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Applications of Artificial Intelligence Technique Development: A Review of Recent Advances

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Abstract: To benefit humanity, increasingly sophisticated instruments have been produced over many generations. In many ways, digital computers are just another tool. They are able to carry out the same kinds of symbolic and numerical operations as the average individual, but more quickly and consistently. A subfield of computer science called artificial intelligence is able to analyze complicated medical data. In many clinical situations, their ability to take advantage of significant relationships within a data collection can be applied to diagnosis, treatment, and outcome prediction. An overview of artificial intelligence algorithms used in software and computer applications is presented in this study. Incorporate knowledge-based systems. The science of simulating human mental abilities in a computer is known as computational intelligence, which leads to artificial intelligenceIt helps doctors perform dissections for medical diagnoses. This study, specifically, offers a thorough analysis of current advancements in the field of artificial intelligence (AI) and its applications. The work is intended for those who are just starting out in the field of artificial intelligence. Additionally, it reminds seasoned researchers of some of the problems they are familiar with. This review's objective was to provide an overview of the main areas of artificial intelligence (AI), including its uses and constraints in surgery. In order to assist surgeons in comprehending and critically assessing novel AI applications and in contributing to advancements, this study examines the primary capabilities of AI.
Key Points: Modelling Techniques and Machine Learning in Nanomedicine, Applications, Different supervised and unsupervised AI Models, limitation, uses

I. INTRODUCTION

A. Human Resources Management: Evolution and Personalization

Human Resources Management (HRM) has undergone significant transformations in recent years. The HR function has evolved to play a more strategic role in companies, focusing on personalizing HR practices to meet the specific needs of each target group. Diversification of HR Issues: The HR function now addresses a wide range of issues, from talent management to employee engagement and retention.. Strategic Decision-Making: HR plays a crucial role in strategic decision-making processes, contributing to the company's overall success. Personalization of HR Practices: HR practices are tailored to meet the specific needs of each target group, including different generations, departments, and individual employees. Benefits of Human Resources Analysis Data-Driven Decision-Making: Human Resources Analysis enables companies to make informed decisions by leveraging employee data. Improved Operational Performance By analyzing HR data, companies can identify areas for improvement and optimize their HR processes Better Intergenerational Collaboration Personalized HR practices help managers achieve better intergenerational collaboration, leading to increased employee engagement and retention. AI in Education: Harnessing the Power of the Fourth Industrial Revolution Artificial intelligence (AI) is transforming the education sector in various ways, offering opportunities for personalized learning, enhanced student engagement, and improved educational outcomes. As AI continues to evolve, it's essential for educators to understand its capabilities and limitations to optimize learning.

B. Benefits of AI in Education

1) Personalized Learning: AI can analyse student data to create tailored learning plans, enabling students to learn at their own pace.
2) Enhanced Student Engagement: AI-powered tools, such as gamification and interactive simulations, can increase student motivation and participation.
3) Improved Accessibility: AI-driven assistive technologies can support students with disabilities, ensuring equal access to education.

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4) Automated Administrative Tasks: AI can automate tasks like grading, scheduling, and report generation freeing up educators to focus on teaching.

Systematic Literature Review (SLR) and the Role of AI in Semi-Automation A Systematic Literature Review (SLR) is a rigorous and organized methodology that assesses and integrates previous research on a specific topic. SLRs are recognized for being time-consuming and resource-intensive, but the incorporation of Artificial Intelligence (AI) solutions can help address these challenges The integration of artificial intelligence (AI) in education has transformed the way instructors teach and students learn. From the early days of computer-aided instruction to the current use of AI-powered systems, technology has played a significant role in shaping the education sector.

C. Modelling Techniques and Machine Learning in Nanomedicine

The application of statistical and analytical methods in nanomedicine has evolved significantly over the years. The integration of artificial intelligence (AI) and machine learning (ML) has transformed the field, enabling researchers to analyze complex data and make informed decisions.

