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Artificial intelligence in pharmacy an overview

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Abstract

Intelligent technologies will someday replace or enhance human talent in many areas. Artificial intelligence is the intelligence exhibited by robots or software. It falls under the field of computer science. Computer scientists are becoming more and more interested in studying artificial intelligence because it has significantly enhanced human lives in a variety of ways. Over the past 20 years, artificial intelligence has led to a major boost in the performance of industrial and service systems. Expert systems are a rapidly developing technology that are the result of research into artificial intelligence. Artificial intelligence applications known as expert systems are widely used today to solve complex problems in a range of fields, including science, engineering, business, medicine, and weather forecasting.

Artificial intelligence technology have led to improvements in quality and efficiency in certain sectors. This page gives a summary of the technology and some possible uses for it. This paper will also look at the current applications of artificial intelligence technologies in the fields of computer games, accounting databases, hospital inpatient care, medical image classification, network intrusion, Power System Stabilization (PSS) design, and network security against hackers.

Keywords: Robotics; Artificial Intelligence (AI); AI components; Type; Application

1. Introduction

The ability of a computer or robotic system to process information and produce outcomes that are similar to how a human may think when learning, making decisions, and solving issues is known as Artificial Intelligence (AI). [1] Within the discipline of computer science, Aartificial Intelligence (AI) focuses on using symbolic programming to solve problems. It has evolved into a science of problem solving with wide-ranging applications in engineering, business, and medicine.[2] To meet the needs of doctors and society in the twenty-first century, the current medication development process needs to be drastically altered. To work more efficiently and greatly improve the success of early drug development, the pharmaceutical sector in particular has a genuine chance to alter the way it conducts research and development. Machine learning and artificial intelligence have created this opportunity. [3] The main objective of this artificial intelligence is to identify real-world information processing problems and offer a theoretical justification for solving them. In mathematics, a description of this kind, called a method, is related to a theorem. Algorithms are developed and utilized in artificial intelligence research to analyze, comprehend, and learn from data. Several statistics and machine learning disciplines Artificial intelligence encompasses learning, pattern recognition, grouping, and similarity-based approaches. [4] AI is a quickly evolving technology that has many applications in both daily life and business. Recently, the pharmaceutical industry has discovered creative and novel ways to use this powerful technology to help address some of the most urgent problems facing the sector right now. Artificial intelligence in the pharmaceutical sector refers to the application of automated algorithms to tasks that would typically need human

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intelligence. Over the past five years, the use of artificial intelligence in the biotech and pharmaceutical industries has completely changed how researchers develop new drugs, manage illnesses, and much more. [5]

1.1. Artificial Intelligence History

The first defense of artificial intelligence was offered by John McCarthy in 1956 at his first conference of scholars discussing the subject. The possibility of building computers with independent thought and learning was put out by mathematician Alan Turing, and scientists quickly turned their attention to this theory. [6] Between 2017 and 2022, the artificial intelligence market is predicted to produce up to ten times as much revenue. It is anticipated that in 2017, the natural language processing industry, which encompasses several applications like speech and voice recognition, text prediction, and more, will grow by 28.5%. Globally, big data and business analytics brought in US$ 122 billion in revenue in 2015, and by 2020, it is expected to have surpassed US$ 200 billion. [7] Artificial intelligence has had a tumultuous history since the 1950s. It was always thought to be a domain for dreamers, but after IBM's Deep Blue computer defeated chess champion Garry Kasparov in 1997, things began to alter. The brand-new IBM Watson supercomputer triumphed in winning the $1 million Jeopardy prize in 2011. Since then, Watson has expanded into the pharmaceutical and healthcare sectors. In order to accelerate the creation of novel immuno-oncology medications, Watson partnered with Pfizer in 2016. IBM Watson is a cloud-based platform that allows researchers to use dynamic visualisations to find links across different data sets. It was unveiled by IBM and Pfizer in December 2016. [8]

1.2. AI's goals [9]

Establishment of Expert Systems It involves creating intelligent, automated systems that can make suggestions to people about the best course of action. Human Intelligence in Computer Implementation [10]: As a result, computers will establish similar cognitive patterns that will allow them to behave like people and make wise decisions in the face of difficult situations. This will reduce the workload for humans by enabling automated activities through the use of algorithms.

