TOWARDS ADVANCED DEVELOPMENT OF CYBORG INTELLIGENCE

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Abstract

The creation of machines with human intelligence is an primary and beneficial aim of artificial intelligence research. One interesting method in developing artificial intelligence is combining a biological method and machine intelligence. Cyborg Intelligence is a new scientific model for the integration of biological and machinery. Brain Machine Interface (BMI) provides an opportunity to integrate both intelligence at various levels. Based on BMI, neural signals can be read for the control of motor actuators and sensory information coding machine can be sent to a specific area of the brain. In fact, Distributed Adaptive Control Theory of Mind and Brain technology is the most advanced brain-based cognitive architecture successfully applied in a wide range of robot tasks. It is expected that by analyzing the cyborg intelligence development can help and facilitate to enhance the knowledge of cyborg intelligence.

Keywords: *Artificial intelligence, biological intelligence, brain machine interface, cyborg intelligence, distributed adaptive control, machine intelligence*

INTRODUCTION

Since the invention of computers or machines, its capability to perform various tasks went on growing exponentially. Computers or machines are created by a branch called Artificial Intelligence that is as intelligent as humans. Artificial intelligence is a way to make the intelligences of intelligent people think in the same way that a computer, a computer-controlled robot or software. The AI is carried out by looking at the thinking and working of the human brain in the process of resolving a problem and then using the results of this study to develop intelligent software or systems [1].

The advent of AI as a field of study great progress has been made. Generations of AI research, AI schools of thought and AI engineering have brought us expert systems, artificial neural networks, excellent chess-playing programs like "Deep Blue," autonomous vehicles like "Stanley," and human-level output question-answering systems like "Watson" [2].

Despite its great progress, research community has well recognized the limitations. Biologic systems have a range of sensory capacities, including vision, hearing, olfactory, haptic and gustatorial senses. We also respond to changes in external environments and exhibit a number of cognitive functions [2]. Both biological

organisms have unique abilities that are hard to mimic biological intelligence. For example, the interpretation of images is a relatively easy job for people, yet it still challenges even the most advanced AI algorithms. Therefore, human-level AI remains impossible to achieve and still has a long way to go.

On another side, the communications of biological nervous systems and computer systems rely, for example, on electrical signals, certain common physical bases. Biological intelligence and machinery also possess their own intrinsic merits, with the natural development of integration of the two intelligences [3]. Machines can help and increase biological beings from the biological side, while biological beings can solve machine tasks from the machine side.

In recent years, quantum advances in research have been made into this relation and the huge potential that biological and computer intelligence can provide for deep interconnection and integration. Thanks to new developments in neuroimaging technologies, however, the gap is no longer insurmountable. Such new developments mark significant advancement in cyborg intelligence. Cyborg intelligence is a new paradigm of science aimed at merging computer and biological intelligence [3]. In this case, cyborg refers to a symbiotic biomachine system consisting of organic as well as computers. An essential characteristic of cyborg intelligence is the strong link between the organic and computing components.

The future of cyborg intelligence will lead to exciting developments, including neural interaction, recovery and medical care, as well as early diagnosis of certain psychological and neurological disorders. It can substitute, repair, assist and increase sensory or cognitive functions for human beings. Intelligence from Cyborg will render the bionic man a reality [3]. In many practical applications, cyborg intelligence has great promise.

Although cyborg intelligence has many potential exciting applications, research is still in the preliminary stages in this field. Cyborg intelligence raises countless interesting and important questions for AI research at the intellectual level, and could fundamentally change the AI landscape in several dimensions. Hence, the authors are interested in analyzing the cyborg intelligence. This research aims to discuss the cutting edge technology implementation of artificial intelligent or system intelligent through cyborg intelligence. It is expected that by analyzing the cyborg intelligence development can help and facilitate to enhance the knowledge of cyborg intelligence.

