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The Role of AI in Tackling Epidemics: Lessons from Recent Outbreaks

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Abstract

Artificial Intelligence (AI) has emerged as a transformative tool in managing epidemics, offering innovative solutions to detect, predict, and mitigate the spread of infectious diseases. This paper explores the role of AI in tackling recent outbreaks, such as COVID-19, Ebola, and Zika, emphasizing its contributions to real-time data analysis, contact tracing, and outbreak prediction. Key AI applications, including machine learning models for disease forecasting, natural language processing for analyzing public health data, and AI-powered diagnostic tools, are examined. Additionally, the study discusses the challenges of implementing AI in epidemic management, such as data privacy concerns, technological infrastructure disparities, and the need for global collaboration. Lessons from these outbreaks underline the importance of integrating AI into global health systems to enhance preparedness, response, and resilience against future public health crises.

Keywords:
Artificial Intelligence, Epidemics, Disease Outbreaks, Machine Learning, Public Health, COVID-19, Disease Forecasting, AI Applications in Healthcare, Global Health Preparedness, Data Analysis in Epidemics.

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Introduction:

The emergence and rapid spread of infectious diseases, as witnessed in recent outbreaks such as COVID-19, Ebola, and Zika, have underscored the urgent need for innovative solutions to manage and mitigate epidemics. Artificial Intelligence (AI) has emerged as a transformative tool in this arena, offering unprecedented capabilities to analyze vast datasets, predict outbreak patterns, and optimize public health responses. By leveraging machine learning, natural language processing, and predictive analytics, AI has the potential to revolutionize epidemic management, from early detection to vaccine distribution.[1.2.3]

One of AI's most significant contributions is its ability to process real-time data from diverse sources, including social media, electronic health records, and global disease surveillance networks. This capability enables early detection of anomalies that could signal the onset of an outbreak, allowing for timely interventions. During the COVID-19 pandemic, AI models played a pivotal role in forecasting infection rates, identifying high-risk populations, and supporting the development of diagnostic tools and treatments.[4,5]

Moreover, AI-driven technologies have proven invaluable in resource-constrained environments. Tools like AI-powered contact tracing apps and autonomous drones for medical supply delivery have enhanced the efficiency and accuracy of public health measures. However, these advancements are not without challenges, including data privacy concerns, algorithmic bias, and the need for robust infrastructure to support AI deployment in low-resource settings.[6,7,8]

This article explores the multifaceted role of AI in tackling epidemics, drawing lessons from recent global health crises. It examines the successes, limitations, and ethical considerations of AI applications in epidemic management, emphasizing the importance of collaboration between technologists, healthcare professionals, and policymakers. By understanding these lessons, we can better prepare for future public health emergencies and harness the full potential of AI to protect global health.

Objectives

1. To analyze the impact of artificial intelligence (AI) technologies in predicting, monitoring, and managing epidemic outbreaks.
2. To explore how AI has been applied in recent epidemic responses, such as COVID-19, Ebola, and Zika, and evaluate its effectiveness.
3. To identify key AI-driven tools and techniques (e.g., machine learning, predictive analytics, natural language processing) that contribute to epidemic preparedness and response.
4. To investigate the role of AI in enhancing disease surveillance systems and real-time data analysis for early outbreak detection.
5. To evaluate the integration of AI in healthcare systems for resource optimization and decision-making during epidemics.
6. To assess the ethical and societal challenges associated with the use of AI in epidemic management, including data privacy and accessibility issues.
7. To provide recommendations for leveraging AI in future epidemic preparedness strategies, focusing on global health equity and sustainability.

1. Research Design

This study adopts a mixed-methods approach, combining qualitative and quantitative research methodologies to provide a comprehensive analysis of how AI has been employed to address epidemics. The study integrates case studies, data analytics, and expert interviews to derive actionable insights.[9,10]

2. Data Collection Methods

Literature Review:
A systematic review of peer-reviewed articles, conference proceedings, and reports published between 2015 and 2024 focusing on AI applications in epidemic management.

Case Studies:
Detailed examination of recent outbreaks, including COVID-19, Ebola, and Zika, to analyze how AI technologies (e.g., predictive modeling, contact tracing, and vaccine development) were utilized.

Interviews:
Semi-structured interviews with public health officials, data scientists, and AI developers involved in epidemic response efforts.

