Section A-Research paper
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Review of Artificial Intelligence in Medical Field

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Abstract

Artificial Intelligence is the potential of a digital computer or computer supervised robots to conduct several tasks correlated with intelligent beings. It is used to implement computers and technology to replicate intelligent behaviour and critical thinking comparable to human being.

The term Artificial Intelligence was first conceived at Dartmouth College in 1956 by the scientist Marvin Minsky who was hopeful about the technology's future. But AI started its entry in healthcare in the early 1970s and then began to be practiced in biomedical fields.

Artificial intelligence research in medicine is growing and developing rapidly all over the world. AI in the healthcare sector is acknowledging great responses among the scientists, researchers and health professionals etc. In this review paper, we have summarized the growth as well as the developments of applications of AI in biomedicine, including disease diagnostics, living assistance, biomedical information processing, biomedical research and the availability of technologies used for AI.

Keywords: Artificial intelligence, medical diagnosis, medical imaging, medical records, precision medicine, drug discovery, clinical decision support, natural language processing, machine learning, deep learning, robotics, predictive analytics, healthcare operations, healthcare management, patient monitoring, patient engagement, clinical trials, healthcare data analytics, health informatics

I. INTRODUCTION

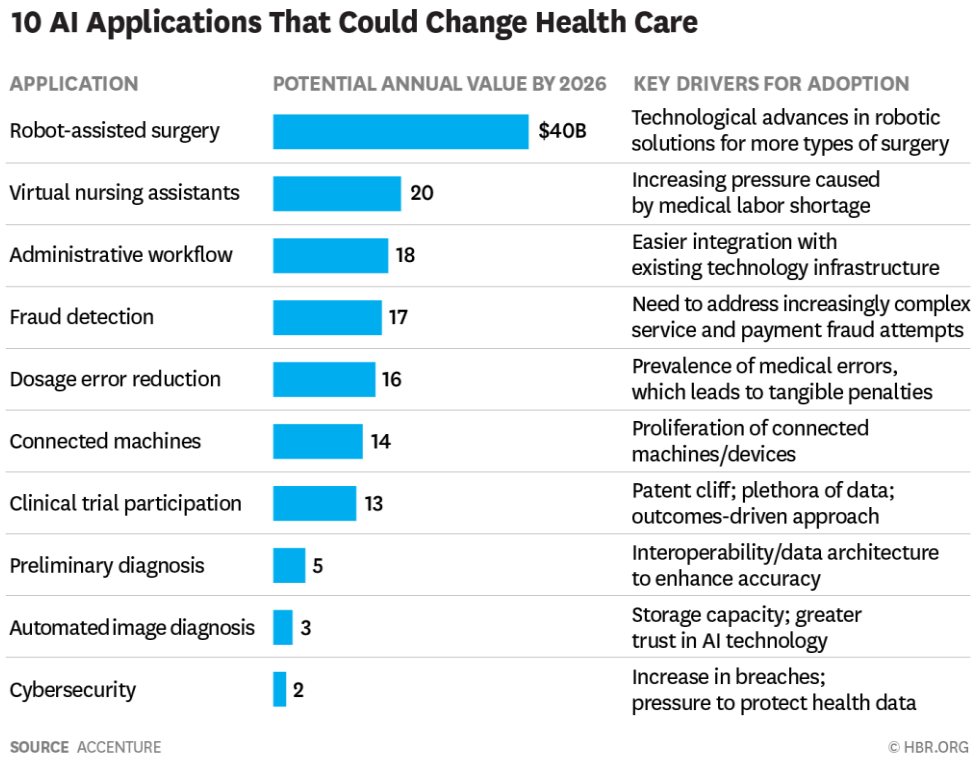
Artificial intelligence (AI) research within medicine is growing immensely and rapidly all over the world. Considered as one of the highest-growth industries in the world, the AI sector was valued at about $600 million in 2014 and is projected to reach a $150 billion by the year 2026 [1].

AI in medicine can be divided into two subcategories: virtual and physical. The virtual category has applications in electronic health record systems and in neural network-based guidance for the treatment decisions. The physical category is used to train robots for the assistance in clinical surgeries, elderly care, advanced protheses for handicapped people and many more.

ISSN 2063-5346

Whether health professionals have to find association between genetic codes or to drive robotic surgery, AI has eased the task by revitalizing modern healthcare system through AI based machines, which can learn, comprehend, detect, act, and predict.

