
Development Trends and Applications of Artificial Intelligence to the Human Society

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Abstract

Artificial Intelligence (AI) has enhanced the human life in many ways and is gradually becoming an integral part of it. Over the last decades, operations and performances in the service and manufacturing industries have been greatly improved by the extensive use of Artificial Intelligence. This is largely due to progressive advancements in studies and research works in AI. The result of these studies is the development of computer systems and machines that use AI to solve the complex problems in various areas such as medicine, weather forecasting, engineering, science, and business. As a result of the use of AI, these fields have seen a huge improvement in quality and efficiency. This paper gives an overview of the artificial intelligence technology and its areas of application. This paper will also explore the directions researchers and further studies are taking in regards to the applications of this technology.

Keywords: Artificial Intelligence, Machine Learning, Computer Systems.

1.0 Introduction

Intelligence is commonly considered as the ability to collect knowledge and reason about knowledge to solve complex problems (Avneet Pannu, 2015). Artificial intelligence refers to the simulation of human intelligence processes by computer systems and machines. These processes include learning, reasoning and self-correction. It is the science behind the study and development of intelligent machines and software that can reason, learn, gather knowledge, communicate, manipulate and perceive the objects in its surrounding (Avneet Pannu, 2015). AI technology makes machines smarter and more useful. Due to the increasingly wide areas of application of AI, intelligent machines are poised to replace human capabilities in many areas in the near future.

Artificial Intelligence technology covers areas such as Expert Systems, Natural Language Processing, Speech Understanding, Robotics and Sensory Systems, Computer Vision and Scene Recognition, Intelligent Computer Aided Instruction, and Neural Computing. These areas are implemented using techniques such as Neural Network, Fuzzy Logic, Evolutionary Computing, and Hybrid Artificial Intelligence and Genetic Algorithms.

The advantages of artificial intelligence over natural intelligence include consistency in operation, cost effectiveness, ease of duplication and dissemination, speed and accuracy in the performance of tasks.

In a publication by (Forrester Research, 2017), it was predicted that businesses that use Artificial Intelligence (AI) and similar technology to unravel new insights about their processes “will steal \$1.2 trillion per annum from their less informed peers by 2020.”

Although AI has been around since the 1950s, the technology only recently began to find real world applications and solve real human needs. Tech giants like Apple, Google, Amazon and few start-ups have tripled their investments in AI to \$40 Billion as of 2017 (Forrester Research, 2017).

Many factors have helped to trigger the sharp rise in the advancement of AI technologies, namely:

1. Access to big data generated from e-commerce, businesses, governments, science, wearables, and social media
2. Improvement in machine learning (ML) algorithms—due to the availability of large amounts of data
3. Greater computing power and the rise of cloud-based services—which helps run sophisticated machine learning algorithms.

Artificial Intelligence is usually broadly classified as either weak AI or strong AI (Shubham P, 2018).

Weak AI is also known as Artificial Narrow Intelligence (ANI), and refers to a class of AI systems designed and trained for a specific type of task. The intelligence focuses its learning on a single task which it has to perform with a great level of smartness and efficiency. This class of AI is considered to demonstrate the basic concept of AI. Its application could be found in Speech Recognition (can only recognize speech) and voice Assistants such as Cortana and Alexa (which only act upon voice commands to perform a certain action).

Strong AI, also known as artificial general intelligence (AGI), is an AI system with generalized human cognitive abilities so that when presented with an unfamiliar task, it has enough intelligence to find a solution. This is a general-purpose artificial intelligence application. Its smartness/efficiency is not limited to doing a single task. Rather this could be applied to do various tasks and the system could as well learn and improve itself unlike ANI. It is comparatively as intelligent as the human brain (Shubham P, 2018). AlphaGo is an example of an AGI. Though it is design to play Go, its intelligence could be applied in various other fields.

There is a third class referred to as Artificial Super Intelligence (ASI). This is a futuristic class which refers to an aspect of intelligence which is more powerful and sophisticated than a human's intelligence. It is referring to the time when the capability of computers will surpass that of humans. Super intelligence are targeted at surpassing human intelligence in terms of thinking and analyzing abstractions which are impossible for humans to process.

1.1 Components of intelligence.

According to mainstream thinking in psychology, human intelligence is not depicted as a single ability or cognitive process but rather as an array of separate components (Copeland B.J, 2000). Thus these components of human intelligence are the focus of the various research works in AI. They are learning, reasoning, problem-solving, perception, and language-understanding.

