International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Application of Artificial Intelligence in Pharmaceutical Industry

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ABSTRACT:

Artificial intelligence is an area of computer that solves the problems through symbolic programming. Artificial intelligence is a branch of science that dealing with process of intelligence involved in problem solving. Human cognitive science reading, observation, planning, interpretation, reasoning, correction, speech recognition, linguistics and other sources are some examples of these mechanisms. Artificial intelligence (AI) make activities easier by computer to learn prior experience mapping efforts and actions to results , detecting and fixing errors adapting to new and random input values and easily carrying out tasks that need human like performance through in depth scenario analysis. By evaluating, filtering, sorting, forecasting, scoping and identifying massive data volumes to adhere to the best implementation practices for generating an ideal solution. 2019 saw the following as the main uses of artificial intelligence in the pharmaceutical industry : The discovery and development of the novel medications ;artificial intelligence is assisting big pharma in developing treatments for the difficult and uncommon illness like Parkinson's disease and the Alzheimer's disease drug adherence and dosage . Applying AI to improve analysis and make some sense of clinical data locating speedier and more trustworthy participants for research trials. Pharma is going to be in the future thanks to AI. Yet the technology is here already. Reduced expenses, novel efficient therapies and most important life preparation are all possible with AI. Therefore the sector stands to gain greatly from adopting AI and machine learning related technologies. Artificial intelligence enables doctors to work with robots to do specific tasks under the supervision of humans.

Keywords: Artificial intelligence, linguistics, leverage.

Introduction

Artificial intelligence is subfield of computer science that uses symbolic programming to assist humans in solving problems. Whether you know it or not, AI has become a major addiction for all of us in the 20th century. Consider social media platforms like telegram, Facebook, what's app, search engines like yahoo and google [1].

What is AI?

Artificial intelligence is one of the recent areas of the science and engineering. After the world war-II, work really got underway and the name was first used in 1956. AI is frequently mentioned as the "field I would most like to be in by the scientists from various fields, along with molecular biology. Physics students may justifiably believe that Galileo, Newton ,Einstein ,and others have already claimed all the best concepts .Conversely ,there are still positions available in AI for a few full time Einstein's and Edison's .Some definitions of artificial intelligence are categorized into following :

- Acting humanly
- Thinking humanly
- Thinking rationally
- Acting rationally

Acting humanly:

Alan Turing developed the Turing test in 1950 in an attempt to give an operational definition of intelligence that would be satisfactory. If, after asking some written questions, a human interrogator is unable to determine whether the written responses are from a person or a machine, the computer passes the test. For present we observe that there is a lot of work to be done in order to programme a computer to pass a rigorously performed test the following essentials should be the:

- Natural language processing
- Knowledge representation

- Automated representation
- Machine learning

Thinking humanly:

When we say that the given program works similar to the humans then we need to first understand that how the humans think?

- Psychological experiments
- Brain imaging
- Introspection

There are some similarities found in the functions of the human brain and the machines. The scientists Allen Newel and Herbert Simon, developed GPS, the "The general problem solver" were not content merely to have their program solve correctly. But their concern was to compare the trace if its reasoning steps to traces of humans subjects solving their problems. Early on the field of artificial intelligence, There was a lot of misunderstanding about the various methods .For example, an author would claim that because algorithm

Performed well on the test, it was a good representation of the human performance, or vice versa. The difference made by contemporary writers between the two categories of assertions has accelerated that advancement of the cognitive science and artificial intelligence. The two disciplines are still influencing one another; this is especially true in the field of the computer vision, where computation models are informed.

Thinking rationally:

It can be explained in the terms of "laws of thought" approach. There are two primary barriers to the strategy. First of all, it might be challenging to translate informal language required by logical notation, especially when the knowledge is not quite certain. Second, there is a significant distribution between problem-solving in principle and problem solving in practice. Any computers computational capacity can be depleted by issues involving merely a few hundred's facts, unless it is provided with instructions regarding which stages in reasoning to attempt first. While these challenges relevant to all efforts to develop computational reasoning systems, the logicist tradition is where they initially surfaced.