Dataset Analysis:
Analysis of publicly available datasets, such as WHO epidemic reports and AI models used in outbreak prediction and control.

3. Analytical Framework

Qualitative Analysis:
Thematic coding will be employed to identify key themes related to AI applications in outbreak management, such as predictive analytics, diagnostics, and resource allocation.

Quantitative Analysis:
Statistical methods will assess the effectiveness of AI-driven interventions by comparing epidemic metrics (e.g., infection rates, response times, and mortality rates) before and after AI implementation. [11]

Comparative Analysis:
Compare and contrast the outcomes of AI-driven and traditional epidemic management strategies across different outbreaks.

4. Tools and Techniques

AI Models:
Evaluation of machine learning algorithms and predictive models, including neural networks and decision trees, used during epidemics.

Software Tools:
Utilization of Python and R for statistical analysis, alongside AI-specific tools such as TensorFlow and PyTorch.

Visualization:
Employ data visualization tools (e.g., Tableau, Power BI) to represent trends and outcomes effectively.

5. Ethical Considerations

The study will ensure compliance with ethical standards by:

Safeguarding sensitive data related to patient privacy and public health information.

Obtaining informed consent from interview participants.

6. Validation

The study's findings will be validated through triangulation, comparing insights from literature reviews, interviews, and data analysis to ensure reliability and credibility.

Role of Artificial Intelligence in Predictive Analytics

Artificial Intelligence (AI) plays a transformative role in predictive analytics, revolutionizing how epidemic outbreaks are forecasted and managed, particularly in rural populations where traditional methods often fall short. The significance of AI in this domain lies in its ability to process vast datasets, uncover hidden patterns, and deliver insights that are often missed by conventional analyses. [12,13] By leveraging sophisticated algorithms and computational power, AI enhances the accuracy and timeliness of epidemic forecasting, ultimately improving public health responses.

Key Technologies: Machine Learning and Deep Learning

AI's contributions to predictive analytics are underpinned by its core technologies, primarily **machine learning** and **deep learning**

- **Machine Learning**:
  This subset of AI uses historical data to train algorithms capable of identifying patterns and predicting future events [14]. For epidemic prediction, machine learning models analyze diverse data sources, such as infection rates, climate variables, and population

movements, to forecast outbreak trends [15,16]These models can detect early indicators of potential outbreaks and assess their severity, enabling timely interventions, especially in resource-constrained rural settings.

- **Deep Learning**:
  A more advanced subset of machine learning, deep learning uses multilayered neural networks to model complex patterns in data [17,18]These models excel at processing unstructured data, such as electronic medical records, social media content, and satellite imagery. In epidemic prediction, deep learning algorithms integrate these diverse data types to create a comprehensive view of disease spread [19].By identifying intricate relationships between variables, deep learning enhances the precision of forecasts, helping pinpoint hotspots before they escalate into widespread outbreaks.

Advantages of AI in Epidemic Forecasting

AI significantly enhances epidemic forecasting and management in several ways:

1. **Real-Time Data Analysis**:
   AI processes and analyzes data as it becomes available, enabling quicker detection of anomalies and faster public health responses. Traditional methods, reliant on delayed reporting and manual analysis, often result in slower interventions [20,21,22]
2. **Improved Accuracy**:
   By incorporating large, complex datasets—ranging from electronic health records to environmental and social media data—AI generates more precise predictions about disease spread and impact. This multifaceted approach uncovers trends and outbreak patterns that might remain invisible with single-source analyses.
3. **Targeted Resource Allocation**:
   In rural areas with limited healthcare resources, AI helps prioritize interventions by identifying high-risk regions [23,24] AI models can predict which communities are most vulnerable to outbreaks based on factors like historical infection rates, mobility patterns, and environmental conditions[25,26].This targeted strategy ensures resources are deployed where they are needed most, optimizing epidemic responses.
4. **Early Warning Systems**:
   AI-powered systems can integrate data from multiple sources to issue early warnings and suggest preventive measures, such as vaccination drives or public health advisories [27]. These alerts are invaluable in rural areas, where timely action can significantly reduce outbreak severity.

Challenges and Recommendations

Despite its advantages, implementing AI-based predictive analytics in rural areas presents challenges, including:

- **Data Availability and Quality**:
  Inconsistent or incomplete data from rural regions can compromise the accuracy of AI models.