The below figure shows the various applications of AI in Health Care:



Figure(i) – Applications of AI (Source: Accenture)

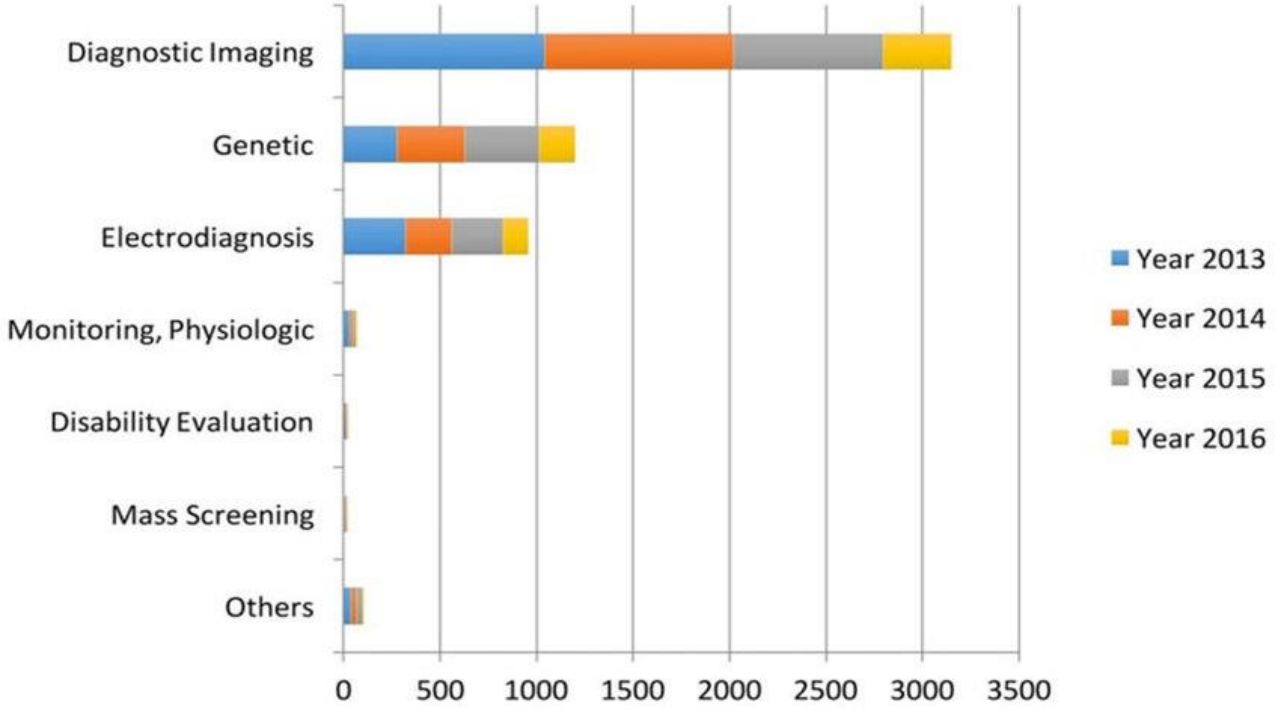
II. Development of AI in medical field

The benefits of AI have been broadly inclined to in the clinical compositions. To learn information from enormous amounts of patient's data and then make use of the results to improve medical care, advanced algorithms might be used by AI. These algorithms may also have the ability to self-correct and learn the results to improve precision based on the data. Exceptional clinical data from journals, course books, and medical strategies offered by AI frameworks may assist specialists with conveying adequate patient consideration. Diagnostic and therapeutic errors which are unavoidable in human medical care, but by using an AI system can reduce them. In addition to it, critical data is being collected by an AI gadget from a huge patient population to make continual deductions for health risk warnings and predictions.

