IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Synthetic Brain in Action using Artificial Intelligence and Robotics

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Abstract— Artificial intelligence (AI) is a wide branch of computer science, the ability of a digital computer or computer-controlled robot to perform tasks commonly associated with intelligent beings. This term is usually applied to the project of developing natural intelligence displayed animals including humans. In today's era, robots are acts as the hardware body. The connection between software and final result which controls the robot is a software that reads data using sensors, take decisions about what to do next and directs
the receptors to act in real world. Current computer can do incredible things, but need huge amount of processing power. Using computer brain human has accomplished many of achievements like visual perception, speech recognition, decision making, translation between languages, Self-driving cars, industrial robots. The aim of this paper is to provide basic background information on two emerging technologies Robotics and Artificial Intelligence and their worldwide scope.

***Keywords*— Artificial Intelligence, Neural Network, Deep Learning, Machine Learning, Decision Making, Brain Based Learning, Robotic Applications, Human-robot Interactions.**

1. INTRODUCTION

Artificial Intelligence is a branch of science which deals with intelligence. As far as intelligence is concerned it can be defined as "The capability of reasoning, thinking and making decision". This is the only reason we are more concerned about intelligence power given to machines and robots. When robot or any machine inhibits intelligence, it could call as Artificial Intelligence. Artificial intelligence gives power or capacity to perform functions such as logic, reasoning, planning, learning and perception. According to the father of Artificial Intelligence John McCarthy, it is "the science and engineering of making intelligent machines, especially intelligent computer programs." It is a way of making computer or computer-controlled robot or software think in similar manner the intelligent human thinks. AI is actually accomplished by studying how human brain thinks and it learns, take decisions and work to solve a problem and then using these results of study as basis of developing intelligent software and system. Thus, developing of AI started with the intention of creating similar intelligence like a human in robotic or computerized system. There are various goals of developing Artificial Intelligence system such as to create expert systems, to implement human intelligence in machines. Many of researchers feel that the goal of mimicking the human abilities to solve problems and achieve goals in real world. This theory is called as "Strong AI". Strong AI is neither likely nor desirable because the long series of conceptual breakthroughs is required for AI systems which are generally embedded within larger system applications can be found in video games speech recognition and in data mining sector. Field of robotics is closely attached with AI, although the definitional issues abound. "Robotics is a domain in AI that deals with the study of creating intelligent and efficient robots." There are various examples that resides in this category as Cruise missile which navigates and controls techniques draw heavily on robotics research. Robotics and AI got involved in our daily life without us really noticing. Unfortunately, many of applications appear to be taking place amongst companies, industries and in military sector that do not readily respond to public concern.

2. Basics

The ability of a system to calculate, reasoning, perceive relationships and analogies, learn from experience, store and retrieve information from memory, solve complicated problems, comprehend complex ideas, use natural language fluently, classify, generalize and adapt new situations, make a better result. There are various types of intelligence Linguistic intelligence, Musical intelligence, Logical mathematical intelligence, Spatial intelligence, Bodily-Kinaestheetic intelligence, Intra-personal intelligence, Interpersonal intelligence. Hence, a machine or a system is artificially intelligent when it is equipped with at least one and at most all intelligences in it. The domain of Artificial Intelligence is huge in breadth and width. While proceeding, we consider the broadly common and prospering research areas in domain of AI: 1) Expert systems

2) Neural Network
3) Natural Language Processing
4) Robotics
5) Fuzzy Logic.

	1st Industrial Revolution	2nd Industrial Revolution	3rd Industrial Revolution	4th Industrial Revolution	5th Industrial Revolution
	Mechanization	Electrification	Automation and Globalization	Digitization	Personalization
Year	During 18th centuries	From late 18th century to 1st world war	Digital revolution occurred around 1980s	Start of 21st century	2nd decade of 21st century
Type	Steam engines replacing animal power	Production of steel, electricity and combustion engine	Computers, digitization and the internet	AI, Robotics, IOT, blockchain and crypto	Innovation purpose and inclusivity.
Evolve	Introduction of mechanical production facilities driven by water and steam	Division of labor and mass production, enabled by electricity	Automation of production through electronic and IT system	Robotics, Artificial Intelligence, Augmented reality, Virtual reality	Deep, multi-level cooperation between people and machines. Consciousness.