Applications Across Domains: Artificial intelligence (AI) will be beneficial to a wide range of subjects, including computer science, cognitive science, statistics, psychology, engineering, ethics, the natural sciences, healthcare, space technology, logic, and linguistics.

Applications in Computer Science: AI is used to develop a wide range of mechanisms that address a wide range of difficult problems in the field of computer science. These mechanisms include Search and Optimization, Logic, Control Theory, Language Analysis, Neural Networks, Classifiers, Statistical Learning Methods, and Probabilistic Methods for Uncertain Reasoning.

1.3. Positive aspects [11]

Artificial intelligence can now be used by the pharmaceutical industry to address problems that could not be solved by simple data analysis.

- AI has the ability to perform specific tasks more accurately, which reduces expenses and increases output.
- AI offers valuable insights that have the potential to greatly improve clinical study outcomes.
- comprehensive knowledge of customer behavior, market dynamics, and their interactions
- It facilitates the selection of participants for clinical trials and helps companies to detect efficacy and safety issues with drugs considerably sooner.
- It stimulates the creation of new artificial intelligence algorithms and improves the functionality of antiviral detection systems.
- It is also beneficial for the industry's patient screening process for clinical trials.
- If AI were properly constructed, it would be less mistake-prone than humans. They would be extraordinarily fast, precise, and accurate.
- Future robotic surgery will surpass humans in precision in performing many sorts of surgery.
- AI can now understand and analyze vast volumes of biological data thanks to deep learning and natural language processing, which is revolutionizing the drug discovery process.

1.4. Negative aspects[11]

- AI lacks human touch in most cases because it is incapable of thinking for itself and can only obey commands.
- It works well to indoctrinate the following generation.

- Able to be adjusted to initially cause widespread destruction.
- Unemployment will occur if robots start to replace people in all occupations.
- May be costly to build, maintain, and rebuild.
- Machines may swiftly inflict destruction when used improperly. Many people fear that, at the very least.
- It has already been partially noticed that humans become mentally deficient in AI and rely on technology like cellphones.
- AI-powered robots have the capacity to surpass humans and subjugate the human race.

1.5. AI classification

AI can be categorized into two groups [12, 13].

A) According to calibre B) According to the presence (Refer to table 1)

Table 1 AI classification

According to calibre	Limited artificial intelligence general artificial intelligence superhuman artificial intelligence low intelligence
According to the presence	Superhuman artificial intelligence Diminished recall System Type 2 The theory of mind is the cornerstone of type 3. Type 4 self-awareness

• The following categories apply to AI systems according on their calibre:

Artificial narrow intelligence (ANI), also known as weak intelligence: this type of system is designed and educated to perform a specific task, such operating a vehicle, playing chess, signaling traffic, or recognizing faces. Social media tagging and Apple SIRI's virtual personal assistant are two examples.

Strong AI, often known as artificial general intelligence (AGI),: It also goes by the name Human-Level AI. It can make intellectual capacity in humans simpler. As a result, it is able to solve problems when presented with new tasks. AGI is capable of doing all that humans can.

• ASI (Artificial Super Intelligence): It is brainpower, which is more active than intelligent people in areas such as sketching, mathematics, space exploration, etc.; in disciplines ranging from science to art. The spectrum is from a computer being only slightly intelligent than a person to a trillion times smarter. Andern Hintze [14], an

AI scientists categorised the AI technology depending on whether it was already in use or not. These are what they are:

Type 1: This kind of AI system is called a reactive machine. Think about Deep Blue, the IBM chess program that beat Garry Kasparov in the 1990s. It is capable of identifying checkers and making predictions on a chessboard, but it lacks the memory to draw from prior encounters. It is ineffective in other situations and was designed with such applications in mind. Another example is Google's Alpha Go.

Type 2: This type of AI system is called a restricted memory system. This technology analyzes historical data to address present and future problems. Only in this way are some of the decision-making mechanisms in autonomous vehicles developed.The observations are used to record the observed behaviors, such as vehicle lane changes. The observations are not kept in the memory indefinitely.