Acting rationally:

A rational agent is a agent that acts to achieve the best outcome or when there is uncertainty, the best expected outcome .The tests used in the Turing test help an agent to act rationally and to lead to good decisions generally. In a complicated society, we must be able to produce coherent statements in natural language. Learning is important for erudition, but it is also important for improving our capacity for productive action. Compared to the other approaches, the rational-agent approach has two advantages. First, since right inference is only one of many potential pathways to rationally, it is more inclusive than the 'laws of thought approach' [1].neurophysiological data.

History of AI:

For academics, artificial intelligence is neither a new term nor a novel. It is surprising how old this technology is. Greek and Egyptian mythology even has stories about mechanical men. The following key moments in the history of artificial intelligence (AI) outline the progression from the AI generation to the present.

Artificial intelligence maturation (1943-1952):

Warren McCulloch and Walter Pits completed first research that is artificial intelligence.

Year 1949: They put forth an artificial neuron model. In 1949, Donald Hebb presented an updating rule that might be used to change the strength of connections between neurons. We now refer to his rule as Hebbian learning.

Year 1950: English mathematician Alan Turing was the first to develop machine learning .in his book "Computing Machinery and Intelligence,"Alan Turing presented a test. The test can determine whether the computer is capable of displaying intelligent behavior comparable to that of a human, known as "Turing test."

Artificial intelligence inception (1952-1956):

1)Year 1955: in 1955 Herbert A. Simon and Allen Newell developed "Logic Theorist ", the first artificial intelligence programme . Of the fifty two mathematics theorems , this software had proven 38 of them . It also discovered new, more elegant proofs for a few theorems .

Year 1956: In 1956 American computer scientist John McCarthy coined the term "artificial intelligence"at the Dartmouth Conference. Additionally, there was a lot of excitement at that time about AI .

The heyday : The initial fervor (1956 -1974) : The focus of the researchers was on creating algorithms that could resolve mathematical puzzles. The first Chabot was developed in 1966 by Joseph Weizenbaum and was called ELIZA.

Year 1972: In the year 1972 saw the creation of WABOT -1 the first intelligent humanoid robot, in Japan.

The first AI winter (1974-1980):

The first intelligence winter occurred from 1974-1980. The term "AI winter" describes a period of the time when computer scientists struggled with a serve lack of government funding fir AI research . Public interest in artificial intelligence declined throughout the AI winter .

A Boom of AI (1980-1987) :

Year 1980: AI returned with the "Expert System "following a period of hibernation . Expert systems have been designed to mimic human experts. decision -making processes . The American Association of Artificial Intelligence hosted its inaugural national conference at Stanford University in 1980.

The second AI winter : The second AI winter occurred from 1987- 1993.once more ,the government and the investors ceased sponsoring AI research because of the high expense but ineffective results . Expert systems like XCON were incredibly economical .

The advent of intelligent agent between 1993-2011:

Year 1997: IBM Deep Blue became the first computer to defeat a world chess champion when it defeated Gary Kasparov in 1997 .Roomba , a vaccum cleaner ,marked the introduction of AI into homes for the first time .

Year 2006 : AI was introduced to the business sector up until that year . Businesses like Netflix , Facebook and Twitter also began utilizing AI.

From 2011 until the present , deep learning ,big data and artificial general intelligence :Year 2011:IBM Watson prevailed in the 2011 Jeopardy competition ,which required it to solve both challenging and riddle-based questions . Watson had demonstrated its ability to comprehend natural language and quickly find answers to challenging problem

Year2012: Google introduced the "Google now" function for android apps which allowed users to receive information in the form of predictions.

Year 2014: The famed "Turing test"saw Chabot "Eugene Goostman "emerge victorious in a competition .

Year 2018 : The IBM " Project Debater" excelled in debating intricate subjects alongside two experienced debaters .When Googles AI program "Duplex "was demonstrated ,it functioned as a virtual assistant and scheduled a call -in hair appointment ;The women on the end was unaware that she was speaking with the machine .These days, AI has advanced to an astounding degree . These days, big data, data science and deep learning are all quite popular. These days businesses like Amazon, IBM , Facebook are utilizing AI to develop incredible products . Artificial intelligence has a bright future ahead of it and will be highly intelligent[2].