1.1.1 Learning

Although this can take different forms, Learning in its simplest form is by trial and error. For example, when applied to artificial intelligence, a simple program for solving mate-in-one chess problems might start out by trying various moves at random. It continues the trial-and-error method until one move is found that achieves mate. The program remembers this successful move such that the next time the computer is given the same problem to solve, it will produce the desired result immediately from the memory of the move that it used earlier to solve a similar problem.

This simple memorizing of individual items--solutions to problems, words of vocabulary, etc.--is known as rote learning (Copeland B.J, 2000). This can be easily implemented on a computer. However, it gets more complex and challenging when it comes to a generalized application of knowledge. With this kind of learning, the individual or computer program is able to perform better in situations not previously encountered.

1.1.2 Reasoning

This component of intelligence refers to the ability to draw logical inferences that are appropriate to the circumstance at hand. The Inferences could be deductive or inductive. A considerable progress has been made and good successes achieved in programming computers to draw inferences, especially deductive inferences. However, the fact that a computer program can draw inferences is in itself is not enough to say that such a computer can reason. Reasoning involves drawing inferences that are relevant to the task or situation in hand. One of the hardest problems confronting AI is that of giving computers the ability to distinguish the relevant from the irrelevant inferences in the face of the situation at hand.

1.1.3 Problem-solving

Human intelligence also give them the ability to solve a problem. When they are presented with a handful of information and a missing link, and asked to provide the answer to the missing link using the available information, this is problem solving. A problem have this general form: given such-and-such data, find x. AI is helping solve a huge variety of this type of problem. Some examples include finding winning moves in board games; identifying people from their photographs; and planning series of movements that enable a robot to carry out a given task (Copeland B.J, 2000).

1.1.4 Perception

This refers to the human or machine ability to make inferences about the environment and the world in general through sounds, images, and other sensory inputs. This has found use cases in medical diagnosis, autonomous vehicles, and surveillance systems.

In perception the individual or system scans the environment by means of various sense-organs, real or artificial, and uses some processes internal to the perceiver to analyze the scene into objects, their features and relationships (Copeland B.J, 2000). Analysis is complicated by the fact that one and the same object may present many different appearances on different occasions, depending on the angle from which it is viewed, whether or not parts of it are projecting shadows, and so forth.

1.1.5 Language-understanding

A language is a system of signs having meaning by convention. This meaning-by-convention that is distinctive of language differs so much from what is called natural meaning, exemplified in statements like 'Those clouds mean rain' and 'The fall in pressure means the valve is malfunctioning'. But by convention, the hazard-ahead sign in traffic light simply means hazard ahead.

Computer programs can be easily written to fluently or in near fluent manner, respond in English to question and statements without actually understanding the language. An appropriately programmed computer can use language without understanding it, in principle even to the point where the computer's linguistic behavior is indistinguishable from that of a native human speaker of the same language.

1.1.6 Advantages of AI over humans

For example in quality control, a learning algorithm can detect anomalies more accurately than humans. While visual inspection is a tiring task for humans, a self-taught machine can give consistent results, work 24/7, and require only fractions of a second to inspect a part.

The transformation of jobs is a pressing topic in the age of AI, as self-learning machines will automate much manufacturing work and reshape the manufacturing job market in the US and globally. As a result, manufacturers will be looking for workers who understand AI technologies such as deep learning models, and know how to use the AI-powered machines.

1.2 Applications of Artificial intelligence

The potentials of AI in solving immensely difficult issues for humans cut across various industries, such as commerce, transport, entertainment, health, education, and utilities.

The applications of AI can be grouped into five categories which will be discussed in the sections that follow.

1.2.1 Reasoning and Decision making:

Applications of AI that fall under this category looks at the ability to solve problems through logical deduction. Such applications include financial asset management, legal assessment, financial application processing, autonomous weapons systems, and games.

Financial services companies use AI-based natural language processing tools to analyze brand sentiment from social media platforms and provide actionable advice based on insights revealed from such analysis (Batrinca, B. & Treleven, P.C, 2015). Companies like Aidya and Nomura Securities among others, use AI algorithms to enable autonomous trading on their platforms (Jen Wieczner, 2015). In this age of ultra-high-frequency trading, financial institutions are turning to artificial intelligence to improve their stock trading performance and boost profit. One such company is Japan's leading brokerage house Nomura Securities (Nikkei Asian Review, 2016).

