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Review of artificial Intelligence

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ABSTRACT:

Over many centuries, tools of increasing sophistication have been developed to serve the human race

Digital computers are, in many respects, just another tool. They can perform the same sort of numerical and symbolic manipulations that an ordinary person can, but faster and more reliably. This paper represents review of artificial intelligence algorithms applying in computer application and software. Include knowledge-based systems; computational intelligence, which leads to Artificial intelligence, is the science of mimicking human mental faculties in a computer. That assists Physician to make dissection in medical diagnosis.

KEYWORD: Artificial intelligence, Computer controlled robot, Modern health care, History for AI

I. INTRODUCTION:

According to the father of Artificial Intelligence, John McCarthy, it is "The science and engineering of making intelligent machines, especially intelligent computer program. Artificial Intelligence is a way of making a computer, a computer-controlled robot, or a software think intelligently, in the similar manner the intelligent humans think. AI is accomplished by studying how human brain thinks and how humans learn, decide, and work while trying to solve a problem, and then using the outcomes of this study as a basis of developing intelligent software and systems [1]. Artificial intelligence (AI), broadly defined , is concerned with intelligent behavior in artifacts intelligent behavior, in turn, involves perception, reasoning, learning, communicating, and acting in complex environments. AI has as one of its long-term goals the development of machines that can do these things as well as human can, or possibly even better. Another goal of AI is to understand this kind of behavior whether it occurs in machines or in humans or other animals. Thus, AI has both engineering and scientific goals. While exploiting the power of the computer systems, the curiosity of human, lead him to wonder, "Can a machine think and behave like humans do? "Thus, the development of AI started with the intention of creating similar intelligence in machines that we find and regard high in humans [2]. Understanding intelligence involves understanding how knowledge is acquired, represented and stored; how intelligent behavior is generated and learned; how motives and emotion; and priorities are developed and used; how sensory signals are transformed into symbols; how symbols are manipulated to perform logic, to reason about the past, and plan for the future; and how the mechanisms of intelligence produce the phenomena of illusion, belief, hope, fear, and dreams and yes even kindness and love. Artificial intelligence (AI) is the simulation of human intelligence processes by machines, especially computer systems. These processes include learning (the acquisition of information and rules for using the information), reasoning (using rules to reach approximate or definite conclusions) and self-correction. Particular applications of AI include expert system, speech recognition and machine vision. AI can be categorized as either week or strong. Weak AI, also known as narrow AI, is an AI system that is designed and trained for a particular task. Virtual personal assistants, such as Apple's Siri, are a form of weak AI. Strong AI, also known as artificial general intelligence, is an AI system with generalized human cognitive abilities. When presented with an unfamiliar task, a strong AI system is able to find a solution without human intervention. Artificial intelligence is a science and technology based on disciplines such as Computer Science, Biology, Psychology, Linguistics, Mathematics, and Engineering. A major thrust of AI is in the development ofcomputer functions associated with human intelligence, such as reasoning, learning, and problem solving. Out of the following areas, one or multiple areas can contribute to build an intelligent system [3].

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Figure 1:- Application of AI in various field

1.1PROGRAMMING WITHOUT AND WITH AI

The programming without and with AI is different in following ways −

Programming Without AI	**Programming With AI**
1. A computer program without AI can answer the **specific** questions it is meant to solve.	**1.** A computer program with AI can answer the generic questions it is meant to solve.
2. Modification in the program leads to change in its structure.	**2.** AI programs can absorb new modifications by putting highly independent pieces of information together. Hence you can modify even a minute piece of information of program without affecting its structure.
3. Modification is not quick and easy. It may lead to affecting the program adversely.	**3.** Quick and Easy program modification [4].

Advantages of AI:

1. In space exploration: Intelligent robots can be used to explore space. They are machines and hence have the ability to endure the hostile environment of the interplanetary space.
2. Intelligent robots can be programmed to reach the Earth's nadirs. They can be used to dig for fuels. They can be used for mining purposes. The intelligence of machines can be harnessed for exploring the depths of oceans.
3. Intelligent machines can replace human beings in many areas of work. Robots can do certain laborious tasks. Painstaking activities, which have long been carried out by humans can be taken over by the robots.
4. Smartphone's In utilities like predicting what a user is going to type and correcting human errors in spelling, machine intelligence is at work. Applications like Siri that act as personal assistants, GPS and Maps applications that give users the best or the shortest routes to take as well as the traffic and time estimates to reach there, use artificial intelligence.
5.Fraud detection in smart card-based systems is possible with the use of AI. It is also employed by financial institutions and banks to organize and manage records.
6.Organizations use avatars that are digital assistants who interact with the users, thus saving the need of human resources.
7. Lacking the emotional side, robots can think logically and take the right decisions. Sentiments are associated with moods that affect human efficiency. This is not the case with machines with artificial intelligence.
8. Artificial intelligence can be utilized in carrying out repetitive and time-consuming tasks efficiently.
9. Intelligent machines can be employed to do certain dangerous tasks. They can adjust their parameters such as their speed and time, and be made to act quickly, unaffected by factors that affect humans.

