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REVIEW ON: ARTIFICIAL INTELLIGENCE (AI) IN PHARMACY

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Abstract:

In many capacities, intelligent machines will eventually replace or improve human talents. The intelligence displayed by software or robots is known as artificial intelligence. It belongs to the domain of computer science. The study of artificial intelligence is growing in popularity among computer scientists since it has greatly improved human lives in many ways. The performance of the industrial and service systems has significantly increased over the last 20 years because to artificial intelligence. Artificial intelligence research has spawned the expert system, a fast-expanding technology. Expert systems, a type of application of artificial intelligence, are frequently employed nowadays to tackle complicated issues in a variety of industries, including science, engineering, commerce, medicine, and weather forecasting. The quality and efficiency have increased in the sectors using artificial intelligence technologies. An overview of the technology and its potential applications is provided in this article. In addition, this paper will examine how artificial intelligence technologies are currently used in computer games, accounting databases, medical image classification, hospital inpatient care, network intrusion, power system stabilisation (PSS) design, medical are a medicine, and to protect computer and communication networks from intruders.

Keywords: Artificial Intelligence (AI), Robotics, Components of AI, Application, Type

Introduction:

Artificial intelligence (AI) is the capacity of a computer or a robotics system that is computer-enabled to process information and create results that are comparable to how a human might think while learning, making decisions, and solving problems. [1] Artificial intelligence (AI) is a subfield of computer science that focuses on the use of symbolic programming to solve problems. It has significantly developed into a problem-solving science with broad applications in business, medicine, and engineering. [2] The existing drug development method has to radically change in order to suit the requirements of society and doctors in the twenty-first century. The pharmaceutical industry, in particular, has a real opportunity to change the way it conducts research and

development in order to work more effectively and significantly increase the success of early drug development. This opportunity is made possible by artificial intelligence and machine learning. [3]

This artificial intelligence's major goal is to recognise practical information processing issues and provide an abstract explanation of how to address them. A theorem in mathematics relates to such an account, which is referred to as a method. In the study of artificial intelligence, algorithms are created and used to analyse, learn from, and understand data. Numerous disciplines of statistical and machine learning, pattern recognition, clustering, and similarity-based techniques are all included in artificial intelligence. [4] AI is a rapidly developing technology with several uses in both business and daily life. The pharmaceutical industry has recently found new and inventive methods to leverage this potent technology to assist address some of the most pressing issues confronting pharma at the moment. In the pharmaceutical industry, artificial intelligence refers to the use of automated algorithms to tasks that normally require human intellect. The application of artificial intelligence in the pharmaceutical and biotech sectors has revolutionised how researchers create new medicines, treat diseases, and more during the last five years. [5]

History of Artificial Intelligence:

John McCarthy made the initial argument in favour of artificial intelligence in 1956 during his first academic meeting on the topic. The mathematician Alan Turing suggested the notion that it would be feasible to create computers that can think and learn on their own, and this theory soon became the focus of scientists' attention.[6] The market for artificial intelligence is expected to generate up to 10 times more revenue between 2017 and 2022. The market for natural language processing, which has several applications such as text prediction, speech and voice recognition, is expected to expand by 28.5% in 2017. Big data and business analytics generated US$ 122 billion in revenue globally in 2015, and it is anticipated that this amount would surpass US$ 200 billion by the year 2020. [7] Since the 1950s, artificial intelligence has had a turbulent history. For a while, it was considered a realm for dreamers, but in 1997, when IBM's Deep Blue computer beat chess champion Garry Kasparov, things started to change. In 2011, the brand-new IBM Watson supercomputer was successful in taking home the $1 million prize on Jeopardy. Since then, Watson has diversified into the healthcare and pharmaceutical industries, forming a relationship with Pfizer in 2016 to quicken the development of new immuno-oncology drugs. In December 2016, IBM and Pfizer unveiled IBM Watson, a cloud-based platform that provides researchers with the capacity to discover connections across various data sets using dynamic visualisations. [8]

Objectives of AI [9]

- **Creation of Expert :**Systems It entails the development of automated systems that behave intelligently and provide people recommendations on the best course of action**.**
- **Implementation of Human Intelligence in Computers [10]:** Similar cognitive patterns will be developed in computers as a result, enabling them to behave like people and make the right decisions when faced with challenging challenges. Through the use of algorithms, this will enable automated operations and lower the workload for humans.