1) Evolution of AI in Nanomedicine

Early Research AI research dates back to the 1950s, with a focus on developing machines that can learn and solve problems. Recent Advancements The availability of large datasets, advanced computing power, and cloud infrastructure has enabled the widespread adoption of AI and ML in nanomedicine.

2) Machine Learning in Nanomedicine

Artificial Neural Networks (ANNs) ANNs are a type of ML algorithm inspired by the structure and function of the human brain. Deep Learning Deep learning is a subset of ML that involves the use of complex neural networks to analyze data.

3) Applications of AI in Nanomedicine

Data Analysis AI and ML can be used to analyze complex data and identify patterns and trends.

Predictive Modeling AI and ML can be used to develop predictive models that forecast the behavior of nanoparticles and their interactions with biological systems.

4) Challenges and Opportunities

Data Quality The quality of the data used to train AI and ML models is critical to their accuracy and reliability. Interpretability AI and ML models can be complex and difficult to interpret, making it challenging to understand the underlying mechanisms.

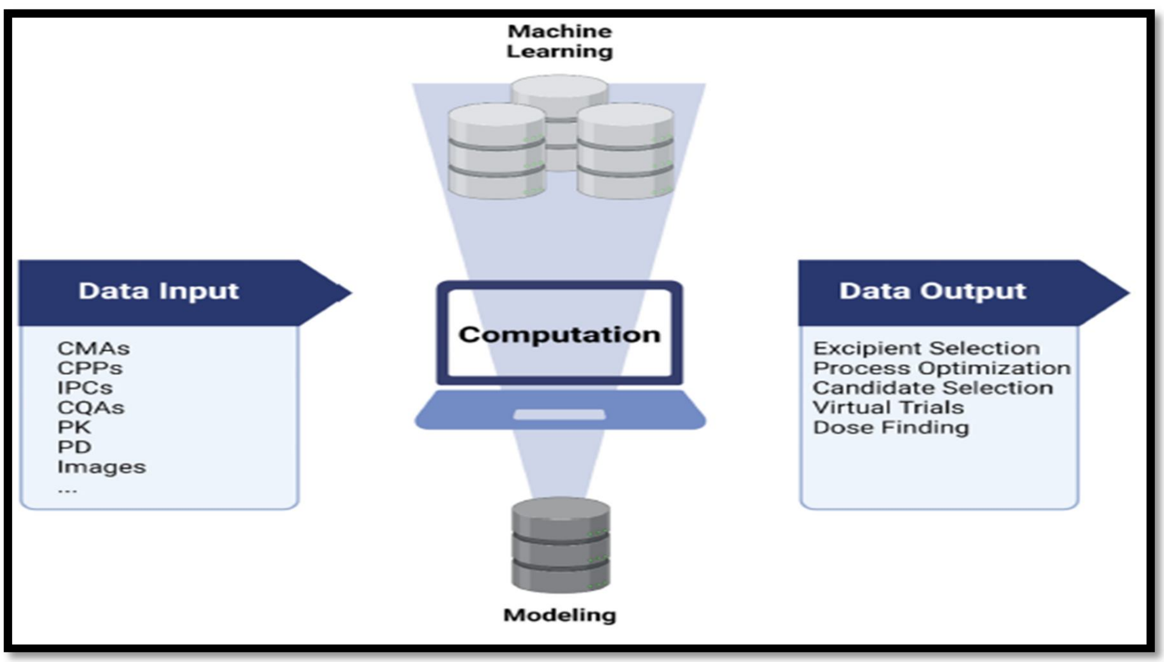

Fig 1. machine learning and modelling

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D. Classification Of AI

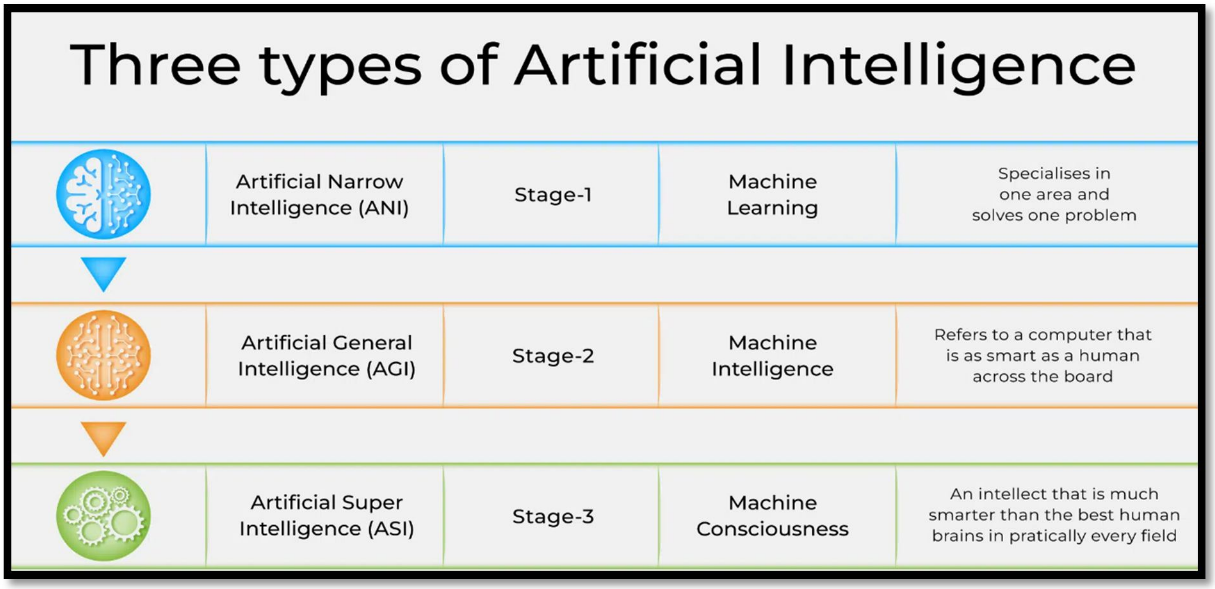


Fig no.2classification of AI

II. APPLICATIONS

A. Diseases and Therapy Selection

The integration of Artificial Intelligence (AI) in healthcare has shown considerable promise in transforming medical diagnosis and treatment. AI's ability to analyze complex data and identify patterns has the potential to revolutionize the way healthcare is delivered.

1) Nosology: AI assists in disease classification and diagnosis, improving patient outcomes and streamlining clinical workflows.
