REVIEW ARTICLE

Artificial Intelligence Technology and its Challenges-A Review

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ABSTRACT

In the last two decades, researchers have found many advantages related to Artificial Intelligence (AI) in the performance of both service and manufacturing systems. It includes alternate methods to conventional techniques and there are mechanisms of integrated systems. Currently, many researches related to artificial intelligence are under process. At present, artificial intelligence has been used to solve various problems in several fields and has become more popular around the world. This field is extremely difficult to review either chronologically or thematically. AI has a long history of growing constantly and changing tremendously. Connected with the history of computers, artificial intelligence is the main concept behind the fifth generation computers. This review paper deals with the framework of artificial intelligence and focuses on fields related to artificial intelligence. Particularly this paper describes about the recent growth in the field of artificial intelligence and its applications. Several issues of artificial intelligence are analysed. It is concluded that still many researches are yet to be conducted for further growth in the field of Artificial Intelligence (AI).

Keywords: Intelligent systems, Knowledge base, Expert systems, Computational language, Interference engine.

1. INTRODUCTION

In the 21st century, the invention of computers or machines and their skills to perform several tasks go on increasing immensely. Artificial Intelligence (AI) is a branch of computer science which deals with a computer controlled robot in the same manner as intelligent humans think. According to [1], AI can be defined as an artificial company having intelligence in solving difficult problems and is typically assumed to be a computer controlled machine. It is a combination of physiological intelligence and computer science in which computational part is analysed in order to accomplish certain worldly goals. Intelligence means attainment of certain skills to think and imagine for creating, understanding, memorizing, recognizing patterns, making several choices that are adapted to change and learning new things from experiences. [2] Artificial intelligence is been concerned with computers to perform like humans. Research in the field of artificial intelligence has certain aims such as generating software in order to simulate various intelligent capacities same as that of human beings such as reasoning, natural language communication, learning, problem solving and discussion making. Thus computers with such programs have to depart from simple tools to progressively become a kind of assistant to humans. [3] It can also be regarded as a kind of robot which can completely do works similar to human beings and this machine (robot) have intelligence similar to human intelligence level. So, efforts are taken so that robots solve various problems within short interval times which are lesser than the time taken by humans. These machines have the capability to reason, think and do all tasks that a human is capable of doing. AI is a combination of science and technology based on areas such as biology, mathematics, computer science, psychology and engineering. [4] highlights that AI is the study of mental abilities through the computational model use and it explains about the behaviour of intelligence in computational

techniques. They describe about the mental abilities through the usage of computational representations. Artificial intelligence is mainly based on computer programs. This computer program must have the capability to do many diverse things and hence it is called intelligent. According to [5] there are many ways to represent an artificially intelligent system that can be classified as follows,

- ➢ Computer controlled machine that think like humans
- ➢ Computer controlled machine that act like humans
- ➢ Computer controlled machine that think rationally
- ➢ Computer controlled machine that act causally.

[6] Recently many researchers attend emerging distinct modules, which is based on several aspects of the human brain in terms of a planning module, a memory module, etc., that could be finally combined to make intelligence. The development of technologies is linked with robots and computing. Though there are lots of merits owing to the use of robots of AI, there are drawbacks due to the failure of certain efforts. Hence, a computer program simulation termed as Artificial General Intelligence (AGI) is developed where computer-generated agents are involved in order to achieve intelligent behaviour. [7] proposed that basically, intelligence is related with neuronal and synaptic activity. Further, it relates to certain tasks involving higher mental processes such as solving problems, classification, learning, building analogies, creativity, language processing, knowledge, etc.

2. MODERN TRENDS IN ARTIFICIAL INTELLIGENCE

[8] discusses about the initial AI systems for problem solving and planning. This could be illustrated in one of the approaches called means-ends analysis, which is directly connected to human thoughts. For certain reasons, these thoughts are slowly replaced with algorithms which limit intricate reasons thus assisting in achieving desired goals. [9] Recently, these trends have changed due to novel techniques that have formalized the planning work in terms of carrying out research in widespread potential paths. Initial methods used natural languages which are aimed to create a deep understanding of

