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Integrating Natural language processing (NLP) and Machine learning Techniques for Healthcare Industries

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ABSTRACT : Machine learning has emerged as a significant trend in the market even though it is a relatively new technological application that is challenging to put into practice. The healthcare and pharmaceutical industries are increasingly turning to technologies that utilize natural language processing, also known as NLP. This is done for these industries to make sense of the data they collect. They can derive valuable data, which can assist them in better comprehending the requirements of their customer's thanks to text analytics, which enables them to do so. NLP has recently experienced a surge in popularity within the healthcare industry and the pharmaceutical industry. This can largely be attributed to the development of deep learning algorithms that can interpret text data and extract information pertinent to the situation. One of the applications of machine learning is finding patterns in medical data, and it also has an excellent ability to predict illness.

KEYWORDS: Deep learning; Healthcare; Machine learning; Precision medicine.

1. INTRODUCTION

Machine learning(ML) is a potent subset of artificial intelligence that contributes to cost savings in the healthcare industry by automating formerly laborious and costly processes[1]. The ability of machine learning to reduce the amount of manual labor required to complete these tasks is responsible for these cost savings. ML techniques are powered by automation algorithms that undergo supervised learning, a procedure in which a model is developed based on historical and real-time healthcare data[2]. This information can be gathered through various means, such as patient records, electronic health records, laboratory results, and imaging scans. Using data analytics, a trained automated system has the potential to generate accurate predictions. This improves clinical decision-making and reduces the cost of providing medical care[3].With the aid of machine learning and natural language processing techniques, it is possible to identify patients who require more intensive treatment due to a history of mental health issues or drug addiction[4]. Additionally, these methods can be utilized to identify patients with complex medical conditions. If patients cannot adhere to treatment protocols due to factors such as food insecurity and unstable housing, they may incur higher costs throughout their lifetimes. This financial burden may fall on the families of the patients[5-7].

It can be difficult to find information about a patient's medical condition, but it can be even more challenging to find information about their social status and demographics. This is because data are generally presented in an unstructured format. NLP can aid in the process of locating solutions to such problems[8]. Individuals struggling with mental or behavioral health issues may also benefit from applying NLP to coordinate better the care they receive. Natural Language Processing (NLP) and Machine Learning are two methods that can be utilized in the process of mining patient data and identifying individuals who are at risk of being overlooked[9,10].

Patient data is a collection of information about a single individual, beginning with that person's birth and extending to the present day. This collection of data begins with the birth of the patient. The majority of this data is stored in non-digital formats, including handwritten medical notes, printed test reports, and diagnostic photographs[11]. Electronic Health Records (EHR or EMR) replace the Patient Medical Record (PMR), which is essentially a digital version of the EHR or EMR. After it has been digitized, it will be much easier for healthcare professionals to examine the PMR and for machine learning-based solutions to utilize. There are daily updates to the electronic health records of patients, which contain previously unseen information. These files contain an abundance of information regarding various medical conditions and treatments administered to patients. The healthcare industry and its decision-making

processes stand to benefit significantly from the information contained in electronic health record (EHR) documents[12].

Clinicians who use natural language processing (NLP) can use NLP techniques in order to search for medical records using full-text searches and access those records. Because of this, doctors can now search through medical unstructured text data quickly and effectively by using free text and queries rather than terms that exactly match the query. This allows them to bypass the need to find terms that exactly match the query[13-15].