Historical development of AI in the pharmacy field 1950-1970:

The ancient use of AI in the pharmacy field was limited up to only the development of medicines .In 1961 General motors first industrial robot arm ,named Unimate (Unimation ,Danbury , Conn.,USA) , joined the assembly line and began to performing automated die casting .(3).Unimate could carry out instructions step-by -step Joseph Weinzenbaum presented Eliza a few years later in 1964 . Eliza was able to simulate human conversation (superficial communication) through the use of natural language processing and the pattern matching and substitution techniques This work provides the foundation for the future Chabot's.(4) Shakey,dubbed "the first electronic person",was created in1966 Developed at the Stanford Research institute ,this was the first mobile robot with speech recognition capabilities (5).Shaky was able to comprehend and execute more complicated instructions than only obeying one -step instructions .(5). This was the significant advancement in Ai and in robotics . Despite these engineering development Ai use in medicine was sluggish .On the other hand ,this initial phase was crucial for digitizing data , which later became the basis for AIM s expansion and use . The National Library of Medicine developed the Medicinal Literature Analysis and retrieval system and the web -based search engine PubMed in the 1960 , and these resources became crucial digital resources for the subsequent advancement of the biomedicine (6).

1970-2000 :

The majority of this frame is known as the AI winter denoting a period of decreased interest and investment and result , less advancements .(7) Many recognize two significant winters : The first occurred in the late 1970s due to perceived Ai limits ,and the second occurred in the late 1980s and continued into the early 1990s because to the exorbitant expense of creating and sustaining experimental digital information databases . Even with the widespread lack of interest at the time , pioneers in AI continued to collaborate with one another encouraged Saul Amarel of Rutgers University to create. The research resource on computers in biomedicine in 1971. Developed in 1973 , the time -shared computer system known as Stanford University Medical Experimental -Artificial intelligence in medicine improved networking between improved networking between clinical and biomedical researchers from other universities (3). The first AIM workshop ,sponsored by the National Institutes of Health, was conducted at Rutgers University in 1975 ,largely due to these relationships . (6). These are the first occasions that AIM pioneers have worked together .one of the initial prototypes .showcasing the viability of utilizing Ai in medicine was the creation of a glaucoma consultation programme on the CASNET architecture . Thirteen three distinct programs make up the CASNET model :construction, consultation , and a database that the collaborators created and kept up to date .This ,methodology has the potential to tailor disease -specific information to individual patients management guidance .(4) the invention was created at Rutgers University ,and in 1976,it was formally presented at the Academy of Ophthalamalogy convection in Las Vegas, Nevada .MYCIN an AI system that used backward chaining was developed in the early 1970s(5)Using patient data entered by doctors and a database of over 600 rules MYCIN might identify possible bacterial illness and then suggest antibiotic treatment alternatives that are suitable for the patient bodyweight . MYCIN served as the foundation for the subsequent rule-based system ,EMYCIN .(6). Later to help primary care physicians with diagnosis , INTEREST -1 was developed utilizing a broader medical knowledge base and the same foundation as EMYCIN .(6). A decision assistance system called DXplain was produced by the University of Massachusetts in 1986 . This software creates a differential diagnosis based on the symptoms that are entered . (3). It also functions as an electronic medical textbook offering through explanations of ailments along with supplementary sources. DXplain could provide information on about 500 ailments when it was originally introduced . It now encompasses more than 2400 disorders .(11) . Together with the aforementioned technical advancements ,a resurgence of interest in machine learning by the late 1990s ,especially in the medical field ,helped pave the way for the current AIM era.

From 2000-2020 :groundbreaking developments in AI:

An open -domain question -answering system called Watson was developed by IBM in 2007 ;It competed against human contestants and took first place on the game show in 2011.Unlike conventional systems that employed it-then rules ,backward reasoning from conclusions to data or forward reasoning from conclusions from data to conclusions ,this technology called DeepQA ,analyzed data over unstructured content using natural language processing and various searches to produce likely answers . (12) This method was more affordable ,easier to maintain ,more widely available for use. Utilizing data from an individuals electronic medical record and the additional digital resources , DeepQA technology can be utilized it deliver evidence -based medicine interventions. Consequently ,it created new avenues for clinical decision -making based on data (12,13) Bakker et .al (14)Effectively identified novel RNA-binding proteins that were changed in amyotrophic lateral sclerosis in 2017 with IBM Watson . With this impetus and the advancement of computer technology and software ,digitalized medicine became more accessible, and AIM began to expand quickly ,natural language processing allowed Chabot's to evolve from meaningless dialogue -based interfaces (like Elizabeth) to meaningful conversational interactions .The virtual assistant Alexa from Amazon and Siri from apple were created using this technology in 2014 . Mandy was built in 2017 as a automated patient intake procedure for a primary care clinic , while pharma-bot was developed in 2015 to help pediatric patients and their parents learn about medications , (15, 16). DL represented a significant development in AIM .DL can be trained to classify data on its own , unlike ML ,which requires human input and employs a fixed amount of attributes despite being invested for first time in the 1950s overfitting was a barrier to DLs use in the medicine learning is overly concentrated on a single dataset and is unable to interpret new datasets. . (5)Using patient data entered by doctors and a database of over 600 rules MYCIN might identify possible bacterial illness and then suggest antibiotic treatment alternatives that are suitable for the patient bodyweight .MYCIN served as the foundation for the subsequent rule-based system ,EMYCIN .(6). Later to help primary care physicians with diagnosis , INTEREST -1 was developed utilizing a broader medical knowledge base and the same foundation as EMYCIN .(6). A decision assistance system called DXplain was produced by the University of Massachusetts in 1986. This software creates a differential diagnosis based on the symptoms that are entered . (3). It also functions as an electronic medical textbook offering through explanations of ailments along with supplementary sources. DXplain could provide information on about 500 ailments when it was originally introduced . It now encompasses more than 2400 disorders .(11) . Together with the aforementioned technical advancements ,a resurgence of interest in machine learning by the late 1990s ,especially in the medical field ,helped pave the way for the current AIM era.

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The foundations of Artificial intelligence :

Basically the foundation of the AI includes variety of the pillars they are as follows :

- Philosophy
- Mathematics
- Economics
- Neuroscience

- Psychology
- Computer engineering
- Control theory and cybernetics
- Linguistics [4].

Types of AI: There are 3 types of AI classified on the basis of functionality

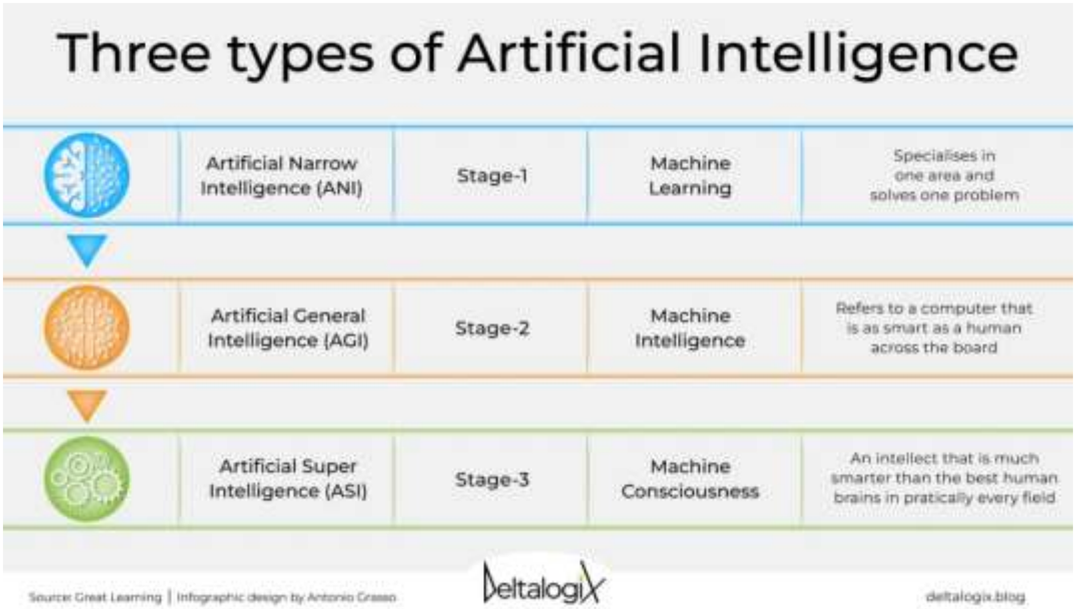

Figure 1: Types of AI *(https://deltalogix.blog/en/2023/03/08/artificial-intelligence-a-look-at-its-three-types-and-their-possible-future-implications/)*