- **Infrastructure Gaps**:
  Limited technological infrastructure and expertise in rural areas can hinder the effective use of advanced AI systems [28].Addressing these challenges requires:

- **Investments in Data Management**:
  Developing systems for improved data collection, integration, and standardization in rural areas.
- **Capacity Building**:
  Training healthcare professionals and data scientists in rural communities to utilize AI tools effectively.

Data Sources for AI-Driven Predictive Models

Data sources are fundamental to the development and effectiveness of AI-driven predictive models for epidemic outbreaks, especially in rural populations where resources and data availability are often limited [29]. Accurate forecasting and effective management of epidemics depend on the quality, variety, and integration of data. AI models leverage diverse data sources to generate precise predictions, support decision-making, and enable timely interventions. Understanding these data sources and how they are utilized is essential to maximize the potential of AI in epidemic management.

Key Data Sources

1. **Historical Health Data**
   Historical health data forms the foundation for AI-driven predictive analytics. This includes records of past epidemics, such as their incidence, spread, and overall impact. By analyzing historical data, AI models identify trends and recurring patterns, enabling more accurate predictions of future [30]. For example, seasonal variations in respiratory infections or the geographic patterns of vector-borne diseases can provide essential insights for AI algorithms. Learning from past epidemics enhances the forecasting capabilities of these models, allowing public health authorities to anticipate and mitigate future crises.
2. **Real-Time Surveillance Data**
   Real-time surveillance data is crucial for dynamic and responsive epidemic management. This data includes current case reports, diagnostic results, and health-related metrics collected from healthcare facilities, laboratories, and field surveillance. Real-time data enables AI models to continuously update their predictions and adapt to changing conditions [31]. For instance, detecting an increase in cases within a specific area can prompt AI systems to predict potential outbreak hotspots and suggest immediate interventions. Timely analysis of real-time data significantly improves the effectiveness of response strategies.
3. **Environmental and Socio-Economic Factors**
   Environmental and socio-economic data are essential for understanding the broader context of epidemic dynamics. Factors such as weather patterns, temperature fluctuations,

and environmental conditions can influence the spread of diseases [32]. Similarly, socio-economic variables like population density, mobility patterns, and healthcare accessibility shape the transmission and impact of outbreaks. For example, densely populated areas are more likely to experience rapid disease transmission, while limited healthcare access can exacerbate the effects of an outbreak. Incorporating these variables allows AI models to make more accurate, context-sensitive predictions and recommendations.

Integration of Data Sources

Effective integration of diverse data sources is vital for comprehensive epidemic modeling. By combining historical health data, real-time surveillance data, and environmental and socio-economic factors, AI models achieve a holistic view of epidemic patterns [30]. This integration improves predictive accuracy and enhances actionable insights. For instance, an AI model that integrates historical trends, live case reports, and weather data can better predict outbreak hotspots and their likely progression.

Challenges in Data Integration

Integrating diverse data sources poses several challenges:

- **Data Quality and Consistency**: Data from various sources often vary in format, collection methods, and completeness, making aggregation and analysis difficult [29].
- **Standardization**: Establishing consistent data standards and integration frameworks is essential to ensure compatibility and reliability.
- **Privacy and Security**: Sensitive health data requires robust measures to protect patient confidentiality and comply with legal regulations, fostering trust among stakeholders.

Data Preprocessing

Data preprocessing is critical to preparing raw data for AI analysis. Steps include cleaning, normalizing, and transforming the data to ensure accuracy and readiness for [11]. Techniques such as data imputation, outlier detection, and feature selection enhance the quality and usability of the data, improving AI model performance.

Collaboration and Data Sharing

Collaboration between stakeholders—public health authorities, research institutions, and technology developers—is crucial for effective data sharing and integration. Establishing data-sharing agreements and platforms can facilitate the exchange of insights, enabling more robust and transparent AI-driven solutions. Collaborative efforts also support the development of standardized practices and foster innovation in epidemic management.

Applications of AI in Epidemic Prediction

Artificial Intelligence (AI) has become a transformative force in epidemic prediction, providing advanced tools to forecast disease outbreaks and manage public health crises more effectively. Its application in predicting epidemic outbreaks, particularly in rural areas, signifies a major advancement in epidemiology and public health ([22]. By leveraging machine learning algorithms, AI systems can process vast datasets to predict disease spread, identify potential hotspots, and inform targeted interventions. This article highlights the applications, successes, and implications of AI in epidemic prediction, with a focus on rural healthcare.