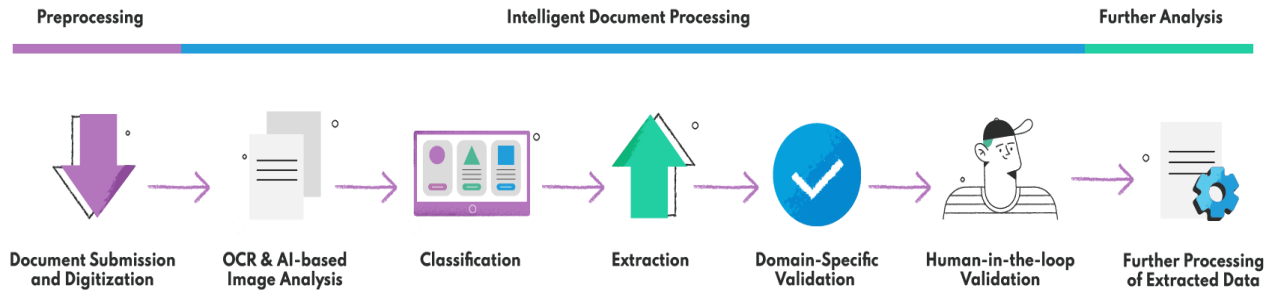


Fig. 1. Natural language processing (NLP) based Healthcare system

Natural language queries, as opposed to keyword searches and searches for specific product names, are becoming increasingly popular for people to use when searching the internet and documents. Because of this, there is an increasing demand for solutions that make it possible for healthcare organizations to interpret the type of user input that was described earlier in this paragraph. The use of natural language processing (NLP) tools and machine learning algorithms is one example of a solution that falls into this category. These are utilized to extract valuable data from interactions with patients[16].

II. LITERATURE SURVEY

Using the growing amount of health data about patients that is made available by the Internet of Things, machine learning is used in medicine to help improve patient outcomes. This is done by making use of the information[17]. These strategies have a lot of potential, but they also have a lot of problems that should be thought about. At the moment, genetic information, medical imaging, and processing the natural language of medical papers are thought to be three of the most important ways machine learning can be used in the medical field. A big part of each of these specialised fields of study involves diagnosing, locating, and making predictions[18-20].

At the moment, a huge network of medical devices is responsible for making data, but not all of them have the supporting infrastructure they need to make good use of that data[21-23]. Medical information can be found in many different formats, which can make the process of formatting data harder and can also cause more noise. Also, the fact that medical information is available in many different formats can lead to more noise[24]. There is a short look at the history of machine learning, as well as some background on the different techniques and their current state of development. There is also some information about the future of machine learning and how it might be used in the future[25].

The current state of the art is always moving forward. Using technology to solve problems in many different fields has led to a lot of important progress in those fields. The same is true in medicine, where AI is adding to many traditional methods by, for example, advising doctors on how to treat patients effectively and predicting illnesses. One area where this is true is in the study of cancer. During this investigation, we will focus on a number of applications or relevant research where Machine Learning is playing an important role in figuring out what's wrong with someone and how to treat it[26].

2. Use cases of NLP in Healthcare

a. Speech Recognition[27]

Voice recognition has gradually improved thanks to the application of NLP, which enables medical professionals to transcribe notes for electronic health record (EHR) data entry. The use of voice recognition at the front end of the process frees doctors from sitting and taking notes at the point of care. In the background, specialised software searches for and corrects any errors that may have been made in the transcription before passing it on to a human proof-reader.

b. Clinical Documentation

Because NLP provides clinical documentation, physicians are freed from the time-consuming task of manually entering patient data into electronic health records (EHRs), allowing them to spend more time directly with patients. NLP could be useful in this regard for medical professionals. The utilisation of structured data entry, as well as speech-to-text dictation, has proven to be of great assistance. The technologies developed by Nuance and M*Modal include team-based and voice recognition tools, as well as formalised vocabularies that will be useful in the future. These tools are intended to obtain structured data at the point of care[28].

In order to obtain useful data, NLP technologies make use of speech recognition equipment. This has the effect of significantly altering the analytical data that is used for VBC and PHM projects. As a consequence of this, the clinical results are significantly improved. In order to determine what the Social Determinants of Health (SDOH) are and how effective wellness-based policies will be in the future, it will examine public data sets and social media using natural language processing (NLP)[29].

c. Reporting to the Registry in an Automatic Manner

Obtaining the necessary values for each use case constitutes an NLP use case. When metrics like ejection fraction aren't recorded as discrete numbers, it is difficult for many health IT systems to comply with regulatory reporting requirements. [36] When an ejection fraction is recorded as part of a note, health systems need to be able to identify it and keep each number in a format that the organization's analytics platform can use for automatic registry reporting. Health systems also need to be able to keep track of the format in which each number is kept[30-32].

d. Clinical Decision support

Utilizing natural language processing in medicine will facilitate improved decision-making on the part of medical professionals. Still, efforts are being made to develop additional options that will assist medical professionals in making better decisions. Accidents in the medical field are one example of a procedure that requires improved monitoring methods[33].