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10. In a game where the computer plays as our opponent, it is with the help of AI that the machine plans the game moves in response to ours. Thus, gaming is among the most common examples of the advantages of artificial intelligence.
11. AI is at work in the medical field too. Algorithms can help the doctors assess patients and their health risks. It can help them know the side effects that various medicines can have. Surgery simulators use machine intelligence in training medical professionals.
12.Robotic pets can help patients with depression and also keep them active. Robotic radio surgery helps achieve precision in the radiation given to tumors, thus reducing the damage to surrounding tissues.
13. The greatest advantage of artificial intelligence is that machines do not require sleep or breaks, and are able to function without stopping. They can continuously perform the same task without getting bored or tired. When employed to carry out dangerous tasks, the risk to human health and safety is reduced.

Disadvantages of AI:
1. One of the main disadvantages of artificial intelligence is the cost incurred in the maintenance and repair. In case of a breakdown, the cost of repair may be very high. Procedures to restore lost code or data may be time-consuming and costly.
2. An important concern regarding the application of artificial intelligence is about ethics and moral values. Is it ethically correct to create replicas of human beings? Intelligence is a gift of nature. It may not be right to install it into a machine to make it work for our benefit.
3. Machines may be able to store enormous amounts of data, but the storage, access, and retrieval is not as effective as in case of the human brain. They may be able to perform repetitive tasks for long, but they do not get better with experience, like humans do.
4. The idea of machines replacing human beings sounds wonderful. It appears to save us from all the pain. Ideas like working wholeheartedly, with a sense of belonging, and with dedication have no existence in the world of artificial intelligence.
5. Imagine intelligent machines employed in creative fields. Do you think robots can excel or even complete the human mind in creative thinking or originality? Thinking machines lack a creative mind. Human beings are emotional intellectuals. They think and feel. Their feelings guide their thoughts. This is not the case with machines. The intuitive abilities that humans possess, the way humans can judge based on previous knowledge, the inherent abilities that they have, cannot be replicated by machines. Also, machines lack common sense.
6. If robots begin to replace humans in every field, it will eventually lead to unemployment.
7. Also, due to the reduced need to use their intelligence, lateral thinking and multitasking abilities of humans may diminish. With so much assistance from machines, if humans do not need to use their thinking abilities, these abilities will gradually decline. With the heavy application of artificial intelligence, humans may become overly dependent on machines, losing their mental capacities.
8. If the control of machines goes in the wrong hands, it may cause destruction. Machines won't think before acting. Thus, they may be programmed to do the wrong things, or for mass destruction.
9. Apart from all these cons of AI, there is a fear of robots superseding humans. Ideally, human beings should continue to be the masters of machines. However, if things turn the other way round, the world will turn into chaos. Intelligent machines may prove to be smarter than us; they might enslave us and start ruling the world [5].

1.2 BRIEF HISTORY OF AI:

YEAR	MILESTONE / INNOVATION
1923	Karel Čapek play named “Rossum's Universal Robots” opens in London, first use of the word "robot" in English.
1943	Foundations for neural networks laid.
1945	Isaac Asimov, Columbia University alumni, coined the term Robotics.
1950	Alan Turing introduced Turing Test for evaluation of intelligence and published Computing Machinery and Intelligence. Claude Shannon published DetailedAnalysis of Chess Playingas asearch.
1965	John McCarthy coined the term Artificial Intelligence. Demonstration of the first running AI program at Carnegie Mellon University.

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1958	John McCarthy invents LISP programming language for AI
1964	Danny Bobrow's dissertation at MIT showed that computers can understand natural language well enough to solve algebra word problems correctly
1965	Joseph Weizenbaum at MIT built ELIZA, an interactive problem that carries on a dialogue in English
1969	Scientists at Stanford Research Institute Developed Shakey, a robot, equipped with locomotion, perception, and problem solving.
1973	The Assembly Robotics group at Edinburgh University built Freddy, the Famous Scottish Robot, capable of using vision to locate and assemble models.
1975	The first computer-controlled autonomous vehicle, Stanford Cart, was built.
1985	Harold Cohen created and demonstrated the drawing program, Aaron.
1990	Major advances in all areas of AI – a) Significant demonstrations in machine learning b) Case-based reasoning c) Multi-agent planning d) Scheduling e) Data mining, Web Crawler f) natural language understanding and translation g) Vision, Virtual Reality h) games
1997	The Deep Blue Chess Program beats the then world chess champion, Garry Kasparov.
2000	Interactive robot pets become commercially available. MIT displays Kismet, a robot with a face that expresses emotions. The robot Nomad explores remote regions of Antarctica and locates meteorites.