RESEARCH METHODOLOGY

The method used is limited to descriptive analysis. Intelligent computing technology, intelligent biology and artificial intelligence related to cyborg intelligence are

explained. Elements of a cyborg namely Brain Machine Interface (BMI), Distributed Active Control (DAC) are described. The author tries to discuss the development of an intelligent system through cyborg intelligence. Examples of implementation of existing cyborg intelligence technology are also given.

Computational Intelligence

Computational knowledge is an artificial intelligence sub-set. The artificial intelligence based on tough calculations and the soft computing intelligence method, which adapt to many situations [4], are two types of machine intelligence. The term computer intelligence refers to a computer's ability to learn from data or experimental monitoring a specific task, even though it is considered synonymous with soft computing.

Computing intelligence is a collection of compute methodologies and methods inspired by nature to deal with complex real world problems that, for a few reasons, may not be useful to mathematical or conventional models: the processes may be too difficult to reason, they may require some ambiguity during processing or simply be stochastic in nature [5]. Yes, several real-life issues for computers to process it can not be converted into binary language (unique values of 0 and 1). Therefore artificial intelligence offers solutions to these problems.

Biological Intelligence

Biological intelligence is a component of intelligence that can be directly attributed to the anatomy and physiology of the central nervous system. Biological intelligence is sometimes distinguished from artificial intelligence, i.e., intelligence demonstrated by computer behavior, and from psychometric intelligence or intelligence as documented by the performance of subjects on IQ tests [6].

Machines have advantages in numerical computation, information retrieval, statistical reasoning and almost unlimited storage when compared to biological intelligence. Artificial intelligence has hit many impressive milestones, including expert systems, artificial neural networks, speech recognition, smart search engines, Q&A applications, and unpiloted vehicles. But AI still can not completely replicate human intelligence at the highest level. Both humans and animals possess special abilities that demonstrate biological intelligence. Their sensory capacities are special (such as dogs with increased senses), their adaptability to external environment changes and their special cognitive capabilities (such as human reason).

Artificial Intelligence

The research and development of smart machines and software which can describe, learn, collect information, communicate the objects, control and perceive them is an artificial intelligence. In 1956 John McCarthy coined the term as an IT branch that aimed at

man-like computers. It is the analysis of the computation that allows the understanding of reason and action[2]. Artificial intelligence differs from psychology due to its computer-related focus and its emphasis on perception, thinking and behavior is distinct from computer science. This makes computers more intelligent, and more efficient. It makes computers intelligent and useful. It deals with artificial neuron(s) and empirical (if applicable, assumptions and logic) theorems (if applicable).

In many of their applications, artificial intelligence technology has evolved to offer real practical advantages. Major fields for artificial intelligence are: expert systems, natural language, speech and sensory systems, computing vision and the scene, intelligent computer-aided instruction, neural computing. Intelligent computer-aided training. This expert method is a technology that is rapidly growing and has a huge impact on different fields of life. Neural Network, Fuzzy Logic, Evolutionary Computing and Hybrid Artificial Intelligence are the different techniques used in artificial intelligence.

The benefits of artificial intelligence over natural intelligence are that it is more stable, reliable, less costly, has the ease of repetition and transmission, can be recorded, and can perform certain tasks much faster and better than the person. Artificial Intelligence is an intelligent machine-building branch of computer science. The technology sector has become an essential part of.

RESULTS AND DISCUSSION

Cyborg Intelligence

The creation of machines with human intelligence is one of the key and constructive objectives of artificial intelligence research [2]. One interesting method in developing artificial intelligence is combining a biological method and machine intelligence. Biological systems include vision, hearing, olfactory, haptic, and gustatory senses of all types of sensory abilities. We often respond to external changes and have a range of cognitive functions. AI systems will benefit greatly from biological intelligence to resolve problems still beyond state-of-the-art capability.

