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USING MACHINE LEARNING ALGORITHMS TO DESIGN PERSONALIZED EXERCISE PROGRAMS FOR HEALTH AND WELLNESS

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Abstract. The research paper showcases an elaborate study of machine learning, which is used in healthcare or medical platforms and can be used by healthcare professionals to adopt better diagnostic instruments and tools for examining medical issues or images. The paper highlights that a machine learning algorithm can be utilized in X-rays or MRI scans to examine disease and health issues. This paper will also discuss how this algorithm can help healthcare professionals, doctors, and nurses make accurate diagnoses for better services and patient outcomes. One of the major advantages of using the secondary research method in the following research is the abundance of the literature. All the data being used here are previously collected and evaluated with the result, and using these will increase the impact of the study overall. This method saves resources, including money, time, and manpower. This research method allows the researcher to build new knowledge and draw new conclusions based on existing expertise and knowledge. The chosen research philosophy is the Interpretivism research philosophy. The chosen research approach here is the inductive research approach. The chosen research design for this study is exploratory. All these help the research to achieve its objectives and reach the proposed goal of this research.

Key words: Machine learning, Drug discovery, Clinical trials, Electronic Health Records (EHRs)

1. Introduction. In healthcare, machine learning is a progressing field of research and development in precision medicines with several potential applications [1]. It has been noted that, as patient data is easily accessible, machine-learning algorithms in medical platforms will become highly important for healthcare experts and the overall medical system to extract accurate issues from medical information. The figure 1.1 given below shows the pillars of machine learning for the health care sector

Machine Learning (ML) has emerged as a transformative force in healthcare, revolutionizing how medical data is analyzed, interpreted, and utilized. In the realm of predictive analysis, ML plays a pivotal role in harnessing the power of data to make accurate forecasts and informed decisions. Its ability to identify various health issues and diseases provides valuable insights into the potential applications of ML in healthcare.

Predictive analysis involves using historical data to predict future outcomes or trends. This can translate into early disease detection, personalized treatment plans, and optimized patient care in healthcare. ML algorithms excel in this domain because they can recognize intricate patterns, even within large datasets, that may elude human observation. By analyzing complex relationships between variables, ML models can anticipate health risks, disease progression, and patient outcomes. ML's role in predictive analysis in healthcare is underscored by its ability to process diverse data sources. This includes electronic health records, medical imaging, genomics, wearable devices, and patient-generated data. Integrating and analyzing these data types can enable accurate predictions regarding disease susceptibility, treatment response, and potential complications. For example, ML algorithms can identify subtle changes in medical images, such as identifying early signs of cancer or anomalies in brain scans, improving diagnostic accuracy.

Furthermore, ML's predictive capabilities are instrumental in identifying health issues before they manifest clinically. By detecting subtle deviations from standard patterns, algorithms can forecast the onset of conditions like diabetes, heart disease, and mental health disorders. Early identification facilitates proactive interventions, enabling healthcare providers to initiate preventive measures and lifestyle modifications to mitigate risks. The application of ML in predictive analysis also extends to drug development and treatment optimization. ML models can predict drug efficacy and potential side effects based on patient characteristics, genetic profiles, and disease parameters. This empowers clinicians to tailor treatments, minimizing adverse reactions and maximizing

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Fig. 1.1: Pillars of ML

therapeutic outcomes.

Moreover, ML's ability to process and analyze vast amounts of data leads to the generation of predictive models that continually evolve and improve over time. As new data is collected, these models refine their predictions, ensuring higher accuracy in healthcare decision-making.

In essence, this research significantly contributes to the advancement of healthcare by highlighting the transformative potential of machine learning in diagnosing medical conditions through medical imaging analysis. It underscores the importance of adopting innovative technologies to enhance healthcare practices and emphasizes the role of secondary research methodologies in consolidating existing knowledge for the generation of novel insights. The chosen research philosophy, approach, and design collectively bolster the study's objectives and contribute to its successful outcome.

2. Objectives. To describe the topic, the following objectives were created:

1. To discuss significant factors related to machine learning algorithms in the case of healthcare and wellness.
2. To elaborate on the role of the machine and deep learning in improving patient treatment, diagnosis, and patient outcomes.
3. To analyze the opportunities in machine learning for health.
4. To identify the key challenges related to implementing machine learning in the healthcare industry.
5. To describe the pros and cons of machine learning technologies in healthcare.

