IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

Impact Factor 8.102 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 13, Issue 6, June 2024

DOI: 10.17148/IJARCCE.2024.13607

Artificial Intelligence (AI) Models of AI Brain (AIB) and Mind (AIM) for Creative Healthcare

Dean M. Aslam

Biomedical Engineering, UT Southwestern, Dallas, Texas (Adjunct Prof.)

Michigan State University, E. Lansing, Michigan (Prof. Emeritus)

Abstract: Although (a) humans have been dealing with 'what we call mind today' for millions of years and (b) the first use of *mind* became obvious by works of Socrates (470 – 399 BC), a universal scientific definition/model of mind, that scientifically links mind to different parts in central and enteric nervous systems (CNS and ENS), was developed earlier. This paper, for the first time, provides a scientific definition/model of how AI Mind and Brain (AIM and BIM) can be built. It also scientifically links AIM and BIM to different parts in central and enteric nervous systems (CNS and ENS).

I. INTRODUCTION

Artificial Intelligence Systems (AIS) have been developed but what is the Artificial Intelligence Mind (AIM) and Artificial Intelligence Brain (AIB)? AIM and AIB are decision makers in AIS. It is important to define the roles of AIM and AIB in AIS. To discuss AIM and AIB further, it is important to know how humans discovered the roles of brain and mind and their roles.

The early humans for millions of years were able to feel their own or others' heartbeat under different environmental conditions. Because the heartbeat was the only thing they could feel and hear, they considered the heart as the center of intelligence and emotions. The ancient Egyptians and other traditions considered this view as the 'mainstream science' until the discovery of Electroencephalogram (EEG) in 1924 (published in 1929) by Hans Berger [1]. After this discovery, the 'heart theory of emotions' was no more part of mainstream science. The brain became the center of intelligence and leader of survival of humans.

Who controls the brain's frontal lobe (logic) and Amygdala (emotions), and their communication with other parts of the brain? When we perceive data through (a) sound, sight, smell, touch, and taste (external senses) and (b) 8 interoceptive senses, who decides how to react? Mind, an algorithm defined by data generated during 8 stages of human development, is the decision maker of every action of humans [2][3]. Artificial Intelligence (AI) is described [4] using the example of how humans were created.

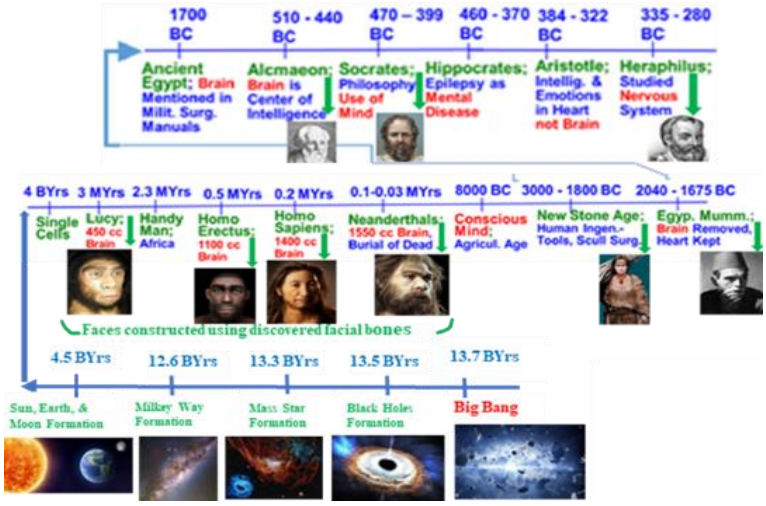

Fig. 1 The development of Human Intelligence (HI) from scratch that, in concept, can be used to develop Artificial Intelligence (AI) Brain (AIB) and AI Mind (AIM) as shown in Fig. 3.

IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

Impact Factor 8.102 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 13, Issue 6, June 2024

DOI: 10.17148/IJARCCE.2024.13607

Artificial Intelligence Mind (AIM) should be the decision maker in any artificial intelligence system. The AIM capabilities have been increasing tremendously with time and in some cases, they are comparable/better to/than an intelligent human system. The analogy to human mind/brain development is amazing as seen Fig. 1. The development of AIM is simlar to creation of life on earth as shown in Fig. 1. A well-developed AIM system can be your personal (a) health provider, (b) teacher, (c) danger advisor, (d) selfdriver of your car (Lexus already has a self drivinhg car as of 2024), etc.