- **Multi-Domain Application:** Computer science, cognitive science, statistics, psychology, engineering, ethics, the natural sciences, healthcare, space technology, logic, linguistics, and other fields will all benefit from AI.
- **Applications in Computer Science:** Numerous mechanisms, including Search and Optimization, Logic, Control Theory, Language Analysis, Neural Networks, Classifiers, Statistical Learning Methods, and Probabilistic Methods for Uncertain Reasoning, are developed with the aid of AI to address a wide range of challenging issues in the field of computer science.
- **Advantages** [11]
  - The pharmaceutical business now has access to artificial intelligence to handle issues that were previously beyond the scope of straightforward data analysis.
  - AI can do particular activities with greater accuracy, which lowers costs while boosting productivity.
  - AI provides useful insights that will significantly enhance the results of clinical studies.
  - In-depth understanding of market dynamics, consumer behaviour, and how they interact.
  - It helps the industry choose patients for clinical trials and enables businesses to identify any problems with compounds much earlier when it comes to efficacy and safety.
  - It enhances the performance of antivirus detection systems and encourages the development of new artificial intelligence algorithms.
  - It also helps in terms of the industry's selection of patients for clinical trials.
  - In comparison to humans, AI would make less mistakes if it were designed correctly. They would be incredibly quick, accurate, and precise.
  - Future robotic surgery will be able to do various types of surgery with more precision than humans.
  - Deep learning and natural language processing enable AI to comprehend and analyse enormous amounts of biological data, changing the drug discovery process.

Disadvantages [11]

- Since AI can't think for itself and can only follow instructions, it mostly lacks human touch.
- It is effective in corrupting the next generation.
- Can be adjusted to mass destruction first.
- If robots begin to replace humans in all occupations, unemployment will result.
- Can be expensive to construct, maintain, and reconstruct.
- When used improperly, machines may quickly cause devastation. At the very least, many people dread that.
- Humans are dependent on AI and lose their mental faculties, as has already been partially observed with cellphones and other technology.
- AI as robots has the potential to surpass humans and enslave humanity.

AI classification

AI may be divided into two categories [12, 13].

A) based on calibre B) based on the existence (See table 1)

Table 1: Classification of AI

according to the calibre	• Poor intellect • Artificial intelligence that is limited • General artificial intelligence • Superhuman artificial intelligence
according to presence	• Artificial intelligence that is superhuman • Limited memory Type 2 system • Type 3's foundation is the theory of mind. • Self-awareness of type 4

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

• Artificial narrow intelligence (ANI) or weak intelligence:

This system is created and trained to carry out a certain activity, such as traffic signalling, driving a car, playing chess, or facial recognition. Examples include social media tagging and Apple SIRI's virtual personal assistant.

• 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**: A reactive machine is the name given to this sort of AI system. Consider the IBM chess programme Deep Blue, which defeated Garry Kasparov in the 1990s. On a chessboard, it can recognise

the checkers and make predictions, but it lacks the memory to draw on previous experiences. It was made specifically for those uses and is useless in other circumstances. Google's Alpha Go is another illustration.