According to a report, recent studies have shown that natural language processing (NLP), which stands for natural language understanding, can assist computers in detecting viruses. M*Modal and IBM Watson Health are both well-known CDS providers that use natural language processing (NLP). Healthcare is also using NLP to assist medical professionals in the process of diagnosing patients and screening for symptoms[34].

e. Coding and billing in the medical industry

With the assistance of natural language processing (NLP), medical coders can more easily obtain diagnostic, procedural, and other clinical data. NLP is used to read the documents, and when those codes are given to a coder for verification. Previously, a coder would have been responsible for reading the documents and turning them into alphanumeric codes.

This makes it possible for the human coder to work on documents that the NLP system is unable to process properly. This results in a reduction in the overall cost of coding medical data. Last but not least, billing that is more accurate and timely is the result of coding that is more complete and accurate[35].

f. The use of the Internet and medical assistants

Natural language processing (NLP), which stands for natural language understanding, is already paving the way for virtual nursing assistants that are able to communicate with patients. When patients routinely engage in conversation with the nursing bot, care is provided that extends beyond the confines of the clinic room. This occurs without placing a strain on the resources that are already present.

It is possible to monitor the patient's compliance with the treatment plan, and triggers can alert clinicians whenever there is a problem that requires their assistance. Patients have access to assistance and information around the clock, seven days a week. They are also able to receive assistance with their medication[36].

g. Using a robot to assist in surgical procedures

Some surgical robots are equipped with artificial intelligence, which allows them to apply what they have learned from previous procedures to the current patient. This ultimately results in better outcomes throughout treatment. In addition to the many well-known advantages of robotic surgery, the addition of a natural language processing (NLP) component enables surgeons to interact with the system by posing questions and providing instructions[37].

3. Applications of Machine learning in healthcare organizations:

a. Making a forecast[38]

Predictive algorithms make use of machine learning to help healthcare organizations in a variety of ways, including predicting when patients won't show up for their appointments, improving clinical decision-making, spotting high-use trends, and many other applications. Algorithms that use machine learning can assist medical professionals in providing more accurate diagnoses, identifying patients who are more likely to be experiencing chronic illnesses or mental health crises, and taking preventative measures at an earlier stage to reduce the number of emergency room visits and hospital readmissions. This is of utmost significance for accomplishing the objectives of value-based care.

Predictive learning models can perform additional tasks when machine learning is coupled with a patient's medical history and a substantial quantity of health data. One of the most cutting-edge aspects of artificial intelligence is machine learning. It mimics how the human brain learns new information, but it does it so much more effectively and quickly. The impact of machine learning and deep learning on patient data analytics will continue to result in cost savings and provide medical professionals with assistance in developing more comprehensive treatment strategies[39].

b. Categorization

The problem of having an excessive amount of medical data can be difficult to solve for humans, but machine learning algorithms may be able to assist in finding a solution to the problem. Algorithms that learn through machine processing can quickly process large data sets and find patterns within them, assisting with accurate information classification and better decision making. Automation algorithms can sort the entirety of a provider's data, and the ones that require attention can be brought to the fore. They are also able to categorize patients into groups according to shared characteristics, symptoms, or requirements. In certain circumstances, this information can be supplemented with the data already collected from the patient by using wearable devices. Clinicians will be able to assist these groups more productively if they employ particular engagement strategies, devise particular treatment plans, and improve their decision-making. In addition, machine learning can be used to reduce the amount of money spent on the supplies required by a method[40,41]. Health care costs typically go up whenever there is a lack of transparent information about prices anywhere in the supply chain. But that is not necessarily the case. It is simple for hospitals to reduce the cost of treatments without affecting either the final result or the efficacy of the process itself. This is possible due to the fact that machine learning algorithms can swiftly classify materials and discover ways to acquire them at lower prices than humans can.