AI progress is amazing in all areas including healthcare [5]. Technologies predict, grasp, learn, and identify new relationships between genetic codes and control surgery-assisting robots [5]. The mind is an algorithm definable and computable by EEG brainwave data generated in MGBA as shown in Fig. 2 [2][3]. It is the decision maker and leader of everything and anything the living humans and non-humans do and feel. This definition should apply to artificial systems and humans.

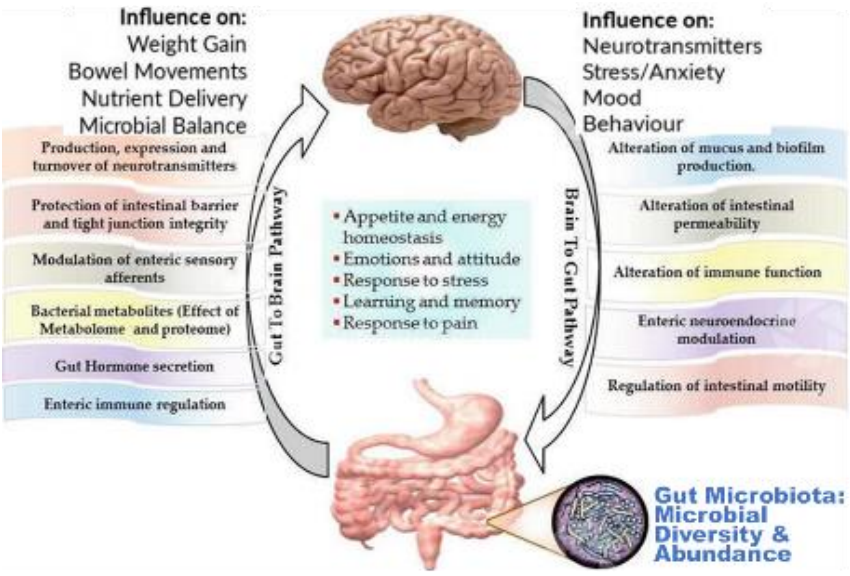

Fig. 2 Gut-brain pathways crucial for MGBA EEG data contributing to artificial mind.

II. HEART, BRAIN AND MIND ROLES

The ancient Egyptians considered heart as the center of intelligence rather than brain [6][7] and mind. Ancient Chinese culture used the term xin that has broader meanings including heart, mind, feeling, intention, wisdom, soul, etc. [8]. With intelligence defined in terms of number of neurons in Prefrontal Cortex (PFC) and cerebellum, the heart with its 40,000 neurons has no high-level intelligence. The role of brain was not recognized until approximately 510 – 440 BC, as shown in Fig. 1, by Alcmaeon [9][10].

Although humans have been dealing with 'what we call mind today' for millions of years in the form of behaviors of both animals [11] and humans, a universal scientific definition/model of mind, that scientifically links mind to different parts in Central Nervous System (CNS) and Enteric Nervous System (ENS), had not been developed. The ENS is a complex network of nerve cells in the gut wall that controls digestion and other functions of the gastrointestinal tract.

There have been different models and views about (a) animal mind [12][13] and (b) human brain-heart-body [14][15] some of which are not supported by mainstream science. The intelligence level of living species depends on the number of neurons in the cerebral cortex of the brain. The latest research shows animal intelligence in terms of number of cerebral neurons [16]. The cerebral cortexes of a gorilla, elephant, parrot, and dog have 9, 3, 2.8 and 0.5 – 0.6 billion neurons, respectively. Human cerebral and cerebellar cortexes have approximately 16 and 69 billion neurons, respectively, which is 99% of total neurons in the brain. Gut has 500 million neurons, the largest number outside of CNS. Artificial intelligence (AI) systems can have very simple to very complex artificial intelligence. The PFC of a human under extreme stresss may have less functional neurons (partial or total PFC shutdown) available [17] [18].

IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

Impact Factor 8.102 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 13, Issue 6, June 2024

DOI: 10.17148/IJARCCE.2024.13607

III. REVIEW OF PRESENT AI SYSTEMS AND THEIR BIOMEDICAL APPLICATIONS

The progress of AI systems and their applications are partly limited and partly amazing [19][20][21][22][23]. Although AI models have achieved human-like performance, their use is still limited [19]. Algorithms and hardware for AI's biomedical applications such as ECG, EEG and hearing aid have been reviewed [20]. Multimodal biomedical AI was also discussed [21]. The AI systems used for biomedical applications [22][23][24][25] have been reviewed. AI has branched out to various applications in healthcare, such as health services management, predictive medicine, clinical decisionmaking, and patient data and diagnostics.