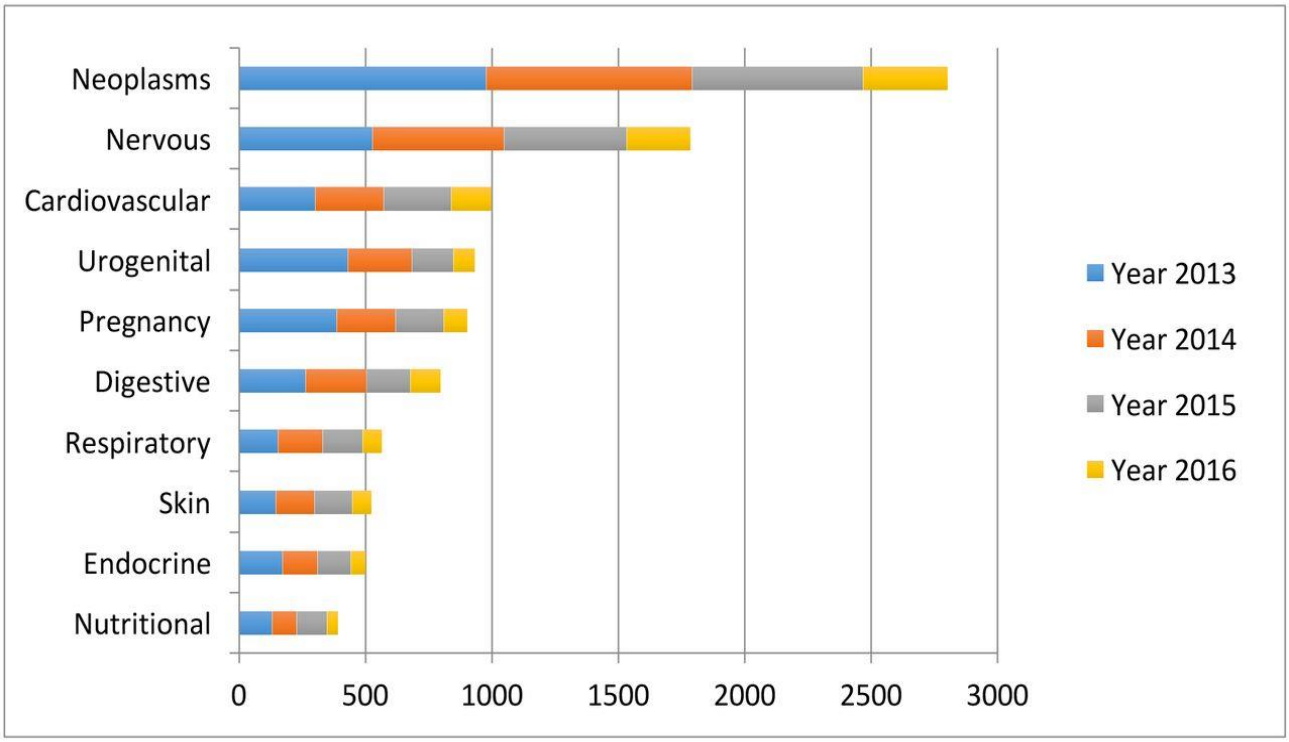
The most basic part of AI is the information that is made from medical exercises like screening, finding, and treatment tasks, among others. A few examples of clinical data are demographics, medical records, digital recordings from medical equipment, clinical examination, medical laboratory tests, and images. Artificial intelligence devices are divided into two types. Machine learning (ML) algorithms which evaluates structured data like imaging, genomics, and EP data fall first. Natural language processing (NLP) addresses pull

ISSN 2063-5346

features from unstructured data sources such as clinical notes and medical literature to supplement and improve organized medical data.

