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Bangladesh University of Business and Technology (BUBT)

CSE 498A: Literature Review Records

Student's Id and Name	22234103382, Umma Sumaiya Riya
Capstone Project Title	High-Efficiency Micro-Expression Recognition for Automated Human Behavior Analysis Systems.
Supervisor Name & Designation	Md. Mijanur Rahman, Assistant Professor
Course Teacher's Name & Designation	Sudipto Chaki, Assistant Professor

Aspects	**Paper # 23 Bio-Inspired Cognitive Architecture for Adaptive and Autonomous Behavior [Published Year: 2024 Publisher: MDPI Biology]**
Problem Statement	The paper addresses the challenge of designing artificial systems capable of adaptive, goal-driven, and autonomous behavior similar to biological organisms. Traditional AI models struggle with integrating perception, decision-making, learning, memory, and motor control into a unified architecture. The authors aim to solve the gap between biological cognition and artificial autonomous systems.
Key Contributions	The core contributions of this paper are: 1)Proposed a bio-inspired cognitive architecture combining perception, motivation, decision-making, and learning. 2)Introduced a multi-layer model integrating affective states, memory, and behavioral selection.

	3)Demonstrated how biological principles improve adaptability, robustness, and autonomy. 4)Provided simulations showing improved performance in dynamic environments.
Methodology/Theory/Framework	The authors propose a bio-inspired multilayer cognitive framework consisting of: ● Perception Module for sensory processing ● Affective–Motivation System inspired by biological emotion regulation ● Memory System with short-term and long-term components ● Action Selection / Decision-Making module ● Learning Mechanism using reinforcement-based adaptation
SoftwareTools/Setup Details	1)Simulations were implemented using custom computational models described in the paper 3)Architecture tested in simulation environments representing dynamic tasks 4)No specialized external software (e.g., PyTorch/TensorFlow) was reported 5)Computational environment: standard PC-based simulation environment
Test/Experiment Analysis	Experiments evaluated the agent's ability to adapt behavior under changing conditions. Parameters analyzed included adaptability, goal-driven decision-making, learning performance, motivation-driven behavior, and robustness against environmental disturbances. The model was compared with traditional AI architectures to measure improvements in flexibility and autonomous control. Accuracy/Performance: ● The proposed system showed significantly higher adaptability and stability ● Improved decision-making under uncertain conditions ● Faster behavioral convergence during learning tasks
Test Data/Dataset Source	The paper did **not** use a traditional dataset. Instead, it used **simulation-based experimental environments** that mimic: ● Biological sensory inputs

	• Dynamic tasks • Environmental changes requiring adaptation
Final Result (Assessment Criteria Wise)	The proposed cognitive architecture demonstrated improved: • Adaptability to environmental changes • Goal-driven decision-making • Learning efficiency • Robustness and autonomous behavior • Biological realism in artificial agents
Limitations (List the limitations the authors mentioned in the article)	• The system was only tested in **simulation**, not in real-world environments. • No large-scale quantitative benchmarks were provided. • Biological processes are simplified, not fully replicated. • Real-time hardware testing and scalability were not evaluated.
Final Summary	The authors proposed a bio-inspired cognitive architecture designed to improve adaptability and autonomous behavior in artificial systems. The framework integrates perception, motivation, memory, learning, and decision-making in a biologically inspired manner. Simulation results show that the model performs better than traditional AI architectures, particularly in dynamic and uncertain environments. The system demonstrates strong adaptability, robust behavioral selection, and effective learning. However, the study is limited to simulation-based experiments and lacks real-world validation. It also simplifies biological processes and does not include hardware testing. Overall, the model represents a promising step toward biologically grounded autonomous AI systems