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A comprehensive study of Artificial Intelligence and its global advances in the 21st Century

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ABSTRACT

Considering the rapid advancement in artificial intelligence, many people are convinced that in years to come, intelligent machines will enhance or replace human competencies. Artificial Intelligence has become a popular field in computer science in the last two decades and it has greatly improved performance of the manufacturing and service systems. Research in the field of artificial intelligence has given rise to the rapidly growing technologies known as expert system which are widely used these days to solve the complex problems in areas like science, engineering, business, medicine and meteorological conditions. With the use of Artificial Intelligence technologies, many areas have seen an increase in the quality and efficiency. This paper gives an overview of this technology and its application areas. This paper tends to explore the current use of Artificial Intelligence technologies in the various sectors of life.

Key words: *Artificial Intelligence; technologies*

I. INTRODUCTION

ICT development, implementation and exploitation are an integral and sustainable component in today's society considering the rapid growth in the recent innovative developments and the high growing need of these high tech innovations. Artificial intelligence has a very long history rating back to the 1950's when Turing formulated the first "Paper Model" of game playing programs but some have dated the origin of Artificial Intelligence to McCarthy's invention of the LISP programming language in the 1956 and it was designed to solve the symbolic problems rather than the numeric ones. Artificial intelligence has been defined by so many scholars but I find favor with the definition proposed by "Barr and Feignenbaum" in 1981 in which they define artificial intelligence as "being concerned with designing computer systems which exhibit the characteristics we associate with intelligence in human behavior".

Looking closely at the definition, there are two key words which one needs to understand in other to better understand the subject matter of Artificial intelligence. The first word is "***Artificial"***; artificial is whatever that is not natural or real. The second word is "***Intelligence***"; intelligence is the ability to learn how to deal with different situations, to acquire, understand and apply knowledge and to analyze and reason. With the aid of these

two (2) key words, one can firmly say that artificial intelligence is the combination of humans plus machines (robots, computer or any other electronic equipment or device). Artificial Intelligence as a field of study and its aims can be determined by what the preface of (Nilsson, 2009) which state that "artificial intelligence is a discipline which devotes its activities to making machines intelligent" and intellect is that quality that enables an entity to function properly with foresight to its environment. This infers that an understanding of Artificial Intelligence is very broad, leading a field of capacity levels ranging from fairly low-level technological systems and lower creatures at the one end to humans (and possibly beyond) on the other end.

II. BACKGROUND OF STUDY

In today's high tech society, machines can basically perform most of the jobs that humans can do without compromising quality. Thinking of the high level of intelligence in machines, robots and other electronic devices, one would start thinking of an article which was published in the mind magazine by Turing in the year 1950, which give birth to a controversial topic "Can machines think"? We know that the human brain is very complex, complicated and advanced with respect to intelligence but the intelligence in machines are used to solve real world problems, although it is human beings who give programmable commands while the problem is being solved by the machines. With the invention of digital computers, time consuming and error-prone numerical computations are done with relative ease and accuracy. It then struck to humans "why not seek the help of the computers in the reasoning process"? The Turing test, proposed by British mathematician Alan Turing in 1950 as a way to verify machine intelligence, gauges whether a computer can fool a human into thinking another human being is speaking during a short dialogue. The computer doesn't have to be able to really think like a human; it only has to seem like human. He proposed that "Turing test is used to determine whether or not computer (machine) can think intelligently like human"?

Imagine a game of three players having two humans and one computer, an interrogator (as human) is isolated from the two players. The interrogator's job is to try and figure out which one is human and which one is computer by asking questions from both of them. To make the things harder the computer is trying to make the interrogator guess wrongly. In other word the computer would try to be indistinguishable from human as much as possible.