2) Drug Indications and Therapeutic Intent: AI identifies potential drug interactions and optimizes treatment plans, improving patient safety and efficacy.

B. Transforming Disease Diagnosis and Management

AI has made significant strides in healthcare, particularly in disease diagnosis and management.

1) Dermatology: AI is being used to diagnose skin conditions with impressive accuracy.
2) Tuberculosis: AI-powered systems can help detect TB from medical images and patient data.
3) Alzheimer's Disease (AD): AI is being explored for early detection and diagnosis of AD.
4) Diabetes: AI can help analyze patient data to predict disease progression and optimize treatment plans.
5) Hypertension: AI-powered systems can monitor blood pressure and detect potential issues.
6) Cancer: AI is being used to analyze medical images and detect cancerous cell

C. Image-Based AI in Medical Diagnosis

Image-based AI systems are transforming medical diagnosis in various fields, including radiology, pathology, and dermatology. These systems use machine learning algorithms to analyse medical images and provide accurate diagnoses.

1) Radiology: AI can analyse medical images such as chest X-rays, MRI scans, and CT scans to detect abnormalities and diagnose conditions.
2) Pathology: Digital pathology involves digitizing histopathology, immunohistochemistry, and cytology slides and training AI systems on this digital data.
3) Dermatology: AI-powered systems can analyse skin images to diagnose conditions such as atopic dermatitis, impetigo, and mycosis fungoides.

D. Nosology in Healthcare AI Systems

Nosology, the classification and recognition of disease terms, is a crucial aspect of healthcare AI systems. Accurate nosology is essential for effective disease diagnosis, treatment, and research.

