Global Journal of Emerging AI and Computing

ISSN : XXXX-XXXX
Volume 1, Number 1, January, 2025

Innovative AI Solutions for Mental Health: Bridging Detection and Therapy

Hira Zainab[1], Ali Raza A Khan[2], Muhammad Ismaeel Khan[3], Aftab Arif[4*]

[1]American National University

[2]Virginia University of Science & Technology

[3,4]Washington University of science and technology

[1]hira.zainab72@gmail.com, [2]hunjra512@gmail.com, [3]Iskhan.student@wust.edu,

[4]Aftaba.student@wust.edu

open access

Corresponding Author

Aftab Arif
Aftaba.student@wust.edu

Article History:
Submitted: 16-01-2025
Accepted: 21-01-2025
Published: 24-01-2025

Keywords

AI-Enhanced Depression Detection, Integrated Mental Health Systems, EEG-Based Detection, Facial Recognition, Optimization Algorithms, Mental Health AI, Computational Challenges.

ABSTRACT

This paper examines how artificial intelligence systems can spot depression symptoms and develop treatment plans. We analyze the combination of physical healthcare devices with software applications to evaluate their worth and costs alongside AI face detection tools and optimization methods. The analysis reveals how expert teams combine their knowledge to develop effective artificial intelligence tools that assist people with mental health challenges. Our research proved that combining mental healthcare and AI technology leads to better diagnosis outcomes while providing tailored treatment solutions for global mental health support.

INTRODUCTION

Across the world depression and anxiety exist as severe mental health issues that impact people everywhere. Despite current mental health treatments making improvements we still require better diagnostic and therapeutic solutions for these mental disorders. AI offers an effective tool to mental

health services by identifying illness and developing personal treatment programs for individual patients [1]. Advanced mental health care benefits from AI's data processing capabilities which uncover useful connections that human professionals cannot observe. The reliance on human judgement in present mental health diagnosis produces unstable patient diagnoses across different examinations. Computers process numerical data with consistency to deliver quicker and more exact mental health evaluations [2].

Machine learning AI systems identify faint mental health signs at an early stage which lets health professionals start therapy promptly and modify treatment strategies for improved outcomes. AI creates personalized healthcare solutions that help healthcare professionals tailor treatment plans for each patient. AI technology integrates personal health details to create customized treatment strategies specific to each individual's specific requirements and wants [3]. Personalized treatment leads to higher treatment effectiveness plus improved patient adherence to therapy. Our AI technology ensures 24-hour patient monitoring while modifying therapy when treating long-term depression [4].

This research analyzes modern AI studies about depression therapy and presents methods to fix system limitations. We analyze the impact of artificial intelligence on mental healthcare to understand its potential and technical development issues. The technology demonstrates how artificial intelligence boosts mental health treatment quality while lowering costs and expanding service reach [5].

LITERATURE REVIEW

AI in Mental Health Diagnostics: AI changes mental health diagnosis by employing new data processing systems instead of traditional manual evaluation. AI systems employing deep learning and machine learning methods study extensive datasets to detect mental health problems in these large information resources [6]. This approach helps mental health experts identify diseases better and track them earlier so they can begin treatment sooner. Research indicates that AI systems detect depression through their ability to review texts vocal qualities and physical activities [7].

EEG-based Detection of Depression and Anxiety: Researchers use EEG test results as key input for their brain research studies. AI systems make EEG technology more effective for detecting mental health disorders. The AI system examines EEG brain wave recordings to detect typical brain changes that appear during depression and anxiety [8]. Medical experts can screen mental health conditions with basic equipment that collects precise patient data to enhance current healthcare approaches. Joint use of EEG gadgets and machine learning systems helps doctors make better medical choices more quickly [9].

Performance and Cost Trade-offs in AI Applications: Emerging systems need to deliver precise

mental health assessments within budget limits to remain accessible. Advanced systems need powerful processing which drives up costs and reduces their reach to users. Affordable mental health screening systems usually produce less accurate and dependable outcomes [10]. Our research examines AI system development choices through examples of facial recognition used for mental health assessments. We study diverse AI solutions and price information to provide guidance for cost-effective strategies that keep performance at high levels [11].