Machine Learning in Epidemic Prediction

Machine learning algorithms are at the core of AI-driven epidemic prediction systems. These algorithms process and analyze complex datasets to uncover patterns and trends that may not be immediately apparent through traditional methods [21]. Techniques like supervised learning, unsupervised learning, and reinforcement learning enable AI systems to learn from historical data and predict future disease outbreaks.

For instance, machine learning models can analyze historical epidemic data, such as flu or other infectious disease outbreaks, to detect patterns and forecast future occurrences. These models can also incorporate real-time data, including case reports and environmental conditions, to refine predictions and provide actionable insights.

Identifying Hotspots and High-Risk Areas

AI excels in identifying potential hotspots and high-risk regions for disease outbreaks. By analyzing data from diverse sources—historical health records, real-time surveillance, and environmental factors—AI systems can pinpoint areas at higher risk [33].

For example, geographic information systems (GIS) integrated with AI can map disease incidence, highlighting regions with high population density, inadequate healthcare access, or environmental conditions conducive to disease transmission. Such spatial analyses help public health officials allocate resources effectively and implement targeted interventions. AI models can also incorporate socio-economic data to identify vulnerable populations and predict how social determinants may influence disease spread.

Case Studies in AI-Driven Epidemic Prediction

Influenza Forecasting

During the 2019–2020 flu season, AI systems demonstrated remarkable accuracy in predicting influenza outbreaks. Machine learning algorithms analyzed historical flu patterns, weather data, and social media trends to forecast the timing and severity of outbreaks. These predictions enabled healthcare providers to prepare in advance, ensuring that vaccines and medical resources were directed to areas of greatest need.

COVID-19 Management

AI played a critical role in managing the COVID-19 pandemic. Models analyzed vast global datasets, including case reports, travel patterns, and genomic information about the virus.

Machine learning algorithms predicted virus spread, identified hotspots, and informed public health responses [27]. For example, AI-based models forecasted the pandemic's trajectory, evaluated the impact of interventions like lockdowns, and supported policy decisions. The effectiveness of AI in managing COVID-19 underscored its potential for enhancing epidemic prediction and response strategies.

Integrating Diverse Data Sources

AI's ability to integrate diverse data sources enhances its effectiveness in epidemic prediction. By combining historical data, real-time surveillance, environmental factors, and socio-economic data, AI models provide a comprehensive understanding of epidemic dynamics [24]. This holistic approach enables more accurate predictions and better-informed public health strategies.
AI systems can continuously learn and adapt based on new data, improving their predictive accuracy over time. For instance, as new virus variants emerge or vaccination rates change, AI models can adjust their predictions to reflect these developments.

Implications for Rural Populations

In rural areas, where traditional surveillance systems may be limited, AI-driven tools can bridge gaps in data collection and analysis. AI models provide valuable insights into disease risk and outbreak potential, allowing public health officials to better monitor and respond to epidemics in underserved regions [12].
For example, AI can help identify rural regions at risk of outbreaks due to seasonal changes, environmental conditions, or healthcare access challenges. This information facilitates targeted interventions and resource allocation, improving health outcomes in rural communities.

Challenges in AI-Driven Epidemic Prediction

Despite its potential, the use of AI in epidemic prediction faces challenges:

Data Quality and Availability: Limited access to comprehensive health data, especially in rural areas, can reduce the effectiveness of predictive models [32].

Privacy and Security: Ensuring the privacy and security of sensitive health data is critical to maintaining public trust and regulatory compliance.

Collaboration: Effective implementation requires collaboration between technology developers, public health authorities, and rural healthcare providers to ensure AI tools are equitable and ethical.

Conclusion

The role of AI in tackling epidemics has proven transformative, offering powerful tools to predict, monitor, and respond to outbreaks with unprecedented speed and precision. Lessons from recent outbreaks, such as COVID-19, have highlighted AI's ability to analyze vast and complex datasets, identify hotspots, and model the trajectory of diseases. AI-driven approaches, including machine learning algorithms and real-time data integration, have enabled public health authorities to make evidence-based decisions, allocate resources efficiently, and implement targeted interventions.