Nosology
- Complexity: Disease classification is complex, with numerous ontologies and terminologies.
- Variability: Different healthcare systems and organizations may use different disease classification systems.

Mondo Disease Ontology
- Comprehensive Resource: Mondo is a comprehensive, community-driven, and computationally driven resource for disease classification.
- Unique Rare Diseases: Mondo has identified nearly 10,500 unique rare diseases, highlighting the complexity of disease classification.
- Human and ML Curation: Mondo's combination of human and machine learning (Bayesian) curation demonstrates the potential for collaboration between human and computer intelligence.

E. Drug Indications and Therapeutic Intent in AI-Driven Drug Discovery

Understanding the relationship between drugs and diseases is crucial in drug discovery. AI systems can help analyze drug indications and therapeutic intent to improve drug development and patient care.

1) Complexity: Capturing therapeutic intent computationally is challenging due to the complexity of disease concepts and contextual factors.
2) Manual Curation: Off-label medical uses require manual curation to ensure accuracy.

F. AI in Medical Technologies: Applications and Future Directions

Artificial intelligence (AI) is transforming various medical fields, including oncology, pulmonology, cardiovascular medicine, orthopedics, hepatology, and neurology. AI applications in medicine involve data collection, analysis, and active treatment.

III. APPLICATIONS OF AI IN MEDICINE

1) Data Collection: Medical data detection and extraction for disease diagnosis.
2) Data Analysis: Classification and identification of information for disease diagnostic activity.
3) Active Treatment: Therapeutic measures, such as physiotherapy, radiotherapy, surgery, and chemotherapy, guided by AI-powered diagnosis and prognosis.

A. AI in Cancer Diagnosis and Treatment

- Lung Cancer: AI-powered deep learning methods can detect lung cancer with high accuracy, supporting optimized cancer screening processes.
- Thyroid Cancer: Deep convolutional neural network (DCNN) models can improve ultrasound detection of thyroid cancer.
- Cancer Detection: AI-powered models can detect cancer with accuracy similar to experienced radiologists.

B. AI in Other Medical Applications

- Tuberculosis Detection: Deep convolutional neural networks can improve tuberculosis detection during chest radiography.
- Medical Imaging: AI-powered models can analyze medical images to detect diseases and support clinical decision-making

