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Applications of Artificial Intelligence in Medical Devices and Healthcare

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ABSTRACT
Artificial intelligence (AI) can detect significant data set interactions and is commonly used for the expectation of outcomes, treatment, and diagnosis in several clinical conditions. For a range of health and research purposes, including disease identification, aligning man to chronic diseases, the delivery of health care, and the discovery of medicines, artificial intelligence (AI) shall be used or checked. In this article, we discuss the application of artificial intelligence (AI) in the modern healthcare system and the challenges of this system in detail. The description of work processes defines various types of artificial intelligence tools. In tissue engineering, alginate, a naturally available polymer found on the brown algae cell wall, is used for its biocompatibility, low cost, and fast friction.

Keywords:- *AI*

I. INTRODUCTION
The most powerful technology in the world of modern healthcare is the Artificial Intelligence (AI) approach [1]. Rapidly growing access to medical knowledge and also the developments in large-scale diagnostic techniques balance the potential for today's effective use of artificial intelligence (AI) in the health system. Potential artificial intelligence (AI) technologies will, by means of essential medical queries, disengage sufficient knowledge secreted in a massive amount of data, which could preserve health decision-making [2]. In different medical fields, modern health care technology has spread to many leading start-ups worldwide, enabling people to live safer and longer lives. Initially, the changes were dictated by the advent of software and accessibility, allowing the health sector to digitize different processes and procedures on plumbing or paper currently in operation. Computer tech is now much smarter and more autonomous. These new technologies are discussed under the same scope of computer education (ML) and artificial intelligence (AI), which increases the speed of healthcare progress. Machine-learning (ML) and artificial intelligence (AI) technologies in the field of health have helped the field to solve some of its significant challenges in areas such as drug development, personal genetics, and the detection and management of diseases. Whenever an advanced technological method joins the health sector, it also faces a number of challenges [3]. Regulatory compliance criteria, patient and provider acceptance, as well as data exchange in the absence of information, are the most common concerns of artificial intelligence (AI) in the healthcare system.

India has a range of problems in terms of healthcare, including increasing costs, high levels of drug-resistant, and hospital-acquired infections and treatment failures leading to preventable adverse health effects. Overtreatment, inadequate care, and failure to follow best practices in prevention and patient protection have significant and clearly observable implications for both healthcare costs and patient outcomes [4]. In comparison, the increased availability of electronic health data as well as the ongoing advancement of computational strategies to interpret these data suggest a potential for improved quality and cost reduction of patient care using artificial intelligence and machine learning methods. Recently AI techniques sent massive waves of medicine, thus sparking an active discussion on the potential substitution of AI doctors in the future. We assume that in the

near future, human doctors will not be replaced by machines, but AI will definitely help doctors make better clinical decisions or even replace human judgment in specific practical health fields (e.g., the radiology sector). With that access to health data, and the rapid growth of the Big Data analysis tools, new popular AI applications in health care have been made possible. Driven by specific clinical questions, powerful AI techniques can access clinically relevant data, which can help to make clinical decisions.

Prior to using AI systems in healthcare applications, they need to be 'educated' with data created from clinical experiences, such as screening, diagnosis, treatment assignment, etc., so that specific subject classes, correlations between subjects, and outcomes of interest can be identified. Such clinical data are also available in demographic, educational, electronic medical system reporting, physical and clinical laboratory examinations, and photographs and not limited to them [5].

Furthermore, the other two main data points (Figure 1) are the physical test observations and clinical laboratory tests. We differentiate them from the fact that they contain vast amounts of unstructured narrative documents, for example, clinical reports, which are not explicitly analyzable with image data, genetics, and electrophysiological (EP) [6].