Artificial narrow intelligence:

Narrow AI , or Artificial Narrow Intelligence ,is popular term . It only concentrates on specific activities or a single issue. Narrow AI and Weak AI are interchangeable . Still ,it was only the dawn of artificial intelligence . AI does not now refer to limited AI multiple tasks are not supported by weak AI . however ,it completes the task with the utmost accuracy. Although it cannot be pinpoint the causes, it can free you from having to perform a tedious task.

Artificial general intelligence :

A frequent term for the strong AI artificial general intelligence (AGI). Human intelligence is suppressed by super intelligence. It has the capacity to replicate human cognitive functions Robust AI is the ideal way to handle the challenging task . Strong AI can function flawlessly in situations when decision - making presents challenges and differences .AGL and AI are terms that some readers are curious about .AI encompasses AGL .

Artificial super intelligence :

The next step up from AGI is artificial super intelligence AGI. This Ai is fictitious and exists outside of the human brain .ASI inhibits human potential and develops self-awareness .It's found foundation is science fiction .Decision -making and problem -solving skills in artificial super intelligence (ASI) will surpass human thought processes .Scientists and engineers are still working to develop Artificial intelligence super intelligence capabilities . ASI is a creation of the mind .Even though we did not succeed ,you can already guess what will happen when we do. It will stand for those who are self -aware and self –conscious .There are just a few billion neurons in the human brain, whereas ASI has infinite. (19)

Applications of artificial intelligence in pharmaceutical industry:

Utilizing AI tools in dosage form designs

The human body system is divided into two compartments for better understand the impact of drug distribution and biological membranes are essential to this process. One of the most important metrics for keeping eye on an effective drug delivery system is the rate of penetration of the drug, which is established by the mode of the administration. While the active penetration mostly depend on the complex biological interactions and is initiated by membrane transport , passive diffusion is dependent on the chemical properties of the drug . (20) A more modern computer model is used to examine the drug delivery systems pharmacokinetics properties. preclinical models predictability based on predetermined parameters is a crucial requirement for the pharmaceutical industry research and development . AI can provide cutting -edge technology for multilayer data analysis ,improving research comprehension (21).AI can be employed in pharmacokinetic research by leveraging cutting -edge Ai technologies like artificial neural networks .

Additionally , AI can provide databases like chemical ,genomic, and phenotypic databases to enhance comprehension of drug interactions and the intricate unit functions of molecules. Certain methods are also employed to look into how the delivery system affects the medications pharmacokinetics, which enables a fuller understanding of toxicity and disposition (22, 23). When developing new medicine, formulations. pharmacokinetics and medical situations have a significant role .access to accurate information databases is a major challenge associated with the widespread application of AI in the development of drug delivery system(24). AI supports future applications by utilizing the existing knowledge, processing or ingesting large amount of data , and carrying out more rigorous codification inside the knowledge database with excellent results from self-supervised experimentation and linked to precise parameter tracking .o sum up, artificial intelligence (AI) is essential to medication delivery since it helps with issues including the recognizing drug interactions, anticipating drug distribution ,and creating efficient drug delivery systems.(25).

AI for diagnosing illness :

