow the deaf to hear via direct nerve stimulation, and also be helpful for many psychological diseases.

Demerits

Due to blue brain system human beings will become dependent on the computer systems. Technical knowledge may be misused by hackers; Computer viruses will pose an increasingly critical threat. The real threat, however, is the fear that people will have of new technologies. That fear may culminate in a large resistance. Clear evidence of this type of fear is found today with respect to human cloning.

Applications:

1) Gathering and Testing 100 Years of Data.
2) Cracking the Neural Code
3) Understanding Neocortical Information Processing
4) A Novel Tool for Drug Discovery for Brain Disorders
5) A Global Facility
6) A Foundation for Whole Brain Simulations
7) A Foundation for Molecular Modeling of Brain

VIII. CONCLUSION AND FUTURE WORK

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.

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