3. Methodology. The methodology part is one of the most important aspects of a paper that determines the different steps used to meet the study's objectives [5]. The above figure shows that the study's outcome relies on the research methods considered for the study. Besides this, secondary qualitative methods provided an extensive spectrum related to the topic of study [16]. Hence, the study is presented as an appropriate source of knowledge related to the machine learning approach as a boon to the healthcare world.

4. Machine Learning to Develop New Treatments, Drug Discovery and Clinical Trials. In the medical system, machine learning tools and algorithms are essential and valuable as these algorithms can help the healthcare professional to make massive amounts of healthcare data, which are created daily within electronic medical data and records [3]. With the help of machine learning tools, medical experts can find exact patterns and insights into health-related data that are difficult to find manually. It has been noted that

Fig. 2.1: Major applications of ML algorithms

Fig. 4.1: ML features for medical services

machine learning algorithms in medical systems have gained widespread adoption, and healthcare experts get the opportunity to use more predictive approaches for stratified medicine [4].

The above figure shows different features of ML technology that can be used in healthcare industries. In healthcare, the most common use cases for ML, among medical experts, are automating prescriptions, medical billing, clinical decision support, and improving clinical practices within the medical system [6]. In the clinical workflow, machine learning can produce healthcare data, and it offers primary care provider clinical decision support within medical health records [7]. Along with this, ML algorithms can be used by healthcare professionals and pharmaceutical companies to identify accurate and relevant data that could help in drug discovery, new drug development, and new treatments.

The most exciting thing about drug discoveries through AI is the convergence between drug development, biology, and technology. All these will lead to more developed medications in a more rapid time [8]. Utilizing all these effects that the ecosystem of technology, including Silicon Valley, has to offer and developed so far will benefit human society. These will leave a considerable impact on the people who are suffering from various diseases. In today's scenario, without the help of AI, the process of drug development takes almost ten years [2]. On the other hand, with the help of AI, the time can be researched to nearly one-tenth, and in this meantime,

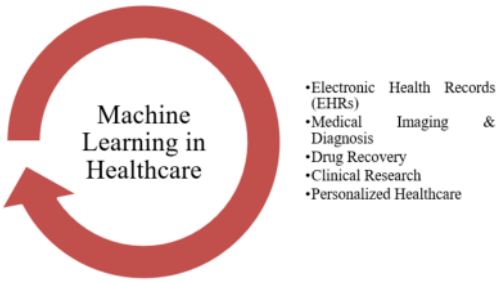

Fig. 4.2: Use of machine learning in Healthcare

the process of being found out of a drug to deliver to the patients to treat them all can be done and dusted. In case the medical research h history is being studied, it can be seen that many diseases today do not have the proper treatment or drug to treat them. Fundamentally thinking, the human being can have the life-changing drugs that can change the game forever if it is delivered by the AI [20]. AI can help to reach the right patient at the right time with the newly developed drugs that no one has seen before and it can save a lot of lives.

It has been noted in the above figure that machine-learning technology in healthcare can also be used to examine the medical data from clinical trials to address earlier unknown aftereffects of drugs. However, this type of technology can help to improve patient treatment, new drug development, safety, and efficiency of medical procedures [9, 13]. Moreover, machine learning technology can also help to optimize patient treatment protocols by examining patient information, medical history, as well as real-time monitoring data.

In the future, that is not very far, it can be possible to collect all the health-related data from different types of input that are documented at different times. All these gadgets can include electronic devices to store medical data, wearable, or from research papers, whether academic or clinical [24]. Everyone will get the opportunity and access to the data that were being uploaded into secure, central storage that is trusted. It is fascinating to imagine that the AI can predict what drug to provide to what patient, and not only that it can also predict what drug will start working at exactly what time and what the sequence is [12].

According to binary classification, these algorithms can provide completely personalized care and treatment and predict patient outcomes by recognizing patient information patterns. Along with this, these algorithms allow healthcare experts and professionals to tailor the treatment process based on the individual characteristics of every patient [10, 14]. However, this led to better patient care and improved patient outcomes.

The above figure 4.3 depicts that, ML approaches offer a set of technologies that can help in new drug discovery and clinical traits with abundant and high-quality data. Clinical traits are important for new drug development and ML algorithms play a significant role in optimizing clinical trials by forecasting patient admission rates and recognizing the number of trial participants [15, 11].