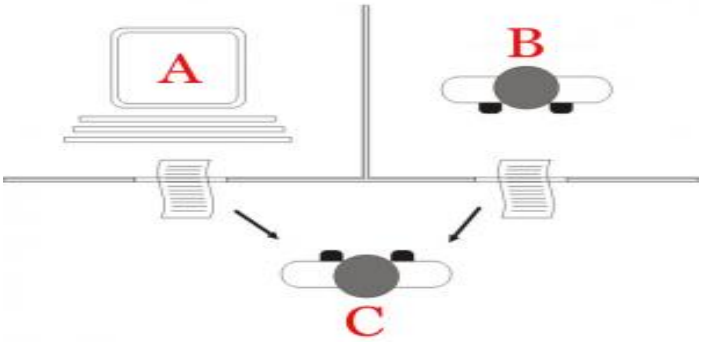

Fig. 1 Turing's Test, player C (interrogator), is given the assignment to determine which player A or B is a computer or human. The interrogator is limited to the replies to transcribed questions to make the determination.

The conversation between interrogator and computer would be like this:

C (Interrogator): Are you a computer?

A (Computer): No

C: Multiply one large number to another, 158745887 * 56755647

A: After a long pause, an incorrect answer!

C: Add5478012,4563145.

A: (Pause about 20 second and then give as answer) 10041157

If interrogator is not able to distinguish between the answer provided by both human and computer, then the computer passes the test and it is considered as intelligent as human. A computer would be considered intelligent if its tête-à-tête couldn't be easily distinguished from a person's. The entire conversation would be restricted to a text-only channel such as a computer keyboard and screen.

He furthermore projected that by the year 2000 a computer would be able to play the imitation game so well that an average interrogator will not have more than a 70 percent chance of making the correct identification (machine or human) after five minutes of questioning. No computer has come close to this standard. We afar from humanlike Artificial Intelligence, nor are we on the track toward that because we don't really understand what makes people intelligent and how people solve problems says Robert Lindsay a professor of psychology and computer science at the University of Michiganin. There is some engineering in the human brain that we just can't understand.

III. BRANCHES OF ARTIFICIAL INTELLIGENCE

Artificial Intelligence is a combination of many fields. Predominantly there are three ***core*** branches in Artificial Intelligence.

a.Symbolic AI: The field of symbolic AI is virtually abandoned, and reduced to mainly course books. In the early stages of developments during the 1960's symbolic AI tasted tremendous success with expert systems and game playing problems, but in 1980s the research was nearly exhausted as result of lack of some implicit design issues with the formulation itself and it was assumed symbolic AI would never be able to achieve human cognition level. One major implicit design issue was "General Knowledge problem" or "common sense problem". Inventors were able to copycat obvious human behavior into machine but implicit common sense which we never say and took for granted which forms the base of explicit behavior was not intellectualized at the design stages, for example if I say that "she is my mother" it implicitly means that "I am her son".

b.Statistical AI: Statistical AI promotes deterministic methodology in Artificial Intelligence enchanting inspiration from mathematics and operation research. Criticizers argue that this approach loses competency of generalization and the ultimate aim of Artificial Intelligence.

c. Computational Intelligence: Computational Intelligence desires to find a solution to real world problems which are computationally expensive to solve or not possible to solve by traditional means (mathematical models). The guiding principle of soft computing is to exploit the lenience for imprecision, ambiguity and partial truth to achieve tractability, robustness and low rate solution with enriched adaptability.

IV. USEFUL PARTS OF PARTS OF ARTIFICIAL INTELLIGENCE

1. Artificial neural network are used in AI.
2. Computer vision.
3. Evolutionary algorithms.
4. Swarm intelligence is also an essential part of AI.
5. Pattern recognition is used in AI.
6. Facilities of Learning from experiences.
7. Genetic programming.
8. Image processing and analysis is used in AI.
9. Human Natural language processing feature is used in AI.
10. Global optimization technique is used in AI.
11. Machine learning.
12. Knowledge representation.
13. AI uses Social intelligence.
14. AI Control theory is used for controlling.
15. Uncertain reasoning is embedded in AI.
16. Mathematical tools.

V. APPLICATIONS OF ARTIFICIAL INTELLIGENCE

- **Game Playing**

Game playing is the design of an artificial intelligence program that enables one to play more than one game successfully. For example, games like chess; computers are programmed to play them using a specifically designed algorithm, which cannot be transferred to another context.

