REVIEW ARTICLE

Artificial Intelligence in Pharma Industry - A Review

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Abstract

The use of artificial intelligence (AI) in pharmaceutical technology has grown over time, and it may help save time and money while also improving our understanding of the connections between various formulations and process parameters. AI is a subfield of computer science called intelligence that focuses on the use of symbolic programming to solve problems. It has significantly developed into a problem-solving science with numerous applications in business, medicine, and engineering. The article discusses the development of novel peptides from natural foods, the treatment and management of rare diseases, drug adherence and dosage, and challenges to the adoption of AI in pharma. It also discusses manufacturing execution systems, automated control process systems, and AI to predict new treatments.

Key words: ACPS, challenges to adoption of artificial intelligence in pharma, drug adherence and dosage, drug discovery, manufacturing execution system, tools of artificial intelligence, treatment and management of rare diseases

INTRODUCTION

A subfield of computer science called artificial intelligence (AI) focuses on using symbolic programming to solve problems. It has significantly developed into a problem-solving science with broad applications in business, medicine, and engineering.[1]

This AI's major goal is to recognize 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 AI, algorithms are created and used to analyze, learn from, and understand data. Statistical and machine learning, pattern recognition, clustering, and similarity-based approaches are all included in the broad category of AI.[2] AI is a rapidly developing technology with numerous 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, AI refers to the use of automated algorithms to tasks that normally require human intellect. The application of AI in the pharmaceutical and biotech sectors has completely changed how researchers create new medications, treat diseases, and more during the last 5 years.[3]

HISTORY

The market for natural language processing, which has numerous 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 2020.[5] Since the 1950s, AI has had a turbulent history.

When IBM's Deep Blue computer beat chess champion Garry Kasparov in 1997, the perception that it was a pitch for dreamers began to shift. In 2011, IBM's brand-new Watson supercomputer was successful in taking home the $1 million prize on Jeopardy in the US. Since then, Watson has diversified into the health-care 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

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discover connections across various data sets using dynamic visualizations.[6]

AI IN DRUG DISCOVERY

Testing chemicals against samples of sick cells is a time-consuming process in the drug discovery process. Further investigation is necessary to identify chemicals that are physiologically active and merit further study. The research teams at Novartis use images generated by machine learning algorithms to forecast which untested chemicals might be worth further investigation. While new data sets are discovered by computers far more quickly than by traditional human analysis and laboratory experimentation, novel and effective medications can be made available sooner while also incurring lower operational expenses than when each substance is manually investigated.[3]

The major biopharmaceutical businesses are currently pursuing AI initiatives that include: (a) Mobile platform to improve health outcomes and (b) the capacity to propose patients through real-time data collecting and hence enhance patient outcomes.

(c) Drug development - pharmaceutical firms are working with software firms to implement the most advanced technology in the pricey and time-consuming process of drug discovery.[7]

TOOLS OF AI ROBOT PHARMACY

The UCSF Medical Center uses robotic technology for the manufacture and monitoring of pharmaceuticals with the aim of enhancing patient safety.

They claim that the technology has accurately prepared 3,50,000 doses of medication.

The robot has demonstrated that it is significantly superior to humans in terms of both size and delivery capabilities. The manufacture of hazardous chemotherapy drugs for oral and injectable use is one of the capabilities of robotic technology. Because of this, UCSF's pharmacists and nurses are now free to put their skills to use by concentrating on providing direct patient care and collaborating with doctors.[8]

MEDI ROBOT

Medical electronic data interchange 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 scream during medical procedures, she had the notion. Although the robot is incapable of thinking, planning, or reasoning, it may be designed to appear to have AI.[9,10] The robot initially establishes a rapport with the kids before explaining what to expect during a medical treatment.