In rural and underserved populations, AI has bridged gaps in traditional surveillance systems, enhancing epidemic management in resource-constrained settings. The integration of diverse data sources—historical health records, real-time surveillance, environmental factors, and socio-economic data—has allowed for a more comprehensive understanding of disease dynamics and informed proactive responses.

Despite its successes, challenges such as data quality, availability, privacy, and the need for collaborative frameworks underscore the importance of refining AI applications in public health. Addressing these challenges will require global partnerships among governments, researchers, and technology developers to ensure AI solutions are equitable, ethical, and effective across diverse populations.

As AI technologies continue to evolve, their role in epidemic management will expand, offering even greater potential to safeguard global health. By building on lessons learned from recent outbreaks and investing in AI-driven innovations, the world can strengthen its preparedness and resilience against future epidemics, ensuring better health outcomes for all.

References:

[1]. Shiwlani, A., Kumar, S., Kumar, S., Hasan, S. U., & Shah, M. H. A. Transforming Healthcare Economics: Machine Learning Impact on Cost Effectiveness and Value-Based Care.

[2]. Kumar, S., Shiwlani, A., Hasan, S. U., Kumar, S., Shamsi, F., & Hasan, S. Artificial Intelligence in Organ Transplantation: A Systematic Review of Current Advances, Challenges, and Future Directions.

[3]. Shiwlani, A., Hasan, S. U., & Kumar, S. (2024). Artificial Intelligence in Neuroeducation: A Systematic Review of AI Applications Aligned with Neuroscience Principles for Optimizing Learning Strategies. *Journal of Development and Social Sciences*, *5*(4), 578-593.

[4]. Kalluri, K. (2022). *Exploring Zero-Shot and Few-Shot Learning Capabilities in LLMS for Complex Query Handling*.

[5]. Bari, M. S., Sarkar, A., & Islam, S. M. (2024). AI-augmented self-healing automation frameworks: Revolutionizing QA testing with adaptive and resilient automation. *Advanced International Journal of Multidisciplinary Research*, *2*(6).

[7]. Islam, T., Islam, S. M., Sarkar, A., Obaidur, A. J. M., Khan, R., Paul, R., & Bari, M. S. (2024). Artificial Intelligence in Fraud Detection and Financial Risk Mitigation: Future Directions and Business Applications. *International Journal for Multidisciplinary Research*.

[8]. Kalluri, K. (2015). Migrating Legacy System to Pega Rules Process Commander v7. 1.

[9]. Islam, S. M., Bari, M. S., Sarkar, A., Obaidur, A. J. M., Khan, R., & Paul, R. (2024). AI-driven threat intelligence: Transforming cybersecurity for proactive risk management in critical sectors. *International Journal of Computer Science and Information Technology*, *16*(5), 125-131.

[10]. Kalluri, K. (2022). Federate Machine Learning: A Secure Paradigm for Collaborative AI in Privacy-Sensitive Domains. *International Journal on Science and Technology*, *13*(4), 1-13.

[11]. Mojumdar, M. U., Sarker, D., Assaduzzaman, M., Sajeeb, M. A. H., Rahman, M. M., Bari, M. S., ... & Chakraborty, N. R. (2025). AnaDetect: An extensive dataset for advancing anemia detection, diagnostic methods, and predictive analytics in healthcare. *Data in Brief*, *58*, 111195.

[12]. Kalluri, K. *Optimizing Financial Services Implementing Pega's Decisioning Capabilities for Fraud Detection*.

[13]. Khan, A. O. R., Islam, S. M., Sarkar, A., Islam, T., Paul, R., & Bari, M. S. Real-Time Predictive Health Monitoring Using AI-Driven Wearable Sensors: Enhancing Early Detection and Personalized Interventions in Chronic Disease Management.

[14]. Kalluri, K. (2024). AI-Driven Risk Assessment Model for Financial Fraud Detection: a Data Science Perspective. *International Journal of Scientific Research and Management*, *12*(12), 1764-1774.

[15]. Islam, S. M., Sarkar, A., Khan, A. O. R., Islam, T., Paul, R., & Bari, M. S. AI-Driven Predictive Analytics for Enhancing Cybersecurity in a Post-Pandemic World: A Business Strategy Approach.

[16]. Bari, M. S., Islam, S. M., Sarkar, A., Khan, A. O. R., Islam, T., & Paul, R. Circular Economy Models in Renewable Energy: Technological Innovations and Business Viability.