sentences and dissertation as humans' exhibit. Hence old trends of artificial intelligence systems created with this skill can make certain troubles such as consuming more time leading to delicate behaviour. [10] Meantime, old methods of AI systems have been totally changed to statistical methods that have slowed down the process in order to develop a scientific study of languages. Moreover, they are emphasized frequently on some tasks like retrieval and extraction of information that attain near-term practical goals, but has little intersection with the broad capabilities that is created from natural language processing. [11] explains that several approaches are generated for the incremental nature of human learning. Later, these approaches along with background knowledge and experiences maintain the AI systems. According to [12], during the 1990s, AI system was developed to give importance to controlled induction in complete classification and strengthening of the learning process. This was done by an increased emphasis on knowledge-lean statistical methods in which the machine learning process is slower than humans, so as to require large amounts of data. [13] During the 20th century, AI was progressively focused on narrowly defined problems that had immediate practical applications to formal analysis.

2.1. Expert system based artificial intelligence

According to [14], an expert system is an artificial intelligence program which has an expert knowledge about a particular area or field. The field or area where tasks are to be performed is called a domain. [15] highlighted that expert system is an intelligent computer program which uses the procedures to solve the difficult problems more than that of human solutions.

AI programs that accomplish expert-level of capability on solving problems in the given task domain by carrying out particular tasks are called knowledge-based systems. Frequently, the term expert systems are represented by computer programs which basically contain the knowledge used by human experts. The area in which the process is carried out is called task domain.
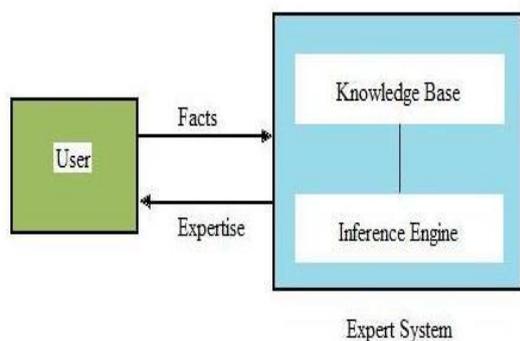
Adapted from [16]

Figure 1.Block diagram of expert system

[16] described that the expert system is a part of AI which is designed to perform certain tasks and also to solve difficult problems by using knowledge of a particular domain. Figure 1 shows the schematic representation of an expert system. This expert system can overcome any situation by the source of knowledge. This knowledge may come from a human expert and/or from books, magazines and internet. Therefore the source of knowledge play an important role in the proper functioning of expert systems and it is named as knowledge-based expert systems and knowledge-based systems. The knowledge base and inference engine are the two main components in an expert system. Knowledge base contains knowledge about the field or area which is used by the inference engine in order to get a conclusion and the inference engine is the mechanism of generic control by which self-evident knowledge is applied to the task-specific data to obtain a conclusion. [17] Users can send facts or related information of question to the expert system. This expert system consisting of knowledge base and inference engine receives advice and expertise in response. The interference engine uses the knowledge base to conclude the solution or query.

2.2. Intelligent systems

[18] An intelligent system is a robot or a machine with an internet-connected computer, which is capable to gather the information, analyse that information and finally communicate with other systems. Figure A1 shows the representation of intelligent systems. [19] describes that the old-style of designing intelligent systems never produced good results. Later, this drawback is predicted and people started to think that computers could be used for just calculating numbers and not more than that. Hence, it is very difficult to construct a set of rules that have the ability to produce actual intelligent behaviour. There are several scientific researchers, who established certain expert systems that can contest on a specialist-level in narrow areas, but there is no general AI program, (i.e.) this system doesn't have the ability of functioning in real life situations. However in practice, many of the systems use AI techniques with a sense of AI community. There are several necessities for an intelligent system to access connectivity, security and capacity for remote monitoring and management where the capacity to be adapted is according to the current information [20].

[21] says that intelligent systems have many uses in the field of integrated cognitive systems. This system not only needs knowledge about the target domain, but also requires some ability to support student knowledge and to monitor tutorial dialogues that accomplish instructional goals. [22] Recent tutoring systems that deal with emotionally-charged social situations are particularly compelling and increasingly fascinating. [23] An intelligent system with embedded elements may be dominant enough to analyse data but basically is specialized for tasks related to the host machine. It present all devices such as smart meters, digital televisions, automobiles, traffic lights, digital signage, airplane controls and Point-of-Sale (POS) terminals, among a large number of other possibilities. This is an on-going trend that may continue in the scenario of Internet of Things (IoT), in which all living animals, human beings and objects can be provided with same identifiers. The capacity to transfer the information automatically over an internet connection without communication between human-to-computer or human-to-human can be achieved [24]. An intelligent system is considered as unique that can

- Learn from various situation experiences,
- Display adaptive goal-based behaviour,
- Display self-awareness,
- Communicate and co-operate with humans using speech and language,
- Tolerate error and vagueness in communication,

- Use huge amounts of knowledge and
- Respond in real time.