ERICA ROBOT

It was created in cooperation with Kyoto University, the Advanced Telecommunications Research Institute International, and the Japan Science and Technology Agency. It speaks Japanese and possesses a fusion of facial features from Europe and Asia.[11] It enjoys watching cartoon movies, wants to go to Southeast Asia, and desires a life partner who will converse with it, just like any other typical human being.

The robot was created with the ability to understand and respond to inquiries with human-like facial expressions, but it cannot freely move.

Ishiguro fixed up the features of 30 beautiful women and utilized the average to build the robot's nose, eyes, and other traits, making Erica the "most beautiful and clever" android.[12]

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 versions, including swap base platforms that may be used to transport racks, bins, and carts, as well as fixed and secured carts.

For the delivery of drugs, delicate items, and laboratory specimens, stationary carts are used; | AI: A new era in the pharmacy profession 75 transportable items that can be arranged on various racks. The TUG is a particularly adaptable and useful resource because it can provide many sorts of carts or racks.[13]

TUG ROBOTS

- Sensing process variable value
- Transmission of signal to measuring element
- Measure process variable
- Presenting the value of the measured variable
- Set the value of the desired variable
- Comparison of desired and measured values
- Control signal transmission to the final control element
- Control of manipulated value.

BERG

One of the leading companies using AI in its numerous processes 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 before choosing treatments based on the information gathered. The company's mission is to use AI to accelerate the drug discovery process and save costs by doing away with the element of guessing that is inherent in drug development.[14]

MANUFACTURING EXECUTION SYSTEM (MES)

Shorter production cycles, better resource utilization, controlled and monitored production phases, and optimized batch release are just a few advantages of utilizing MES.[15] Compliance with regulatory laws is also guaranteed.

AI TO PREDICT NEW TREATMENTS

Verge is addressing key issues in drug discovery by employing automated data collection and analysis.

In other words, hundreds of genes that play intricate roles in brain illnesses like Alzheimer's, Parkinson's, or ALS are being mapped out using an algorithmic technique. Verge's theory is that collecting and interpreting gene data will have a good effect on the preclinical trial stage of drug research. The idea is that Verge can utilize AI to track, beginning in the preclinical stage, the effects that particular medication treatments have on the human brain. As a result, pharmaceutical companies can learn more quickly about a drug's impact on human cells.

In more detail, Verge makes use of AI to monitor the effects of various treatments on the human brain, with an emphasis on the preclinical stage.[16]

Development of novel peptides from natural food

The Irish begin Nerites makes use of AI and other cutting-edge technology to accelerate the search for new, more robust foods and nutritious components. By utilizing this collaboration, Baden Aniline and Soda Factory (BASF) will create brand-new functional peptides derived from organic foods. To forecast, examine, and validate peptides from natural sources, BASF really makes use of Nuritas AI and DNA analysis capabilities. Discovering and bringing to market peptide-based treatments that would aid in the treatment of illnesses like diabetes is BASF's key objective.

Treatment and management of rare diseases

AI developments and growing interest in remedies for rare diseases. Almost 350 million people worldwide suffer from one of the 7,000 uncommon diseases that exist today. Yet, Heal, a biotech company with headquarters in the UK, has received $10 million in Series A funding, so not everything is lost for patients with uncommon disorders. A funding for the creation of novel medicines for uncommon illnesses using AI. Another Swiss biotech firm, Thera Chon, has acquired $60 million in financing to use AI to create medicines to address uncommon genetic illnesses.

DRUG ADHERENCE AND DOSAGE

Funding for the research of novel medicines for uncommon illnesses using AI. Another Swiss biotech firm, Thera Chon, has acquired $60 million in financing to use AI to create medicines to address uncommon genetic illnesses. To boost treatment adherence and increase drug trial vigilance, Abbvie teamed up with the New York-based Acura. In this partnership, Abbvie deployed the AiCure mobile SaaS platform's facial and image recognition algorithm to track adherence. To be more explicit, the platform powered by AI verifies that the appropriate individual did indeed swallow the right pill after the patients use their smartphones to record a video of themselves eating a pill. Moreover, the outcomes were astounding, increasing adherence by as much as 90%. Some clinical trials have changed the dosage given to particular individuals in order to improve the outcomes using Genpact's AI solution. In this collaboration, Bayer uses Genpact's Pharmacovigilance AI to monitor medication compliance as well as identify potential adverse effects considerably sooner.