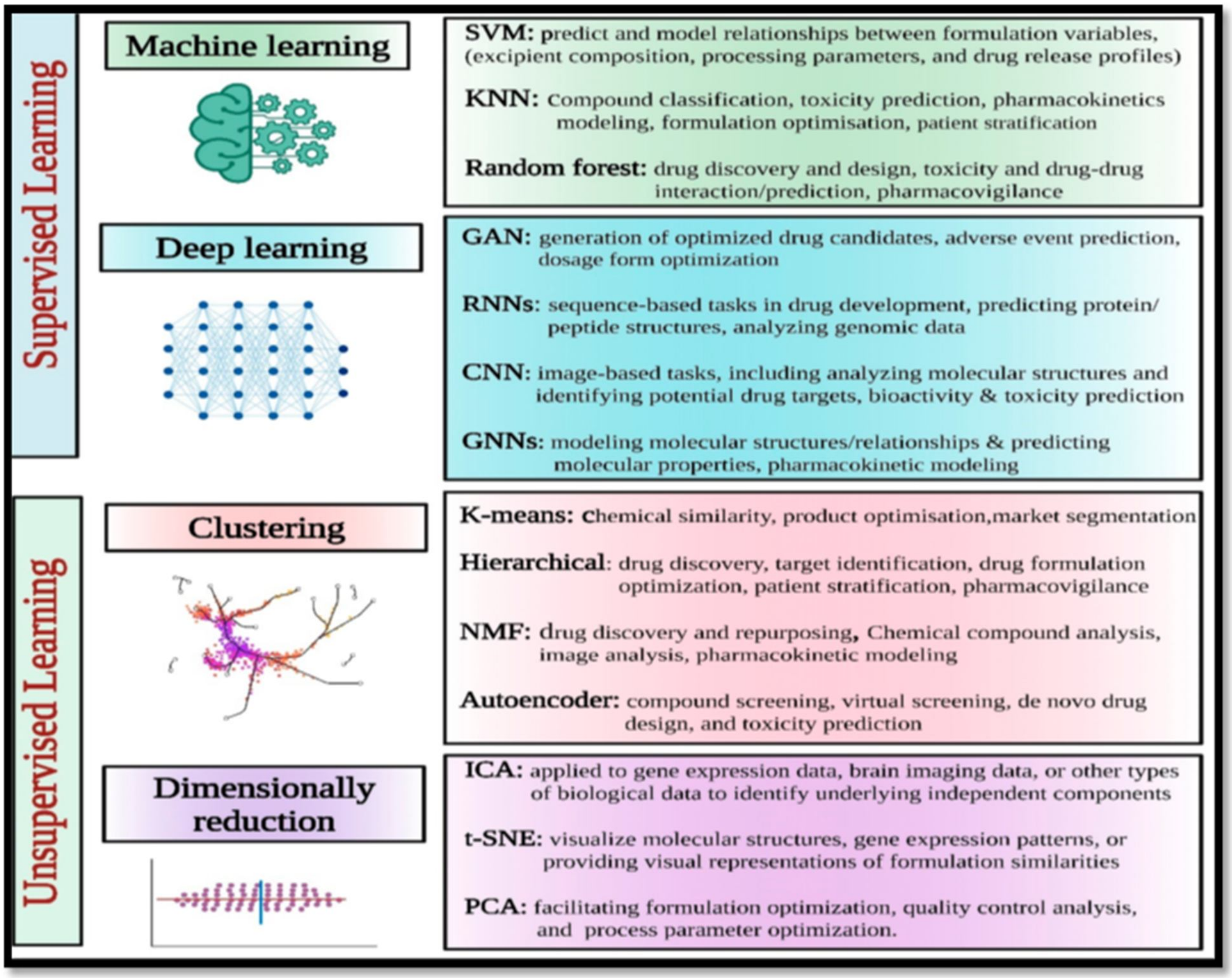


Fig 3.Different supervised and unsupervised AI Models /tools for pharmaceutical applications

C. Industry Supervised Learning in the Pharmaceutical

Supervised learning is a type of machine learning where an algorithm is trained on a labeled dataset to learn patterns and relationships between input data and desired outputs. This approach has various applications in the pharmaceutical industry.

Techniques Used in Supervised Learning

1) Naïve Bayes: A probabilistic algorithm used for classification tasks.
2) K-Nearest Neighbors (KNN): An algorithm used for classification and regression tasks.
3) Support Vector Machines (SVM): A powerful algorithm used for classification and regression tasks.
4) Ensemble Learning: A technique that combines multiple models to improve prediction accuracy.
5) Random Forest: An ensemble learning method used for classification and regression tasks.
6) Linear Regression: A regression algorithm used for predicting continuous outcomes.

D. Unsupervised Learning in Pharmaceutical Applications

Unsupervised learning is a type of machine learning that involves identifying patterns and relationships within data without prior labeling or annotation. This approach is particularly useful in exploratory data analysis and can help discover hidden structures or clusters within datasets.

1) Techniques Used in Unsupervised Learning

1.Clustering Algorithms: Hierarchical clustering, K-means, K-medoids, and other techniques group data points based on similarities.

2. Dimensionality Reduction: Techniques like principal component analysis (PCA) and t-distributed stochastic neighbor embedding (t-SNE) reduce data complexity while preserving meaningful information.

3. Anomaly Detection: Algorithms like local outlier factor (LOF) and isolation forest identify rare or unusual data points.
4. Association Rule Mining: Techniques like the Apriori algorithm discover relationships between items in a dataset.
5. Topic Modeling: Algorithms like latent Dirichlet allocation (LDA) extract latent topics from large text datasets.