2.2.1. Handwriting recognition

[25] By using pen or a stylus, the software of handwriting recognition reads the text which is written on paper or screen. It can identify the shape of the letters and convert it into edittable format.

2.2.2. Speech recognition

Some intelligent systems have the ability to comprehend and hear the language in terms of sentences and understand their meaning while a person talks. [26] It is capable of handling various situations such as slang, background noise, change in human's voice owing to cold, etc.

2.2.3. Intelligent robots

Robots are capable of performing tasks given by humans. It contains a device called sensor in order to identify the physical information from real time such as heat, light, temperature, bump, sound, pressure and movement. They have multiple sensors, efficient processors and vast memory in order to exhibit intelligence. Moreover they have the capacity to learn from their mistakes and can also adjust to the new environment [27].

3. COMPUTER BASED LANGUAGES IN AI SYSTEMS

In 1960, John McCarthy developed the first computational language called LISP [28]. This language is a combination of both lambda calculus and Information Processing Language (IPL). Another language was developed for AI in 1970's and was named PROLOG. This language used an official language that made it suitable for several applications of artificial intelligence. [29] In 2003, Conscious Software Research Group (CSRG) developed a reusable java framework named ConAg, in which intelligent software agents can be produced. This was developed for reducing AI implementation costs and development time. Baar's global workspace theory is used by the intelligence model. [30] More over this trend has been recently continued with the introduction of freely distributed computer simulations of robots or machines. Other researches include various tools such as NRM, Web Bots and the SIMNOS program in which they are used to simulate the CRONUS robot.

[31] In 2005, Moreno and de Miguel developed the Consciousness and Emotion Reasoning Architecture (CERA) for intelligent agents. This software uses the architecture of Baar's global workspace theory. The main purpose of the system software is to allow different kinds components to be combined together. Their simulation model has been applied only on computer simulations.

4. STRONG AND WEAK ARTIFICIAL INTELLIGENCE

[32] discusses about the interface creation of real intelligence. Strong AI hypothesis states that robot or machine can be made self-aware. It has two types, human-like AI and non-human-like AI. Human-like AI means computer program based robot in which thinking and reasoning are at the same level of human beings. Non-human-like AI means computer program based robot in which thinking and reasoning are in a non-human way. Weak AI believes that a machine running a program is almost incapable of simulating real human being consciousness and behaviour. According to [33], strong AI believes that the correct program running on a machine does not include vital differences between a piece of software exactly matching with the actions of a human being and the actions of their brain containing their consciousness and understanding. Weak AI considers that it is not possible to create human-level intelligence in machines but techniques of AI can be established to solve a lot of real-life problems.

5. CHALLENGES OF ARTIFICIAL INTELLIGENCE

[34] explains that the most important challenge of AI is to develop mechanisms and models of intelligent action. AI is basically an empirical science, in which scientific researchers perform test research and classical hypothesis paradigm to authenticate mechanisms and models. The AI experiments are conducted in the computer laboratory. AI researchers verify the hypotheses in the process of testing, design, construction and validation of computer programs. AI systems easily compete with even a three year old child on various parameters such as ability to understand and interpret human languages and in recognizing and remembering different objects. [35] Table 1 indicates that AI

researchers have explored certain tasks. This AI task demonstrate the range of knowledge content, data rates and response times.

6. APPLICATIONS OF ARTIFICIAL INTELLIGENCE

[36] Recent developments in every aspect of artificial intelligence contain machine learning, multi agent systems, data mining, computer vision, fuzzy logic and evolutionary computations. Algorithms of AI have attracted close focus of researchers. However, irrespective of the problem size, AI algorithms consume substantial computation time due to stochastic aspects of the search methods [37]. Hence, there is a possible need to create an efficient AI algorithm to find solutions under limited time, cost and resources in real time applications.