The above figure 4.4 describes the clinical data of the patients. ML algorithms help to make the design of clinical trials more effective, and lower treatment costs by analyzing the previous trial data and characteristics of the patients. Besides this, machine-learning approaches enable medical experts to respond better to some specific treatments, predict the post-treatment effects, and predict the effectiveness of the treatment process [16].

However, these approaches also provide better treatment and care strategies and better patient outcomes. Thus, healthcare industries can develop innovative treatment processes, therapies, and new treatment protocols by adopting machine-learning approaches.

However, these approaches also provide better treatment and care strategies and patient outcomes. It has been noted that ML technology has the ability to transform the medical system and develop new treatment processes, drug development, and clinical trials. Thus, healthcare industries can develop innovative treatment processes, therapies, and new treatment protocols by adopting machine-learning approaches.

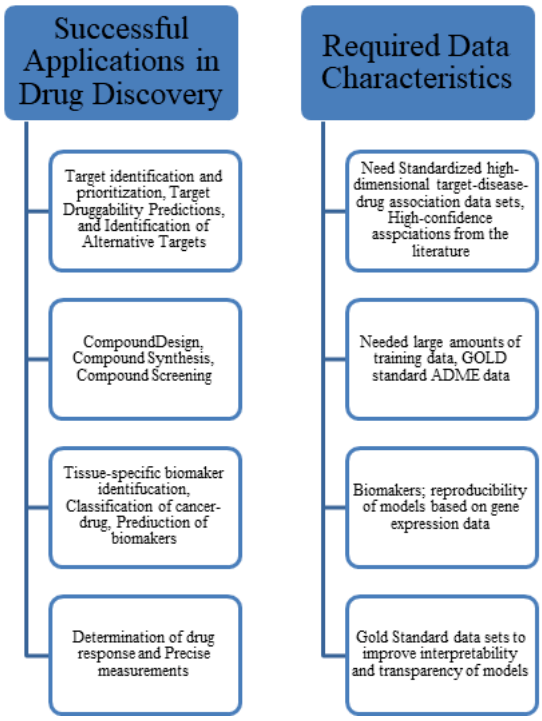

Fig. 4.3: Applications of machine learning in drug discovery and clinical traits development

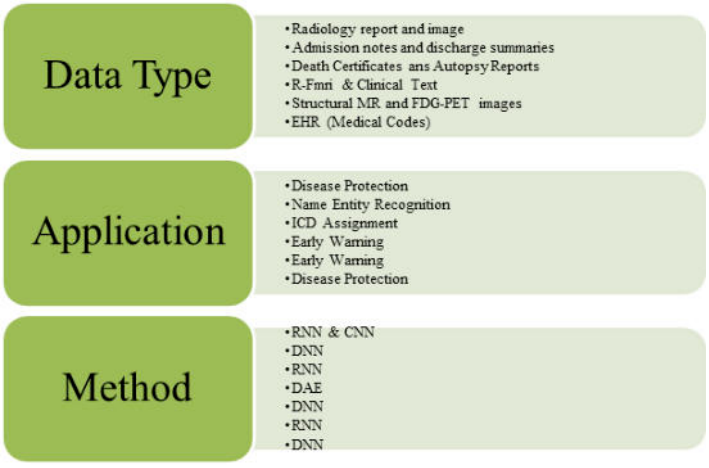

Fig. 4.4: Clinical big data and deep learning

5. Analyze the Medical History. In the healthcare industry machine learning, works like a blessing. In the healthcare and pharmaceutical industries, a massive amount of data is presented in the form of new and old records of patients, previous treatment as well as medical history of both patients and their families. ML approaches help to examine the previous records and data of the patients [17]. In this way, clinicians, nurses, and medical experts can predict the exact health condition of the patient.

It has been depicted in figure 5.1, that the key issues in the healthcare system such as overtreatment,

Table 4.1: Pros and cons of ML technologies in healthcare

Pros	Cons
MLO algorithms provide an accurate diagnosis and better prediction of disease outcomes.	Machine learning models are complex and there is an absence of transparency.
This allows for faster diagnosis and treatment plans for the patients.	This approach requires human oversight and surveillance.
It helps in remote monitoring of patients' medicine and improves patient convenience	Using this algorithm can create legal and regulatory issues.
Using ML technology in healthcare can provide a more effective and efficient treatment process.	ML approaches use patients' personal and sensitive data which can create ethical concerns regarding privacy and security.