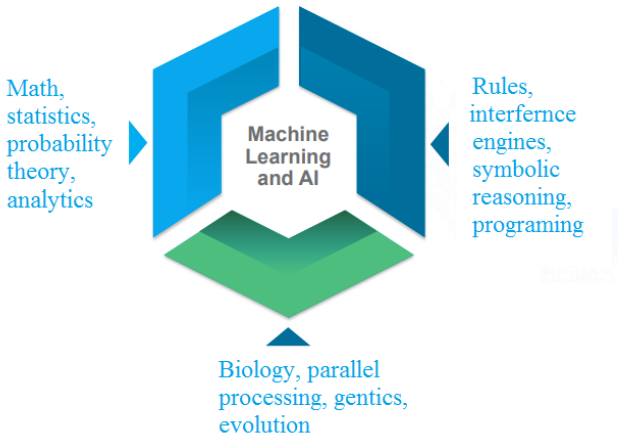

Figure 1: Areas of artificial intelligence

II. ARTIFICIAL INTELLIGENCE (AI)DEVICES

Artificial intelligence systems (AI) are classified by two primary types: machine learning (ML), for example, electric physiological (EP) data, genetic information, and imagery data [7]. Machine Learning (ML) systems seek to capture the personality of patients in medical applications or to understand the possible disease consequences. The second type of artificial intelligence (AI) system is the technique of natural language processing (NLP), which enhances structured health-checking data by taking information free or unstructured [8]. The processing of natural language (NLP) processes objects with the contents revolving into organized records that are comprehensible to the system and can subsequently be considered by ML procedures. Figure 2 describes the pathway from medical data development to data enhancement and machine learning (ML) data investigation during natural language processing (NLP) to the formation of medical decisions. The roadmap starts in this figure and ends with medical activities. As powerful as artificial intelligence (AI) approaches, medical / health care problems can inspire them and can be realistic to add to their medical success [9].

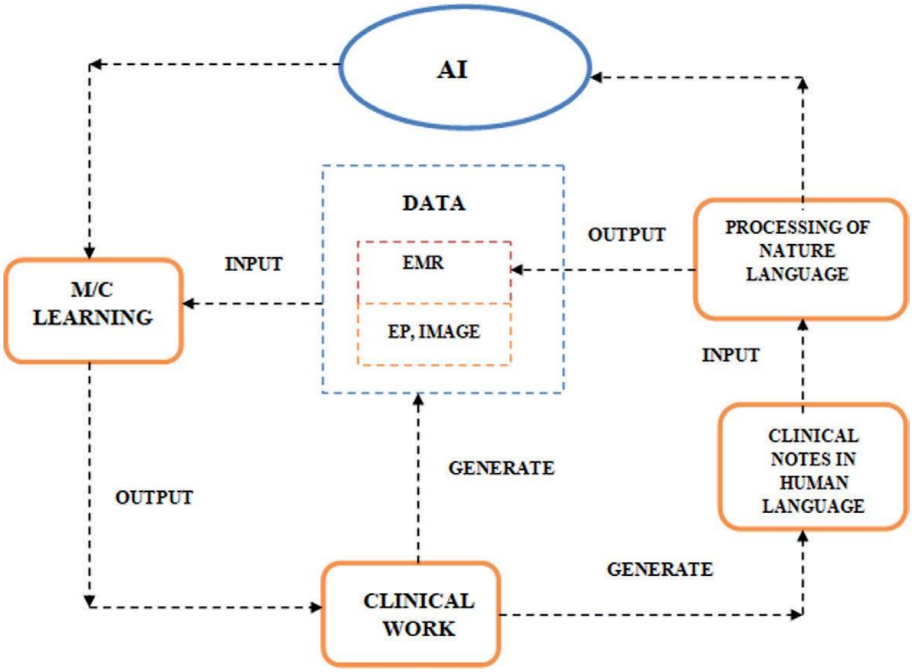

Figure 2.

The roadmap for medical data creation, data development and machine learning (ML) data analysis during natural language processing (NLP).

Ai devices

The debate above indicates that AI systems are primarily divided into two major categories. Machine learning (ML) methods are part of the first category, which analyzes structured data, for example, imagery, genetic, and EP data [10]. In medical applications, the ML mechanism aims to aggregate the characteristics of the patient or delay the likelihood of the outcome of the disease. The second group includes natural language processing methods (NLPs) to complement and improve structured medical information by extracting data from unstructured information such as clinical notes / medical journals. The NLP procedures are designed to transform texts into organized machine-readable data that can then be analyzed by ML techniques [11].

Table 1. Applications of Ai

Applications of Ai
Healthcare and Medicines
Automotive
Finance and economic
Video Games
Heavy Industries
Robotics

Artificial Intelligence in Medical Devices is the capacity of the computer program or a machine to think and learn. It is likewise a field of study which attempts to make the computer brilliant. They take a shot at their very own without being encoded with directions. In general terms, artificial intelligence implies a machine that mimics human discernment [12]. Artificial intelligence (AI) frameworks are intended to animate human intuition abilities so as to encourage mind-boggling or redundant undertakings, regularly giving detailed new bits of knowledge and enabling clients to concentrate on their parts of activities [13].

Table 1. AI in Healthcare

AI in Healthcare
Managing Medical Records and other data
Doing repetitive jobs
Treatment Design
Digital Consultation
Virtual Nurses
Medication Management
Drug Discovery
Precision Medicine
Healthcare Monitoring

Healthcare System Analysis

All programs have the capacity to obtain data, utilize intelligent principles to process information, sensible structure arrangements dependent on known factors, and perceive and right slip-ups, making it feasible for differing ventures to offer more excellent products and services. These systems have opened up a world of possibilities within the medical device industries, such as enabling doctors to provide relevant and effective care more quickly. 79% of the (AI) technology plays an important part in the healthcare sector [14].