A careful treatment plan and patient welfare depend on the essential component of illness analysis. Accurate diagnosis is difficult to human error and the work is getting more difficult by incorrect information interpretation. AI shows up as a flexible answer that inspires faith in precision and effectiveness . A thorough review of literature demonstrates the variety of technology and methods used in the disease diagnosis. The changing needs of the human population and a wide range of environmental factors are what keep driving up the cost of the healthcare system (26). Notwithstanding flaws, inconsistencies and non-analysis off incongruities, new data indicates the creation of the fresh approaches to define their applicability, illustrating as yet undiscovered possibilities. The use of AI in the diagnosis process is highlighted by the classification of the patients according to the severity of the diseases. This procedure helps to compile evolutions that come from tests and exams, allowing for prompt and customized medical needs. (27)Because clinician derived analysis is subjective and vulnerable to variation, early illness prediction focused diagnostic techniques are necessary. AI plays a critical role in the identification and determination of the early prediction stage of the diseases . Especially in cases of dementia and cancer. Deep learning, neural networking, and algorithms for data extraction, processing and identification of all part of the modern technology practices. Particularly AI has a big impact on illness like dementia and the cancer, where objectives algorithms supported by pertinent information can make precise predictions. (28).While unsupervised learning facilities the diagnosis of hepatitis ,deep learning relationships improve predictions in response to changes of the evolution . Classifying dermatological conditions and identifying atrial fibrillation are two examples of the deep learning applications in the diagnosis . One method of estimating algorithms that uses random splitting into various sets is called cross-validation .The three key components that determine AI s effectiveness are the accuracy, sensitivity and the specificity which are highlighted in the most evolutions of the technology (29). After a review of the literature thorough results can be obtained by clinical aspects supervising clinical pathways and deep learning networks and using the vector support machines ,nearest neighbor's, random forests decision trees, logistic regression, naive bays, discriminant analysis and convolutional neural networks (30). It is possible to do algorithm-based performance analysis, accounting for the factors such as sample size, origin and the quantity of characteristics in training and testing samples, decision trees and reasoning were utilized together . A great deal of study has been done on the predictive modeling, most notably in the area of early Parkinson s disease prediction (31). A rib segmentation algorithm based on the chest X-ray images was created in the field of lung problems to address the shortcomings of conventional rib-wise segmentation techniques. Thanks to unpaired sample augmentation and a multi-scale network the algorithm achieves remarkable performance particularly in rib segmentation. It may find use in the diagnosis of the lung cancer and other pulmonary diseases (32). And diagnose cardiac arrhythmias by interpretation of ECG information (33). Another study effectively classified and diagnosed tuberculosis (TB) using an optimization genetic algorithm (GA) and support vector machine (SVM)(34).

Artificial intelligence for pharmaceutical distribution :

Computational pharmacy was born out of the application of AI and big data in the pharmaceutical industry. Its goal is to enhance medication delivery systems by the application of the multistate modeling techniques. In the computational pharmaceutics, artificial intelligence (AI) algorithms and the machine learning techniques are used to analyze large datasets and predict drug behavior. This enables researchers to evaluate various scenarios and optimize drug delivery systems without the need for time -consuming trial -and -error investigations (35). This reduces costs, speeds up the discovery of new medications and efficient treatment plans. Furthermore, incorporating AI algorithms into medication delivery system can assist in identifying potential adverse effects or drug -drug interactions, ensuring patient safety (36, 37). In order to predict drug behavior at multiple scales, AI algorithms may analyze complex interaction between physiological parameters, formulation elements and drug characteristics. This allows for a more thorough understanding of drug delivery processes and aids in the creation of the efficient drug delivery systems. Predicting the drugs physiochemical properties, in vitro release profile and stability is aided by it (38). The same techniques are also applied to in vitro vivo pharmacokinetics parameters and drug distribution (39).

AI in the formulation of oral solid dosage forms:

AI can help in the exploration of desirable process characteristics and the search for the best formulations. Artificial neural networks (ANN) ,fuzzy logics ,neural networks and evolutionary algorithms are used to generate consistent dosage forms and get a better understanding of the outputs for processing and operations (40, 41). A substantial portion of the pharmaceutical delivery market is made up of tablets a common solid dose form . Excipients are materials added tablets with the purpose of affecting the desired product outcome, such as the release of the medication and the disintegration of the tablets .AI has the potential to ensure consistent quality control methods in the setting of systemic drug administration by predicting drug release and analyzing the effects of important tablet production parameters. (42). Tablet faults have been identified by certain Ai programmes . (43) . Reliable quality control may be possible if the formulations could be used to forecast drug release . In vivo and in vitro techniques are used in the drug release studies;

both approaches are considered fundamental technologies that are routinely analyzed or tested during the product development process. AI is utilized in medicine formulation to help predict drug release, which reduces the number of runs needed to optimize the batch and saves the time and money on pilot bath scale and production procedures (42, 44).Artificial intelligence has the potential to assist in forecasting drug release and dissolution characteristics and investigating disintegration time to choose the optimal batch for further scale processing (45).