Table 1:- History of Artificial intelligence [4]

1.3 GOALS OF AI:

a) To Create Expert Systems − the systems which exhibit intelligent behavior, learn, demonstrate, explain, and advice its users.

b) To Implement Human Intelligence in Machines − Creating systems that understand, think, learn, and behave like humans

1.4 TYPES OF ARTIFICIAL INTELLIGENCE:

Arend Hintze, an assistant professor of integrative biology and computer science and engineering at Michigan State University, categorizes AI into four types, from the kind of AI systems that exist today to sentient systems, which do not yet exist. His categories are as follows:

a) Type 1: Reactive machines. An example is Deep Blue, the IBM chess program that beat Garry Kasparov in the 1990s. Deep Blue can identify pieces on the chess board and make predictions, but it has no memory and cannot use past experiences to inform future ones. It analyzes possible moves - its own and its opponent - and chooses the most strategic move. Deep Blue and Google's Alpha GO were designed for narrow purposes and cannot easily be applied to another situation.

b)Type 2: Limited memory. These AI systems can use past experiences to inform future decisions. Some of the decision-making functions in self-driving cars are designed this way. Observations inform actions happening in the not-so-distant future, such as a car changing lanes. These observations are not stored permanently.

c) Type 3: Theory of mind. This psychology term refers to the understanding that others have their own beliefs, desires and intentions that impact the decisions they make. This kind of AI does not yet exist.

d) Type 4: Self-awareness. In this category, AI systems have a sense of self, have consciousness. Machines with self-awareness understand their current state and an use the information to infer what others are feeling. This type of AI does not yet exist [6].

II. AI TECHNOLOGY:

AI is incorporated into a variety of different types of technology.

1. Automation: What makes a system or process function automatically? For example, robotic process automation (RPA) can be programmed to perform high-volume, repeatable tasks that human

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normally performed. RPA is different from IT automation in that it can adapt to changing circumstances.

2. Machine learning: The science of getting a computer to act without programming. Deep learning is a subset of machine learning that, in very simple terms, can be thought of as the automation of predictive analytics. There are three types of machine learning algorithms:

a. Supervised learning: Data sets are labeled so that patterns can be detected and used to label new data sets

b. Unsupervised learning: Data sets aren't labeled and are sorted according to similarities or differences

c. Reinforcement learning: Data sets aren't labeled but, after performing an action or several actions, the AI system is given feedback

3. Machine vision: The science of allowing computers to see. This technology captures and analyzes visual information using a camera, analog-to-digital conversion and digital signal processing. It is often compared to human eyesight, but machine vision isn't bound by biology and can be programmed to see through walls, for example. It is used in a range of applications from signature identification to medical image analysis. Computer vision, which is focused on machine-based image processing, is often conflated with machine vision.

1. Natural language processing (NLP): The processing of human and not computerlanguage by a computer program. One of the older and best-known examples of NLP is spam detection, which looks at the subject line and the text of an email and decides if it's junk. Current approaches to NLP are based on machine learning. NLP tasks include text translation, sentiment analysis and speech recognition.

2. Robotics: A field of engineering focused on the design and manufacturing of robots. Robots are often used to perform tasks that are difficult for humans to perform or perform consistently. They are used in assembly lines for car production or by NASA to move large objects in space. Researchers are also using machine learning to build robots that can interact in social settings.

3. Self-driving cars: These use a combination of computer vision, image recognition and deep learning to build automated skill at piloting a vehicle while staying in a given lane and avoiding unexpected obstructions, such as pedestrians [2].

2.1 HUMAN INTELLIGENCE VS MACHINE INTELLIGENCE:

1. Humans perceive by patterns whereas the machines perceive by set of rules and data.
2. Humans store and recall information by patterns; machines do it by searching algorithms.
3. Humans can figure out the complete object even if some part of it is missing or distorted;

Whereas the Machines cannot do it correctly.

2.2- COMPUTATIONAL TOOLS OF AI:

According to Bezdek (1994), computational tools are the subsets of AI. Generally computational tools is a set of nature-inspired computational methodologies and approaches to address complex real-world problems to which mathematical or traditional modeling can be useless for a few reasons, computational tools provides solutions for such problems.

Principle computational tools are based on the process of natural selection, learning theory, and probabilistic methods which helps dealing with uncertainty imprecision.

1] Natural language processing:

Natural language such as english. Processing of Natural Language is required when you want an intelligent system like robot to perform as per your instructions, when you want to hear decision from a dialogue based clinical expert system, etc. The field of NLP involves making computers to perform useful tasks with the natural languages humans use. The input and output of an NLP system can be –

a. Speechb. Written Text

Components of NLP: There are two components of NLP as given

A.Natural Language Understanding:

a. Mapping the given input in natural language into useful representations.

b. Analyzing different aspects of the language.

B.Natural Language Generation: It is the process of producing meaningful phrases and sentences in the form of natural language from some internal representation.

a.Text planning − It includes retrieving the relevant content from knowledge base.

b. Sentence planning − It includes choosing required words, forming meaningful phrases, setting tone of the sentence.

c. Text Realization − It is mapping sentence plan into sentence structure.