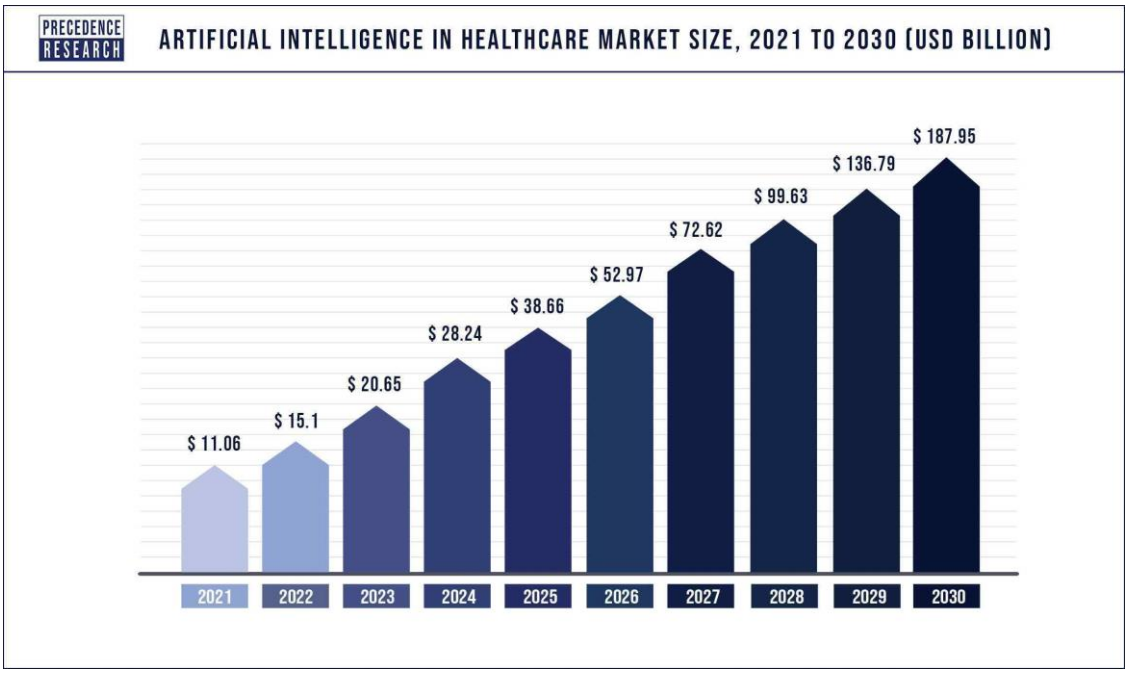


Figure(ii) - The types of data considered in AI literature (Source : https://svn.bmj.com)



Figure(iii) – Growth of AI in various healthcare sectors: past, present and future (Source: Jiang F, Jiang etal)

ISSN 2063-5346



Figure(iv) - Growth of AI in upcoming years (Source: www.precedenceresearch.com)

1. EXAMPLES OF ARTIFICIAL INTELLIGENCE IN HEALTHCARE:

In the following, some of the examples are mentioned where AI is being used for early detection and diagnosis of disease, robotic surgery, telemedicine and other health care systems.

A. Early Disease Detection

Various AI-based techniques have been used by researchers such as machine and deep learning models to detect the diseases such as skin, liver, etc. An AI-based deep learning method can be developed in two stages to detect critical illnesses like melanoma. In the first stage we create and train a model using available medical images previously taken using dermatoscopic (skin surface microscopic) cameras.

Disease detection driven by artificial intelligence (AI) has demonstrated to be an effective tool for identifying undiagnosed patients with complex common as well as rare diseases [14].

B. An Intelligent Symptom Checker

Natural language processing (NLP) is used by an AI symptom checker to understand a patient's free-text symptom description, and then it guides the patients through an appropriate symptom pursuit [4]. After the history of patient's present illness is being gathered, machine learning algorithms assess its inputs to produce differential and care recommendations. The differential is typically written down in order of condition severity and level of urgency of the patient.

C. AI Deep Learning for Actionable Insights

PaveAI is one of the common AI tools which turns google analytics into reports with AI insights and summaries for agencies and SMBs. It also integrates with google search console and among most of the popular social media networks [2].

Section A-Research paper
ISSN 2063-5346

Another common tool used for growth teams is Narrative BI. It is a no-code augmented analytics platform that automatically turns the raw data into actionable narratives. It merges with the company's existing data sources such as marketing, CRM, and Google Analytics, and then it automatically detects the correlations in the company's data. Narrative BI delivers analytics insights across the organization, enabling them with a wider adoption of advanced analytics across teams [5].

D. Earlier Cancer Detection with AI

Several AI tools have been developed by scientists to aid screening tests for several kinds of cancer, including breast cancer, blood cancer, lung cancer, etc. A new AI tool, called Sybil was shown to precisely predict whether a person will develop lung cancer in the next year 86% to 94% of the time. Sybil precisely predicted the risk of lung cancer for individuals even with or without a remarkable smoking history. Sybil takes the screening by first analyzing the LDCT image data without the assistance of a radiologist to predict the risk of a patient developing a future lung cancer within the six years [6].

2. DEVELOPING NEW MEDICINES WITH AI

A. AI In Biopharmaceutical Development

AI is used by BioXcel Therapeutics to recognize and develop new medicines in the fields of immuno-oncology and neuroscience [7]. In affiliation to that the company's drug re-invention program enrols AI to find new applications for the existing drugs or to identify new patients.