Table 3. Elements of Artificial intelligence and their three steps

Three elements of AI	Three Steps
Massive amount of data	Computers and programs
Sophisticated algorithms	The Turing test
High-performance parallel processors	The Darmont Conference

III. MODES OF ARTIFICIAL INTELLIGENCE IN MEDICAL DEVICES

Based on our research, current emerging applications appear to fall into three main categories:

Management of chronic diseases – Companies are using machine learning to monitor patients using sensors and to automate the delivery of treatment using connected mobile apps (Example: Diabetes and automated insulin delivery) [15].

Medical imaging – companies are integrating AI-driven platforms in medical scanning devices to improve image clarity and clinical outcomes by reducing exposure to radiation (Example: GE Healthcare CT scans for liver and kidney lesions) [16].

AI and Internet of Things (IoT) – Companies are integrating AI and IoT to better monitor patient adherence to treatment protocols and to improve clinical outcomes (Example: Philips Healthcare solution for continuous monitoring of patients in critical condition) [9].

The executives of Chronic Diseases: Companies are utilizing machines figuring out how to screen patients using sensors and mechanize the conveyance of treatment utilizing associated versatile applications [11].

Medicinal imaging: Companies are incorporating AI-driven stages in medical scanning devices to improve picture lucidity and clinical results by diminishing presentation to radiation.

AI Internet of Things: Companies are incorporating AI and IoT to more readily screen quiet adherence to treatment conventions and to improve clinical results [17].

Artificial intelligence from a Regulatory point of view:

Regulatory Requirements

There are as of now no laws or harmonized guidelines that explicitly control the utilization of artificial intelligence in medical devices, in any case, these devices must meet the current regulatory requirements, for example,

The manufacturers must show the advantage and execution of the medical device. For devices that are utilized for diagnostics purposes, the affectability and explicitness, for instance, should be illustrated [18].

The devices must be approved against the proposed reason and partner necessities and checked against the details. They must guarantee that the product has been created in a manner that guarantees repeatability, reliability, quality, and execution. Manufacturers must portray the technique that they will use for the verification. If the

clinical assessment depends on a comparator device, this device must be adequately specialized identical, which unequivocally incorporates the assessment of the product calculations [19].

FDA's requirements about Artificial Intelligence:

The FDA attempts to clarify for the two sorts of calculation adjustment, when:

It doesn't anticipate another accommodation, just the documentation of the adjustment by the manufacturer.

It might want to play out an audit of the alterations and approvals before the manufacturers are permitted to showcase the changed product. It will demand a totally new accommodation or approval. The effort to make medical devices increasingly dependable, precise, and robotized is creating a developing enthusiasm for discovering approaches to incorporate AI [20]. Medicinal Imaging is a territory that is relentlessly picking up footing while clinical substantial wearable is as yet rising. Anyway creating and improving devices to help the administration and treatment of incessant sicknesses will in all probability be kept on being a significant territory of core interest [21]. An ever-increasing number of medical devices are utilizing Artificial Intelligence to analyze patients all the more exactly and to treat them all the more successfully. Despite the fact that part of medical devices has just been endorsed by the FDA. While huge numbers of the AI's energizing commitments towards the medicinal field are a work in progress, buyers and care suppliers have just begun to utilize and encounter its advantages. Medical devices makers keep on actualizing AI to make enlightening, dependable parts just as to improve all the generation. MedTech also uses as-needed contract tools, which can be very costly. They spend millions each year to verify the contract for all of this work. But it can be very difficult to predict the length of the software validation process, and so costs can very rapidly escalate when contract services are used [22].

Table 4. Problems and Challenges of Artificial intelligence

Problems of AI/ Challenges
Reasoning, Problem Solving
Knowledge representation
Planning
Learning
Natural language processing
Perception
Motion manipulation
Social Intelligence
Creativity
General Intelligence

IV. CONCLUSION

While medical research focuses heightened attention on AI technologies, there are still obstacles to implementation in real life. The regulations make up the first hurdle. There is a shortage of requirements for the health and efficacy evaluation of AI systems under existing regulations. The first guidance classifies AI systems as the 'general well-being products' which are loosely regulated, as long as the equipment is equipped for general well-being and is at low risk to users. The first guideline classifies AI systems. The second guideline supports the use of real evidence to access AI system results. Finally, the guidelines explain the adaptive design principles for the clinical trials, which will be commonly applied in the assessment of the operating properties of AI systems. Not long after these guidelines were published, the medical imaging platform of Arterys

became the first deep clinical learning platform FDA approved for cardiologists to diagnose heart disease.