Optimization Algorithms for AI Systems: Optimization algorithms strengthen AI systems through better performance and accuracy levels. The optimization of mental health diagnostic AI models relies on algorithms that make these systems perform tasks better [12]. The subsequent part explains optimization techniques comprising gradient descent, genetic algorithms and the cat swarm optimization algorithm. Studies reveal optimization algorithms improve AI mental health systems by solving neural network problems with graph colorization [13].

METHODOLOGY

Data Collection: A perfect AI requires many kinds of useful data to make dependable calculations. The team used EEG sensors to track brain activity and gathered medical assessments plus patient facial recordings for their research. We performed strict quality control tests on our data collection process [14]. We refined our data collection by removing statistical noise and adjusting input values before creating better AI predictions. AI models can only assess accurately in training and testing when they process clean and standardized data [15].

AI Model Development: Scientists created AI detection models using strong machine learning tools to identify depression symptoms. We designed our study to work with CNN and RNN deep learning systems that examined the complex patterns within our database. The team used various data samples to train their prediction models and improved the models during repeated training sessions [16]. The following subsection presents the designed model architecture and shows how we train it to avoid overfitting while making better predictions on new cases. Our team tested transfer learning and ensemble approaches to improve how well the model works [17].

Performance Evaluation: The right way to test models is essential to reach their goals. After exploring different model features the research monitored how well models worked and how fast they processed tasks. We tested our AI models against regular diagnostic methods to check their results. Our study confirmed AI system strengths and weaknesses which will help us develop better solutions going forward. The researchers stated that models must receive valid testing and verification to demonstrate reliable performance in multiple environments [18].

Ethical Considerations: To ensure ethical patient care, mental health AI technology calls for strong

security systems that defend all patient medical records from brain scans to medical history. We ensured all ethical requirements were met as our team collected approval from participants and protected their personal data [19]. All participants signed consent forms before we collected data and converted their personal details into safe code identifiers. AI technology processed information through organized thinking patterns to help doctors and patients accept system results. The team improved AI model ethics through regular monitoring to ensure unbiased decision-making and fair care guidelines [20].

Model Deployment and User Interface Design: We executed our AI models inside our digital healthcare system to observe their functionality. We established a logical system that makes AI technologies available to healthcare workers seamlessly. The healthcare interface allows professionals to capture patient information before showing lab results paired with proposed treatments [21]. We designed our new method to blend with existing procedures while enhancing teamwork and reducing obstacles for hospital staff. Medical professionals used AI-enhanced information quickly to make their practice decisions [22].

Validation in Clinical Settings: We verified the AI systems would perform as designed by observing their use in medical environments. Healthcare professionals tested these AI systems during their daily practice to see how they would work for real medical treatment [23]. The research team assessed AI functionality by connecting it to regular EHR platforms and medical instruments in ongoing practice. During medical testing the team added patient feedback to enhance AI models to work efficiently for various patient populations [24].

RESULTS AND DISCUSSION

System Performance: The AI systems showed better results for depression detection than traditional human analysis procedures. New deep learning systems proved more effective than old approaches at spotting mental health risks in their early stages. Our analysis studies both the strengths and weaknesses of the system's ability to work. Studies demonstrate AI technology holds promise as an effective mental health diagnosis tool that works effectively and serves many different people [25].

EEG-based Detection Results: The EEG system successfully detected depression and anxiety related conditions among study participants. EEG sensors paired with artificial intelligence analysis created a complete and zero-risk system to detect mental illnesses [26]. Medical professionals should adopt these results because the method provides validated data evidence for better treatment practices. The team explored how recent EEG technology combined with smart learning systems helps doctors monitor changes in patient conditions better [27].

Cost-Performance Trade-offs: AI adoption rates are linked directly to finding the right balance

between performance and expense. We will investigate how well systems work and how system costs affect user service capabilities and server resources. The investigation analyzes several mental health diagnosis techniques and their costs to help create economical approaches to advanced mental health testing. Research explores how setting up systems in cloud environments alongside distributed learning methods can help reduce expenses while preserving performance output according to their study [28].

Optimization Challenges: Optimization algorithms showed their value and technology capabilities in practical use yet had performance limits. AI optimization brought improvements to AI systems yet created deep processing demands that called for professional technical management [29]. We study optimization roadblocks and propose methods to make networks work better. Scientists studied how using several optimization techniques together with parallel processing instances could make computation run faster. Our optimization methods applied during preprocessing and feature extraction helped maintain model precision levels while making it perform better [30].

