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A comparative study of artificial brains

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Abstract - **The development of truly intelligent system are challenging tasks. The artificial brain projects aims to simulate the real human brain.Human brain have neurons about 1011 neurons with 10 15 interconnections.However,it is difficult to create 1011 artificial neurons with 10 15 interconnections .There are many artificial brains developed during past decades trying to achieve the goal. This papers gives a comparative study of some artificial brain projects.As technology develops ,the artificial brain projects progressed to achieve the goal .The development of blue brain project is the very well known. Henry Markon started blue brain project. It uses IBM "Blue Gene" supercomputer to simulate the neural signal of rat brain. IBM computer scientist Dharmendra Modha started cognitive computing project aiming the construction of a "brain atlas"for highly local cortical regions. Kwabena boahen[5] an stanford researcher started "Neurogrid project".The research goal is to "understand how cognition arises from neuronal properties" Eligene M.Izhikuch[6] the chairman and CEO of "Brain corporation " started the "large scale model of mammalian thalamo-cortical systems.This model based on experimental data from many mammalians species. Horwitz strated "Brain Image and modeling project" that differ from previous model because they lack neuron-level processing. Master prince and Suliman Alsuhaibani[4] created adaptive artificial brain for humoid robot.This uses pattern recognization and machine learning. There are discussion of some projects with some future recommendations.**

Keywords: **Artificial brains,machine learning,artificial intelligence etc**

1.INTRODUCTION

Artificial brains simulate human brain architects .The neuron signaling of artificial brain has an speed of 25Hz per neuron and performed by PC in real-time .One of the major problem is the slow evolution time of individual networks .Artificial brain consists of many neural networks.For real time processing it is necessary for each network to work fastly and with efficiency .So,the evolution time of network have to be increased. The celoxica board aims lowering the price of high speed evolution and achieving higher performance in evoling hardware led us to choose to use FPGAs(Field programmble Gate Arrays)Multiple copies of same sub circuit running simultaneously on different areas of the FGPA.There are various types of cortical cells,Neuron from each class of cell are present in layers of the column. They are pieced together various sorts of evidence to make interferences regarding the way different cells are composed to architect a cortical column and artificial brain projects like bluebrain project,CAM brain ,CBM project,etc are established

II. CASE STUDY

2.1 Blue Brain projectAbout Blue brain project [1]Markam understand the properties of various types of cortical cells and implement these for properties for reasonable accuracy.The blue brain project in 2007 ,announced the completion of following these goals given in

1.Modeling technique
2.Creation of new process
3.First cellular level model of new neocortical column

The modeling technique that can be used to construct automatically and on-demand micro-circuitry based on biological dataThe creation of new process allows to simulation and calibrates and analyze systematically the biological accuracy and consistency of each modification of their neocortical column model.The creation of first cellular level model of a neocortical column that is constructed entirely from biological data that now provides an essential tool simulate research into the simulation of neural micro -circuitry.

The blue brain project uses 1 millions artificial neurons .The blue column composed of ~10,000 neocortical neurons within the dimensions of a neocortical column (~0.5 mm in diameter and ~1.5mm in height).There are many different types of neuron in blue column .

Layer -1 – All neurons are of different types
Layer 4 – spiny stellate neurons

Layer 2-6 : multiple subtypes of pyramidal neuron .There are more than 30 anatomical electric types of interneuron with variations

2.2 IBM's Cognitive computing (Synaptronics)[2]

The goal of the project to understand and build a brain .The project of cognitive computing uses "Syaptronics and supercomputing" to achieve the goal. It performed two cortical simulations. Simulate uses C2 simulator ran on IBM BlueGene/P supercomputer with 147,456 CPU's and 144 TB main memory .These signals are performed at unprecented scale

First Simulation -It consists of 1.6 billion neurons and 8.87 trillion synapses and measure gray matter thalamo-cortical commonly Second simulation – It consists of 900 millions neurons and 9 trillion synapses for simulation

Simulation	Neurons	Synapses	Inspiration	Speed	
First	1.6 billion	8.87 trillion			
Second	900 million	9 trillion			
Biologically inspired model	$1.617*10^{9}$	$0.887*10^{3}$	From cat visual cortex	0.1ms	
Probabilistic connectivity type	$0.9*10^{9}$	$0.9*10^{13}$	From cat visual cortex	1 ms	

2.3 Neurogrid[5]

Neurogrid uses silicon neurons ,which behaviours and connections can be programmed.This project is build upon Grid technologies and tools to integrate image acquisition,storage and analysis ,storage and analysis etc. There are three elements of neurogrid ,First ,Neuro grid will create a grid based infrastructure,Seconds ,Neurogrid will develop distributed Grid-based data analysis tools and services with a neuroimaging toolkit. Neuromorphic engineering research group has designing and build both -a silicon retina that could be used to give the blind some degree of sight.;-a self-organizing chip,that emulated the way a developing brain wires itself up.