C. Steps in NLP:

a. Lexical Analysis: It involves identifying and analyzing the structure of words. Lexicon of a

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language means the collection of words and phrases in a language. Lexical analysis is dividing the whole chunk of txt into paragraphs, sentences, and words.

b. Syntactic Analysis Parsing: It involves analysis of words in the sentence for grammar and arranging words in a manner that shows the relationship among the words.

c. Semantic Analysis: It draws the exact meaning or the dictionary meaning from the text. The text is checked for meaningfulness. It is done by mapping syntactic structures and objects in the task domain. The semantic analyzer disregards sentence such as "hot ice-cream".

d. Discourse Integration: The meaning of any sentence depends upon the meaning of the sentence just before it. In addition, it also brings about the meaning of immediately succeeding sentence.

e. Pragmatic Analysis: During this, what was said is re-interpreted on what it actually meant. It involves deriving those aspects of language which require real world knowledge.

2] FUZZY LOGIC:

Fuzzy Logic is a method of reasoning that resembles human reasoning. The approach of FL imitates the wayof decision making in humans that involves all intermediate possibilities between digital values YES and NO. The conventional logic block that a computer can understand takes precise input and produces a definite output as TRUE or FALSE, which is equivalent to human's YES or NO.The inventor of fuzzy logic, Lotfi Zadeh, observed that unlike computers, the human decision making includes a range of possibilities between YES and NO. Drugs discovery & design is an intense, lengthy and consecutive process that starts with the lead & target discovery followed by lead optimization and pre-clinical in vitro & in vivo studies. Earlier, computational techniques are use in the field of computer science, electrical engineering and electronics & communication engineering to solve the problems. But, now day's use of these techniques has changed the scenario in drugs discovery. & design from the last two decades. These techniques include Artificial Neural Network, Fuzzy logic, Genetic Algorithm, Genetic Programming, Evolutionary Programming, Evolutionary Strategy etc. Fuzzy logic is the science of reasoning, thinking and inference that recognizes and uses the real world phenomenon that everything is a matter of degree. Fuzzy set is differing from traditional set theory i.e. fuzzy set has unsharp boundaries. So the traditional set theory has either value 0 or 1 but in fuzzy set the value is lie in between $0 \leq \mu \geq 1$ where μ is the membership function. Most important characteristic of fuzzy logic is fuzzy inference. Fuzzy inference systems based on fuzzy set theory are considered suitable for dealing with many real world problems, characterized by complexities, uncertainties, and a lack of knowledge of the governing physical laws. The most important application of fuzzy set theory is the fuzzy rule-based models, where the relationships among system variables are modeled using linguistically interpretable rules. Fuzzy logic can be especially useful in describing target properties for optimizations. For example, the formulator might be seeking a tablet disintegration time of 200 s, i.e. any value less than 200 s has a desirability of 1 (i.e. 100%). But a tablet which disintegrates in 210 s is not entirely undesirable (as crisp logic would insist), and instead might be assigned a desirability value of 0.9. The basic steps of the fuzzy set in the process modeling described as,

a) Arrange the input and output dataset.
b) Clustering the output set.
c) Map the fuzzy inputs to the output.
d) Identify the significant variables [3].

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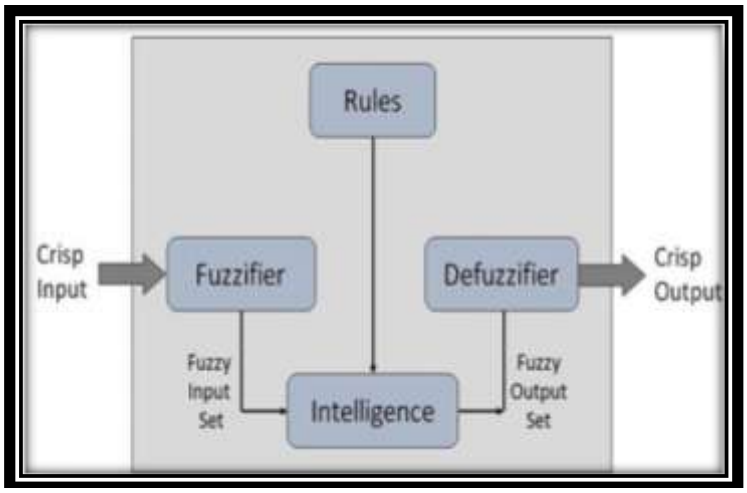

Figure 2: Fuzzy logic [8]

III. ARTIFICIAL NEURAL NETWORKS:

"A computing system made up of a number of simple, highly interconnected processing elements, which process information by their dynamic state response to external inputs.**"**

Types of Artificial Neural Networks:

There are two Artificial Neural Network topologies − **Feed Forward** and **Feedback.**

a) Feed Forward ANN:

In this ANN, the information flow is unidirectional. A unit sends information to other unit from which it does not receive any information. There are no feedback loops. They are used in pattern generation /recognition /classification. They have fixed inputs and outputs.

b) Feedback ANN:

Here, feedback loops are allowed. They are used in content addressable memories. In the last few years, neural networks have received recognition among scientists and engineers and they are being recommended as one of the greatest computational tools ever developed. Much of this elation is due to the potential of neural networks to reproduce the brain's capability to assimilate by example. This network makes decision and draws conclusions even when presented with incomplete information. Moreover, at some primitive level, neural network imitates brain's creative process in adapting to a novel situation. Artificial neural networks (ANNs) technology models the pattern recognition capabilities of the neural networks of the brain. Similarly, to a single neuron in the brain, artificial neuron unit receives inputs from many external sources, processes them, and makes decisions. Interestingly, ANN simulates the biological nervous system and draws on analogues of adaptive biological neurons. ANN is composed of numerous processing units (PE), artificial neurons. The connections among all the units vary in strength, which is defined by coefficients or weights. The ANN mimics working of human brain and potentially fulfills the cherished dream of scientists to develop machines that can think like human beings. ANNs simulate learning and generalization behavior of the human brain through data modeling and pattern recognition for complex multidimensional problems. A significant difference between an ANN model and a statistical model is that the ANN can generalize the relationship between independent and dependent variables without a specific mathematical function. Thus, an ANN works well for solving nonlinear problems of multivariate and multi response systems such as space analysis in quantitative structure-activity relationships in pharmacokinetic studies and structure prediction in drug development [9].

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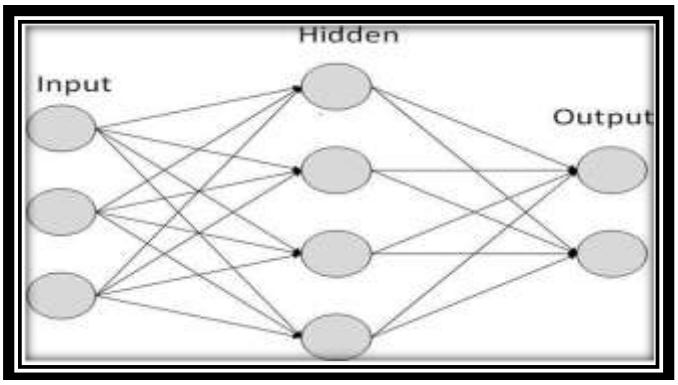

Figure 3: Neural network [10]

IV. GENETIC ALGORITHM:

A genetic algorithm (GA) is a search heuristic that imitates the process of natural advancement in the discipline of Artificial Intelligence. This heuristic (also sometimes called a met heuristic) is regularly used to originate useful solutions to optimization and search problems. Genetic algorithm is a probing technique that is used to find concurrent solutions for optimization and search problems. They are stochastic optimization methods and provide a powerful means to perform directed random searches in a large problem space as encountered in chemo metrics and drug design. A genetic algorithm needs two things to be defined i.e. genetic representation of solutions and fitness function. To solve any problem, the first requirement is to draw the genetic representation. After the genetic representation the second requirement is to define a fitness function for the problem. The different problems have different type of fitness function. The Genetic Algorithm starts with the initialization of the population of solutions randomly and several individual solutions are randomly generated to form an initial population. The size of population relay on the nature of problem. It may consist hundreds or thousands of individual solutions. In the next, the fitness function is evaluated for each individual population. The last step is the reproduction of population. In this step the genetic operator such as selection, crossover and mutation are applied to generate the next generation of population. In drugs designing, a molecule is defined as input to GA and a binary string is used to code the molecule. A large number of the solution is generated by using genetic operator. The best population is selected and further used to generate the new population until a desired solution is reached [2]

V. MACHINE LEARNING:

Machine learning is the process of teaching machines to recognize patterns by providing them data and an algorithm to work with the data. And it has helped a lot in the field of healthcare in a number of different ways.Many sectors are using machine learning, healthcare cannot stand behindExperts call the process of machine learning as ‘training’ of machines and the output that is produced is known as ‘model’. The model is provided with data and it creates new information with whatever it had previously learned

a. **Classification:** The purpose of this model is to determine a category- it is one thing or another. The model is trained to categorize the dataset.
b. **Clustering –** This model is created when there is a bunch of data available but didn’t have a determined outcome and just want to see distinctive patterns in the data.
c. **Regression –** This model is created for the purpose of finding value. With the help of data, the algorithm can find associations between any two variables and the outcome is predicted accordingly.

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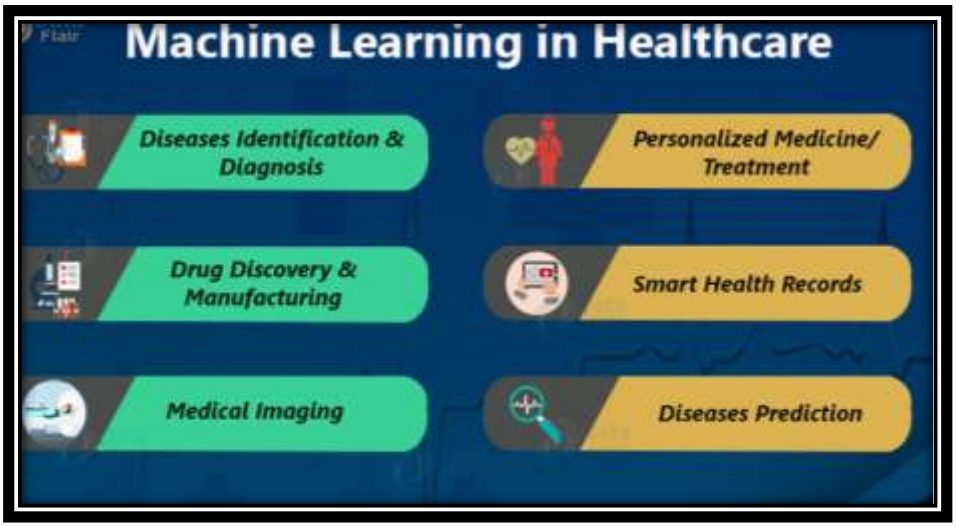