IV. INITIAL MODELS OF AI BRAIN (AIB) AND AI MIND (AIM)

As the PFC of a human under extreme stresss may have less functional neurons (partial or total PFC shutdown) available [17] [18] than PFC of a dog not under stress, the mind of human under stress may have less intelligence than a dog. AI systems can be designed not having such limitations.

A version of MUSE-2 can be used to test the capability of AI systems. AI-mind-controlled LEGO robot can be built for enhanced learning motivation.

AI medical professionals/doctors can also be built. What about other AI professionals/systems?

As shown in Fig. 3, an initial artificial scientific mind model suggests that AI Mind (AIM) and AI Brain (AIB) models are based on 6 primary algorithms (D, L, R, M, P, and S). Each of these is for mind and brain factors related to neural data, generated in Central Nervous System (CNS) and Enteric Nervous System (ENS) needed to develop algorithms. The suggested models, AIM and AIB, are algorithms relying on EEG data. The most challenging part of AIM and AIB models is to identify the EEG data originating from certain brain parts as shown in Fig. 3.

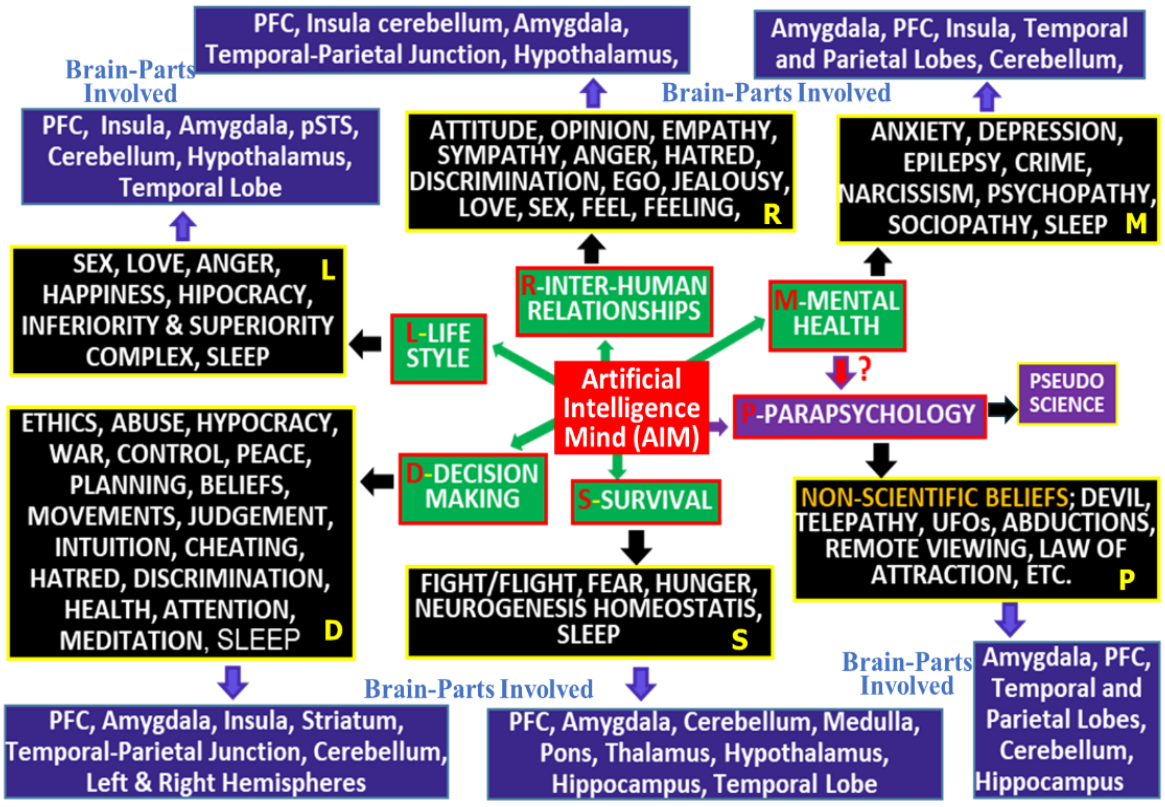

Fig. 3 Scientific definition and models of Artificial Intelligence Mind (AIM) and AIM's decision-making areas and abilities. The brain parts for human involved are shown for information only.