2) Applications of Unsupervised Learning in Pharmaceuticals

1. Exploratory Analysis: Uncovering patterns and structures within pharmaceutical datasets.
2. Pattern Recognition: Identifying natural groupings or clusters within data.
3. Data Visualization: Reducing data complexity to facilitate visualization and exploration.
4. Target Identification: Identifying potential drug targets through clustering and pattern recognition.
5. Patient Stratification: Grouping patients based on similar characteristics.
6. Adverse Event Detection: Identifying potential safety concerns through anomaly detection.
7. Pharmacovigilance: Analyzing data to identify potential drug interactions and medication patterns.
8. Literature Mining: Analyzing scientific literature and clinical trial reports to identify key research themes and emerging trends.

3) Challenges and Limitations

1. Data Privacy and Confidentiality: Handling sensitive patient data while complying with regulations like GDPR and HIPAA.
2. Bias and Fairness: AI systems can perpetuate existing disparities if trained on biased data, leading to unequal treatment in drug development and patient care.
3. Transparency and Explainability: Complexity of deep learning models can hinder trust and accountability, particularly in healthcare.
4. Regulatory Compliance: Adhering to stringent pharmaceutical regulations and standards, requiring validation for clinical use and navigation of complex regulatory pathways.
5. Dependency on AI: Potential skill gap in the pharmaceutical workforce, necessitating ongoing education and training.
6. Intellectual Property Rights: Determining ownership of AI-generated discoveries can be complex.
7. Data Quality and Reliability: Gathering and maintaining high-quality datasets is challenging in pharmaceutical sciences.
8. High Cost of Integration: Limiting accessibility, particularly in low-resource settings, potentially widening global healthcare disparities.

4) Prospects of AI in Formulation Development

The integration of Artificial Intelligence (AI) in formulation development has shown significant promise, but there are still unexplored areas worth investigating. Some potential areas for future research include:

a) Advanced Deep Learning Algorithms

- Graph Convolutional Networks (GCN): GCN has been successfully applied in chemistry and material science to predict compound-protein interactions and visualize atomic contributions.
- Generative Adversarial Networks (GAN): GAN facilitates exploring and optimizing the chemical design space for desired functionality, making it a promising tool for drug discovery.

b) Applications in Drug Formulation Development

- Limited Literature: There is limited research on the applications of GCN and GAN in drug formulation development, making it an area ripe for exploration.
- Deep Learning-based Image Analysis: This technology can extract properties of formulations, such as particle size distribution, and could be integrated with Process Analytical Technology (PAT) instruments for in-silico measurement.

c) Future Research Directions

1. Reinforcement Learning: A robust learning algorithm that has yet to be studied extensively in formulation development.
2. Incorporating Image Analysis with PAT: Integrating image analysis with PAT instruments could enable real-time measurement of formulation properties during manufacturing.

5) Comparative Analysis of Classification Techniques

Classification Technique	Data Requirement	Interpretability	Accuracy	Computational Complexity	Suitable For	Limitations
Logistic Regression	Low to Moderate	High (Very Interpretable)	Moderate	Low	Problems with linear/separable data	Not suitable for complex non-linear patterns
Decision Tree	Low	High (Easy to understand visually)	Moderate	Low to Moderate	Simple, rule-based classification	Can overfit easily
k-Nearest Neighbors (k-NN)	High	Low (No model structure to interpret)	Good for small data	High at prediction time (distance calculation)	Real-time classification with small datasets	Slow for large datasets
Support Vector Machine (SVM)	Moderate	Low to Moderate	High, especially with kernel	Moderate to High	High-dimensional and non-linear classification	Not suitable for very large datasets; kernel selection is critical
Random Forest	Moderate to High	Moderate (feature importance visible)	High	Moderate	Complex classification with robustness	Less interpretable than single decision tree
Artificial Neural Networks (ANN/Deep Learning)	Very High	Very Low (Black-box)	Very High	High (requires GPU/TPU)	Large-scale, complex, non-linear datasets (images, text, signals)	Requires large labeled data & computational power