USING AI TO MAKE SENSE OF CLINICAL DATA AND TO PRODUCE BETTER ANALYTICS

Anyone can easily enroll in clinical trials and studies using Apple's Research Kit without having to go through a formal physical enrollment process. It is an ecosystem for clinical research built around the company's two major devices, the iPhone and the Apple Watch. For instance, Duke University employs a facial recognition algorithm powered by AI and patient data gathered from these Apple devices to identify autistic youngsters. Making sense of the gathered health data has been made simple with the aid of research kit.

FINDING MORE RELIABLE PATIENTS FASTER FOR CLINICAL TRIALS

Although there is a wealth of patient data available, big pharma finds it challenging to find the suitable people for clinical trials. Clinical trials, for instance, can last an average of 7.5 years and cost between $161 million to $2 billion per medicine if the right individuals are found and enrolled.

Regrettably, clinical trials miss deadlines by 80% of the time. The $65 billion clinical trial sector requires an overhaul with over 18,000 clinical studies currently recruiting participants in the US. The biggest difficulty facing pharmaceutical companies may be obtaining relevant information from patient records. Fortunately, that's where AI and machine learning come into play.

While AI has an extensive potential to help redefine the pharmaceutical industry, the adoption itself is not an easy walk in the park.

CHALLENGES THAT PHARMA COMPANIES FACE WHILE TRYING TO ADOPT AI

- The technology's unfamiliarity - due to its youth and esoteric nature, AI still appears to be a "black box" for many pharmaceutical companies.
- Absence of appropriate IT infrastructure - this is a result of the fact that the majority of present IT applications and infrastructure were not created or designed with AI in mind. Even worse, pharma companies must spend a lot of money on upgrading their IT infrastructure.
- As a large portion of the data are in free text format, pharmaceutical companies must go above and beyond to compile and convert these data into a format that can be examined. Despite all of these restrictions, one thing is certain: AI is already revolutionizing the biotech and pharmaceutical industries. Moreover, in ten years, the pharmaceutical industry will just regard AI as a common, everyday technology.

AI IN PHARMA IS A GOOD IDEA

The pharmaceutical industry can speed up innovation by utilizing new technologies. AI, the development of computer systems capable of performing activities typically requiring human intelligence, such as visual perception, speech recognition, decision-making, and language translation, would be the most recent technical development that comes to mind. According to an IBM estimate, the total amount of data in the health-care industry was 161 billion GB as of 2011. While there is a vast amount of data in this field, AI can really help by evaluating the data and providing results that would aid in decision-making, save human effort, time, and money, and ultimately help save lives. Epidermic outbreak prediction: Using machine learning and AI, it is possible to research previous outbreaks, examine social media activity, and forecast where and when an outbreak will occur with a high degree of accuracy.

In addition to the aforementioned use cases, there are a wide range of alternatives, including customizing the course of therapy and developing new tools for patients and doctors. Using predictive analytics to social media and doctor visits to find trial participants is known as clinical trial research.

LIMITATIONS

Electronic documents that need to be streamlined must first be cleaned up because they are disorganized and dispersed over several databases. Transparency: Given the difficulty of AI-based processes, consumers require transparency in the health care they receive. Medical data are confidential and legally accessible, according to data governance. It is crucial to obtain public approval. Pharma businesses are renowned for being conservative and change resistant. To provide the greatest care possible, we must eliminate the stigma.