Figure 4: Machine learning in healthcare types [11]

a) Identification of Diseases and Diagnosis

It is hard to diagnose diseases manually, machine learning plays a huge role in identifying the patient's disease, monitor his health, and suggest necessary steps to be taken in order to prevent it. It can include anything from minor diseases to major ones such as cancer which is tough to identify in the early stages.

Any type of cancer is a killer disease and researchers are fighting every day to get new solutions and developments to help the people.

b) Drug Discovery and Manufacturing

R&D technologies such as next-generation sequencing and precision medicine can help to find therapy of multifaceted health diseases. Machine learning algorithms such as unsupervised learning can identify patterns in data without providing for any predictions.

Discovering or manufacturing a new drug can be expensive and a long process because there are a number of compounds that are put to the test and only one result can prove to be useful. With the advancements in technology, machine learning can lead to stimulating this process.

c) Medical Imaging

With the help of machine learning techniques such as deep learning, it is now possible to find microscopic deformities in the scanned images within the patients and as a result, doctors are able to suggest a proper diagnosis. Traditionally, techniques like x-ray and CT scan were enough to inspect minor irregularities, but with the increasing diseases, there was a need to inspect them properly.

d) Personalized Medicine/Treatment

With the explosion of patient data in the form of genetic information and electronic health records, doctors are able to provide personalized treatment to individual patients according to their precise needs. Their aim is to gain insights from massive amounts of datasets and use it to make patients healthy at individual level. These insights are able to suggest personalized combinations, and predict disease risk with the help of machine learning technologies.

e) Smart Health Records

While technology has eased the process of data entry, there are still some processes that take up a lot of time. Maintaining up-to-date health records every day is exhausting as well as time-consuming. After initiating such huge works, maintaining health records is another area where machine learning has entered to save time, effort, and money. Google's Cloud Vision API and MATLAB's machine learning-based handwriting recognition technology are used for document classification methods.

f) Predicting Diseases

Various machine learning technologies are being put to use in monitoring and predicting outbreaks around the world. Scientists have access to a massive amount of data collected from satellites, social media platforms, websites, etc. ML techniques such as artificial neural networks help to collaborate with this information and predict everything from minor diseases to severe chronic infectious [12].

5. APPLICATION OF AI IN HEALTHCARE:

A. Formulation and Development:

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a) Controlled release tablets: The first work in the use of neural networks for modeling pharmaceutical formulations was performed by Hussein and coworkers at the University of Cincinnati (OH, USA). In various studies they modeled the in vitro release characteristics of a range of drugs dispersed in matrices prepared from various hydrophilic polymers. In all cases, neural networks with a single hidden layer were found to offer reasonable performance in the prediction of drug release. In general, the results were comparable with those generated through the use of statistical analysis, but when predictions outside the limits of the input data were attempted performance was poor. No attempt was made to optimize the formulations using genetic algorithms, but the results generated did lead the researchers to propose the concept of computer aided formulation design based on neural networks. In a more recent study involving the formulation of diclofenac sodium from a matrix tablet prepared from cetyl alcohol, personnel from the pharmaceutical company KRKA and the University of Ljubljana (Slovenia) have used neural networks to predict the rate of drug release and to undertake optimization using two- and three-dimensional response surface analysis. Non-linear relationships were found between the release rate and the amounts of the ingredients used in the formulation, suggesting the possibility of the production of several formulations with the same release profile.

b) Immediate release tablets: Neural networks and statistics to model tablet formulations of hydrochlorothiazide. The networks produced were used to prepare three-dimensional plots of massing time, compression pressure and crushing strength, or drug release, massing time and compression pressure in an attempt to maximize tablet strength or to select the best lubricant. Although trends were observed no optimal formulations were given. The trends were comparable to those generated by statistical procedures. Comparable neural network models were generated and then optimized using genetic algorithms. It was found that the optimum formulation depended on the constraints applied to ingredient levels used in the formulation and the relative importance placed on the output parameters. A high tablet strength and low friability could only be obtained at the expense of disintegration time. In all cases lactose was the preferred diluents and fluidized bed the preferred granulating technique [13].