- **Type 2**: A limited memory system is the name given to this kind of AI system. This technology can analyse prior data to solve current and upcoming issues. Some of the decision-making processes in autonomous cars are only created using this way. The observed behaviours, such as lane changes for vehicles, are recorded using the observations. The observations are not permanently stored in the memory.
- **Type 3:** The term "theory of mind" is used to describe this kind of AI system. It implies that everyone has thoughts, ideas, and wants that influence their decision-making. This AI doesn't exist.
- **Type 4**:These are referred to as self-awareness. The AI systems are sentient and have a feeling of self. If the machine has self-awareness, it recognises its situation and makes use of the concepts stored in other people's minds. This AI does not exist.
- **Limitations** [15]

  Electronic records that are cluttered and disorganised across several databases need to be cleaned up first before being streamlined. Openness: Due to the intricacy of artificial intelligence-based procedures, consumers want transparency in the health care they get. Medical data is confidential and not legally accessible, according to data governance. It's crucial to obtain public approval. Pharma businesses are renowned for being conservative and resistant to change.

Technologies used in AI [16]

- **Natural language processing (NLP)**: instruct computers to process and examine a lot of data in natural language.
- **Support vector machine (SVM):** Given a set of labelled training examples, the method generates an ideal hyperplane that classifies fresh cases.
- **Heuristics:** mental evasions that lessen the strain of decision-making. For instance, utilising a generalisation, a well-informed estimate, an estimation, profiling, or common sense.
- **Artificial neural networks (ANN):** An information processing model that was first developed in the 1940s takes its cues from how organic nerve systems, like the brain, process information. A mathematical function is a synthetic neuron. In order to find answers, ANN uses data samples rather than whole data sets, which saves both time and money. Three linked layers make up ANNs (PYTHON). Similar to how the brain learns new information, neural networks also do so through a feedback mechanism known as back-propagation (backprop). Self-driving vehicles, character recognition, image compression, and stock market forecasting all make use of ANNs. Artificial neural network (ANN) software simulates the capabilities of brain neural networks for pattern recognition. The artificial neuron system gets data from several external sources, analyses it, and makes decisions just like a single neuron in the brain. It's interesting to note that ANN mimics adaptable biological neurons and the biological nervous system. Particularly for data sets with non-linear correlations, which are typically seen in pharmaceutical operations, ANN is a viable modelling tool.

- **Area Of Artificial Intelligence**

➢ **Language understanding**

the capacity to "understand," reply to spoken language in written form, translate from one natural language to another, and translate between two natural languages.

• Speech Recognition

• Processing Semantic Information (Computational Linguistics)

• Replying to inquiries

• Getting information back

• Translation of a language

Fig.2: Components of AI

➢ **Learning and adaptive systems**

the capacity to modify behaviour in light of prior experience and to create universal laws for the universe using such experience.

• Cybernetics

• Idea Formation

Problem solving: Ability to describe an issue in a way that will be useful for solving it, to recognise when and how to get additional information.

• Inference (Resolution-Based Theorem Proving, Plausible Inference and Inductive Inference) (Resolution-Based Theorem Proving, Plausible Inference and Inductive Inference)

• engaging in problem-solving

• Writing Automatic Programs

- Heuristic Analysis

This analysis produces a systematic set of connections between the different elements of the scene

.• Pattern Identification

Modelling: the capacity to create an internal representation and a set of transformation rules that may be used to forecast how a group of real-world objects or entities would behave and interact.

• The Representation Issue for a System of Problem Solving

• a simulation of natural systems (Economic, Sociological, Ecological, and Biological etc.)

• World Modeling by Hobot (Perceptual and Functional Representations)

Artificial intelligence and Robotics [17,18]

Robotics and artificial intelligence have a shared origin and a long history of interaction and scholarly debate. One may counter that not all machines are robots, and that artificial intelligence is definitely interested in virtual agents. Robots are produced as hardware and artificial intelligence is a hypothesis. The two are related because a software agent that receives data from these sensors, decides what to do next, and then directs the actions to be taken in the real world is what controls the robot. It is widely used in robotics.

Patients will also look at potential drug options as they become more involved in their healthcare decision. Pharmaceutical firms may further ensure that the appropriate information is delivered at the appropriate time to allow informed dialogues between providers and patents by using target audience marketing. The era of linked pharma is arrived. However, advancement is not always smooth and is most likely to be "lumpy." AI technology is well on its way to becoming widely used and has a vast range of applications that can enhance technology at many different levels and produce far better, quicker patient results.