Utilizing AI for Nano medicine: For the researchers studying Nano medicine applying the artificial intelligence (AI) capabilities to data analysis, pattern recognition and optimization offers enormous promise. This combination could lead to faster research into new Nano scale treatments, better diagnostics, and advancement in personalized medicine. AI has the potential to revolutionize healthcare by enabling focused and accurate treatment methods at the Nano scale. This is just an example of AI in Nano medicine (46, 47). AI algorithms assist the researchers in the creation and optimization of nanoparticles for the particular purposes by forecasting their stability, efficacy and physicochemical characteristics.

Use of AI by mucosal ,transdermal , and parenteral methods: The development and production of complex pharmaceutical formulations , such as injectable and biologics ,heavily rely on AI .AI systems analyze formulations ingredients and manufacturing processes to help anticipate physicochemical characteristics for medication formulations and optimize the pH,solubility ,and viscosity . As a result, stable parenteral formulations with improved quality, effectiveness, and variability are produced (48, 58). By identifying the critical process variables that affect the product characteristics, artificial intelligence (AI) algorithms are important in optimizing the production of parenteral products. The examination of process data in real time improves product consistency reduces batch failures, increases overall production productivity. Artificial intelligence detects patterns and variances by examining large scale datasets obtained from analytical tests such as chromatography and particle size analysis. This makes it possible to identify the address quality issues early on leading to a production process that is more dependable and efficient .AI is used to assess particle behavior inside containers during visual examination, distinguishing between swimming, sinking and adhering particles. Accurate particle inspection and separation are achieved by using this method such as particle tracking and deep learning algorithms (37, 59).

Applications of AI in gastro-enter ology:

Use if Ai in the gastroenterology over the past ten years, there has been a significant expansion in the use of AI in gastroenterology. Colonoscopy can be benefit from the use of computer -assisted diagnosis to identify and distinguish benign from malignant cancer .(60) AI has been utilized to assist in a common clinical difficulty of distinguishing pancreatic cancer from chronic pancreatitis utilizing the EUS platform (61,62)DL can also be used to crate prognostic. In order to develop and evaluate prediction and diagnosis models for gastroenterology, numerous ANNs have been developed. In a retrospective analysis involving 150 patients, GERD was 100% accurately diagnosed using 45 clinical characteristics (63). In a prospective, multi-Centre research involving 2380 individuals In a prospective , multicenter research with 2380 patients , Rotondano et al.64)reported that Ann predicted the mortality in nonvariceal upper GI hemorrhage with 96.8% accuracy using 68 clinical factors. Among other related uses, AI has been used to predict survival of in oesophageal adenocarcinoma, (65). Predict relapse and severity of inflammatory bowel disease, (66) and determine the likelihood of distant metastases in oesophageal squamous cell carcinoma. (67)These preliminary investigations show potential for use in clinical practice in the future. Utilizing AI in the forecasting of an epidemic /pandemic Pandemics have no boundaries and can result in both morbidity and death. numerous pandemic outbreaks have occurred world-wide, including the Spanish Flu, AIDS, COVID-19, influenzas, cholera and the black death (68). These outbreaks have the potential to disrupt society and the economy. Early diagnosis and effective treatment of the illness are critically dependent on one another, which lessons the toll that it has on people’s health as well as on the political, social, and economic institutions. Surveillance is crucial to achieving early detection (69). Extensive resources, labor and time are required for active surveillance. It is difficult to forecast epidemics and pandemics in practice. The greatest way to accomplish surveillance while using the resources efficiently is with the artificial intelligence (AI) Deep learning and machine learning are being used in many health care domains and are shown to be more efficient than the human resources (70). Developing epidemiological models is challenging due to complexity (71-73).Artificial intelligence is being utilized in pandemic and epidemic detection, prevention, recovery. Prediction, surveillance and information are starting to be widely employed in prevention, particularly in light of the most recent COVID 19 outbreak (74). Because of the fluctuations in epidemic peak, etc. influenza epidemics are always very difficult to anticipate. Even in regions with variable seasonal influenza, a reliable forecast is achievable with the integration of the SAAIM (self - adaptive Ai model) (75). In Taiwan, for instance, seasonal influenza has been accurately predicted through the application of machine learning ensembles techniques (76). The predictive output precision for influenza with machine learning feed forward propagation neural network model (MSDII -FFNN) 90% (77). Australia and the United States have integrated machine learning anonymized mobility map (AMM) into their influenza prediction systems. Using the people mobility across state lines, AMM can forecast epidemics by grouping the data from smart phones (78).Ebola is still a problem in Africa. Numerous methods have been used to forecast Ebola, including a hybrid neural network created by Umang Soni et al. That exhibits 100% accuracy when random forest is used as a classification method (79). Reliable findings in predicting the propagation have been obtained by the combination of machine learning and the use of experimental models incorporating artificial communities. For instance, the consequence of studying the transmission of Ebola in a computer model of Beijing has been anticipated (80). Because there was no trust worthy prediction available during 2015 Zika outbreak, it was extremely difficult to allocate surveillance resources. A dynamic neural network model was then employed to predictive model framework proved to be dependable and valuable (81). In the Zika project, mobile applications were utilized to track the number of mosquitoes and artificial intelligence neural networks were used to detect infections early (182). The results of vaccine -derived poliovirus (VDPV) epidemic can be predicted by combining the whale optimization algorithm (WOA) with random vector functional link (RVFL) networks in hybrid machine learning(83). ML has the ability to identify potential candidates for pre-exposure prophylaxis in HIV / AIDS prevention efforts (84) in tropical and subtropical regions, dengue fever is common. The ML algorithm support vector regression .(85) Dengue in Malaysia was the ML support vector model (SVM) with a linear kernel (86) , while Bayesian network machine learning (ML) approaches were used to forecast dengue outbreaks (87). ANN is included for quick diagnosis with tuberculosis suspect .with TB suspicious data ,the ANN is integrated for quick diagnosis and its total efficacy exceeds