B. Product Development:

The pharmaceutical product development process is a multivariate optimization problem. It involves the optimization of formulation and process variables. One of the most useful properties of artificial neural networks is their ability to generalize. These features make them suitable for solving problems in the area of optimization of formulations in pharmaceutical product development. ANN models showed better fitting and predicting abilities in the development of solid dosage forms in investigations of the effects of several factors (such as formulation, compression parameters) on tablet properties (such as dissolution). ANNs provided a useful tool for the development of microemulsion-based drug-delivery systems in which experimental effort was minimized. ANNs were used to predict the phase behavior of quaternary microemulsion-forming systems consisting of oil, water and two surfactants. ANN was also used to simulate aerosol behavior, with a view to employing this type of methodology in the evaluation and design of pulmonary drug-delivery systems . For controlling and decision-making, fuzzy logic is a very powerful problem-solving technique. It provides very useful rules from input data, in the form of "if… so… then". Fuzzy logic can be combined with neural networks as neuro fuzzy logic. This combination provides more flexibility and capability to the technique and provides powerful results [14].

C. IBM Watson for oncology:

IBM has developed a supercomputer and named it Watson, which is a combination of AI and sophisticated analytical software designed basically to answer questions. Watson for oncology has been designed to assist oncologists in taking better decisions for the treatment of cancer. It works by analyzing the medical information of a patient from a vast network of data and expertise and then providing treatment options based on the evidence obtained. Watson for oncology is capable of analyzing both the meaning and context of any data present in clinical notes or reports, be they properly structured or unstructured. It can easily collect critical information regarding the patient and write it in plain English which can turn out to be a very critical step in providing the correct treatment plan for the patient. It combines critical attributes from the file of a patient with external research, clinical research, and data and then decides the most effective treatment plans that can be implemented for a patient. Watson has a huge array of information from literature and rationales curetted

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by MSK, over 200 textbooks, 12 million text pages, and over 290 medical journals.

(Recently, an Indian software engineer, aged 37 years, was diagnosed with breast cancer of a rare form and it was spreading across both her breasts very fast which was posing a threat of both breast removals. Her medical records along with her genomics data were fed into Watson by Dr. Somashekhar, an oncologist in Bangalore, and Watson provided viable treatment options within 60 s [15].

D. Robot pharmacy:

With the objective of improving the safety of patients, UCSF Medical Center uses robotic technology for the preparation and tracking of medications. According to them, the technology has prepared 3, 50, 000 medication doses without any error. The robot has proved to be far better than humans both in size as well as its ability to deliver accurate medications.The abilities of the robotic technology include preparation of oral as well as injectable medicines which include chemotherapy drugs that are toxic. This has given freedom to the pharmacists and nurses of UCSF so that they can utilize their expertise by focusing on direct patient care and working with the physicians.Within the automated system of the pharmacy, the computers first receive medication orders electronically from the physicians and pharmacists of UCSF. After this, individual doses of pills are picked, packaged, and dispensed by the robotics. This is followed by machines assembling the doses onto a bar-coded plastic ring. The thin plastic ring contains all medications that have to take by a patient within a period of 12 h. The automated facility also consist an inventory management system that keeps track of every product along with a refrigerated and two non-refrigerated pharmacy warehouses for providing with storage and withdrawal of supplies and medications. All these facilities are fully automated [16].

Figure 7:- Robot pharmacy

E. MEDi robot:

MEDi is a short form for Medicine and Engineering Designing Intelligence. The pain management robot was developed as part of a project led by Tanya Beran, professor of Community Health Sciences at the University of Calgary in Alberta. She got the idea after working in hospitals where children scream during medical procedures. The robot first builds a rapport with the children and then tells them what to expect during a medical procedure. During the medical procedure, it guides them on what should be done, how to breathe during the procedure, and how to cope. Although the robot cannot think, plan, or reason, it can be programmed such that it shows to have AI.MEDi, manufactured by Aldebaran Robotics, having inbuilt facial recognition technology, can speak 20 different languages and is highly adaptable to different situations. The retail price of the robot is $9000; however, the cost rises to $15000–$30000 when the applications needed for the robot to help in medical procedures are installed. The robot was initially developed for pain management, but with time its use has expanded to comfort between procedures, physical rehabilitation, and fundraising [17].

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Figure 8:- MEDi robot [18]

F. Erica Robot:

Erica is a new care robot that has been developed in Japan by Hiroshi Ishiguro, a professor at Osaka University. It was developed in collaboration with the Japan Science and Technology Agency, Kyoto University, and the Advanced Telecommunications Research Institute International (ATR). It can speak Japanese and has a blend of European and Asian facial features. Like any normal human being, it likes animated films, desire to visit south-east Asia, and wants a life partner who would chat with it. The robot cannot walk independently; however, it has been developed with the ability to understand and answer questions with human-like facial expressions. Erica is the "most beautiful and intelligent" android as Ishiguro fixed up the features of 30 beautiful women and used the average for designing the robot's nose, eyes, and so on [9].