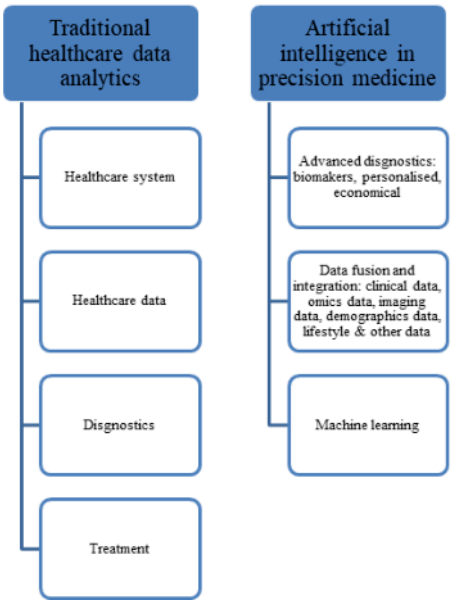

Fig. 5.1: ML in traditional healthcare data analytics

misdiagnoses, decreased productivity, and under-utilized data can be intelligently analyzed providing economic, and personalized treatment options. Along with this, ML approaches allow medical experts to extract valuable insights from previous records such as old diseases, family medical history, and hereditary diseases [18].

From the above figure 5.2, it is crystal-clear that imaging, lifestyle data fusion, logistic regression, decision tree, and discriminate analysis can be done deftly to cater to generic algorithms. ML algorithms play a significant role in pre-posing patients' records for ensuring data consistency and data privacy [19]. However, this step includes data cleaning, identifying missing data, and data transformation in a suitable format. It has been seen that ML algorithms help to extract more useful data from previous records. This process includes old medical records, patient demographics, diagnosis or test outcomes, MRI reports, chemotherapy records, and clinical notes [21]. Besides this, these technologies help healthcare experts to make more effective, efficient, and advanced treatment processes to improve patient's health.

6. Electronic Health Records (EHRS). EHRs comprise a surfeit of information for the patient's health history that involves both unstructured and structured data such as lab test results, disease codes, and treatments. A combination of ML and DL has been significant in maintaining the EHRs in a well-directed

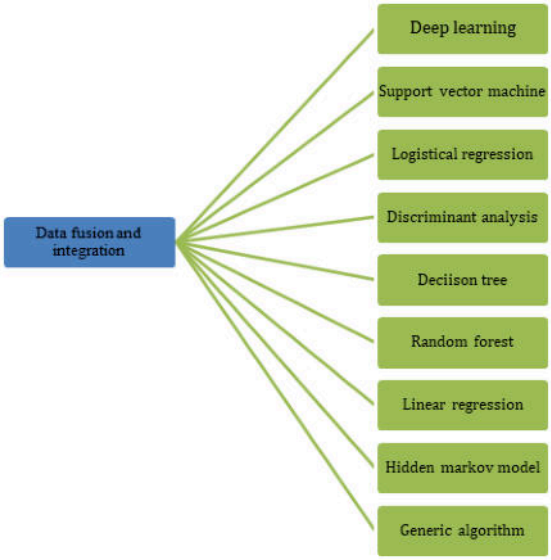

Fig. 5.2: Applying ML for genomics

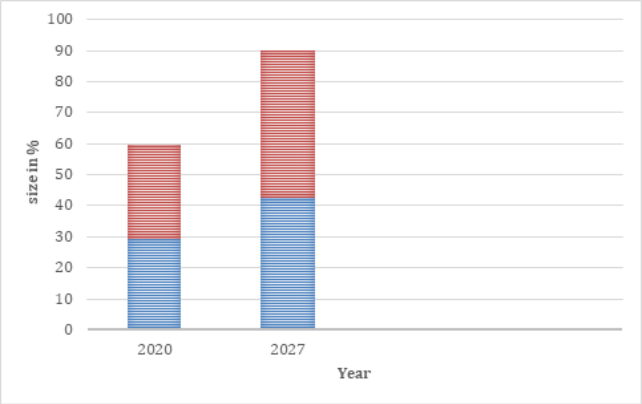

Fig. 6.1: Market size of EHR

way [22]. All these will lead to a personalized experience of getting diagnosed and getting the drug as per the requirement of the patient. In these cases, there is a slight chance of getting wrongly diagnosed but the chance is so slim [20]. Treating patients with AI can open the door to a whole new world of drugs and treatments.

