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Neurocognitive Intelligence Engine

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ABSTRACT : The current study explores the use of neurocognitive intelligence engines (NIEs) and their simulation of the human brain. It is based on a review of secondary sources from the recent, scholarly and academic literature. The findings show that the emulation of human neurons to artificial neurons has had a wide spectrum of applications in various fields including healthcare, business, security, and others. However, it also faces various challenges including the difficulty in simulating a perfect human brain due to the latter's complexity. Ethical considerations such as neuro-privacy, data security issues, as well as responsibility in case of failure have also arisen.

KEYWORDS: Artificial neuron networks, algorithm, deep learning, artificial intelligence

I. INTRODUCTION

Neurocognitive systems concern the ability to think or reason. The Human brain performs all the cognitive functions such as attention, memory, decision-making, language, perception, as well as problem-solving (Sreena and Ilankumaran 670). In artificial intelligence (AI), neurocognitive intelligence engine (NIE) systems are designed with in-built deep learning algorithms that simulate the functioning of the human brain's primary building blocks called neural networks. One of the benefits is the design to learn and adapt from experience, recognize patterns, and make decisions in similitude to the working of the human brain. As a result, it becomes ideal for applications in areas like visual/image recognition, natural language processing, and robotics in which deep learning and adapting are critical. Today, NIE has shown a great prospect in revolutionizing diverse fields ranging from health care to finance, text analytics, cybersecurity, transportation, and criminal justice, as well as smart cities. Despite the several potential benefits, the task of building an effective deep-learning model remains a challenge (Sarker 420). Deep learning technology is the core of machine learning and artificial intelligence that drives the Industry 4.0 revolution today. Thus, reviewing the prospects of NIEs, deploying and developing AI systems face ethical challenges in data use.

PROPOSED METHODOLOGY BLOCK DIAGRAM

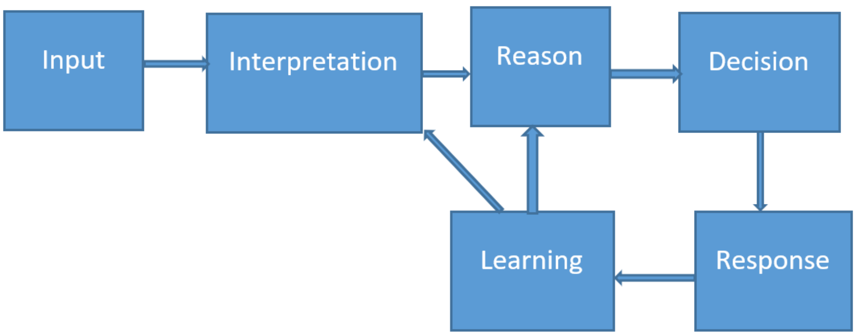

Fig. 1: *Proposed System for an AI-Based BICIE Systems*

II. ALGORITHMS

Human brain cells, neurons, are a highly complex, interconnected network that sends electrical signals as a means of processing information (Guo et al. 1). In a similar manner, ANNs are computing systems made of artificial neurons modeled like the human brain's natural neurons. These artificial neurons consist of dozens or hundreds of multilayered interconnected algorithms (Megarit). Each layer receives and interprets information sent to it from the layer before it. They perform data and information processing, pattern recognition, comparison of new to past data, analysis and generating solutions to problems as efficiently as possible. There is an underlying benefit of automatic algorithmic adjustments or becoming more intelligent over time without human interference. Wang, however, acknowledges that presently, it is difficult to model an absolute artificial brain similar to the human brain as it is very complex as the AI system will have to undergo "isomorphic states or structure changes as the brain does" (8). For instance, computer vision simulates human visual perception while natural language processing simulates human language understanding. Computer memory, however, is much more capable than human memory. Therefore, the development of algorithms, on the one hand, aims at surpassing humans' neural networks as seen in computer memories, while others seek to mimic humans or other animals. An artificial general intelligence (AGI) is where machines reason independently and generate solutions beyond what they are programmed to do, and risks surpassing human intelligence (Siemens et al. 4). This is however perceived to portend dire consequences as depicted in Ex Machina or The Terminator films.