Type 3: AI systems of this type are referred to as "theory of mind" systems. It suggests that everyone makes decisions based on thoughts, ideas, and desires. There is no such AI.

Type 4: They're known as self-awareness. The artificial intelligence systems are self-aware and sentient. When a machine possesses self-awareness, it is able to identify its surroundings and use the ideas that are stored in the minds of other individuals. There is no such AI.

1.6. Restrictions[15]

Prior to being streamlined, electronic records that are disorganized and jumbled across several databases must be cleaned up. Openness: People expect their medical care to be transparent because of the complexity of AI-based processes. Based on data governance, medical data is private and not legally available. It is imperative to secure popular endorsement. Pharma companies are notoriously traditional and change-averse.

1.7. AI-related technologies [16]

One use of natural language processing (NLP): Is to teach computers to analyze and interpret large amounts of natural language data.

Support vector machine (SVM): The technique creates an ideal hyperplane that categorizes new cases given a set of labelled training examples.

Heuristics: are mental shortcuts that make making decisions easier. Using a generalization, an estimate, an estimation, profiling, or common sense are a few examples.

Artificial neural networks (ANNs): Originally created in the 1940s, ANNs are a type of information processing model that draws inspiration from the way in which biological nerve systems, such as the brain, handle information. A synthetic neuron is a mathematical function. An Artificial Neural Network (ANN) employs data samples instead of compared to complete data sets, saving time and money. ANNs are composed of three linked layers (PYTHON). Neural networks acquire new information via a feedback process called back-propagation (backprop), which is akin to how the brain does it. ANNs are used in picture compression, stock market predictions, character recognition, and self-driving cars. Software known as Artificial Neural Networks (ANNs) mimics the pattern-recognition abilities of brain neural networks.The artificial neural network gathers information from multiple outside sources, processes it, and renders judgments. similar to a solitary neuron in the brain. Interestingly, ANN replicates the biological nervous system and adaptive biological neurons. ANN is a useful modeling technique, especially for data sets having non-linear correlations, which are commonly found in pharmaceutical processes.

1.8. Domain of Artificial Intelligence

1.8.1. Comprehending language

The ability to "understand," write down responses to spoken language, translate between two natural languages, and translate between one natural language and another.

- Dialogue Encoding
    - Computational linguistics: handling semantic information processing
    - Responding to questions
    - Retrieving data
    - Linguistic translation

1.8.2. Components of AI

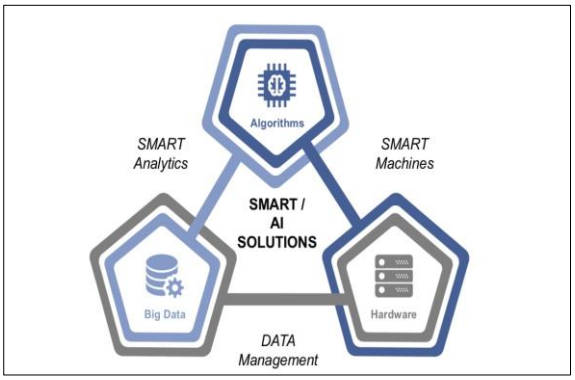

Figure 1 Components of AI

1.9. Adaptive and learning systems

The ability to change behavior based on past experiences and use those experiences to formulate universal principles for the cosmos.

- The study of cybernetics
    - Concept Generation
- Solving problems: The capacity to identify when and how to obtain more information, as well as to explain a problem in a way that will aid in finding a solution.
- The topics of inference include resolution-based theorem's proof, Both Inductive and Plausible Inference
    - attempting to solve problems
    - Creating Automated Programs
- Heuristic Examination
- A methodical list of relationships between the various scene components is produced by this study.
    - Recognition of Patterns
- Modeling is the process of developing an internal representation and a set of transformation rules to predict the behavior and interactions of a collection of real-world objects or entities.
    - The Issue of Representation for a Problem-Solving System
    - a simulation of biological, ecological, sociological, and economic systems, among others.
    - Hobot's Perceptual and Functional Representations of the World Robotics and artificial intelligence [17, 18]

Artificial intelligence and robotics have a similar history, as well as extensive collaboration and academic discussion. It may be argued, however, that not all machines are robots and that virtual agents are something artificial intelligence is clearly interested in. Hardware is made of robots, and artificial intelligence is a conjecture. The reason the two are connected is that the robot is controlled by a software agent that takes in information from these sensors, makes decisions about what to do next, and then orders actions to be executed in the real environment. Robotics makes extensive use of it.