B. Treating Rare Disease With AI

An AI-based biotech platform named BERG is a clinical-stage, that maps diseases to open up the discovery and development of breakthrough medicines [9].

C. AI, Cloud-Based Digital Drug Discovery

On combining AI, the cloud and quantum physics, XtalPi's ID4 is a platform that predicts the chemical and pharmaceutical properties of small-molecule candidates for drug design and development [12].

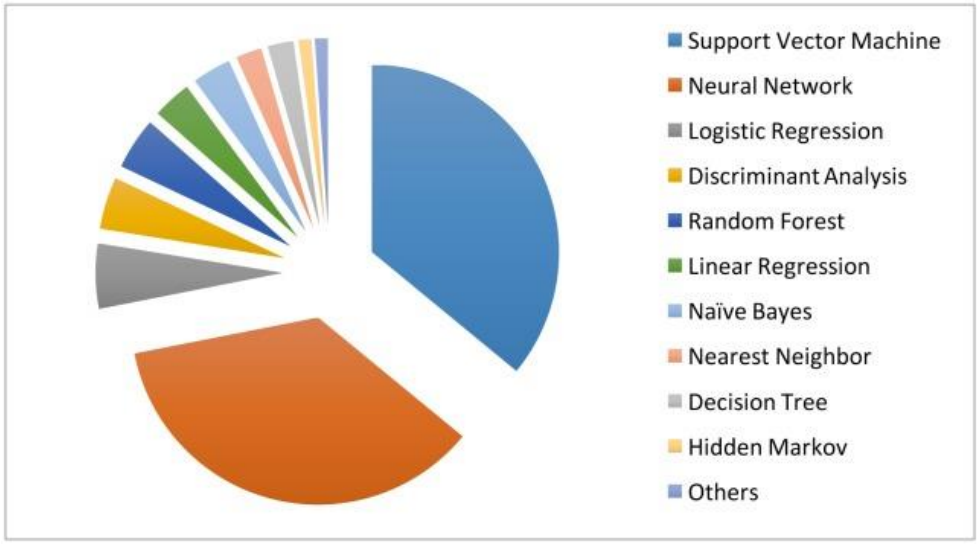
3. CHALLENGES IN AI DEVELOPMENT

Artificial intelligence in healthcare has several barriers. A vast amount of data is required to train machine learning algorithms or neural networks. However, we generally do not get clean or unbiased data. Data from several healthcare environments may contain noise, bias, imbalanced medical data, incomplete information, etc. The model trained on one hospital data may not be generic to the another. As a result, researchers must make sure that the data they collect represents the deliberate patient group. The few challenges faced are, data is growing aggressively, and the most important, providing perfect information at the point of decision making. One of the massive challenges is accountability of the system because the patient's life is at stake if someone dies due to wrong insight given by the AI. Who will be responsible for his death? The medical staff or the AI? This is not easy to answer because the medical staff put in the system provided for the better service for patients to take care of them. The following tools are used for extraction and evaluation of the health data.

Section A-Research paper
ISSN 2063-5346

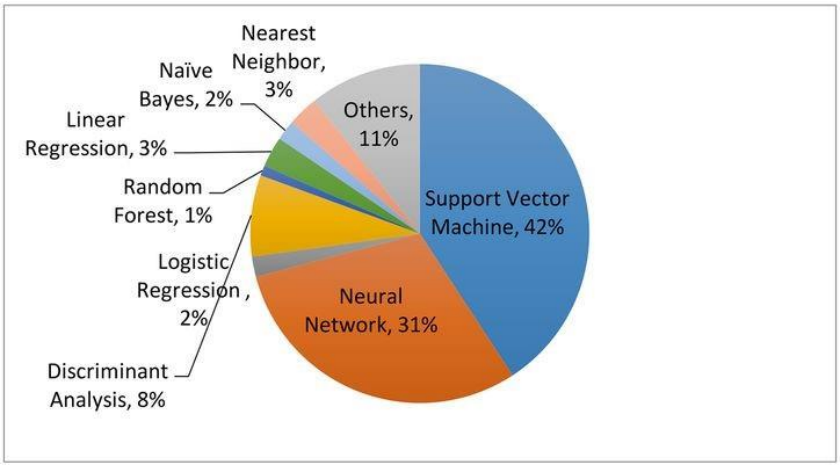
A. Machine Learning

In machine learning, the algorithms are designed to evaluate the data and extract information from it. In machine learning algorithm, the patient's "characteristics" and, in rare cases, the medical results of interest are fed into it. The two types of machine learning algorithms are unsupervised learning and supervised learning. Unsupervised learning is well-known for feature extraction, whereas supervised learning is more suited for predictive modelling since it establishes the link between patient data as the input and the desired outcome [3].