CONCLUSION

AI technology creates better prospects for proper mental health assessments and superior patient care delivery. This paper delivers essential advancements and holistic systems to advance healthcare knowledge. To enhance these technology tools, we must solve their computing challenges while maintaining their performance standards and reasonable costs.

Our AI systems for mental health need to balance low costs with high performance results as the field continues to evolve. Healthcare professionals must form productive partnerships with technology groups and scientific researchers to create solutions that offer superior treatment at more reasonable prices. Experts must keep working on optimization algorithms and data integration methods to enhance AI mental health systems.

Future mental health treatment approaches will develop tailored solutions to help patients reach optimal health results. Artificial intelligence helps us design more effective mental health detection and healing systems that help people across the world. AI developers must put patient protection first and verify that algorithms work without bias while they design new systems.

REFERENCES

[1]. Graham S, Depp C, Lee EE, Nebeker C, Tu X, Kim HC, Jeste DV. Artificial intelligence for mental health and mental illnesses: an overview. Current psychiatry reports. 2019 Nov; 21:1-8.

[2]. Shatte AB, Hutchinson DM, Teague SJ. Machine learning in mental health: a scoping review of methods and applications. Psychological medicine. 2019 Jul; 49(9):1426-48.

[3]. Silver LB. Attention-deficit/hyperactivity disorder: A clinical guide to diagnosis and treatment for health and mental health professionals. American Psychiatric Pub; 2008 May 20.

[4]. Qayyum MU, Sherani AM, Khan M, Shiwlani A, Hussain HK. Using AI in Healthcare to Manage Vaccines Effectively. JURIHUM: Jurnal Inovasi dan Humaniora. 2024 May 27; 1(6):841-54.

[5]. Husnain, A., & Saeed, A. (2024). AI-enhanced depression detection and therapy: Analyzing the VPSYC system. IRE Journals, 8(2), 162-168. https://doi.org/IRE1706118

[6]. Bughin J, Hazan E, Sree Ramaswamy P, DC W, Chu M. Artificial intelligence the next digital frontier.

[7]. Choudhary V, Mehta A, Patel K, Niaz M, Panwala M, Nwagwu U. Integrating Data Analytics and Decision Support Systems in Public Health Management. South Eastern European Journal of Public Health. 2024 May 27:158-72.

[8]. Joshi ML, Kanoongo N. Depression detection using emotional artificial intelligence and machine learning: A closer review. Materials Today: Proceedings. 2022 Jan 1; 58:217-26.

[9]. Husnain, A., Alomari, G., & Saeed, A. (2024). AI-driven integrated hardware and software solution for EEG-based detection of depression and anxiety. International Journal for Multidisciplinary Research (IJFMR), 6(3), 1-24. https://doi.org/10.30574/ijfmr.2024.v06i03.22645

[10]. Kumar S, Talukder MB, Tyagi PK. The impact of artificial intelligence on improving efficiency in service and implementing best practices in service marketing. InAI Innovations in Service and Tourism Marketing 2024 (pp. 57-79). IGI Global.

[11]. Khan M, Shiwlani A, Qayyum MU, Sherani AM, Hussain HK. Revolutionizing Healthcare with AI: Innovative Strategies in Cancer Medicine. International Journal of Multidisciplinary Sciences and Arts. 2024 May 26; 3(1):316-24.

[12]. Shiwlani, A., Khan, M., Sherani, A. M. K., & Qayyum, M. U. (2023). Synergies of AI and smart technology: Revolutionizing cancer medicine, vaccine development, and patient care. International Journal of Social, Humanities and Life Sciences, 1(1), 10-18.

[13]. Zha D, Bhat ZP, Lai KH, Yang F, Jiang Z, Zhong S, Hu X. Data-centric artificial intelligence: A survey. ACM Computing Surveys. 2023 Apr.

[14]. Mehta A, Niaz M, Adetoro A, Nwagwu U. Advancements in Manufacturing Technology for the Biotechnology Industry: The Role of Artificial Intelligence and Emerging Trends. International Journal of Chemistry, Mathematics and Physics. 2024;8(2):12-8.