As patients take a more active role in choosing their medical treatment, they will also consider possible medication options. By utilizing target audiences, pharmaceutical companies can further guarantee that the right information is provided at the right moment to enable knowledgeable conversations between providers and patents advertising. We have entered the interconnected pharma era. Nevertheless, progress is rarely easy and is usually "lumpy." AI technology has a wide range of applications that can improve technology at many different levels and result in considerably better, faster patient outcomes. It is well on its way to becoming extensively employed.

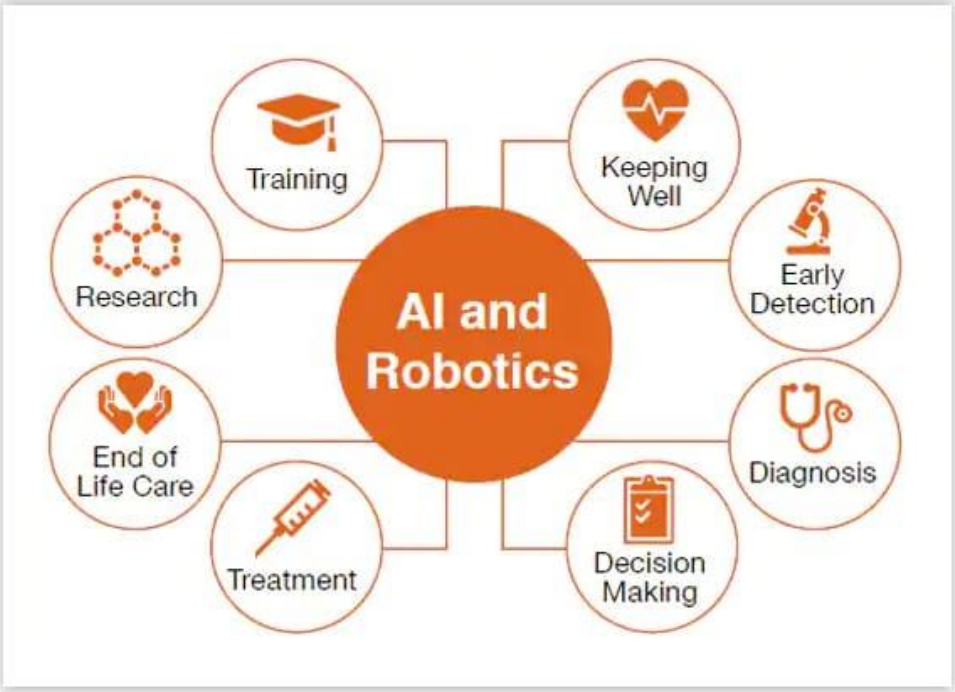

Figure 2 Flowchart for AI Robotics used

1.10. AI Tools

Robotic pharmacy: To improve patient safety, the UCSF Medical Center uses robotic technology for medication manufacturing and monitoring. They assert that 3,50,000 doses of medication have been precisely prepared by the machine. The robot has shown to be noticeably better. both in terms of size and ability to deliver certain medications to humans. One of the uses of robotic technology is the production of dangerous injectable and oral chemotherapy drugs. With greater freedom to concentrate on direct patient care and teamwork with the physicians, the UCSF pharmacists and nurses are able to utilize their expertise to the fullest. [19]

MEDi Robot: MEDi stands for medicine and engineering designing intelligence. AI-powered instruments The project manager for the development of the pain management robot was Tanya Beran, a professor of community health sciences at the University of Calgary in Alberta. After employment in medical facilities She thought of the places where kids weep during surgeries. By building a relationship with the children and then describing what to expect during a medical procedure, the robot can be made to appear to have artificial intelligence (AI) even if it is incapable of thinking, planning, or reasoning. [20].. [21]