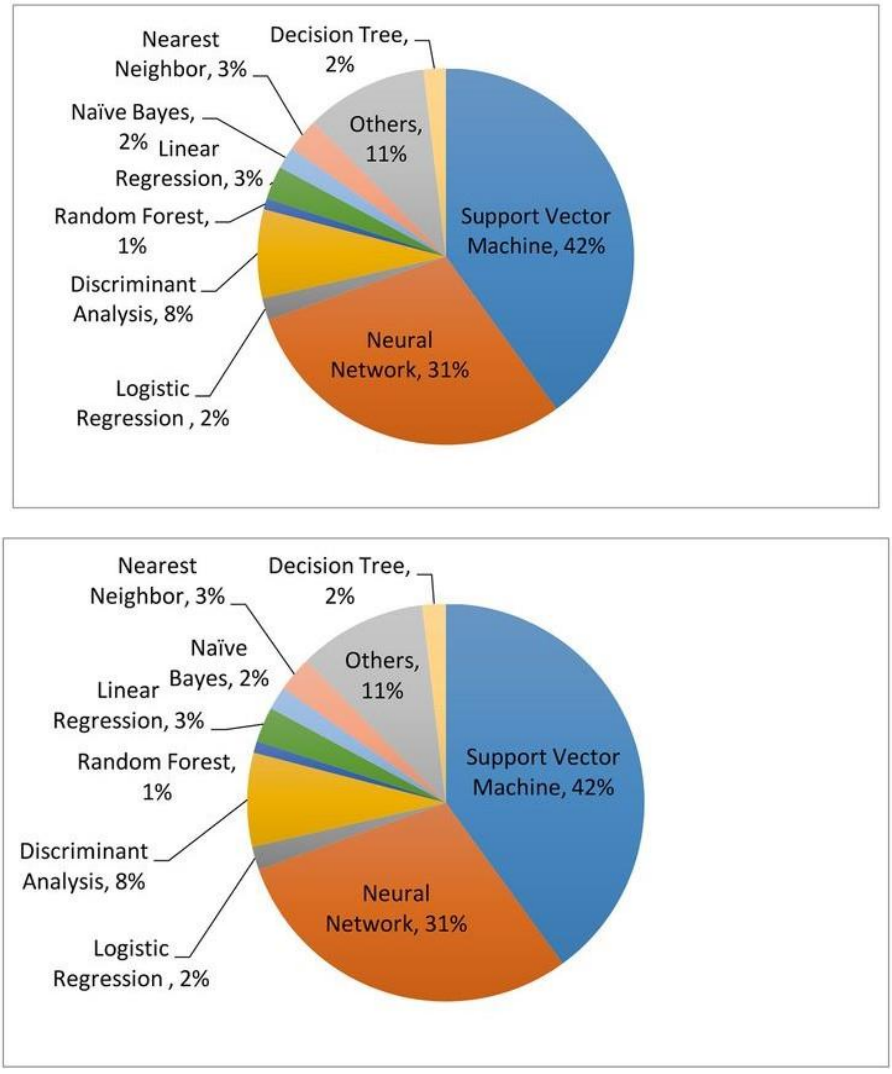


Figure(v) - Machine learning algorithm used in healthcare (Source : https://www.researchgate.net/publication/355855821_Review_on_Artificial_Intelligence_in_Healthcare)

Since unsupervised learning algorithm produces more clinically helpful outcomes; hence, supervised learning is used more often in AI implementations in healthcare. The prevalence of various supervised learning techniques in medical applications, the most common of which are being used are SVM and neural networks [13].