- **General Problem Solving**

Problem solving is something AI does very well as long as the problem is narrow in focus and clearly defined. For example, mathematicians, scientists, and engineers are often required to prove theorems. A theorem is a mathematical statement that is part of a larger theory or structure of ideas. Because the formulas involved in such tasks may be large and complex, this can take an enormous amount of time, thought, and trial and error. A specially designed AI program can reduce and simplify such formulas in a fraction of the time needed by human workers.

- **Expert System**

In artificial intelligence, an expert system is a computer system that imitates the decision-making ability of a human expert. Expert systems are designed to solve complex problems by reasoning about knowledge, represented mainly as if they are rules rather than through conventional procedural code.

- **Natural Language Processing**

Natural Language Processing refers to a mode of communicating with intelligent systems using a natural human language such as English.

Processing a Natural Language is required when you want an intelligent system like robot to perform as per your requisite instructions, when you want to hear decision from a dialogue based clinical expert system, etc.

Natural Language is when computers are able to perform useful tasks with the human spoken languages. The input and output of an NLP system can be:

- Speech
- Written Text

- **Computer Vision**

Computer vision refers to the science and technology of machines that are labeled as belonging to artificial intelligence which are used in relation to computer vision in pattern recognition and learning techniques.

- **Robotics**

Robotics is the combination of mechanical and electrical Engineering with Computer Science for designing and construction of robots. Robotics is the field that deals with the creation of intelligent and efficient robots.

- **Education**

Artificial intelligence can program basic activities in education, like the college grading systems**.** In college, grading of homework and tests for large lecture courses can be a very tedious work and teachers often find that grading takes up a significant amount of time that could be used to interact with students and prepare for class or work on a professional development.

- **HealthCare**

Artificial intelligence in healthcare systems uses algorithms and software's to estimate human cognition in the analysis of complex medical data. The primary aim of health related AI applications is to examine the relationship between prevention or treatment techniques and patient outcomes. AI packages are being developed and applied to practices such as diagnosis processes and treatment protocol development, drug development, personalized medicine and patient monitoring and care.

VI. PROBLEMS RELATED TO ARTIFICIAL INTELLIGENCE

"Can a machine really act intelligently?" is still an open problem that many researchers are still finding answers to. Taking ***"A machine can act intelligently"*** as a working hypothesis, many researchers have attempted to build such a machine. Mimicking intelligence has been broken into a number of specific sub-problems. These comprise of specific traits scholars would want any intelligent system to display. Some of the most important traits are described below:

- **REASONING AND PROBLEM SOLVING**

AI researchers in the past have developed various algorithms that follow the step-by-step reasoning of human beings in solving puzzles or making logical deductions. In the 1980s and '90s, researchers developed successful methods of dealing with uncertain or incomplete information whereby employing concepts from probability and economics. For difficult problems these algorithms require an enormous computational resource which makes the search for efficient problem-solving algorithms a high priority for AI researchers. Human beings solve problems using fast intuitive judgments rather than the step-by-step deduction used by early AI researchers which was a model. Progress has been made in the field of AI by imitating the "sub-symbolic" problem solving techniques which emphasize the importance of sensorimotor skills to higher reasoning; neural net researchers have attempted to simulate the structures inside humans and animal brains which give rise to this skill.

- **KNOWLEDGE REPRESENTATION**

Knowledge representation and knowledge engineering are important areas to AI research because many of the problems machines are expected to solve will require extensive knowledge about the world we live since AI needs to represent objects, properties, categories and relationships between objects, situations, events, states and time. Knowledge about what we know about what other know are central researched domain based on how they are represented.

- **High Cost**

Creation of artificial intelligence incurs huge financial costs as machines are very complex in nature to assemble.

- **No Replicating**

Intelligence is understood to be a gift of nature and AI cannot replace human intelligence since we are the creators of AI systems.

- **Singularity**

This is situation where in robots can go out of control and Artificial intelligence gets evil.