Adapted from [35]

Table 1.Domains and their characteristics in AI problem

Problem domain	Knowledge content	Data rate	Response time
Puzzles	Poor	Low	Hours
Chess	Medium	Low	Minutes
Theorem proving	Medium	Low	Variable
Expert systems	Rich	Medium	Variable
Natural language	Rich	Medium	Real time
Motor processes	Rich	High	Real time
Speech	Rich	High	Real time

There are some applications which combine robot, computer software and special data to communicate advising and reasoning. They offer advice and explanation to the users. It is used for games, general problem solving, expert system, natural language processing, computer vision, robotics, finance, education, entertainment etc. AI plays an important role in planned games such as tic-tac-toe, poker, chess, etc., where a robot can think of large ways of possible positions based on their experimental knowledge. [38] The application of AI in training simulators consists of effective training which frequently requires thousands of people in Military simulations, Management simulations and economic simulations. The simulated world prefers scientists of AI researches to concentrate on algorithms instead of using sensors. The other applications of AI are heavy industries, space science, music, video games, transportation, hospitals and medicines. The techniques of Artificial Intelligence (AI) are currently being used by the working engineers to solve a wide range of previously intractable problems.

7. CONCLUSION

In this review, it is concluded that AI is in the middle of creating a new computational model of intelligence. It is not implemented as intelligent robots yet, however steps are taken to take it to a higher level and make it an important component in the market. The main hypothesis is that intelligence systems can be represented in terms of symbolic operations and symbol structures that can be programmed in a digital computer. Features of intelligent behaviour consist of making inferences, solving problems, learning and understanding language that have already been coded as computer programs under very limited domains. New machines and robots have to be developed that can solve the present difficulties to create conventional digital computers that may be able to run a wide variety of programs. AI is a power tool that might enlarge human intelligence and provide capability to progress forward in all ways. It might also eliminate poverty and cure diseases. Certainly it should prevent environmental disaster. Nevertheless, there is still a lot of scientific researches going on in AI field to achieve the final goal. There are several advantages of using computer where they do not loose temper and become faster. Similarly in future, AI with computer programs will also be in the same category and it would accomplish the level of human-level intelligence.

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APPENDIX A
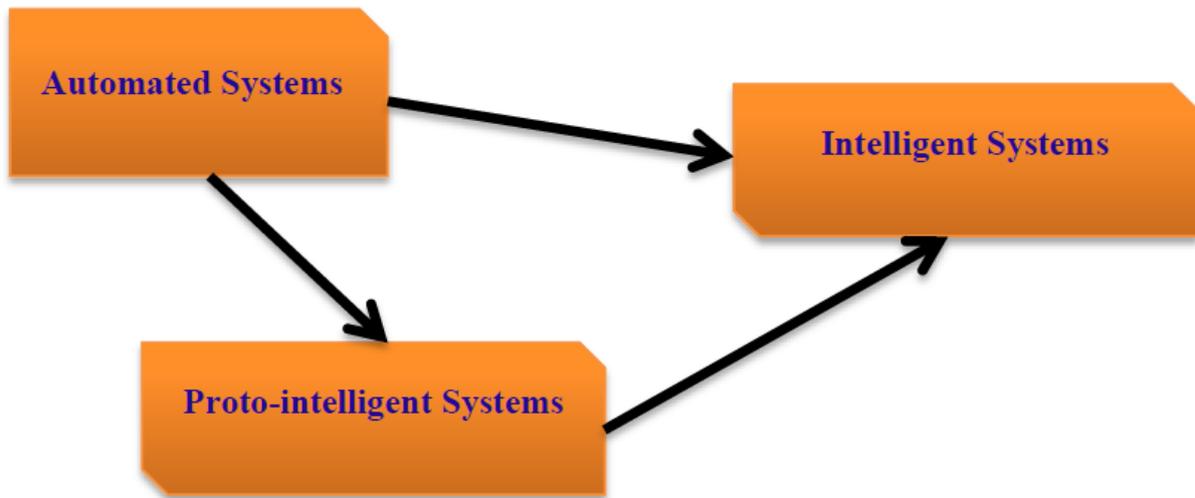
Adapted from [18]

Figure A1.Intelligent systems [18]