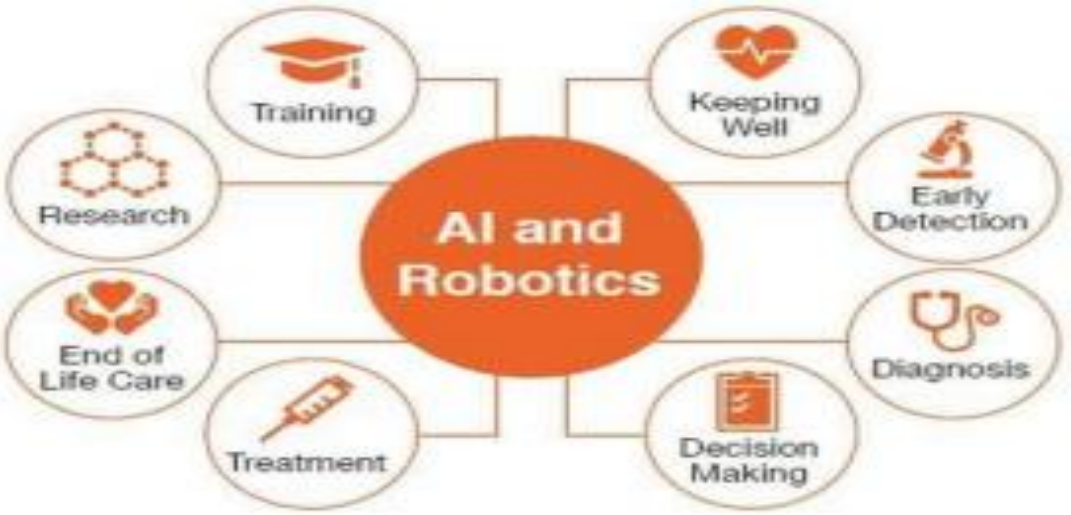

Fig.3: Flowchart for AI Robotics used

TOOLS OF AI

- **Robot pharmacy**:

The UCSF Medical Center employs robotic technology for the manufacture and monitoring of pharmaceuticals with the aim of enhancing patient safety. They claim that the system has accurately prepared 3,50,000 doses of medicine. The robot has shown to be significantly superior to humans in terms of size and its capacity to administer precise drugs. The manufacture of hazardous chemotherapy medications for oral and injectable use is one of the capabilities of robotic technology. The UCSF pharmacists and nurses now have more freedom to focus on providing direct patient care and collaborating with the doctors, allowing them to make the most of their knowledge. [19]

- **MEDi Robot**:

Medicine and engineering designing intelligence is abbreviated as MEDi. AI-based tools The community health sciences professor at the University of Calgary in Alberta, Tanya Beran, served as the project leader for the creation of the pain management robot. After working in hospitals where children cry during medical procedures, she had the notion. Though the robot cannot think, plan, or reason, it may be made to appear to have AI by first establishing a connection with the kids and then explaining what to expect during a medical treatment [20]..[21]

- **Erica robot:**

A researcher at Osaka University named Hiroshi Ishiguro created the new care robot Erica in Japan. It was created in cooperation with Kyoto University, the Advanced Telecommunications Research Institute International, and the Japan Science and Technology Agency (ATR). It speaks Japanese and has facial features that combine those of Europe and Asia..[22]

- **TUG robots:**

Robots called Aethon TUG are made to autonomously move around the hospital and transport large items like trash and linen as well as prescriptions, meals, specimens, and resources. It features two variants, including fixed and secured carts and an interchange base platform for carrying racks, bins, and carts..[23]

- **Berg:**

One of the leading companies using AI in its numerous operations is Berg, a biotech company with headquarters in Boston. It has an AI-based drug discovery platform with a sizable patient database that is used to locate and validate the many disease-causing biomarkers, and it then chooses treatments based on the data acquired..[4]

FUTURE SCOPE OF ARTIFICIAL INTELLIGENCE [24,25,26]

- AI used in science and research.
- AI in cyber security.
- AI in data analysis.
- AI in health care etc.