Robot Erica: Developed in Japan, Erica is a new care robot designed by Hiroshi Ishiguro, an Osaka University researcher. It was developed in collaboration with the Japan Science and Technology Agency, Advanced Telecommunications Research Institute International, and Kyoto University. (ATR). Its characteristics blend those of Europe and Asia, and it speaks Japanese. [22]

TUG robots: Aethon TUG robots are designed to roam the hospital on their own and move heavy objects, such as trash and linen, along with supplies, food, medicine, and specimens. It comes in two varieties: an interchangeable base platform for carrying items, and fixed, secured carts. Carts, boxes, racks... [23]

Berg: The biotech company, Berg, headquartered in Boston, is one of the top users of AI in its many operations. Its vast patient database and AI-powered drug discovery platform are utilized to identify and confirm the numerous disease-causing biomarkers, from which it selects therapies determined by the collected data. [4]

1.11. Artificial intelligence's future scope [24, 25, 26]

- AI applied to scientific and research fields.
- The use of AI in cybersecurity.

- AI in data processing.
- AI in transportation, AI in residence, AI in health care, etc.
- AI in security

Another area where AI is helpful is cybersecurity. The increasing migration of business data to cloud and IT networks is making hackers a more serious danger.AI in higher education and business With AI, science has advanced significantly. Artificial intelligence has the capacity to handle large volumes of data and processes information faster than human brains. Because of this, it's perfect for research where the sources include a lot of data. Here, artificial intelligence has already achieved progress.

AI in security

Another area where AI is helpful is cybersecurity. The increasing migration of business data to cloud and IT networks is making hackers a more serious danger.

Using AI for data analysis Data analysis is significantly impacted by AI and ML. Artificial intelligence algorithms have the capacity to improve with each use, gaining more precision and accuracy in the process. working data analysts with massive datasets can take advantage of AI.

AI in transportation The application of AI in the transportation sector dates back many years. Aircraft have been navigating in the air using autopilot since 1912.An autopilot system manages an aircraft's course, however it is not limited to aviation technology. Additionally, ships and spaceships employ autopilot. to help them stay on their intended course

1.12. Ai's applications in medical

The following are some ways that medical artificial intelligence applications are used in the healthcare industry.

1.12.1. AI in Drug Development

AI technology in healthcare have allowed pharmaceutical companies to expedite their drug discovery process. However, it also automates the target identification procedure. Furthermore, by analyzing off-target compounds, AI in healthcare 2021 facilitates the repurposing of medications. [27] Consequently, in the AI and healthcare sectors, the process of developing AI drugs is sped up and repetitive work is reduced. [28] Several therapies have been created by leading biopharmaceutical companies. Pfizer is utilizing IBM Watson, a machine learning system, to help it discover immuno-oncology treatments. [29]

It has been used particularly for interpreting signals and images and for forecasting functional changes, such as seizures, bladder control, and strokes. [30] The third benefit of AI for public health and epidemiology medical care. AI can be used to detect infectious disease outbreaks, such as those caused by malaria, dengue fever, TB, and influenza. Artificial intelligence (AI) has been used to forecast the spread of the COVID-19 pandemic and the Zika virus.

AI applications in healthcare: AI is widely used in the healthcare sector for data collection, storage, normalization, and traceability. Deep genomics uses patterns found in enormous databases of genetic information and medical records to look for mutations and links to the disease. [31] A fresh cohort Using computational techniques is being created to demonstrate to medical professionals what happens inside a cell when genetic variation, whether it is from a medicinal or natural source, alters the DNA. Drug development clinical trials can frequently cost billions of dollars and run longer than ten years. [32, 33]

AI for tailored genomic therapy and diagnosis AI is employed in hospital-based health care systems in many different ways, such as selecting treatment regimens or acceptable or available administration techniques, as well as organizing dose forms for specific patients. [34, 35]

Medical accuracy: Artificial intelligence has a positive impact on genomics and genetic evolution. Progression in Genomics [36] Finding patterns in genetic data and medical records that indicate linkages and mutations that cause disease is a useful application of artificial intelligence (AI). This method offers physicians with knowledge about the processes by which genetic diversity alters DNA within a cell.