BENEFITS AND ISSUES

- Efficient use of incomplete data sets.
- Quick data analysis
- Flexibility to account for preferences and limits
- Capacity to produce clear rules. improving product performance
- Quality at a cheap cost
- Shorter time to market
- Development of new products
- Improved customer response
- Improved confidence amongst patients[3]
- Shortening the time to market
- Creating innovative products
- Getting better client feedback
- Boosting confidence.

If properly coded, AI would have a lower mistake rate than humans. They would be extremely quick, accurate, and precise. They would not be influenced by adverse settings, enabling them to carry out risky tasks, explore space, and withstand difficulties that might harm or kill us. This may also entail mining and delving through materials that are dangerous to people. Replace people with machines in hard jobs and repetitive, boring duties. Assume what a user will type, enquire about, look up, and do. They can readily serve as helpers and suggest or order a variety of things. It can identify fraud in card-based systems, as well as potential future systems. Records are managed and organized. Engage with people as avatars or robots for fun or to complete a task. An illustration of this is AI used in numerous video games. They are able to make reasoned decisions with few or no mistakes because they are able to think clearly and without emotion. This may be done for medical reasons, such as assessing mental and physical health concerns. This can provide information about side effects and medical procedure simulations. Robotic surgery, including radiosurgery in the future, will be able to do procedures with greater precision than humans.

APPLICATION

In formulation

Controlled release tablets: Alfred *et al*. at the University of Cincinnati carried out the initial study in the application of neural networks for modeling pharmaceutical formulations (OH, USA). They modeled the *in vitro* release properties of a variety of medicines distributed in matrices made from different hydrophilic polymers in separate investigations. In every instance, it was discovered that neural networks[17] with a single hidden layer provided acceptable performance in the prediction of drug release. In a more recent study, researchers from the University of Ljubljana in Slovenia and the pharmaceutical company KRKA dd (Smerjeska, Slovenia) used neural networks to predict the rate of drug release and to carry out optimization using the formulation of diclofenac sodium from a matrix tablet made from cetyl alcohol.[18]

Tablets for immediate release

Two studies were the first to be conducted in this field about 3 years ago. One study11 by Turkoglu *et al*. from the University of Marmara (Turkey) and the University of Cincinnati employed statistics and neural networks to predict different hydrochlorothiazide tablet compositions. In an effort to maximize tablet strength or choose the optimal lubricant, the networks created were utilized to construct three-dimensional plots of massing time, compression pressure, and crushing strength, or drug release, massing time, and compression pressure.[19] Despite patterns being seen, no ideal formulations were offered. The patterns were on par with those produced by statistical methods. Models of comparable neural networks were created, and then genetic algorithms were used to enhance them. The best formulation was discovered to be dependent on the restrictions set on the constituent amounts utilized in the formulation and the relative weight given to the output parameters. The only way to achieve a high tablet strength and low friability was at the expense of a long disintegration period. In every situation, fluidized bed granulating was chosen over other diluents, and lactose was the preferred diluent.[20]

In product development

One example of a multivariate optimization problem is the development of medicinal products. Variables used in formulation and process optimization are involved. The ability of artificial neural networks to generalize is one of their most advantageous traits. These characteristics make them excellent for dealing with issues relating to formulation optimization in the production of pharmaceutical products.[21] In studies of the influence of various elements (such as formulation and compression parameters), on tablet qualities, ANN models demonstrated greater fitting and forecasting skills in the production of solid dosage forms (such as dissolution). In order to build microemulsion-based drug delivery systems with the least amount of experimental work, ANNs were a helpful tool.

CONCLUSION

The human body is the most advanced machine that has ever been built. The human brain is actively attempting to develop something that is significantly more effective than a human being at performing any given task, and it has had remarkable success in doing so to some level. The field has undergone a significant transformation thanks to AI tools such as the robotic pharmacy, pull robot, and Watson for cancer. The infrastructure required for the health-care industry will need to be more sophisticated and technologically advanced as it grows. The creation and use of algorithms for data analysis, learning, and interpretation constitute AI.

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