- AI in transport, AI in home.
- AI in academia and industry Science has made significant progress with AI. Large amounts of data can be handled by artificial intelligence, which can process information more quickly than human brains. This makes it ideal for studies where the sources have large amounts of data. In this area, AI has already made strides.

AI in cyber security

Cybersecurity is another area where AI is useful. The threat of hackers is getting worse as businesses move their data to IT networks and the cloud.

AI in data analysis

AI and ML have a significant impact on data analysis. AI algorithms are capable of getting better with each repetition, increasing their accuracy and precision in the process. Data analysts that work with enormous datasets can benefit from AI.

AI in transport

For decades, AI has been used in the transportation industry. Since 1912, autopilot has been used by aircraft to navigate them while in the air. A plane's trajectory is controlled by an autopilot system, however this technology is not exclusive to aeroplanes. Autopilot is also used by ships and spacecraft to assist in maintaining their intended path.

APPLICATIONS OF AI IN HEALTHCARE

The healthcare business uses medical artificial intelligence applications in the ways listed below.

- **AI for Drug Discovery**:

Pharmaceutical businesses have been able to accelerate their drug discovery process with the use of AI technologies in healthcare. On the other hand, it automates the process of identifying targets. In addition, AI in healthcare 2021 supports medication repurposing by analysing off-target chemicals..[27] As a consequence, AI drug development accelerates the procedure and minimises repetitive work in the AI and healthcare industries..[28] There are several treatments that top biopharmaceutical firms have developed. Pfizer is using IBM Watson, a system based on machine learning, to assist it in finding immuno-oncology therapies..[29] It has been utilised specifically for signal and image processing, as well as for making predictions about changes in function, including bladder control, epileptic seizures, and strokes. [30]

Public health and epidemiology are a third advantage of AI for healthcare. AI can help identify infectious epidemics of diseases including influenza, dengue fever, TB, and malaria. Zika virus and the current COVID-19 pandemic transmission patterns have both been predicted using artificial intelligence (AI).