[15]. Khan, M., Shiwlani, A., Qayyum, M. U., Sherani, A. M. K., & Hussain, H. K. (2024). AI-powered healthcare revolution: An extensive examination of innovative methods in cancer treatment. BULLET: Journal Multidisiplin Ilmu, 3(1), 87-98.

[16]. Oberkampf WL, Roy CJ. Verification and validation in scientific computing. Cambridge university press; 2010 Oct 14.

[17]. Ueda D, Kakinuma T, Fujita S, Kamagata K, Fushimi Y, Ito R, Matsui Y, Nozaki T, Nakaura T, Fujima N, Tatsugami F. Fairness of artificial intelligence in healthcare: review and recommendations. Japanese Journal of Radiology. 2024 Jan; 42(1):3-15.

[18]. Kaur J. AI-Augmented Medicine: Exploring the Role of Advanced AI alongside Medical Professionals. InAdvances in Computational Intelligence for the Healthcare Industry 4.0 2024 (pp. 139-159). IGI Global.

[19]. Qayyum MU, Sherani AM, Khan M, Hussain HK. Revolutionizing Healthcare: The Transformative Impact of Artificial Intelligence in Medicine. BIN: Bulletin of Informatics. 2023; 1(2):71-83.

[20]. Chen, JJ. Husnain, A., Cheng, WW. (2024). Exploring the Trade-Off between Performance and Cost in Facial Recognition: Deep Learning Versus Traditional Computer Vision. In: Arai, K. (Eds) Intelligent Systems and Applications. IntelliSys 2023. Lecture Notes in Networks and Systems, vol 823. Springer, Cham. https://doi.org/10.1007/978-3-031-47724-9_27

[21]. Luxton DD. Artificial intelligence in psychological practice: Current and future applications and implications. Professional Psychology: Research and Practice. 2014 Oct; 45(5):332.

[22]. Mehta A, Patel N, Joshi R. Method Development and Validation for Simultaneous Estimation of Trace Level Ions in Purified Water by Ion Chromatography. Journal of Pharmaceutical and Medicinal Chemistry. 2024 Jan; 10(1).

[23]. Ahmad, A., Dharejo, N., Saeed, F., Shiwlani, A., Tahir, A., & Umar, M. (2024). Prediction of fetal brain and heart abnormalities using artificial intelligence algorithms: A review. American Journal of Biomedical Science & Research, 22(3), 456-466.

[24]. Sherani AM, Qayyum MU, Khan M, Shiwlani A, Hussain HK. Transforming Healthcare: The Dual Impact of Artificial Intelligence on Vaccines and Patient Care. BULLET: Jurnal Multidisiplin Ilmu. 2024 May 27;3(2):270-80.

[25]. Saeed, A., Husnain, A., Zahoor, A., & Gondal, R. M. (2024). A comparative study of cat swarm algorithm for graph coloring problem: Convergence analysis and performance

evaluation. International Journal of Innovative Research in Computer Science and Technology (IJIRCST), 12(4), 1-9. https://doi.org/10.55524/ijircst.2024.12.4.1

[26]. Dwivedi YK, Hughes L, Ismagilova E, Aarts G, Coombs C, Crick T, Duan Y, Dwivedi R, Edwards J, Eirug A, Galanos V. Artificial Intelligence (AI): Multidisciplinary perspectives on emerging challenges, opportunities, and agenda for research, practice and policy. International journal of information management. 2021 Apr 1; 57:101994.

[27]. Sherani AM, Khan M. AI in Clinical Practice: Current Uses and the Path Forward. Global Journal of Universal Studies. 1(1):226-45.

[28]. Olawade DB, Wada OZ, Odetayo A, David-Olawade AC, Asaolu F, Eberhardt J. Enhancing mental health with Artificial Intelligence: Current trends and future prospects. Journal of medicine, surgery, and public health. 2024 Apr 17:100099.

[29]. Ajayi R. AI-POWERED INNOVATIONS FOR MANAGING COMPLEX MENTAL HEALTH CONDITIONS AND ADDICTION TREATMENTS.

[30]. Umar, M., Shiwlani, A., Saeed, F., Ahmad, A., Ali, M. H., & Shah, A. T. (2023). Role of deep learning in diagnosis, treatment, and prognosis of oncological conditions. International Journal, 10(5), 1059-1071.