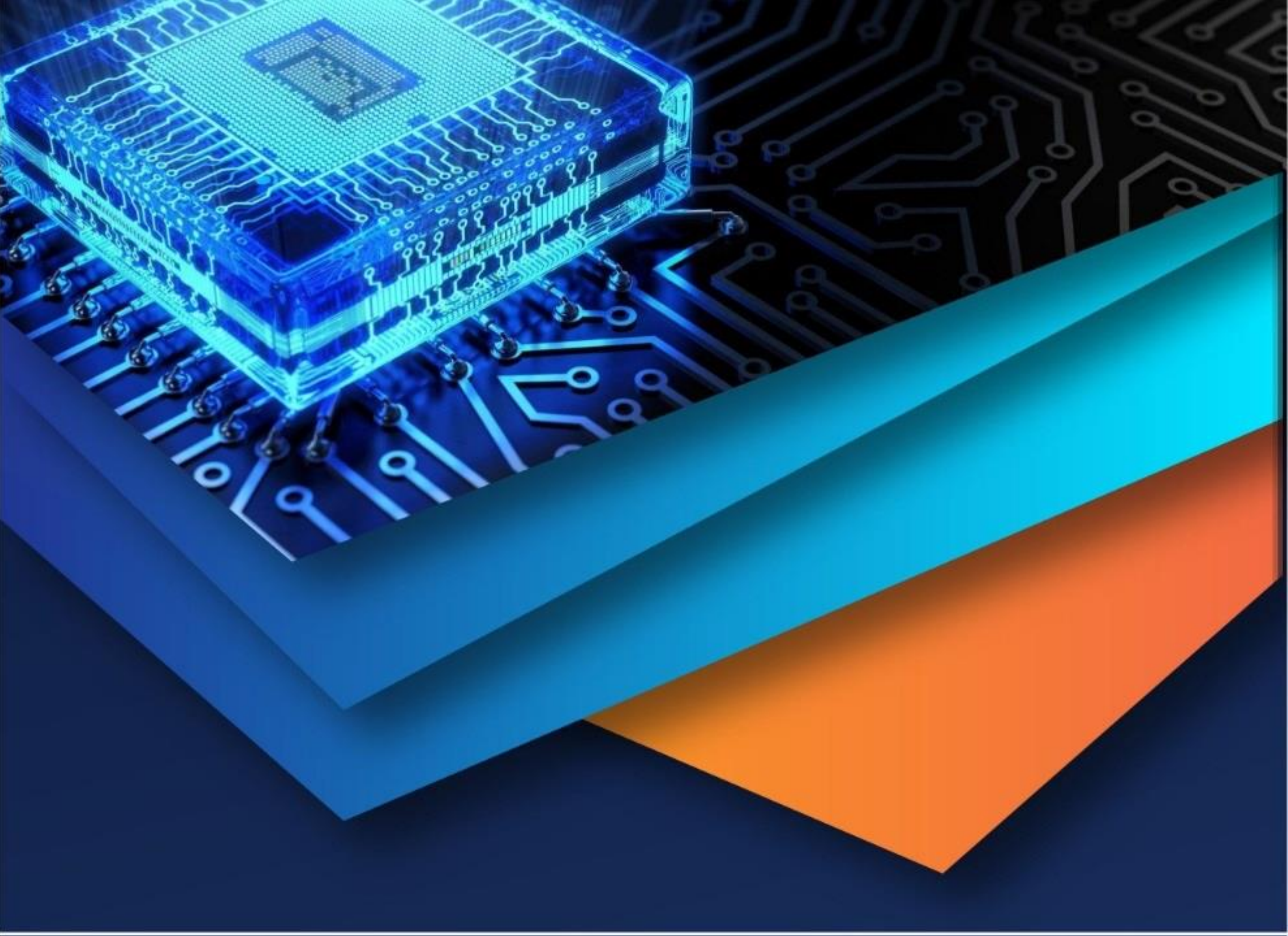
IV. CONCLUSION

Artificial Intelligence (AI) has emerged as one of the most transformative technologies of the 21st century, influencing nearly every sector including healthcare, education, finance, transportation, and research. Through continuous advancements in machine learning, deep learning, and natural language processing, AI is enabling smarter systems capable of performing complex tasks with high accuracy and efficiency. However, alongside its immense potential, AI also raises important ethical, social, and security challenges that demand responsible development and governance. AI represents both an opportunity and a responsibility. Its future success depends on transparent algorithms, unbiased data, ethical standards, and human–machine collaboration. By balancing innovation with accountability, AI can continue to evolve as a powerful tool for societal progress and sustainable development.