From the above figure 5.2, it is writ large that the market size of EHRs is expected to reach over 47 million USD by 2027. For healthcare organizations, electronic health records are the major advancement in ML [23]. The figure reflected that the measurement was 29.16 during 2020; however, it can be accelerated within 7 years to 47.25. It has been observed that EHR allows healthcare providers to access patients' old medical records and reports. At the same time, the same reports and records can be accessed by another doctor who wants to know which treatments and medicines have worked positively in the past.

EHRs are expected to boost the market in the near future as the market value can reach 18 billion USD by 2026 as shown in the above figure 6.2 [25]. It has been noted that electronic health records systems cover the entire array of patient records.

The overhead table 6.1 is showing the pros and cons of EHRs. Along with this, EHR is a significant

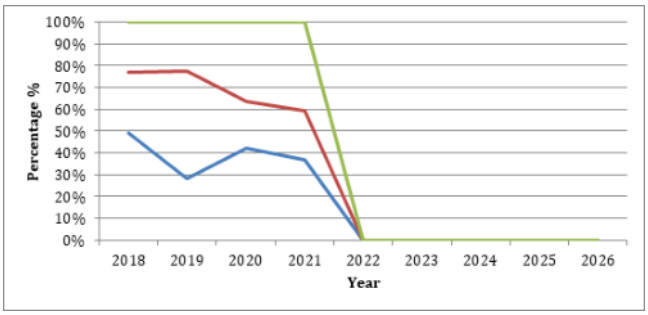

Fig. 6.2: Market value of EHRs in smart hospitals

Table 6.1: Pros and cons of EHRs in healthcare

Pros of EHRs	**Cons of EHRs**
EHRs provide better analysis and information.	Healthcare professionals need proper training to effectively use EHR systems.
EHR allows healthcare providers to access patient information safely and securely.	EHR may receive incorrect or incomplete information.
EHRs increase accuracy and promote transparency.	Privacy and Cyber security Issues

application of ML algorithms that can be done with the help of OCR technology. Cross-functional access and automatic document scanning can be possible through EHR [26]. Thus, smart medical records help to save time and money, in administrative record management and provide super-effective patient outcomes.

Machine learning has emerged as a transformative force in the field of healthcare, revolutionizing the way medical data is processed, analyzed, and utilized. Its importance in healthcare stems from its unparalleled ability to extract meaningful insights from vast and complex datasets, enabling healthcare professionals to make more informed decisions and deliver personalized patient care. One of the key contributions of machine learning in healthcare is its potential to enhance diagnostic accuracy. Machine learning algorithms can analyze medical images, such as X-rays, MRIs, and CT scans, with a remarkable level of precision, aiding in the early detection and diagnosis of various diseases. This not only speeds up the diagnostic process but also improves patient outcomes by enabling timely interventions.

Machine learning also plays a critical role in predictive analytics. By analyzing patient data, including medical history, genetic information, and lifestyle factors, machine-learning models can predict the likelihood of certain medical conditions or complications. This empowers healthcare providers to take proactive measures and design personalized treatment plans that align with the unique needs of each patient. Another area where machine learning shines is drug discovery and development. It can analyze massive datasets to identify potential drug candidates, predict their efficacy, and even simulate their interactions within the human body. This accelerates the drug discovery process and holds the promise of bringing new treatments to market faster.

In healthcare operations, machine learning optimizes resource allocation and improves efficiency. It can predict patient admission rates, optimize staff scheduling, and enhance inventory management, ultimately leading to cost savings and better resource utilization. Furthermore, machine learning contributes to personalized medicine by tailoring treatments to individual patients. By analyzing genetic and molecular data, machine learning models can identify the most effective treatment options and predict how patients respond to specific therapies, minimizing adverse effects and increasing treatment success rates.

In summary, the importance of machine learning in healthcare is profound. It empowers healthcare professionals with data-driven insights, improves diagnostics, accelerates drug discovery, enhances patient care, and contributes to the overall advancement of medical science. As technology continues to evolve, the integration of machine learning is expected to further transform healthcare by enabling more precise, efficient, and