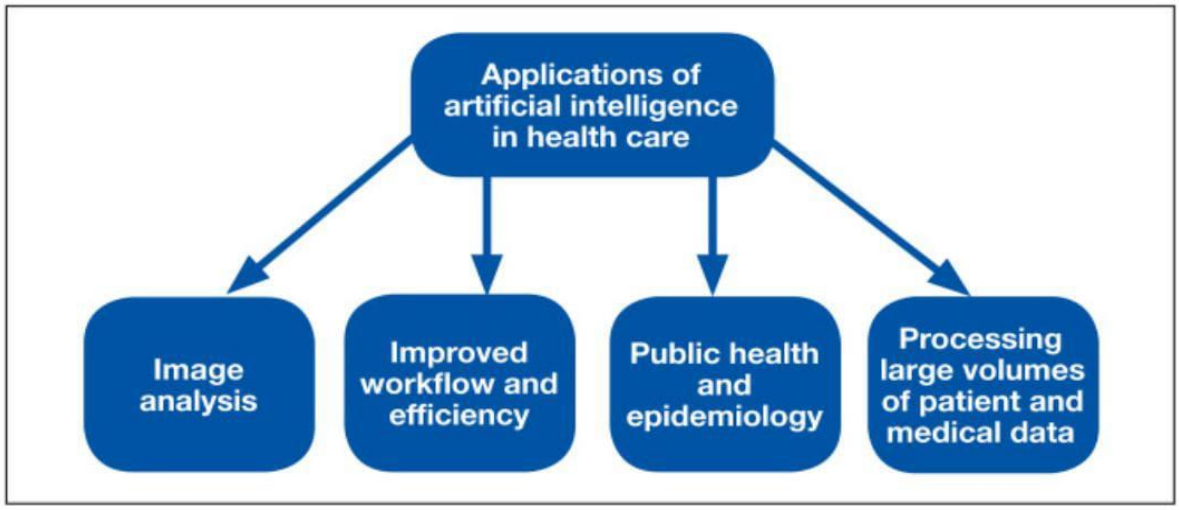

Figure 3 Artificial Intelligence Health Care Applications

2. Applications for medical specialties

2.1. Radiology

Currently, more than 70% of all FDA-approved AI medical devices are in the field of radiology. Most radiology departments have been employing AI-friendly digital imagery, like the picture, for many years. systems for communication and archiving that are used by numerous healthcare organizations, including VAMCs. The grayscale images commonly employed in radiology lend themselves to standardization, while AI is not limited to their usage in black and white image interpretation. There is a wealth of information available regarding the use of AI for basic radiograph analysis. When emergency medical personnel used a single FDA-approved platform, wrist fractures were better identified on X-rays. AI has improved the interpretation of chest X-rays (CXRs) for a number of diseases, including COVID19, TB, pneumonia, and malignant lung lesions. [37]

2.2. Cardiology

Cardiology has the second-highest number of AI applications approved by the FDA. Many recent reviews have found that image analysis is a prevalent component of cardiac AI platforms. AI has been utilized in echocardiography to determine ejection fractions and detect valve abnormalities, as well as to diagnose heart failure brought on by amyloidosis, hypertrophic and restrictive cardiomyopathy, and other conditions. Cardiovascular CT scans and CT angiography have been used to measure both calcified and noncalcified coronary artery plaques and lumens, score coronary artery calcium, and assess myocardial perfusion. Similarly, AI applications for cardiac MRI have been used to quantify cardiac scar load, major vascular flow measurement, and ejection fraction. [38, 39]

2.3. Pathology

The introduction of whole slide imaging, which enables full slides to be scanned and digitalized at high speed and quality, has opened up a world of possibilities for AI applications in pathology. A landmark study demonstrated the potential of artificial intelligence (AI) for assessing complete slide imaging by analyzing sentinel lymph node metastases in breast cancer patients. Several algorithms in the study demonstrated that AI was at least as good as pathologists in identifying metastases, particularly in situations when the pathologists had to work under strict time constraints. Notably, the most accurate and successful diagnoses were obtained when the pathologist's and the AI's interpretations were merged. AI has demonstrated potential in the detection of numerous ailments, such as skin, lung, breast,AI has demonstrated promise in diagnosing a variety of ailments, such as Gleason-scored skin, lung, breast, and prostate cancers. [40, 41, 42, 43]