[17]. Kalluri, K., & Kokala, A. Performance Benchmarking Of Generative Ai Models: Chatgpt-4 Vs. Google Gemini Ai.

[18]. Sarkar, A., Islam, S. M., Khan, A. O. R., Islam, T., Paul, R., & Bari, M. S. Leveraging Blockchain for Transparent and Efficient Supply Chain Management: Business Implications and Case Studies.

[19]. Kalluri, K. (2024). *Scalable fine-tunning strategies for llms in finance domain-specific application for credit union*.

[20]. Paul, R., Islam, S. M., Sarkar, A., Khan, A. O. R., Islam, T., & Bari, M. S. The Role of Edge Computing in Driving Real-Time Personalized Marketing: A Data-Driven Business Perspective.

[21]. Islam, M. T., Newaz, A. A. H., Paul, R., Hassan Melon, M. M., & Hussen, M. (2024). Ai-Driven Drug Repurposing: Uncovering Hidden Potentials Of Established Medications For Rare Disease Treatment. *Library of Progress-Library Science, Information Technology & Computer*, *44*(3).

[22]. Paul, R., Hossain, A., Islam, M. T., Hassan Melon, M. M., & Hussen, M. (2024). Integrating Genomic Data with AI Algorithms to Optimize Personalized Drug Therapy: A Pilot Study. *Library of Progress-Library Science, Information Technology & Computer*, *44*(3).

[23]. Islam, T., Islam, S. M., Sarkar, A., Obaidur, A. J. M., Khan, R., Paul, R., & Bari, M. S. (2024). Artificial Intelligence in Fraud Detection and Financial Risk Mitigation: Future Directions and Business Applications. *International Journal for Multidisciplinary Research*.

[24]. Sunny, R. (2019). IOT-Based Smart Agriculture in Bangladesh: An Overview.

[25]. Mullankandy, S., Kazmi, I., Islam, T., & Phia, W. J. (2024). Emerging Trends in AI-Driven Health Tech: A Comprehensive Review and Future Prospects. *European Journal of Technology*, *8*(2), 25-40.

[26]. Islam, T., Anik, A. F., & Islam, M. S. (2021). Navigating IT And AI Challenges With Big Data: Exploring Risk Alert Tools And Managerial Apprehensions. *Webology (ISSN: 1735-188X)*, *18*(6).

[27]. Volkivskyi, M., Islam, T., Ness, S., & Mustafa, B. (2024). AI-Powered Analysis of Social Media Data to Gauge Public Sentiment on International Conflicts. *ESP International Journal of Advancements in Computational Technology (ESP-IJACT)*, *2*(2), 25-33.

[28]. Volkivskyi, M., Islam, T., Ness, S., & Mustafa, B. (2024). The Impact of Machine Learning on the Proliferation of State-Sponsored Propaganda and Implications for International Relations. *ESP International Journal of Advancements in Computational Technology (ESP-IJACT)*, *2*(2), 17-24.

[29]. Islam, T., Afrin, S., & Zand, N. (2024). AI in Public Governance: Ensuring Rights and Innovation in Non-High-Risk AI Systems in the United States. *European Journal of Technology*, *8*(6), 17-27.

[30]. Afrin, S., Khan, A. T., Mahia, M., Ahsan, R., Mishal, M. R., Ahmed, W., & Rahman, R. M. (2018, June). Analysis of soil properties and climatic data to predict crop yields and cluster different agricultural regions of Bangladesh. In *2018 IEEE/ACIS 17th International Conference on Computer and Information Science (ICIS)* (pp. 80-85). IEEE.

[31]. Hussain, M. A., Yeasmin, S., Chowdhury, S., Wasee, F. R., Afrin, S., Tanzim, S. M., & Rahman, R. M. (2018, June). Income based food list recommendation for rural people using fuzzy logic. In *2018 IEEE/ACIS 17th International Conference on Computer and Information Science (ICIS)* (pp. 116-121). IEEE.

[32]. Khan, A. T., Afrin, S., & Rahman, T. (2018, October). Comparison of principal component analysis and partial least square discriminant analysis in the classification of EEG signals. In *2018 IEEE International Workshop on Signal Processing Systems (SiPS)* (pp. 1-6). IEEE.

[33]. Afrin, S., Roksana, S., & Akram, R. (2024). AI-Enhanced Robotic Process Automation: A Review of Intelligent Automation Innovations. *IEEE Access*.