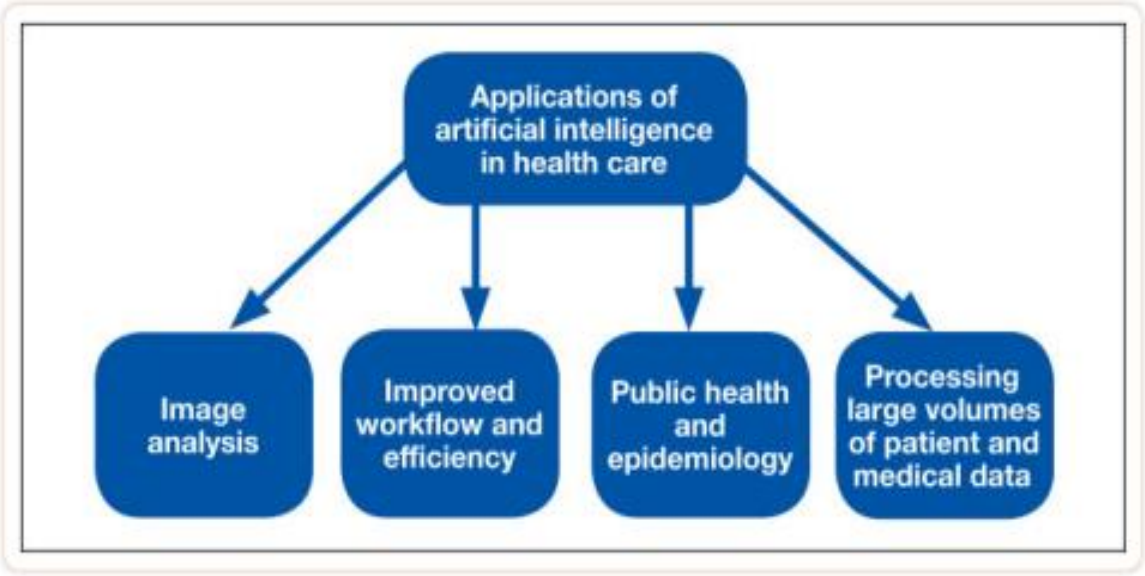

Fig 4: Artificial Intelligence Health Care Applications

- **AI in clinical practice:**

Data collection, storage, normalisation, and tracing are significant uses of AI in the healthcare industry. Deep genomics searches for mutations and connections to the disease by identifying patterns in massive databases of genetic data and medical records. [31] A new generation of computational methods is being developed to show doctors what will happen within a cell when genetic variation, whether natural or therapeutic, modifies the DNA.

Clinical trials for the development of drugs can often last more than ten years and cost billions of dollars. [32,33]

- **AI in diagnosis and targeted genomic treatments**

AI is used in hospital-based health care systems in a variety of ways, including arranging dose forms for particular patients and choosing appropriate or available administration methods or treatment plans. [34,35]

- **Accuracy of medicine:**

The influence of AI on genetic evolution and genomics is positive. Advanced Genomics [36] An AI system is effective for identifying patterns in genomic data and medical records that point to disease-causing mutations and connections. This technique provides clinicians with information on what happens within a cell when genetic variation modifies DNA.

Medical specialty applications:

- **Radiology**

Radiology now accounts for > 70% of all FDA-approved AI medical devices. Since many years ago, the majority of radiology departments have been using AI-friendly digital imaging, such as the photo archiving and communication systems utilised by many healthcare organisations, including VAMCs. Although AI is not just used for interpreting black-and-white pictures, the grayscale images that are frequently used in radiology lend

themselves to standardisation. There is a plenty of material that discusses utilising AI to analyse simple radiographs. When emergency care professionals employed one FDA-approved platform, the X-ray diagnosis of wrist fractures was improved. Chest X-ray (CXR) interpretation of several illnesses, such as pneumonia, TB, malignant lung lesions, and COVID19, has benefited by the use of AI.[37]

- **Cardiology**

The second-highest number of AI applications with FDA approval are in cardiology. Image analysis is a common feature of cardiac AI platforms, according to numerous recent evaluations. AI has been used in echocardiography to diagnose heart failure caused by amyloidosis, hypertrophic and restrictive cardiomyopathy, and valve disease, as well as to estimate ejection fractions and identify valvular disease. Applications for cardiac CT scans and CT angiography have effectively evaluated myocardial perfusion, scored coronary artery calcium, and measured both calcified and noncalcified coronary artery plaques and lumens. Similarly, cardiac scar load, major vessel flow measurement, and ejection fraction have all been quantified using AI applications for cardiac MRI. [38,39]

- **Pathology**

AI applications in pathology have a lot of potential because to the development of whole slide imaging, which allows complete slides to be scanned and digitalized at high speed and quality. Sentinel lymph node metastases in breast cancer patients were evaluated in a seminal work proving the potential of AI for evaluating full slide imaging. In the study, a number of algorithms showed that AI was just as good as pathologists in spotting metastases, if not better, especially when the pathologists had to operate under regular time constraints. Notably, when the pathologist and AI interpretations were combined, the most precise and effective diagnoses were made. AI has showed promise in the diagnosis of a wide range of different conditions, including skin, lung, breast, and prostate cancers (with Gleason scores). [40,.41,42,43]

- **Ophthalmology**

Due to the advent of whole slide imaging, which enables full slides to be scanned and digitalized at high speed and quality, AI applications in pathology have a lot of potential. A groundbreaking study that demonstrated the potential of AI for analysing complete slide imaging examined sentinel lymph node metastases in breast cancer patients. At the study, a variety of algorithms demonstrated that AI was equally as proficient in identifying metastases as pathologists, if not more so, particularly when the pathologists had to work under consistent time limits. Notably, the most accurate and successful diagnoses were achieved when the pathologist and AI interpretations were combined. AI has demonstrated potential in the identification of a variety of ailments, including skin, lung, breast, and prostate disorders. [44,45,46,47]