Figure 9:- Erica robot [19]

G. TUG robots:

Aethon TUG robots are designed to autonomously travel through the hospital and deliver medications, meals; specimens, materials, and haul carry heavy loads such as linen and trash. It has two configurations, i.e., fixed and secured carts as well as exchange base platform that can be used to carry racks, bins, and carts. The fixed carts are used for delivering medications, sensitive materials, and laboratory specimens, whereas, the exchange platform is employed to transport materials that can be loaded on different racks. The TUG can deliver several types of carts or racks thus making it a very flexible and utilizable resource. During working, a touch screen that is simple to use, allows users to determine where the TUG has to make deliveries or from where it has to pick up supplies or materials. In the case of multiple destinations, the TUG automatically computes the best path. It has sensors that overlap to ensure 180° coverage while navigation and to detect obstacles. The array of sonar and infrared sensors called

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"Light whisker" are able to detect low lying obstacles. The benefits of using TUG include 24/7 improved productivity, improved patient experience, worker safety, employee satisfaction, and patient safety [20].

Figure 10:- TUG robot [21]

H. Manufacturing Execution System (MES):

A MES is a control system that is designed to manage, monitor, and track the various manufacturing information in real time by receiving minute by minute data from various sources which include robots, employees, and machine monitors. In today's world, MES is being widely integrated with enterprise resource planning systems. MES facilitates compliance with regulatory guidelines along with ensuring that drug makers get high-quality products in their manufacturing processes. The benefits of using MES include compliance with guaranteed legal regulations, minimized risks, increased transparency, shortened production cycles, optimized resource utilization, controlled, and monitored production steps, and optimized up to batch release.

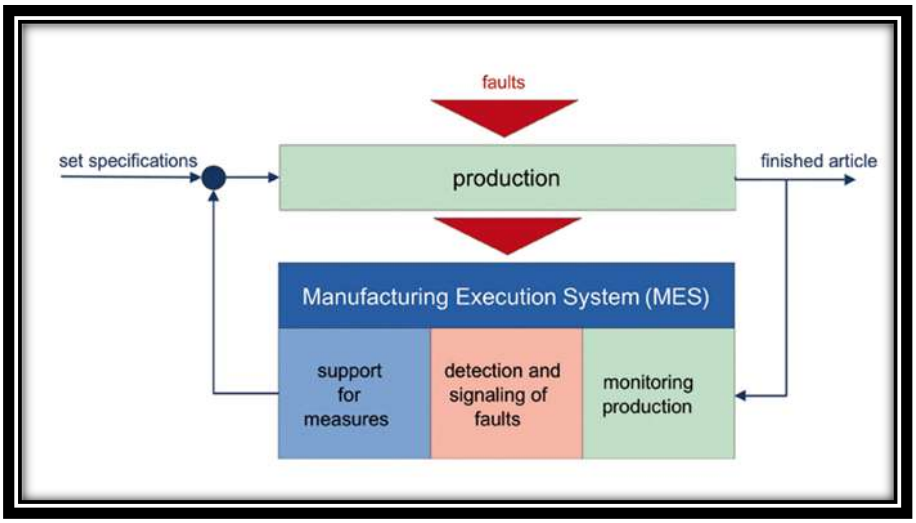

Figure 11:- Manufacturing Execution System

I. Automated Control Process System (ACPS):

The objective of an ACPS is to ensure that a process is carried out in a safe and profitable manner. This is achieved by continually monitoring the various process variables which include temperature, pressure, flow, vacuum, and concentration and as and when required, taking necessary actions such as slowing down pumps, opening valves, and turning the heaters up so as to ensure that the process variables are maintained at the required values. The advantages of ACPS are good quality achieved at low cost, saving of material, assured personnel, plant, and processes

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safety, increased yield, and reduced labor cost. The elements of ACPS include
(1) Sensing process variables' value,
(2) Transmission of signal to measuring element,
(3) Measure process variable,
(4) Presenting the value of the measured variable,
(5) Set the value of the desired variable,
(6) Comparison of desired and measured values,
(7) Control signal transmission to final control element, and
(8) Control of manipulated value.

J. Berg:

Berg is Boston-based biotech and is one of the key players employing AI in its various processes. It has an AI-based platform for drug discovery, which has a huge database of patients and this is used to find as well as validate the various biomarkers responsible for causing diseases and then decides therapies according to the obtained data. The motto of the company is to speed up the process of drug discovery and to bring about a reduction in the cost with the aid of AI as it obliterates guesswork that is involved in the process of drug development. The steps that are followed by Berg include procurement of sequencing data from samples of human tissue, finding information regarding metabolites, and protein formation, and testing of data using algorithms of AI to correctly determine the actual cause of disease [22].

VI. CONCLUSION:

Induction of AI in health has already taken a central stage and in future it has potential to radically transform healthcare. The technological advancement in mobile computing, artificial neural networks, robotics, storage of huge data in internet, cloud- based machine learning and information processing algorithms etc. has propelled the use of AI in modern healthcare. AI is also use in philosophy, sociology, math, psychology and other fields. With AI, chances of error are almost nil. The use of technology can save time and money while better understanding the relationship between formulations and processes parameters. Pharmaceutical companies have been actively adopting AI approaches for drug discovery and are starting to focus this technology on clinical trials.

Compliance with ethical Standards

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Disclosure of conflict of interest
There was no conflict of interest in this study.

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