Calver Mead designed neuromorphic chip ,Mead predicts correctly that the computer of 2010 would be approximately 10-7 time more energy per instruction than used by the brain for each synaptic activation.The project has alternative to "group process units " and "Field programmable Gate Array "to build artificial brains namely his neurogrid architecture.The neurogrid is capable of simulating a million neurons .It uses two sub-cellular compartments per neurons i.e. the non-linear interaction between project that terminate in certain layers of the cortex have been simulated using a pyramidal -cell model with only two compartments.

2.4 ATRs CAM project[8]

The aim of CAM is to build/evolve/grow an artificial brain containing a billion artificial neurons by the year 2001.The basis ideas of the CAM-brain project -use cellular automata (CA) as the foundation upon which to grow and evolve neural network circuits with user-defined functionality

The state of each cellular automata cell can be stored in one or two bytes of RAM. Now there are workstation with GB's of RAM so there is huge space to store cellular automata space to store CA states and it is enough to build artificial brain. Next consideration in CAM brain is how to evolve neural network for "brain-building".

2.4.1 CoDi neural network model

CoDi is a simplified CA-based neural network model developed at ATR with these goals

-to make neural network functioning much simpler compared with the older CAM-brain model to implement the model directly in electronics and thus to evolve neural net modules at electronic speeds

2.4.2 Features of CBM ;CAM brain model consists of following features

1.Cellular automata module

2.genotype and phenotype memory

3.fitness evoluation unit

4.genetic algorithm unit

5.module interconnection memory

III. DEMONSTRATIONS

The cognitive computing project used "single-comparment phenomological spiking neurons ,learning synapses with spike-timing dependent plasticity and axonal delays" in simulating the cat brain.

It simulated biologically inspired model with 1.617*10 9 neuron and 0.887*10 13 synapses Model uses biological measured gray matter thalamo-cortical connectivity from the cat visual cortex,dynamic synaptic channels, and simulation time series of 0.1 ms.It also simulates with 0.9*10 9 neurons and 0.9*10 13 synapse using probabilistic connectivity and a simulation time step of 1ms,only 83 times slower than real-time starts of the average neuronal firing rate. “Demonstrates that the simulator had nearly perfect weak scaling” “Doubly the memory resource would translate into a computing doubling of the model size that could be simulated. “Demonstrated that from a strong scaling perspective at conn model size ,that using more CPU would reduce the simulation time ,thus closing the gap to real-time simulations” Neurogrid project uses silicon material and it is softwired .Human brain functions parallely with billions of neurons firing simultaneously in distributed fashion using a interconnected neural network. Lack of parallelism increase speed but waste a lot of time.

CAM project justifies that there are much memory (of gigabytes) in today's workstation ,and this is enough for brain building.

So,by demonstrating the above features of various projects ,there are some suggestions to achieve the following goals

1.Reducing the model size

2.Use of less memory resource

3.Increase speed without wasting time.

1.Reducing the model size : In order to reduce the model size,softwiring of neurons is a good idea by considering these two factors .Softwiring allows programming and so usage of threads .So, each networks -evolve many times paralley and randomly as required.

2.Use of less memory resource : Multitasking is a good idea for reducing memory resource .Use of high speed processing unit integrated with multitasking keep a balance between model size and memory resource.

3.Increase speed without wasting time : Use distributed system concepts is effective in increasing speed and network performs in parallel way. So,the network gain advantages of distributed concepts such as scalibility,fault tolarency ,etc

IV. RECOMMENDATION TO SUGGESTION IN DEMONSTRATIONS

Regarding to reduce model size ,thread concepts are effective ,but it is highly recommended to use threads only at desired amount of times .here,desired times means it does not affect the social behaviour of robots. In fact, the network must considers battery capacity and charging times before implement the multitasking concepts. Dividing the task and applying distributed concepts must implement the features of distributed system for sufficient advantages.

V.APPLICATION OF SUGGESTIONS

1.Robotics : It can be used for designing the operating system of robots. Controlling the social behaviour and managing the available resources.

2.Intelligent web applications :The web application requires server and servers use concepts of threads.So,it is compatible and portable to use in web applications.

VI.CONCLUSION

The artificial brain projects progressed much but requires certain changes and recommendations

in terms of processing ,memory ,and time. Even other changes like battery life,machine life ,robot locomotion .This paper describes some changes and techniques to build a better artificial brain.

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