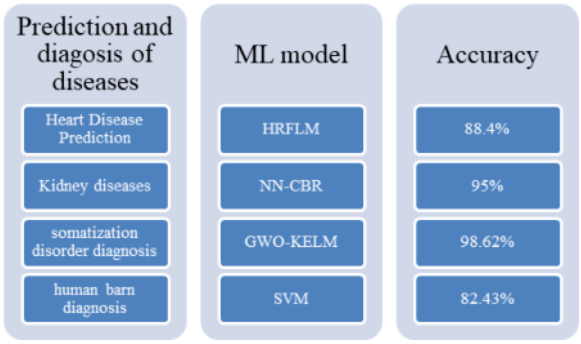

Fig. 7.1: Predict and Diagnosis of Diseases

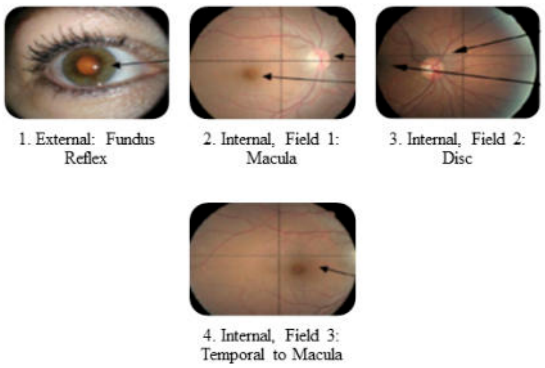

Fig. 7.2: Medical imaging for diabetic retinopathy

patient-centered approaches to diagnosis, treatment, and disease prevention

7. Results. In medical imaging, the aspects of ML are spearheading these days in the form of making decision trees, protein function prediction, swarm intelligence, and supporting the vector machine with evolutionary algorithms. Machine learning algorithms extract relevant information from massive unstructured data such as test reports, clinical notes, and electronic medical records [27].

The able figure depicts ongoing research in the diagnosis of different diseases. ML algorithms can monitor effective signs and symptoms including heart rate and blood pressure for identifying the early warning symptoms and signs of any health issues and diseases. ML algorithms can monitor the most vital signs by examining the video MRI reports, and scans [28].

From the overhead figure 7.2, it is clear that the screening using the ***fundus photography*** along with manual image analysis has been beneficial in yielding sensitivity with a heightening of the specificity rates. Medical imaging is one of the significant advancements in Machine Learning for healthcare industries [24]. Medical imaging has become more effective and advanced with the help of machine learning technology as it possesses a huge amount of pathology and radiology and makes faster decisions. It also helps doctors detect tumors at their initial stage prevent their growth and provide an accurate image of the disease to provide the doctor with the visual representation of the disease.

The overhead figure 7.3 shows that the process of setting up the CTA imaging with ***computational FFR*** has a significant impact on ***per-vessel assessments*** to maintain the quality of the diagnosis procedure.

Predictive analysis can help medical experts make informed decisions about treatment processes based on patients' health conditions. ML models help doctors to identify potential health issues, and disease management, and prevent readmissions. Predictive models can be used to identify various types of health issues and diseases

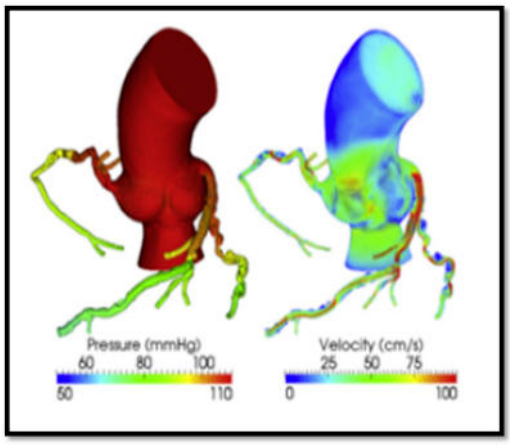

Fig. 7.3: Cardiac cycling using the CTA imaging

like heart disease, kidney disease, diabetes, liver disease, and cancer and take effective actions for patients who are in dangerous health conditions [2]. It has been noted that ML technologies can examine the data from electronic health records as well as other sources like medical records, and test results. Besides, this, by incorporating ML algorithms with predictive models, healthcare providers can predict the requirement for medical services and resources including beds, operating rooms, and staff [27].

With the help of wearable smart devices healthcare services are getting more advanced and super effective. Smart devices, tools, and instruments are resulting in a great advancement in personal health monitoring and ML technology has also taken a most important part in this. ML technology for medical systems enables completely personal as well as patient-centric treatment processes through apps [20]. There are several AI bots presented in the applications that can help to identify common problems and queries and forward the same patient to other doctors.