VII. RECENT INNOVATIONS IN THE FIELD OF ARTIFICIAL INTELLIGENCE

Google Assistant is a computer-generated personal assistant developed by Google was announced at its developer conference in May 2016. Not like Google, the Google Assistant can engage in two-way conversations. Assistant initially debuted as part of Google's messaging app Allo, and its voice-activated speaker Google Home. After a period of exclusivity on the Pixel and Pixel XL smartphones, it began to be deployed on other Android devices in February 2017, including third-party smartphones and Android Wear, and was released as a standalone app on the iOS operating system in May. Alongside the announcement of a software development kit in April 2017, the Assistant has been, and is being, further extended to support a large variety of devices, including cars and smart home appliances. The functionality of the Assistant can also be enhanced by third-party developers. Users primarily interact with the Google Assistant through natural voice, though keyboard input is also supported. In the same nature and manner as Google Now, the Assistant is able to search the Internet, schedule events and alarms, adjust hardware settings on the user's device, and show information from the user's Google account. Google has also announced that the Assistant will be able to identify objects and gather visual information through the device's camera, and support purchasing products and sending money. There are so many recent innovations of AI but the Google assistant is one of its kinds.

VIII. Will AI disappear?

As people in other fields recognize their own problems within artificial intelligence, they will reformulate them, taking away the special trappings of their former treatments. What will remain if all the big problems are stripped from artificial intelligence and accorded to other fields? While it is possible that artificial intelligence will disappear altogether, what seems more likely is a revision of the field, some of which may already be observed to be taking place. If one considers the distinct intellectual tasks to be accomplished, a revision along the following lines seems possible.

• First, each of the standard fields related to artificial intelligence will continue to absorb the method of looking for computational complexity explanations for their phenomena. The parts of artificial intelligence most directly affected by this absorption are the branches concerned with human psychology and linguistics. A good example is how Marr's [1982] work transformed AI work on vision.

• Second, work on articulating intelligence, on codifying common and expert knowledge on all topics will continue, increasingly as an activity separate from computation (though often with the ultimate aim of automation). This sort of work has been going on since long before computers arrived. The areas of expert systems and commonsense knowledge (e.g., naive physics, discourse conventions) fall into this category.

• Third, the mathematical and theoretical studies in artificial intelligence, logic, economics, statistics, etc. of possible psychological structures and organizations will draw together into a new mathematical science. [Doyle 1983] calls this field rational psychology, meaning the conceptual investigation of psychology by means of the most appropriate mathematical notions, with the aim of understanding the underlying nature of and connections between psychological concepts.

• Fourth, and finally, much of current artificial systems and techniques of mechanization will draw together as the engineering discipline corresponding to the mathematical field of rational psychology and to the scientific fields of psychology and economics. The aim of psychological engineering, as [Doyle 1983] calls it, is parallel to the aim of any engineering field, namely to find economical designs for implementing or mechanizing agents with specified capacities or behaviors. For example, the characteristic concern of artificial intelligence, mechanization, is treated differently in human psychology, in rational psychology, and in psychological engineering. Human psychology, of course, seeks both to discover the materials chemical and neural from which human minds are constructed and how human behaviors are realized in these materials. Rational psychology, like the theory of computation and computational complexity, would consider questions of existence of mechanizations of specific classes of psychologies by means of specific classes of machines or materials. Psychological engineering, like the field of design and analysis of algorithms, would be concerned with inventing and comparing machines that realize specified psychologies. Thus artificial intelligence will not disappear, but it will likely be greatly transformed in ways that will demand adopting new standards of competence and learning new ways of thinking and writing about its problems.

IX. CONCLUSION

Artificial intelligence gives the capability to machines to think analytically using Computer programs and there have been incredible contributions to the various areas made by the Artificial Intelligence techniques over the past decades. Artificial intelligence (AI) can be simply defined as the intelligence exhibited by machine or software. Artificial Intelligence will continue to play its ever increasing role in in today's world. This paper is based on the concept of artificial intelligence looking closely at the early periods, current trends and the future. I will conclude that further study can be done in this area as there are very promising and profitable results that can be obtained in years to come. While Computer scientists have not yet realized the fully the potential and ability of artificial intelligence, the technological innovations and its applications will have far-reaching effects on human life in the years ahead. I will conclude by submitting that artificial intelligence is the gate way to a brighter future for all of us.

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