Today, successful AI applications range from custom-built expert system to mass produced software and consumer electronics. On other hand, robotics may be thought of as "the science of extending human motor capabilities with machines". This definition creates a more complicated picture of theory. With the trend of automation and digitalization continues to develop in worldwide, but the question arises as to whether this is also happening in every country of world. Robotics is a branch of AI, which is deeply composed of Electrical Engineering, Mechanical Engineering, and Computer Science for designing, construction and application of robots. Robots are the artificial agents acting in real world environment. Robotics is a field involved two or more different areas of study ranging from mechanical and electrical to control theory and computer science with recent extension toward material physics, bioengineering or cognitive science.

The AI-Robotics intersection is very rich, and covers issues such as: 1) Deliberate action, planning, acting, monitoring and goal reasoning.

2) Perceiving, modeling and understanding open environments.

3) Interacting with human and other robots.

4) Learning models required by the above functions.

5) Integrating these functions in an adaptable and resilient architecture.

3. RELATED RESEARCH

AI is based upon the capacity of virtual computers to manipulate symbols; it is not sufficient to achieve anything like true intelligence. This is because symbolic AI systems are designed and programmed rather than trained or learned. AI software designers are beginning to co-up with psychologist and started using cognitive science concepts. Moreover, cognitive science is interdisciplinary, scientific study of human reasoning, emotions, language, perception, attention and memory. Integration of AI and cognitive science with deep understanding of human cognition and communication. In addition, the creative and technical skills are applying the knowledge in AI solutions and applications in engineering psychology. This special issue is forming connection to examine human performance and design of engineering psychology. The researcher's studies have been revealed powerful principle, methodologies and algorithms, prompting in human self-examination and perception for building AI system that compete better than human performance. As an alternative, connectionists aim to develop AI through Artificial Neural Networks (ANN). An ANN is based on collection of connected units or nodes called as artificial neuros, which loosely model the neurons in biological brain. After a sufficient number of adjustments, the training can be terminated based on criteria known as Supervised learning. Such kind of systems "learns" to perform task by considering examples, generally without being programmed with task-specific rules. For example, in image recognition, they might learn to identify images that have been manually labeled. The emergence of ANNs reflect an underlying paradigm change within the AI research community, the fact remains that ANNs have not nearly been able to replace symbolic AI. There are many advantages of ANN and these advances in this field will increase their popularity. Major advantage of ANN lies in their ability to classify and recognize patterns and to handle abnormal input data and as a result they give the proper range of data. To this end, these systems are often used in stock market analysis, fingerprint identification, character recognition, speech recognition and even in scientific analysis of data.

Application

1. Intelligent Simulation System:

System simulation is area of computer science that is being used to model complex system. AI programming methods permit more realistic and robust simulation models and help the user develop, run and interpret simulation experiments. The potential contributions of AI to the design and development of smart systems are being considered more widely. AI techniques can play a variety of roles in simulation process for smart systems,
including knowledge representation in a model, decision making within a simulation, rapid prototyping of models, data analysis of
simulator-generated outputs, and model modification and
maintenance. One of such type of software is Matlab which can
mimic the process involved in your research work and can produce
the possible result. We can easily find Mfiles related to research
work on internet and can upload on software to get simulated
results of paper. So, research paper can be written and together
compiled to form complete research ready for peer review.