On the other hand, patients are able to make proper and best decisions for their health and lifestyles by uploading their health-related information in the app. Similarly, older patients can also create an emergency alarm on the smart devices because whenever they need any help, they can call for emergency help. The benefit of ML algorithms in healthcare industries for such devices is plenty. Since the patient data and information are uploaded in the online app, both patients and doctors can easily access these records to understand the real-time condition of the patient's health.

Identification of pre-signs of any health risks is another significant advantage of ML technology in healthcare industries. ML technology helps to analyze the huge amount of patient records because clinicians and healthcare providers can identify the risks before they turn to any kind of health disease. On the other hand, clinical facilities can also use this technology to identify strokes from current health conditions, heart conditions, as well as any other complications [12]. Therefore ML algorithms provide a real-time examination and investigation, and healthcare experts can diagnose potential much before.

This extreme secondary research showed that there are several aspects of machine learning-related algorithms such as impacts of different AI (Artificial Intelligence) tools, data systems on the cloud, several digital tools and services, creating smart reports, providing smart acres, and so on that can strategically be indulged within the healthcare system so that the entire healthcare can be digitized which make the delivery of treatments to the patients fast and effective. On the other hand, according to one of the objectives, the contribution related to machine and deep learning has been found to be required in today's time so that all the services to the patients such as diagnosis, treatment, and results can become more efficient. If the medical service providers can access all the required details of the patients from the smart reports system using the cloud storage system in a minute instead of asking for details from the patients which can possibly have errors or going through several notes from previous treatments physically, the entire process would be more time effective and the patient

would get better treatment. Also, the mechanical system of the concerned industry has not been updated for long; there is plenty of room for improvement in the X-ray, MRI, and other machines through the inclusion of the machine learning system that would make the results free from, manual errors.

During the entire analysis, it was noted that the adoption of ML technology in healthcare can create several problems for healthcare providers. High-quality data is highly important for testing the machine learning models. Poor data quality can negatively affect the performance of the models and fail to provide correct results. Usually, healthcare industries require more data, and making correct predictions and analyses can become complicated by the ML models when patients' records have insufficient data [8].

Similarly, while using ML algorithms in healthcare, it becomes difficult to ensure the confidentiality and security of patient data. Along with this, it was seen that there is a problem regarding the implication of ML algorithms because made by machine learning algorithms highly depend on the data [28]. It has been observed that wrong data can lead to wrong results and can harm the patient.

8. Conclusions. From the overall study it can be concluded that machine learning approaches technology provides a more effective framework for healthcare professionals to design personalized treatment programs for patients' health and wellness. At the same time, the paper has highlighted the benefits and disadvantages of using ML approaches in the medical system. It was found that these algorithms ensure that the treatment and diagnosis program can meet each and every patient's needs.

This research underscores the paramount importance of integrating machine learning into the realm of healthcare, particularly in the context of medical diagnostics and imaging. By harnessing the power of machine learning algorithms, healthcare professionals can significantly enhance their diagnostic capabilities, leading to more accurate and timely identification of various health conditions. This, in turn, translates to improved patient care, better treatment outcomes, and overall advancements in the healthcare industry. The findings of this study shed light on the potential of machine learning to revolutionize healthcare practices, enabling medical practitioners to make well-informed decisions based on comprehensive data analysis. The demonstrated application of machine learning algorithms in interpreting medical images like X-rays and MRI scans holds great promise for the future of medical diagnosis.

However, it is crucial to acknowledge the limitations of this research. The study primarily relies on secondary research methodologies, which might limit the depth of original insights that could have been generated through primary data collection. Additionally, while machine learning offers transformative potential, its implementation requires careful consideration of data security, privacy, and ethical concerns, which are complex and evolving issues.

For future work, further exploration is warranted to delve deeper into the integration of machine learning algorithms with other areas of healthcare, such as patient monitoring, drug discovery, and personalized treatment plans. Addressing the challenges related to data privacy, security, and ethics will also be pivotal to ensuring the responsible and effective deployment of machine learning technologies in healthcare settings. Moreover, conducting empirical research that involves real-world case studies and validation of the algorithms' performance could provide more robust insights and a clearer understanding of their real-world impact. This research serves as a stepping stone toward harnessing the full potential of machine learning in healthcare, highlighting its capabilities, limitations, and future directions. By continuously advancing our understanding and application of machine learning technologies, we can aspire to create a healthcare landscape that is characterized by precision, efficiency, and improved patient well-being.

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