Fintech firms like Kensho and ForwardLane use AI-powered B2C robo-advisors to augment rebalancing decisions and portfolio management performed by human analysts. With the help of AI algorithms, Wealthfront tracks the activities on their customers' accounts and help financial advisors customize their advice (Antoine Gara, 2017).

Chatbots have been developed which are powered by natural language processing techniques, and which have the ability to serve banking customers quickly and efficiently by answering common queries and providing the needed information in a timely manner.

1.2.2 Application of AI in accounting

It is difficult for humans to understand and process computerized accounting databases. The focus of such databases on the numeric data makes such systems difficult to use. Incorporating intelligent systems with accounting databases helps in the speedy examination and analysis of large volumes of information with or without the coordinate support of humans.

With the artificial intelligence, knowledge can be stored and retrieved in natural language. With an AI database system, there is more emphasis on symbolic or text data rather than just numeric data to capture a context. The artificial intelligence and expert system incorporates textual and symbolic insight with the database to help the users of the accounting systems to understand the events captured by the system faster. Without users direct participation such models help the users by sorting through large quantities of data with great ease and enables quick decision making.

1.2.3 Artificial Visual Perception

At present, artificial perception is sufficiently well advanced to enable a self-controlled car-like device to drive at moderate speeds on the open road, and a mobile robot to roam through a suite of busy offices searching for and clearing away empty soda cans, serve foods in restaurants, sort inventories in warehouses, etc.

Andrew Ng of Landing.ai claims they have developed a machine-vision tool which can be used to find microscopic defects in objects like circuit boards using an ML algorithm trained using tiny volumes of sample images. It is widely believed that in the future, self-driving robots may be created which can move finished goods around without endangering anyone or anything around.

1.2.4 Knowledge acquisition and sharing:

The ability to present knowledge about the events in the world such as financial market trading, purchase prediction, fraud prevention, drug creation, medical diagnosis, and media recommendation are some huge successes that AI technologies have achieved. Fraud detection and prevention is an important application of AI in financial services. For example, Mastercard introduced its latest pioneering security platform, Decision Intelligence, which uses AI technology to analyze various data points to detect fraudulent transactions, improve real-time approval accuracy, and reduce false declines (Matthew Cochrane, 2017). According to the press release, this program "uses artificial intelligence technology to help financial institutions increase the accuracy of real-time approvals of genuine transactions and reduce false declines." The service leverages machine learning so that each transaction is assigned a score, which is then used to help judge future payments.

AI algorithms can influence the manufacturing supply chain by detecting the patterns of demand for products across geographies, socioeconomic segments, and time, and predicting market demand. This, in turn, will affect inventory, raw material sourcing, financing decisions, human staffing, energy consumption, and maintenance of equipment.

AI tools have been used in predicting malfunctions and breakdown of equipment and taking or recommending preemptive actions as well as tracking operating conditions and performance of factory machines.

1.2.5 Planning and forecasting

This area of application of AI has to do with the ability to use an algorithm to set and achieve goals¹. This can be used in inventory management by companies, demand forecasting, predictive maintenance, physical and digital network optimization, navigation, scheduling, and logistics.

As an example, services like Netflix or Amazon, use machine learning algorithms to analyze a user's activity and compare it with that of other users to determine which shows or products to recommend to that user. These algorithms have become more intelligent with time, so much so that they could infer that a user may want to buy a product as a gift and not for himself/herself, or they could understand that different family members have different watching preferences.

1.2.6 Communication

Here we have Natural Language Generation and speech recognition systems. The former uses AI to produce text from the computer data while the later transcribes and transforms human speech into a format useful for computer applications. Natural language generation is used in customer service, report generation, and summarizing business intelligence insights. Speech recognition on the other hand is presently used in interactive voice response systems and

mobile applications. It has also been applied in real-time translation of spoken and written languages, intelligent assistants, and voice control.

Furthermore, through the use of AI, virtual agents have been developed. A virtual agent is a computer generated, animated, artificial intelligence virtual character (usually with anthropomorphic appearance) that are often used online as customer service representative. It holds an intelligent conversation with users, responds to their questions and performs adequate non-verbal behavior. An example of a typical Virtual Agent is Louise, the Virtual Agent of the online ecommerce company eBay.

Machine learning algorithms are being integrated into analytics and online CRM (Customer relationship management) platforms to uncover information on how to better serve customers. Chatbots have already been incorporated into websites to provide immediate service to customers.