Data sharing is the second challenge. For the effective functioning of AI systems, data from clinical trials must be educated. However, after initial training with historical data, the further development and enhancement of the system will rely on continuing data supplies after an AI system has been deployed. There is no opportunity in the current health care climate for the exchange of program data. However, a revolution in healthcare is on the way to encourage India knowledge sharing. The program ends by reforming the payment system for health care. Many payers, most of whom are insurance undertakings, have moved from the doctors' compensation to the result of treatment. By turn, the payers often refund the value of a drug or treatment procedure. This new framework offers further opportunities to the collection and exchange of knowledge for all parties involved in the health care system, doctors, pharmaceuticals, and patients.

REFERENCES

[1] James G, Witten D, Hastie T, et al. An Introduction to Statistical Learning with Applications in R. 1st ed. Springer; 2013

[2] Darcy AM, Louie AK, Roberts LW. Machine learning and the profession of medicine. JAMA. 2016;315:551-552

[3] Christopher DM, Hinrich S. Foundations of Statistical Natural Language Processing. Cambridge, London, England: The MIT Press; 1999

[4] Murff HJ, FitzHenry F, Matheny ME, et al. Automated identification of postoperative complications within an electronic medical record using natural language processing. JAMA. 2011;306:848-855

[5] Good fellow I, Bengio Y, Courville A. Deep Learning. 1st ed. Cambridge, London, England: The MIT Press; 2016

[6] Mirtskhulava L, Wong J, Al- Majeed S, Pearce G, et al., editors. Artificial neural network model in stroke diagnosis. In: 2015 17th UKSim- AMSS International Conference on Modelling and Simulation (UKSim). IEEE; 2015

[7] Bishop CM, editor. Pattern Recognition and Machine Learning (Information Science and Statistics); 2007

[8] Khan J, Wei JS, Ringnér M, et al. Classification and diagnostic prediction of cancers using gene expression profiling and artificial neural networks. Nature Medicine. 2001;7:673-679

[9] Dheeba J, Albert Singh N, Tamil Selvi S. Computer-aided detection of breast cancer on mammograms: A swarm intelligence optimized wavelet neural network approach. Journal of Biomedical Informatics. 2014;49:45-52

[10] Hirschauer TJ, Adeli H, Buford JA. Computer-aided diagnosis of Parkinson's disease using enhanced probabilistic neural network. Journal of Medical Systems. 2015;39:179

[11] Orrù G, Pettersson-Yeo W, Marquand AF, et al. Using support vector machine to identify imaging biomarkers of neurological and psychiatric disease: A critical review. Neuroscience & Biobehavioral Reviews. 2012;36:1140-1152

[12] Sweilam NH, Tharwat AA, Abdel Moniem NK, Moniem NKA. Supportvector machine for diagnosis cancer disease: A comparative study. Egyptian Informatics Journal. 2010;11:81-92

[13] Khedher L, Ramírez J, Górriz JM, et al. Early diagnosis of Alzheimer's disease based on partial least squares, principal component analysis and support vector machine using segmented MRI images. Neurocomputing. 2015;151:139-150

[14] Farina D, Vujaklija I, Sartori M, et al. Man/machine interface based on the discharge timings of spinal motor neurons after targeted musclere innervation. Nature Biomedical Engineering. 2017;1:0025

[15] Ravi D, Wong C, Deligianni F, et al. Deep learning for health informatics. IEEE Journal of Biomedical and Health Informatics. 2017;21:4-21

[16] Lecun Y, Bottou L, Bengio Y, et al. Gradient-based learning applied to document recognition. Proceedings of the IEEE (Inst Electr Electron Eng). 1998;86:2278-2324

[17] Research BA. Caffe. 2017. Available from: http://caffe.berkeleyvision.org/ [Accessed: 1 June 2017] DOI: http://dx.doi.org/10.5772/intechopen.90454
[18] Abadi M, Agarwal A, Barham P, et al; Tensor Flow: Large-Scale Machine Learning on Heterogeneous Distributed Systems; 2016
[19] Long E, Lin H, Liu Z, et al. An Artificial Intelligence Platform for the Multihospital Collaborative Management of Congenital Cataracts; 2017
[20] Esteva A, Kuprel B, Novoa RA, et al. Dermatologist-level classification of skin cancer with deep neural networks. Nature. 2017;542:115-118
[21] Gulshan V, Peng L, Coram M, et al. Development and validation of deep learning algorithm for detection of diabetic retinopathy in retinal fundus photographs. JAMA. 2016;316:2402-2410
[22] Kalli, Venkata & Gadde, Sai. (2020). Technology Engineering for Medical Devices - A Lean Manufacturing Plant Viewpoint. 9. 1-6. 10.17148/IJARCCE.2020.9401.