ISSN 2063-5346



Figure(vi) - Machine learning algorithm used for diagnosis analysis (Source : https://www.researchgate.net/publication/355855821_Review_on_Artificial_Intelligence_in_Healthcare)

B. Natural Language Processing

The clinical data in textual language, including physical examinations, reports from clinical laboratories, operation papers are in unstructured format, including the discharge summaries and indecipherable to a computer programmer. NLP tries to extract meaningful information from written texts to help with the therapeutic decision-making. Text processing and categorization are the two primary elements of an NLP pipeline. The NLP pipeline is planned in such a way to assist clinicians in side effect tracking as well as determining treatment decisions plan notification [14].

Section A-Research paper
ISSN 2063-5346

4. THE CHALLENGES FACED IN APPLYING AI

A. Injuries and Error

The most definite risk is that AI systems can sometimes be wrong, and patient's injury or other health-care problems may result. If an AI system endorse the wrong drug for a patient, fails to notice a tumour on a radiological scan, or give out a hospital bed to one patient over another because it predicted wrongly which patient would benefit more, the patient could be injured. Firstly, the patients and providers may react adversely to injuries resulting from software than from human error. Secondly, if AI systems become widespread, a basic problem in one AI system might result in injuries to thousands of patients – rather than the limited number of patients injured by any single provider's error.

B. Data Availability

To train AI systems it needs large amounts of data from sources such as electronic health records, pharmacy records, insurance claims records, or customer-generated details like fitness trackers or purchasing history of medicines or medical equipment [7]. But since these health data are generally shattered across many different systems, they are often complex. Apart from the variety just mentioned, patients usually see different providers and switch insurance companies, leading to data break in multiple systems and multiple formats. This disintegration increases the risk of error, decreases the inclusiveness of datasets, and increases the expense of collecting data which also limits the types of structure that can evolve productive health-care AI.

C. Privacy Concerns

Another set of danger arises around privacy. The exigency of large datasets creates instigation for developers to collect data from the patients. Some patients may be concerned about that this collection of data may infringe their privacy, and lawsuits have been filed against it based on the data-sharing between large health systems and AI developers [8]. AI could implicate their privacy in another way: AI can anticipate the private information of the patients even though the algorithm never received that information.

D. Bias and Inequality

There are a number of risks involving bias and inequity in AI health-care. The AI system learns from the data on which they are trained, and then they can integrate biases from those data. For example, if the data which is available for AI are firstly assembled in academic medical centers, then the arising AI systems will know less about it and therefore will treat less adequately.

E. Professional Realignment

Shifts in the medical profession involve long-term risks. Some medical specialities, such as radiology, are expected to shift importantly as much of their work becomes automatable. Some professors are bothered that with the extensive use of AI will result in the decrease of human knowledge and capacity over time, such that the providers lose the ability to catch and correct the AI errors and further to develop medical knowledge.

Section A-Research paper
ISSN 2063-5346

F. The Nirvana Fallacy

AI has the capability for boundless good in health care system. According to the nirvana fallacy problems arises when policymakers and others compare a new option to excellence, rather than that of the status quo. Since health-care AI faces risks and challenges, the current system is also common with problems. Because AI is imperfect and doing nothing creates the risk of maintaining a complicated status quo.

5. APPLICATIONS OF AI IN HEALTHCARE

A. In-Patient Mobility Monitoring

The health workers are very busy people. For instance, the intensive care unit (ICU) nurses, who have multiple patients in critical condition under their observation. Bounded flexibility and awareness during long-term treatments can adversely affect the patient's overall recovery. Keeping an eye on their activity is vital. So, the technology of AI correctly identified their movements 87 percent of the time [8]. Hereafter, the researchers aim to provide ICU staff with notifications when patients are in trouble.

B. Clinical Trials for Drug Development

One of the biggest challenges faced in drug development is organizing successful clinical tests. According to a report published in Trends in Pharmacological Sciences, in its present form, it might take up to 15 years to bring a new and possibly life-saving drug to market. It could also cost between $1.5 and $2 billion [10]. Around half of that time is spent in clinical tests, among which many of them failed. However, using AI technology, researchers can identify the right patients to go in for the experiments. Also, they can note their medical responses more competently and exactly, saving their time and money along the way.

C. Quality of Electronic Health Records (EHR)

If asked by any healthcare professional about what the hardship of their existence is, no doubly cumbersome EHR systems will come up. Usually, doctors would manually write down or type observations and information of the patients, and no two did it the same. Often, it is done after the patient's visit, inviting human error. However, backed speech recognition technology, interactions with patients, clinical diagnoses, and potential treatments can be augmented and documented more accurately and in near real-time with AI and deep learning.