- **Dermatology**

Numerous studies show that AI is at least as effective as seasoned dermatologists in differentiating specific skin lesions. 78–81 For instance, Esteva and colleagues showed AI could distinguish malignant melanomas from benign nevi and keratinocyte carcinomas from benign seborrheic keratoses with accuracy comparable to board-certified dermatologists. Dermoscopy, extremely high-frequency ultrasound, and reflectance confocal

microscopy are just a few of the dermatological imaging techniques that might benefit from artificial intelligence..[48]

- **Oncology**

Oncology uses of AI include determining a patient's prognosis for cancer based on histological and/or genetic data. Programs can forecast the probability of problems prior to and after surgery for malignancies. 14,68,86 44,87–89 AI can also help with treatment planning and foretell radiation therapy treatment failure. The analysis of the vast amounts of patient data in cancer genomics holds a significant deal of potential for AI. To find genetic aberrations, next-generation sequencing has made it possible to identify millions of DNA sequences in a single tumour. [49,50,51]

- **Neurology**

Due to the delicate presentation of many neurologic disorders, it has been claimed that AI technologies are ideally suited for use in neurology. Viz LVO, the first CMS-approved artificial intelligence (AI) reimbursement for the diagnosis of strokes, examines CTs to find signs of an impending ischemic stroke and notifies the medical staff, speeding up the course of treatment. There are other additional AI platforms in use or in research that employ CT and MRI for stroke early diagnosis, treatment, and prognosis. [52,53]

- **Mental Health**

The field of mental health care has lagged behind in the development of AI applications because of its interactive character. 18 Successful AI applications in this industry will probably largely rely on NLP because to the high reliance on textual data (e.g., clinical notes, mood assessment scales, and documentation of interactions)..[54]

- **General and Personalized**

Medicine Other uses for AI include identifying patients with suspected sepsis, calculating iron levels in the liver, estimating hospital mortality at the time of admission, and more. Decisions on the status of resuscitation or whether to start mechanical breathing at the end of life can be guided by AI. [55,56,]

Future Directions AI:

Self-driving car technology is already being used by businesses like Google and Uber. AI will significantly impact the field of automated transportation by assisting drivers with disabilities and reducing accidents. More advanced AI systems may replace people as well as assist in dangerous industry occupations. AI systems can forecast climate change utilising environmental technology and data sciences.

AI is Pharma's next frontier in life sciences.

- Research and development - Pharmaceutical businesses must build portfolios in order to manage risk. To achieve this, they must make sure that R and D dollars are allocated appropriately to support decision-making. [57,58]

A. By raising the probability of effective medication discovery.

B. provide a noticeable increase in revenue.

C. . To get advantages from a production, sales, and marketing ecosystem that integrates R and D.

- Bots Powered by Artificial Intelligence – Pharmaceutical firms will be able to develop bots for doctors in the future, similar to how they make apps.[59]

For example

- A bot that responds to all patient questions concerning a certain ailment for that disease. A special form of treatment is about to go into effect that involves educating patients in this way.
- Chatbots are created specifically for a therapy, giving patients and physicians access to all the pertinent information about the brand they need to prescribe or begin treatment.

Conclusion

Due to the complex current problems and promising future, AI would aid the world by identifying a pharmaceutical core for medication research & development to healthcare such ANN, CFD, & Robotics. Artificial intelligence insights may be utilised to more precisely define patients and expected outcomes. These conclusions were drawn using facts from the actual world. Because of this, artificial intelligence has opened up enticing opportunities for pharmaceutical firms that are developing a new generation of computational tools that can tell doctors what will happen within a cell when DNA is altered by genetic variation. We should be able to go forward while being aware of and understanding the repercussions of every technological advancement. We should welcome this change and accept it by using AI and striving toward a better society since, in my opinion, we are living in the era of AI revelation.

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