A machine can store it more quickly, obtain information quickly, and calculate numbers. While humans are better at sensing context, adapting to external changes, and engaging in special cognition. Long-term evolutionary processes have given human beings incredibly intelligent behaviors that allow them to correctly and effectively sense the environmental context, make decisions, understand, think, adapt and mobilize. The two will be integrated by a cyborg intelligence, which is between a machine and biological intelligence. Merging the two can be something great.

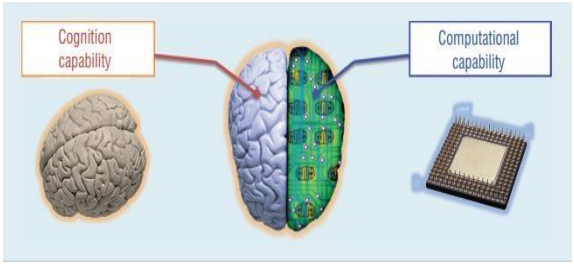

Figure 1. Illustration of Cyborg Intelligence

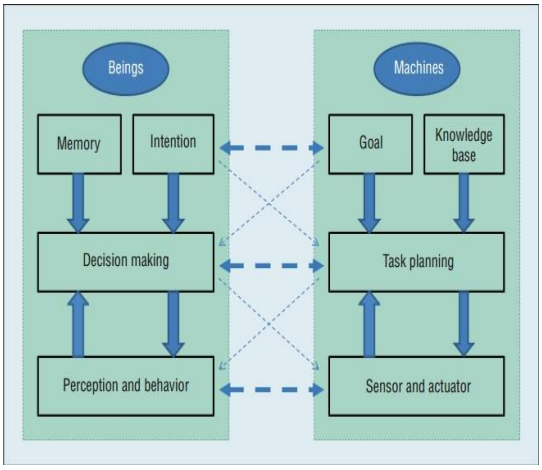

Figure 2. The Hierarchical Conceptual Framework for Cyborg Intelligence

The purpose of the creation of cyborg intelligence is to integrate machine intelligence with bio-intelligence, through BMI, through a connection of machinery and living beings. The aim of this is to improve strengths and make up for weaknesses through the combination of biologically capable cognition and computing capacity of the machine, as illustrated in Figure 1, called a cyborg intelligence system.

Figure 2 illustrates the biological component of the cyborg inteligence structure has an outline of three levels, reveals a hierarchical conceptual frame for cyborg intelligence. This is the way we interpret, make decisions and remember and intent [7]. In turn, a sensor and actuator, a task design, and the knowledge and target layers are available in the machine part. The same part is called homogeneous interaction between layers. Interaction between the layer and the system is defined as heterogeneous interactions between the biological and machine components. For example, if the sensor is the scent of an animal in a lab, that is heterogeneous,whereas an animal making a decision based on sensory information is homogeneous. Here are the important concepts as a framework of cyborg:

1. *Fusion and Representation of Information in Sensory Engine Integration* - Previous neuroscience study shows that motor behaviors depend on the integration of multisensory neural information from multiple cortex regions. To decode and encode neural signals about motor behaviors, we have to determine how the information from the primary sensory

cortex is integrated with that from multimodal external environment contexts, How local pathways work and the best coding for microelectrode stimuli between sensory and motor cortexes.