An intelligent virtual assistant called TeslaBot has been integrated with Tesla models S and X. This AI based assistant allows the car users to interact with their car from their phone or desktop.

Nvidia has partnered with Volkswagen to develop “intelligent co-pilot systems” in cars that will enable safety warnings, gesture control, and voice and facial recognition. The two companies said they would initially work on an "Intelligent Co-Pilot" system that will gather data from both in and outside the car. Throw in some gesture and natural language voice controls and then fuse all that with what the AI has learned about the driver and the result you will get is a helpful AI assistant (Roberto Baldwin, 2018). In the near future, Ericsson predicts that 5G technology will improve vehicle-to-vehicle communication wherein sensors will be implanted in airport runways, railways, and road.

AI is also applied in natural language processing (NLP). This is a process that analyzes texts, facilitating the understanding of sentence structure and meaning, sentiment, and intent through statistical and machine learning methods.

1.2.7 Medicine and Healthcare

One of the effective applications of AI is the clinical decision support systems (CDSS). Using a patient’s test results, vital signs and medical records, the CDSS could do a quick and reliable analysis of the patient’s condition and help physician in speedy diagnosis and prescribing the right course of treatment for the patient.

Artificial Intelligence systems have been used for medical image classifications. This system helps radiologist who uses the output from a computerized analysis of medical images as a second opinion in detecting lesions, assessing extent of disease, and improving the accuracy and consistency of radiological diagnosis to reduce the rate of false negative cases.

1.2.8 Manufacturing

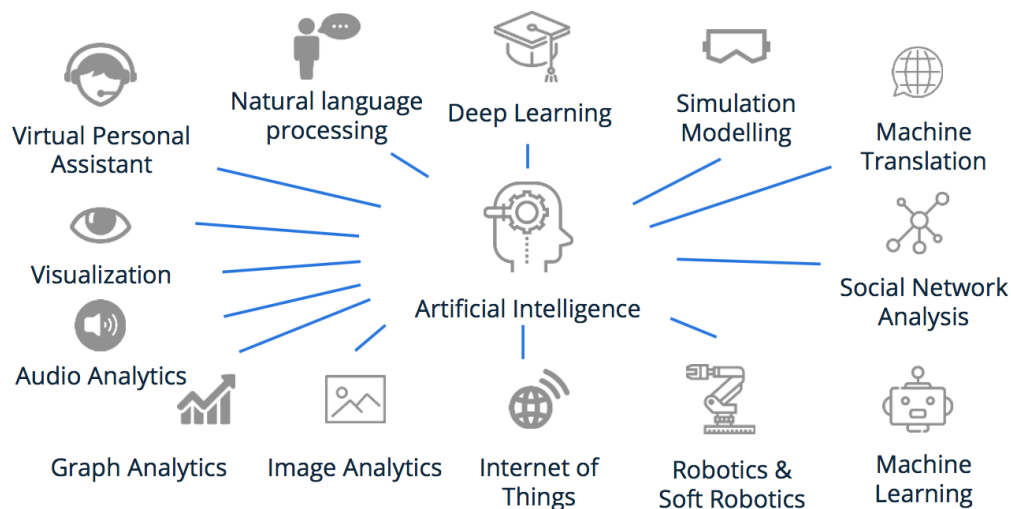
There has also been some new advancements in the application of AI to manufacturing. In manufacturing, there is a growing need to integrate robots into the workforce in order to take advantage of the diverse strengths of both humans and robots (Len Calderone, 2016). This integration requires the timing of human and robotic work so that the tasks are completed within a single shift. A new concept called collaborative robots or “cobots, enabled by AI, is able to take instructions from humans, including instructions that the robot has not

been previously exposed to, and work productively with them. A "cobot" is a robot that works in tandem with a human worker. A Cobot and a human can produce an end result better and faster than either could do working alone. These cobots are usually designed for an explicit task. In one such task, a human worker provides motion power, while the cobot provides guidance, utilizing servomotors (Len Calderone 2016).

Andrew Ng, one of the top minds in artificial intelligence announced Landing.ai, a company aimed at accelerating AI's implementation in manufacturing. According to Ng, Landing.ai targets all industries but is initially focused on manufacturing. Ng believes AI technologies can expand their foothold in manufacturing, and overcome hurdles such as variable quality and yield, inflexible production line design, inability to manage capacity, and rising production costs.

Robotic process automation is being applied to highly repetitive tasks normally performed by humans.