D. Healthcare System Analysis

In Netherlands about 97% of the healthcare invoices are in digital format. A Dutch company uses AI to filter through the data to point up mistakes in treatments, workflow inadequacies, and helps area healthcare systems to avoid unessential patient hospitalizations [12].

These are just a few samples of the solutions AI offering the healthcare industry. As innovation pushes the proficiency of automation and digital workforces, from providers like Novatio, more solutions will be achievable in near future to save time, lower costs, and increase accuracy.

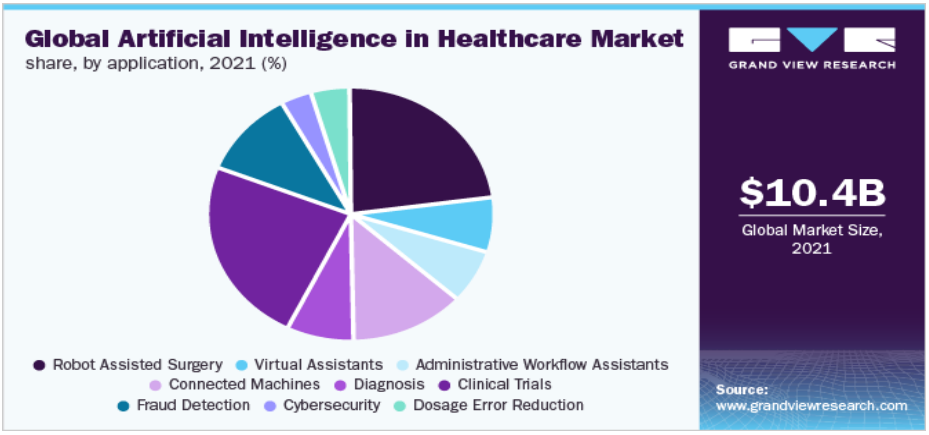
E. Administrative Workflow Assistance

One of the AI applications in healthcare is automation of administrative workflow. It guarantees that care providers prioritize urgent tasks, sustaining doctors, assistants, and nurses save time on their routine jobs. In the healthcare AI Applications could lead to about $18 billion savings for the healthcare industry [11]. Technologies like voice-to-text transcriptions offers help on the administrative end of healthcare. Non-patient care activities, such as ordering tests, prescribing medications, and writing chart notes, etc are also served by AI.

F. Robotic Surgeries

The technology of AI in the form of combined robots has brought revolution in the field of surgery. This revolution can be seen in terms of their speed and depth when making fine dissections. The result of a surgery, especially a new or complex process, can change with a surgeon's skills. AI implementation can minimize with case-to-case differences, hence, improving the proficiency of even the most skilled surgeons at the same time. As AI machines are precise, they reduce the probability of shudders or any accidental movements during any surgery.

Figure(vii) – AI latest applications (Source: ideas2it.com)



Figure(viii) – AI in healthcare Market Size Report (Source: www.grandviewresearch.com)

Section A-Research paper
ISSN 2063-5346

III. CONCLUSION

In this paper, the newest developments in the applications of AI are reviewed in biomedicine, including disease diagnostics, prediction and health services, living assistance, biomedical information processing, and biomedical research. AI has several applications in many other biomedical areas as well. AI plays a progressively vital role in biomedicine, not only because of the continuous advancement of AI itself, but also because of the inherent complex nature of biomedical problems and the propriety of AI to solve such problems. New AI accomplishments provide novel solutions for biomedicine, and the development of biomedicine demands new levels of capability from AI. This match of supply and demand and coupled developments will enable both fields to advance significantly in the foreseeable future, which will ultimately benefit the quality of life of people in need. AI has completely changed the traditional model of medicine, significantly improved the level of medical services, and guaranteed human health in various aspects. A broader development anticipation for medical AI is highly expected in the future. Artificial Intelligence is growing science which has various applications in several fields as well as medicinal services framework. Studies illustrate that AI is an inherently developing market in the field of healthcare. It has wide diversity of applications in this field such as data management, drug discovery, diabetic management, digital consultation etc. There is some proven evidence that medical AI can play an important role in helping the doctors and patients to deliver healthcare much more professionally in the 21st century.

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