FLOW CHART

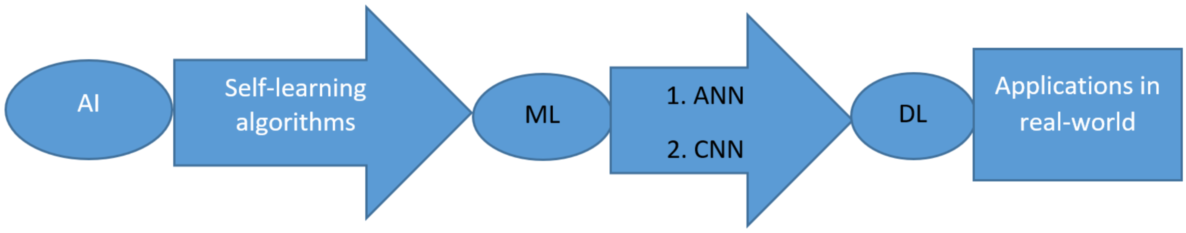

Fig. 2: Flow Diagram for AI, ML, and DL Are Related

III. RESULT ANALYSIS

Neuroscience and Cognitive Science : Cognitive neuroscience integrates cognitive science and neuroscience as inspired by the human brain. It concerns how brain functioning relates to cognition. In studying the mind, cognitive science includes the fields of artificial intelligence (AI) and neuroscience (Uddin 113). Conceptually, these form the basis of designing neurocognitive intelligence engine (NIE) models that simulate the complexity of the human mind and brain. AI today encapsulates the principles of cognitive science in a manner that has led to the emergence of intelligent machines with the ability to perform speech/emotion recognition, learning, problem-solving, planning, and reasoning. Robots with cognitive powers, also known as cognitive robots, are examples of such intelligent machines that can undertake various open-ended tasks in the absence of human assistance. Neurocognitive scientists have integrated into these robots a processing architecture that makes them learn and respond appropriately to complex situations.

Artificial Intelligence and Machine Learning: ML is a subset of AI that involves training a machine how to learn and has algorithms that make these systems identify and follow patterns, make decisions, and operate in line with experience and data (Thompson et al., n.d.). AI incorporates into machines human behavior and intelligence, whereas, ML is the machine's technique of learning from data or experience for an automated analytical model (Sarker 420). In other words. AI is the field that involves designing computers and robots that can mimic the behavior of humans and even go beyond human capabilities. AI-enabled programs can perform data analysis and contextualization to prompt actions without the need for human help. Today, neurocognitive scientists are advancing the techniques of AI to develop natural language processing or the ability of cognitive robots to process human language as well the computer vision, their techniques to interpret images. Computer programmers and software developers create AI systems with analytical and problem-solving capabilities by using tools like deep learning (DL) and neural networks. DL technology derived from artificial neural networks has advanced AI to the level of "smarter AI" (Sarker 419). As Mathur et al. note, advances in AI are such that ML and DL programs today enable the simulation of the brain's "neocortex neural activity" which performs most of the reasoning, thinking, and cognitive functions (1). This is modeled in Fig.2.

IV. APPLICATIONS

In business, ANNs have shown great potential in the design of self-driving robotic taxi cars. Finance experts can also forecast future stock prices plus algorithmic trading. The use of AI in vocal and facial recognition has also enhanced security and surveillance. The image-based face recognition algorithms build a face model based on the backpropagation of errors through neural networks to enhance security (Li and Zhang, 1). In healthcare, AI-enabled technologies augment patient diagnosis and treatment as well as nursing activities and management of healthcare organizations. For example, Mayo Clinic today has invented an AI-based cervical cancer screening device to identify pre-cancerous signs in women. It uses an algorithm for up to the National Cancer Institute's

60,000 cervical images to identify the signs (Lee and Yoon 6). This has the potential for reducing diagnostic errors which until recently accounted for about 60% of all medical errors or 40,000-80,000 deaths yearly in U.S. hospitals (Lee and Yoon 6). Ienca and Ignatiadis state that embedding AI in BCIs plus other neuro-technologies can significantly improve independent living for patients with motor, communication, and cognitive disorders (84). In other hospitals, AI-imbedded pill-cam have been used to replace the upper endoscopy for examining gastrointestinal cancer (Guo and Li 178). There are promising prospects in medical robots like Chinese AI-driven smart clinics with AI-powered Chabot that can communicate with patients in rural regions, offer medical advice, and train health workers remotely (Guo and Li 178). Medical robots have also been useful in ambulating recovering patients as well as AI-personal health monitoring algorithms.

Challenges and Limitations: Major limitations that hinder the development and deployment of an NIE relate to data privacy, security, and ethical concerns. The predictive AI algorithms that inferentially reveal sensitive personal information elicit privacy. Neuro-privacy concerns aggravate when information lands in the hands of third parties (Ienca and Ignatiadis 84). Also, the deployment of AI for surveillance or cybersecurity without human assistance increases vulnerabilities or attack vectors (Naik et al. 4). Another ethical concern is the party to be responsible in case of drastic failure of AI-based systems, thus the need for Responsible AI-based systems that are accountable. The challenge to model working memory is a major setback to creating a brain-like AI system (Macpherson et al. 604). Working memory in humans enhances information retention.

V. CONCLUSION

In conclusion, neurocognitive intelligence engines (NIE) are designed with artificial neurons that mimic the cognitive processes of the human brain's neurons. The engine by design can learn and adapt from experience without the need for re-programming and also recognize patterns and make decisions just like the human brain or better. As a part of artificial intelligence and machine learning, NIEs like BICIE systems are designed with deep learning algorithms to emulate the neurocognitive processes of human or animal brains. It has a wide range of applications in healthcare, finance, and security but also challenges the ethical use of data that affects deployment.

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