2. *Brain-Machine Cognitive Computational Models* - The aim of a cognitive model is to simulate the cognitive and psychological processes of a cyborg intelligentsia system brain-machine-cooperatively, thus allowing a cyborg system to be developed and tested. To simulate cognition and organize behavior through mutual thoughts and signals, the model must interpret environmental contexts in a brain-machine-cooperative way.
3. *Decoding and Encoding Brain Signals Machine Learning Approaches* - The encoding and decoding of brain signals is an important part of the communication between the brain and external devices. Scientists employed computational computer training methods to model the intrinsic signal-processing structures of the brain, such as direction of arm movement, to decipher neural reactions to the stimulus. Due to the complexity and plasticity of the brain neuronal system, however, how to construct a decryption approach remains a challenge. Neural encoding also fails to address specific aspects of it, meaning that sensational stimuli are mapped to neuronal responses and that external information is transferred into the brain is still problematic.
4. *Computational Architecture and Design for Cyborg Intelligence* - Not only should the full integration of the brain with the computer make signal communication easy, but also combine the brain's cognitive functions with computer power. The abstract interactions and relationships between a brain's cognitive units vary profoundly from those between functional intelligent units, so how to build an integration framework is a key problem in cyborg intelligence. Possible key issues include a hierarchic computational model, a multi-layered cyborg intelligence architecture, computational methods which are aimed at and designed, and approaches to task-oriented integration.
5. *Enhancing perception and motor functionality Reconstruction*– Intelligence improvement and reconstruction of motor functionality are two possible applications for cyborg intelligence. Both require further research on perception and functional brain mechanisms. Neural function reconstruction technique may give an important clue. Cyborg intelligence and coadaptation work could also help by providing a systematic framework for improving vision and rehabilitating motor function.

Cyborg Element

Brain Machine Interface

Brain Machine Interface (BMI) is a research area in which significant advances are achieved in the past decade, with the goal of creating a direct line of communication between brain and external devices. Neural signals for regulating engine actuators can interpret mind information based on BMI, and sensory information coding system can be sent to a different area of the brain. BMI techniques require mechanical intelligence integration at different levels to build a more efficient smart system that creates a new field called cyborg intelligence [8].

Current Artificial Intelligence (AI) involves learning how to mimic human intelligence, and building an intelligence-showing computer or software program. Successful AI involves the processing of natural speech, speech-identification, smart search engines, face-identification and a Q&A framework. While high-performance calculation AI technology has shown outstanding, probabilistic, statistical reasoning, optimisation, and storage models are almost limitless. Modern AI technology, which is known as the best feature of biological intelligence, can suit people in thinking, high-level reasoning and adaptive adaptation to different environments. The study of the convergence of machinery and biological intelligence, namely cyborg intelligence, is very important to optimize their capabilities through incorporation, due to the complementary strengths that they have described.

The important topic of cyborg intelligence includes information and representation fusion in integration in the sensory motor, cognitive computing models in the collaboration brain and machine, a statistical model of brain signal decoding and encoding, cyborg intelligence computing models, and associated data and standard calculations.

Distributed Active Control

Cognitive brain-based architecture is the most advanced theory of mind and brain distributed adaptive control (DAC), which has been successfully implemented and validated in a broad range of robotic tasks against a broad range of neuroscience and psychological information [9].

The DAC specifically states that the manner in which operation is carried out by means of five basic processes, called H5W for short:

1. Why – motivation in terms of desires, drives and ambitions to act;
2. What – the world's items to which acts relate;
3. Where – the placement of world objects and the selfsame;
4. When – the timing of action with respect to world dynamics; and
5. Who – other agents ' hidden states.

Whatever the truth of this H5W consciousness theory, it is an idea that can lead to a more holistic approach to state-of - the-art machinery. Particularly when we analyze the state of the art of consciousness science, there are five complementary dimensions organized around it, the majority of which are the core of the contemporary study of advanced machinery. In particular, the components of conscious states can be said to be:

1. Based on the experience of physically installed self, co-defined in the coupling of the agent's sensorimotor to the world,
2. Consistent between the agent's sensorimotor projections and the nature of world interaction,
3. Combined with high differentiation rates with high levels of integration (every single conscious scene is unique), and
4. realized with very parallel and implicit factors distributed and metastable explicit factors, continuous and unified.

The Architecture of Distributed Adaptive Control (DAC) for vision, learning, and behavior (Figure 3). DAC says the brain is based on four straight layers: soma, reactive, adaptive and contextual. In the following layers three functional organi-zational columns can be distinguished, namely exo-sensing (yellow; world sensation and perception), endo-sensing (green; physicalinstantiated self detection & signaling states), and action interface (red). The arrows display the primary flow of information, mapping into practice exo-and endo-sensing. Each level introduces more advanced, sensory-dependent mappings to behavior produced according to the internal status of the agent.