2.4. Dermatology

Several studies demonstrate that AI can distinguish between different types of skin lesions at least as well as skilled dermatologists. 78–81 Esteva and colleagues, for example, demonstrated that AI could differentiate with accuracy

equivalent to board-certified dermatologists, malignant melanomas from benign nevi and keratinocyte carcinomas from benign seborrheic keratoses. Among the dermatological imaging methods that could profit from artificial intelligence include dermoscopy, reflectance confocal microscopy, and ultra highfrequency ultrasound. [48]

2.5. Cancer

AI is used in oncology to determine a patient's prognosis for cancer based on genetic and/or histology information. Programs can predict the likelihood of issues both before and after surgery for cancers. 14,68,86, 44, 87–89 AI can also predict treatment failure in radiation therapy and assist with treatment planning. AI has a great deal of promise in the analysis of the enormous patient data sets in cancer genomics. Next-generation sequencing has enabled the identification of millions of DNA sequences in a single tumour, which can be used to detect genetic abnormalities. [49, 50, 51]

2.6. The nervous system

Many neurologic illnesses present delicately, leading some to argue that artificial intelligence (AI) technologies are well suited for employment in the field of neurology. Introducing Viz LVO, the first artificial intelligence (AI) reimbursement for stroke diagnosis, scans CT scans for indications of an ischemic stroke and alerts medical personnel, expediting the treatment regimen. Other AI platforms are being used or are being studied for early diagnosis, treatment, and prognosis of stroke using CT and MRI. [52, 53]

Mental Well-Being Because mental health care is an interactive field, it has not kept up with the growth of AI applications. 18 Promising AI uses in this sector are likely to mostly rely on natural language processing (NLP) due to the heavy dependence on textual data (such as clinical notes, mood assessment scales, and interaction recording). [54]

Prescription and Customized Drugs Artificial intelligence (AI) can also be used to identify patients who may have sepsis, calculate liver iron levels, estimate hospital mortality at admission, and more. Choices about the status AI can advise on the best course of resuscitation or when to begin mechanical breathing in a patient near death. [55, 56,]

2.7. Prospective Courses AI:

Companies like Google and Uber are already utilizing self-driving car technology. The topic of automated transportation will be greatly impacted by AI since it will help drivers with disabilities and decreasing the number of accidents. More sophisticated AI systems have the potential to help in hazardous industrial jobs as well as replace human workers. AI systems that use data sciences and environmental technologies can foresee climate change.

The next frontier in the life sciences for pharma is AI.

Research and development: To control risk, pharmaceutical companies need to create portfolios. They have to make sure that R&D funds are distributed properly to facilitate decision-making in order to do this. [57,58]

By increasing the likelihood that a useful drug will be discovered yield a discernible rise in income

To benefit from an ecosystem that combines R&D and sales, marketing, and production.

Artificial Intelligence-Powered Bots: In the future, pharmaceutical companies will be able to create bots for doctors in a manner akin to that of app developers. [59]

- One such example; might be a bot that answers all queries from patients about a particular illness. There's going to be a new type of treatment that involves teaching individuals in this manner.
- Chatbots are designed with a specific therapy in mind, providing doctors and patients with all the necessary brand-specific information to prescribe or start treatment.

3. Discussion

Artificial intelligence (AI) has the potential to benefit the globe by discovering a pharmaceutical core for drug research and development in healthcare, including ANN, CFD, & automation. It may be possible to more precisely characterize patients and desired results by using artificial intelligence insights. Real-world facts were used to arrive at these results.

As a result, pharmaceutical companies that are creating a new generation of computational tools that can inform physicians of what will happen within a cell when genetic diversity modifies DNA. As technology advances, we ought to be able to go forward while being conscious of and comprehending the consequences. We are, in my opinion, living in the era of AI revelation, so we should embrace this shift, accept it, use AI, and work to create a better society.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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