REFERENCES

[1] K. P. V. Sai Aakarsh1, Adwin Manhar2 Review of Artificial Intelligence International Journal of Scientific Research in Science, Engineering and Technology Volume 7 Issue 6 Page Number: 143-171
[2] AN Ramesh1, C Kambhampati2, JRT Monson1, PJ Drew1 Artificial intelligence in medicine Ann R Coll Surg Engl 2004; **86**: 334–338
[3] Jameela Ali Akrimi1, Abdul RahimAhmad2, Loay E. George3, Sherna Aziz4 Review of Artificial Intelligence International Journal of Science and Research (IJSR), India Online ISSN: 2319-7064 Volume 2 Issue 2, February 2013
[4] S. A. Oke A Literature Review on Artificial Intelligence International Journal of Information and Management Sciences Volume 19, Number 4, pp. 535-570, 2008
[5] FACS1 Artificial Intelligence in Surgery: Promises and Perils Ann Surg. 2018 July ; 268(1): 70–76.
[6] Siham Berhil1, Habib Benlahmar2, Nasser Labani3 A review paper on artificial intelligence at the service of human resources management Indonesian Journal of Electrical Engineering and Computer Science Vol. 18, No. 1, April 2020, pp. 32~40 ISSN: 2502-4752
[7] Xuesong Zhai ,1 Xiaoyan Chu ,1 Ching Sing Chai ,2 Morris Siu Yung Jong ,2 Andreja Istenic ,3,4,5 Michael Spector ,6 Jia-Bao Liu ,7 Jing Yuan,8 and Yan Li 1A Review of Artificial Intelligence (AI) in Education from 2010 to 2020
[8] LIJIA CHEN1, PINGPING CHEN 2,4, (Member, IEEE), AND ZHIJIAN LIN 3, (Member, IEEE) Artificial Intelligence in Education: A Review VOLUME 8, 2020

[9] Francisco Bolaños1 · Angelo Salatino1 · Francesco Osborne1,2 · Enrico Motta1 Artificial intelligence for literature reviews: opportunities and challenge Artificial Intelligence Review (2024) 57:259
[10] Mônica Villa Nova1†, Tzu Ping Lin2†, Saeed Shanehsazzadeh3, Kinjal Jain2,Samuel Cheng Yong Ng2, Richard Wacker 4, Karim Chichakly 5 and Matthias G. Wacker 2Nanomedicine Ex Machina: Between Model-Informed Development and Artificial Intelligence
[11] Catrin Hasselgren1and Tudor I. Oprea2,3 Annual Review of Pharmacology and Toxicology Artificial Intelligence for Drug Discovery: Are We There Yet?
[12] Sai Krishna Chaitanya Tulli1*Application of artificial intelligence in pharmaceutical and biotechnologies: A systematic Literature review INTERNATIONAL JOURNAL OF ACTA INFORMATICA VOLUME (2023)
[13] Negar Mottaghi-Dastjerdi1 , *, Mohammad Soltany-Rezaee-Rad 2 Advancements and Applications of Artificial Intelligence in Pharmaceutical Sciences: A Comprehensive Review
[14] Junhuang Jiang 1, Xiangyu Ma 2, Defang Ouyang 3 and Robert O. Williams III 1,* Emerging Artificial Intelligence (AI) Technologies Used in the Development of Solid Dosage Forms Pierluigi Granata, Artificial Intelligence: a look at its three types and their possible future implications, on 8 March 2023



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