Cyborg Implementation

Cyborg Rat

A group of Chinese scientists have developed a highly efficient cyborg rat for labyrinth resolution. The robot rat was rendered through the brain implanting electrodes and a portable micro-stimulator mounted on its back. Such devices allowed a computer to interact with the rat remotely, allowing it to determine the shortest route to take in a labyrinth, avoid dead ends and traverse loops. The computer provided the rat with suggestions to help the rat take decisions rather than remotely control the rat [10].

This kind of work aims at an "enhanced" or the "cyborg" intelligence, which combines the brain force of animals and the computing power of machines, instead of artificial intelligence. Researchers also want to research the possible use of combined computer and biological intelligence in situations such as search and rescue operations, and remove body parts, producing "upgraded" humans.

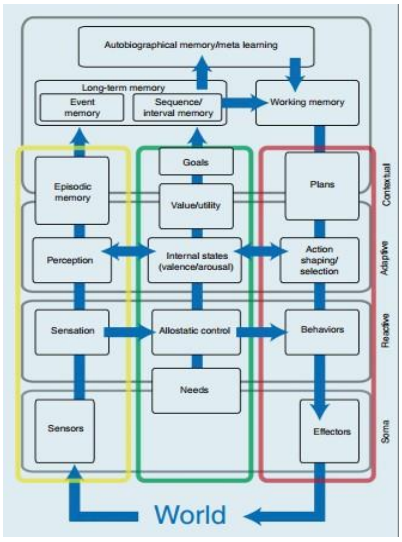

Figure 3. The Architecture of DAC

The Driverless Farm Tractor

A groundbreaking technology has been demonstrated in Case IH, the company agricultural equipment. It's a technology they claim to culminate in a range of tractors without drivers one day. This device is not supposed to be entirely independent. Rather, it is a tractor which is remotely controlled. It still is a project at this stage and is known as the autonomous concept car Case IH [11].

The application requires people to control the computer, not to hop in and drive through fields. And frankly, what could happen if we were to operate a piece of equipment of several tons, when we are opposite the ground. The team claims the tractor can plant crops and collect data on plant activity in real time.

The Future Works of Cyborg

Based on the Cyborg Intelligence that has been made, further research is needed to make Cyborg Intelligence more useful for the common good around us. For example, a bank is a work area that has a lot of customers each day and a bank is also a very important need in everyday life. So the more customers there are, the more employees are also required.

If we made a Cyborg Intelligence in the bank, such as Bank Teller, it would be more efficient in serving each customer there. To represent it, it requires an intelligence possessed by a Bank Teller is put into a robot similar to a human. Some of the intelligence of a teller is nice to communicate with customers, respond to and resolve customer complaints, serving the needs of customers such as opening a new account, taking money, saving money in the bank and others. Additionally in realizing it must pay attention to issues such as the fusion of information and representation in the integration of sensory-motor, compu-tational models of cognitive in

collaboration brain and machine, Statistical model for brain signals, computer models and Cyborg intelligence systems for decoding and encoding and data related and standard calculations.

CONCLUSION AND SUGGESTION

A main goal of Artificial Intelligence Investigations is to develop a computer with human intelligence. A cyborg intelligence that blends computer and biological intelligence is the newest artificial intelligence break-through. Intelligent sophisticated cyborg can be generated by combining elements such as cyborg Brain Machine Interface and distributed active control as has already been created, cyborg paint and driverless farm tractor. In developing cyborg intelligent must pay attention to issues such as the fusion of information and representation in the inte-gration of sensory-motor, computational models of cognitive brain collaboration and machinery, Cyborg intellectual system for the decoding and encoding of brain signals, computer models and data associated and standard calculations statistic model.

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