The current possible applications of Artificial intelligence are summarized in figure 1.



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Fig 1: applications of Artificial Intelligence.

1.3 Future research trends in AI applications

- 5G mobile communication technology

The latest generation of mobile and wireless networks represented by the fifth generation (5G) is expected to change the landscape of communication in general

People are smoothly transitioning to a more transient lifestyle enabled by the global adoption of mobile networks. Communication service providers (CSPs) have reached a tipping point. The modernization of network infrastructure needed to support the ever-increasing demands placed upon the network—from streaming, applications' usage, social media and more—mean that CSPs will have to scale-up their efforts to create and maintain networks that are more agile and efficient than ever. In the face of this greater complexity, service providers will be increasingly reliant upon automation to support both service agility and quality and minimize operational costs (Jo Hicks, 2019),

This will enable 5G networks to offer end-to-end high performance, low latency, and flexibility in providing different kinds of services in a ubiquitous way. However, this

automation cannot be achieved only through the use of tools but also by using artificial intelligent mechanisms and predictive analytics in order to make them responsive to different customers' requirements.

Its value lies in its ability to improve efficiency, cut operating expenses and reduce human error (Ericsson, 2019). From the operators' perspective, the primary purpose of network automation is simplified network deployment, operational experience (OPEX) optimization and a guarantee of user experience and service agility (GSMA, 2019)

- Development of advanced electromagnetic sensing techniques.

As a key tool for sensor data analysis, AI is becoming a core part of novel sensor design. The information obtained by the electromagnetic sensing techniques have to be pre-treated to remove noise. To have a reliable and automated sensor system, the data pre-treatment also needs to detect possible outliers that could influence modeling effect. Researchers are looking for a way to perform this function accurately using Artificial intelligence techniques. This data are finally converted in order to provide information directly usable by the engineers for process control, monitoring, etc.

A successful AI-based electromagnetic sensing technology can find applications in oil and gas for analyzing minerals in the ground, predicting refinery sensor failure, and in streamlining oil distribution to make it more efficient and cost-effective.

- Smart Water Networks

A smart water network is an integrated set of products, solutions and systems that enable utilities to remotely and continuously monitor and diagnose problems, prioritize and manage maintenance issues and use data to optimize all aspects of the water distribution network. This includes two-way real time networks with field sensors, intelligent measurement and control devices; along with software and services (Amir Cahn, 2014). The sensors and data technologies available for smart water networks extend to water resources and production, transmission and distribution, consumer end-points and internal piping.

Managing the supply of water is increasingly becoming a challenging task for cities around the world and their water utilities. Many countries, especially developing nations, face regular water-related disasters such as extreme flooding and droughts, due to the change in climate thus creating increased necessity for national water management and security (Anna Di Mauro et al, 2018). While some countries are already in the process of including smart technologies as a core element to their approaches in monitoring and managing their water systems, others are yet to begin this process.

Researchers are working on developing AI technologies that offer new and advanced sensing technologies for water systems monitoring. Such technologies are intended to transform the traditional water networks into modern Smart Water Networks (SWAN) (Sensus, 2019). The purpose is to promote optimal management and protection of the water networks and their facilities.

1.4 Conclusion

Automation and intelligent machines are fast taking deep roots into every aspects of human lives. They are found in self-driving cars, voice-powered personal assistants, suggestive search algorithms on the internet, just to mention a few of the practical uses of artificial intelligence today. Though these human- mimicking technologies have not taken over yet, the

odds that they will occupy a greater percent of the works traditionally reserved for human is very high. These devices use algorithms that respond based on some pre-defined multifaceted input or user behavior. That is not necessarily what AI is all about. A truly artificially- intelligent system is one that can learn on its own (R.L Adams, 2019). Such systems are powered by neural networks and are able to make connections and reach meanings without relying on pre-defined behavioral algorithms. They can improve on past iterations, getting smarter and more aware, and autonomously enhancing its capabilities and its knowledge (R.L Adams, 2019).

However, many people still lack knowledge about the depth of use and the ways AI is being used today by businesses, individuals, in all the aspects of human life. It is still unknown to many how much positively or otherwise extensive use of this technology will have on humans. AI has come to stay and will continue to grow in the length and breadth of its fields of application. This will be fuelled by humans' fixation on improving life in all aspects of it. AI has proven to be a potent tool for achieving that. The focus of this paper has been to look at the areas of application of this technology.

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