c. Optimizations[42]

Making the most of a hospital's available medical resources is one of its primary responsibilities, as doing so can pave the way for improved medical care that is also more cost-effective. However, for automation and data analytics to function at their optimum levels, a substantial amount of health data must be gathered. Artificial intelligence (AI) may be of assistance in this situation. Algorithms that learn from machine data have the potential to completely revolutionize the delivery of medical care by making the most labor-intensive processes more productive. Today, machine learning is used in many different facets of the healthcare industry, including better planning of hospital resources and shorter wait times for emergency room admissions as a result of better control of capacity for emergency operations. Moreover, machine learning is also being used in many other areas of the healthcare industry. Applications that use data analytics are expanding rapidly in the healthcare industry, which is making a large number of data-driven administrative tasks more effective.

d. Interpretation[43]

Obtaining information from patient medical records and other papers and determining what it means can take a significant amount of time, but artificial intelligence can quickly complete this task. Machine learning algorithms can "read" and understand medical charts by utilizing AI technologies such as natural language processing (NLP) and computer vision. This allows the algorithms to extract meaningful information that can assist people in making more informed decisions (CV). Algorithms that AI powers can evaluate outputs in the appropriate manner, interact with unstructured EHR data to gain a better understanding of it, and extract key insights that could be beneficial to the health and treatment of patients. Once analyzed and processed by AI, these documents become a valuable source of data that makes healthcare automation more helpful and efficient.

e. Generation[44]

Large quantities of high-quality healthcare data sets are required for machine learning algorithms in order for them to be able to learn how to perform predictive analytics and make clinical decisions. Now, individuals are required to make these decisions and send in codes or descriptions that correspond with the procedure that was performed on the

patient. On the other hand, machines can access data stored in system files and convert it into codes and notes that explain what transpired. Because of this, clinicians are able to spend additional time with patients.

People will be able to focus more on what they do best once algorithms can collaborate with them and perform some of the more tedious tasks. As a result of their interactions with various other automated procedures, the generated healthcare codes and comments learn from their experiences and improve over time. They will be more accurate as a result, and workflows will be improved.

f. The application of AI has an ongoing impact on medical care[45]

Because of the volume of data that is readily available to us in the health care industry, artificial intelligence and automation can streamline and enhance the data-driven procedures and contribute to the slowdown of our system. Machine learning algorithms have made it much simpler for healthcare organizations to analyze large amounts of data. These data points can be used to locate outbreaks of viruses, identify possible holes in treatment plans, enhance the effectiveness of clinical trials, enhance medical imaging, assist in the discovery of new medicines, and many other things. The electronic health record will not consume most of the clinicians' time during the workday (EHR). This will result in fewer clinicians experiencing burnout, improved revenue operations, and clinicians returning to what they do best, providing excellent care.

III. CONCLUSION

The field of medicine is increasingly adopting and using the concept of machine learning. Because it makes their jobs easier, ML is beneficial to both patients and doctors in many different ways. The automation of medical billing, assistance with clinical decision-making, and the formulation of recommendations for clinical care are three of the most common applications of machine learning. Learning through machines has a wide range of potential applications, which are currently being researched and developed further. The application of machine learning in the medical field will become increasingly widespread in the not-too-distant future, which will simplify patients' lives. The study of how computers and people can communicate with one another using natural language focuses on a subfield of artificial intelligence known as natural language processing or NLP. The term "natural language processing" refers to various applications, some of which include data mining, document summarization, text categorization, and sentiment analysis, to name just a few. The primary objective of natural language processing is to develop robots capable of reading and comprehending written instructions in the same way that people can do so.

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