94% . This will facilitate the prompt implementation of some control measures and aid in the detection of the diseases overall spread (88). A CNN model called tuberculosis AI (TB-AI) recognized TB bacillus and demonstrated 97. 94% sensitivity using deep learning (89). Using the seven psychological symptoms of yellow fever as a guide, the multiplayer perceptron neural network classifier (MPNN) was proposed for yellow fever diagnosis and attained an 88% prediction precision (90). The world was rocked by the COVID -19outbreak (91). The COVID-19 was predicted using AI-inspired modified stacked auto-encoder modeling (92). Using the fuzzy rule in conjunction with Deep Learning Composite Monte Carlo (CMC) proved beneficial for making decisions. Making decisions and forecasting the COVID-19 pandemic was made easier with the use of the fuzzy rule and deep learning Composite Monte Carlo (CMC) [93]. To forecast with negligible error, a polynomial neural**.** Corrective feedback (PNN + CF) is employed [94]. China uses CNN, a deep neural network with accurate prediction efficacy [95]. In Switzerland, COVID-19 predictions are made using Big Data and the AI model Enerpol [96]. Statistical and deep learning systems such autoregressive integrated moving average (ARIMA), multilayer perception (MLP), feed-forward neural network (FNN), and long short-term memory (LSTM) were integrated in order to study the dynamical pattern of COVID-19. The generated data may serve as a helpful resource for the COVID-19 forecast (97).

Conclusion:

In conclusion, the integration of AI in the pharmaceutical industry marks a transformative era, driving significant advancements in drug discovery, development, and patient care. AI's ability to analyze vast datasets at unprecedented speeds has streamlined the identification of potential drug candidates, optimized clinical trial processes and personalized treatment plans. These innovations not only expedite the time-to-market for new drugs but also reduce costs and enhance the overall efficacy and safety of treatments. However, the successful implementation of AI in this sector requires ongoing collaboration between technologists, healthcare professionals, and regulatory bodies to address challenges such as data privacy, ethical considerations, and the need for robust validation frameworks. As the technology continues to evolve, its potential to revolutionize pharmaceutical research and healthcare delivery remains immense, promising a future where precision medicine becomes the norm and patient outcomes are significantly improved.

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