RADemics

Human Behavior Modeling Using AI and Machine Learning Techniques

Deepika Dubey, Indrani Merugu
Dr D Y Patil College of Architecture, Narasimha Reddy Engineering College NRCM

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[1]Deepika Dubey, Assistant Professor, Department of soft skills, Dr D Y Patil College of Architecture, Pune, Maharashtra, India. deepikadubey@dypcoa.ac.in

[2]Indrani Merugu, Associate Professor & Soft Skills Trainer, Narasimha Reddy Engineering College NRCM, Maisammaguda, Kompally, Hyderabad, Telangana, India. chadaindu@gmail.com

Abstract

Human behavior modeling has emerged as a transformative research domain driven by rapid advancements in artificial intelligence and machine learning technologies. Increasing availability of large-scale behavioral data from wearable devices, smart environments, healthcare systems, surveillance platforms, social media networks, and Internet of Things infrastructures has accelerated the development of intelligent computational frameworks capable of understanding complex human activities, emotional responses, cognitive interactions, and decision-making patterns. This book chapter presents a comprehensive exploration of advanced artificial intelligence and machine learning techniques for human behavior analysis, emphasizing deep learning architectures, hybrid machine learning frameworks, attention mechanisms, intelligent decision-making systems, temporal behavior analysis, and multimodal behavioral datasets. The chapter critically examines behavioral data acquisition methods, contextual behavior prediction, activity recognition systems, emotional intelligence modeling, and adaptive learning strategies across healthcare, cybersecurity, smart transportation, education, and human-computer interaction domains. Significant research challenges associated with privacy preservation, interpretability, algorithmic fairness, multimodal data fusion, and real-time behavioral analytics receive detailed analytical attention for identifying future research opportunities within intelligent behavioral computing. Integration of explainable artificial intelligence, federated learning, edge intelligence, and context-aware adaptive systems highlights emerging directions for developing trustworthy and scalable human-centered behavioral frameworks. The presented discussion establishes a strong foundation for advancing intelligent behavior prediction systems capable of delivering accurate, ethical, and context-sensitive computational intelligence across dynamic real-world environments.

Keywords: Human Behavior Modeling, Artificial Intelligence, Machine Learning, Deep Learning, Behavioral Analytics, Multimodal Data Fusion

Introduction

Human behavior modeling has emerged as a rapidly evolving interdisciplinary research domain that integrates artificial intelligence (AI), machine learning (ML), cognitive science, behavioral psychology, neuroscience, and data analytics to understand, analyze, and predict human activities and decision-making patterns [1]. The increasing digitization of modern society has resulted in the continuous generation of large volumes of behavioral data through smartphones, wearable sensors, social media platforms, healthcare monitoring systems, surveillance technologies, smart transportation infrastructures, and Internet of Things (IoT)-enabled environments [2]. These heterogeneous and high-dimensional datasets have created new opportunities for developing intelligent computational systems capable of identifying hidden behavioral patterns and generating predictive insights for real-world applications [3]. Consequently, AI-driven human behavior modeling has gained significant attention in both academic research and industrial applications due to its potential to improve automation, personalization, security, and decision support systems [4,5].

The rapid advancement of computational intelligence techniques has substantially transformed traditional approaches to behavioral analysis [6]. Earlier human behavior studies primarily relied on statistical methods, psychological theories, and rule-based systems that were limited in handling complex, nonlinear, and context-dependent human interactions [7]. Human behavior is inherently dynamic and influenced by multiple cognitive, emotional, social, and environmental factors, making accurate prediction and interpretation a challenging task [8]. Conventional methods often fail to process large-scale real-time data generated from modern digital ecosystems and lack adaptability in continuously changing environments [9]. To address these limitations, machine learning and deep learning approaches have become increasingly important due to their ability to learn complex representations from structured and unstructured datasets without explicit programming [10].