International Journal of Advanced Research in Computer and Communication Engineering

Impact Factor 8.102 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 13, Issue 6, June 2024

DOI: 10.17148/IJARCCE.2024.13607

IV-1. Decision Making by Artificial Intelligence (AI) Brain (AIB) and Mind (AIM)

The decision-making for brain and mind relates to so many factors mentioned in Fig. 3. The human brain parts involved are mentioned for information (blue background) and are not part of AIM and AIB. The factors S, D, L, R, M and P are involved in AIM and AIB that can be defined and built using the information in S, D, L, R, M and P boxes labelled with yellow letters. The AIM and AIB should have cognitive abilities like human and animal brains and minds. Such systems based on algorithms can feel and think of the world around them like a human. Fig. 3 provides some ideas to define AIM and AIB, but the challenge is to find the equivalent of S, D, L, R, M and P for the AIM and AIB which can be used to develop any artificial system to perform any function. Further sub-algorithms, highlighted in black backgrounds in Fig. 3, can be developed depending upon the applications of AI.

IV-2. AIB and AIM Testing by MUSE-2

MUSE-2 can be used in AI systems to test the capabilities of any of the AI systems mentioned above [26]. Portable EEG monitoring for older adults with dementia has also been studied [27]. MUSE-2 studies are very challenging and will be subject of next paper by the author focussing on decision making by mind and brain studied by MUSE-2.

V. CONCLUSIONS

Although (a) humans have been dealing with 'what we call mind today' for millions of years and (b) the first use of *mind* became obvious by works of Socrates (470 – 399 BC), a universal scientific definition/model of mind, that scientifically links mind to different parts in central and enteric nervous systems (CNS and ENS), was developed earlier. This paper, for the first time, provides a scientific definition/model of how AI Mind and Brain (AIM and BIM) can be built. It also scientifically links AIM and BIM to different parts in central and enteric nervous systems (CNS and ENS).

REFERENCES

[1]. H. Berger, "Über das Elektrenkephalogramm des Menschen", Archive für Psychiatre und Nervenkrankheiten, 87, 527-570, 1929; "About EEG of a human", Archives for Psychiatric and Nerve Diseases, 87, 527-570, 1929.
[2]. D.M. Aslam, "Technology, MGBA and Mind Roles in Personality, Health, and Longevity of Humans", Vol. 12 (10), 2023; DOI: 10.17148/IJARCCE.2023.121009; https://ijarcce.com/wp-content/uploads/2023/11/IJARCCE.2023.121009.pdf
[3]. D.M. Aslam, "Intriguing Aspects of New Scientific Mind Model as EEG Data Based Algorithm"; https://ijarcce.com/wp-content/uploads/2020/01/IJARCCE.2019.81216.pdf
[4]. Mustafa Suleyman, April 2024; https://www.ted.com/talks/mustafa_suleyman_what_is_an_ai_anyway?language=en
[5]. Mohammed Yousef Shaheen, "Applications of Artificial Intelligence (AI) in healthcare: A review", 2021, DOI: 10.14293/S2199-1006.1.SOR-.PPVRY8K.v1; https://www.scienceopen.com/document_file/a8536285-4c3c-47c2-8d5c-78cf38231c76/ScienceOpenPreprint/Applications%20of%20Artificial%20Intelligence%20%28AI%29%20in%20healthcare%20A%20review.pdf
[6]. M. A. Loukas, P. Youssef, J. Gielecki, J. Walocha, K. Natsis, and R. S. Tubbs, "History of Cardiac Anatomy: A Comprehensive Review from the Egyptians to Today", Clinical Anatomy 29:270–284 (2016).
[7]. M. LOUKAS, M. HANNA, N. ALSAIEGH, M. O. M. SHOJA, and R. S. TUBBS, "Clinical Anatomy as Practiced by Ancient Egyptians", Clinical Anatomy 24:409–415 (2011).
[8]. J. Li, C. Ericsson and M. Quennerstedt, "The meaning of the Chinese cultural keyword xin", J. Languages and Culture, Vol. 4(5), pp. 75-89, 2013.
[9]. Alberto Debernardi et al., "Alcmaeon of Croton", Neurosurgery, vol 66 (2), 2010.
[10]. G. G. Celesia, "Alcmaeon of Croton's Observations on Health, Brain, Mind, and Soul", J. History of Neurosciences, 21, 409–426, 2012.
[11]. Birds' intelligence in mate selection; https://www.youtube.com/watch?v=rX40mBb8bkU
[12]. Robert Lurz, Historical reasoning; https://www.iep.utm.edu/ani-mind/
[13]. Lurz, R. (2009). The Philosophy of Animal Minds: New Essays on Animal Thought and Consciousness. Cambridge: Cambridge University Press.
[14]. Rollin McCraty, "Heart–Brain Neurodynamics: The Making of Emotions"; https://www.researchgate.net/profile/Rollin_Mccraty2/publication/275613419_Heart-Brain_Neurodynamics_The_Making_of_Emotion/links/55938d0008ae1e9cb429a7df.pdf
[15]. C.G. Gross, "Aristotle on the Brain", The Neuroscientist, vol. 1(4), 1995.

International Journal of Advanced Research in Computer and Communication Engineering

Impact Factor 8.102 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 13, Issue 6, June 2024

DOI: 10.17148/IJARCCE.2024.13607

[16]. D. Jardim-Messeder, S. Noctor, K. Lambert, F. M. Pestana, M. E. de Castro Leal, M. F. Bertelsen, A. N. Alagaili, O. B. Mohammad, P. R. Manger and S. Herculano-Houzel "Dogs Have the Most Neurons, Though Not the Largest Brain: Trade-Off between Body Mass and Number of Neurons in the Cerebral Cortex of Large Carnivoran Species", Front. Neuroanat., 12 December 2017; https://doi.org/10.3389/fnana.2017.00118

[17]. C. Listona, B. S. McEwen, and B. J. Casey, "Psychosocial stress reversibly disrupts prefrontal processing and attentional control", PNAS, 106 (3), 2009.

[18]. D. Datta and A. F. T. Arnsten, "Loss of Prefrontal Cortical Higher Cognition with Uncontrollable Stress: Molecular Mechanisms, Changes with Age, and Relevance to Treatment", Brain Sci., 9, 113, 2019.

[19]. H.W. Loha et al., "Application of Explainable Artificial Intelligence for Healthcare: A Systematic Review of the Last Decade (2011– 2022)", https://www.sciencedirect.com/science/article/pii/S0169260722005429; https://www.elsevier.com/open-access/userlicense/1.0/

[20]. Ying Wei et al., "A Review of Algorithm & Hardware Design for AI-Based Biomedical Applications", IEEE TRANSACTIONS ON BIOMEDICAL CIRCUITS AND SYSTEMS, VOL. 14 (2), 2020.

[21]. J.N. Alcosta, et al., "Multimodal biomedical AI", Nature Medicine, vol 28, 1773–1784, 2022; www.nature.com/naturemedicine

[22]. M.Y. Shaheen, "Applications of Artificial Intelligence (AI) in healthcare: A review", 2021; https://www.scienceopen.com/document_file/a8536285-4c3c-47c2-8d5c-78cf38231c76/ScienceOpenPreprint/Applications%20of%20Artificial%20Intelligence%20%28AI%29%20in%20healthcare%20A%20review.pdf

[23]. Jiang F, Jiang Y, Zhi H, et al., "Artificial intelligence in healthcare: past, present and future", Stroke and Vascular Neurology 2017;2: e000101. doi:10.1136/svn-2017-000101

[24]. Kenji Suzuki, "Artificial Neural Networks - Methodological Advances and Biomedical Applications", Published by InTech Janeza Trdine 9, 51000 Rijeka, Croatia, 2011; https://www.researchgate.net/profile/Kenji-Suzuki-2/publication/319316102_Artificial_Neural_Networks_-_Methodological_Advances_and_Biomedical_Applications/links/59a42f16aca272a6461bb35e/Artificial-Neural-Networks-Methodological-Advances-and-Biomedical-Applications.pdf#page=15

[25]. G. R. Yang, and X-J Wang "Artificial Neural Networks for Neuroscientists: A Primer", Neuron 107, September 23, Elsevier Inc., 2020.

[26]. H.K.S. Alsayigh, A.S.M. Khidhir, "Deep learning-based mental task classification using a muse 2 EEG headset", *AIP Conf. Proc.* Vol. 3091, 040002; https://pubs.aip.org/aip/acp/issue/3091/1, 2024, https://doi.org/10.1063/5.0204932

[27]. L. Pu, K. M. Lion, M. Todorovic, and W. Moyle, "Portable EEG monitoring for older adults with dementia and chronic pain - A feasibility study", Geriatric Nursing, Vol. 42 (1), Pages 124-128, 2021; https://doi.org/10.1016/j.gerinurse.2020.12.008