2. Sensors

Robotic sensors are used to estimate a robot's condition and environment. These signals are passed to a controller to enable appropriate behavior. On one hand we have passive

sensors like cameras which capture signals that are generated by other sources in the environment. And on other hand we have active sensors which emits energy into the environment like sonar, radar etc. This energy is reflected by objects which are present. These reflections can then be used to gather information which is needed to make results. Moreover, active sensors provide more information than passive sensors but they also consume more power. So there is possibility to a problem for mobile robots which need to carry their way of energy in batteries. Robotic sensing is a subarea of robotics science intended to give robots sensing capabilities. Robotic sensing mainly gives robots ability to see, touch, hear ad move and uses algorithms that require environmental feedback. The visual sensing system can be based on anything from the traditional camera, sonar and laser to the new technology radio frequency identification (RFID), which transmits radio signals to tag on an object that emits back an identification code. All methods aim for three procedure- sensation, estimation and matching. For image processing, image quality is important applications that require excellent robotic vision. Algorithm is generally based on wavelet transform for fusing image of different spectra and different foci improves image quality. Robots gather more accurate information from this improved image. Visual sensors help robots to identify the surrounding take appropriate action. Robots analyze the image of immediate environment imported from visual sensors. Touch patterns enable robots to interpret human emotions in interactive applications. Four measurable features are present like force, contact time, repetition and contact area change that can effectively categories touch patterns. Touch sensory signals can be generated by the robot's own movement. It is very important to identify only external tactile signals for accurate operations. Recent solution applies ad adaptive filter to the robot's logic. It enables to predict the resulting sensor signals of its internal motions, screening these wrong signals out. The next type of sensor which mainly used in robots is for hearing i.e. Accurate audio sensing requires low internal noise contribution. Traditionally audio sensors combine acoustical arrays and microphones to reduce internal noise level. However, recent solutions combine also piezoelectric devices which are basically passive device uses piezoelectric effect to transform force to voltage, so the vibration that is causing the internal noise could be eliminated. On average, internal noise up to 7-8dB can be reduced. Robots may interpret strayed noise as speech instructions. Currently, Voice Activity Detection (VAD) system uses the complex spectrum circle centroid (CSCC) method and a maximum signal-to-noise ration (SNR). The VAD system with two microphones enables the robot to locate the instructional speech by comparing the signal strengths of two microphones. Robots can perceive emotions through the way we talk. Acoustic and linguistic features are generally used to characterized emotions. Combination of seven acoustic and four linguistic features improves the recognition performance. Some range sensors measure distances like touch sensors, and Global Positioning Sensor for long distance. Third important class of sensors is Proprioceptive sensors. These inform the robot of its own state. To measure the exact configuration of robotics joint motors are mainly equipped with shaft decoders. That counts the revolution of motor in small increment.

3. Intelligent Information System.

Intelligent Information System (IIS) provides different levels of intelligent support for its intended use such as decision support. The required knowledge can be obtained from domain knowledge and extracted from data using intelligent data analysis. This system must be able to provide including visual and audio data in addition to commonplace structured databases. One development in this area that is receiving more attention is data science and data mining. This area is becoming very important due to all types of commercial and government institutions are now logging huge volume of data and it requires to optimize

Computer vision

AI and computer vision technology can help robots to identify and recognize objects they encounter; help pick out details in objects and help with navigation and avoidance. Machines can visualize different scenarios through this technology that helps computer systems to precisely locate and identify image and videos. In AI, computer vision is playing big role in training visual perception-based Machine Learning or deep learning models to work in real life environment. Main motive of integrating computer vision in AI is to create visual perception model that can visualize the situation and perform the task itself without human intervention while taking the right decision. The whole process involves methods of acquiring datasets, processing, analyzing and understanding the digital images to utilize the same in real world. Computer vision playing following roles in various fields:

1) Face Recognition
2) Video Surveillance
3) Object Detection
4) Object Recognition
5) Medical Imaging Analysis
6) Localization and Mapping
7) Augmented Reality / Virtual Reality
8) Transforming the paperwork into digital data
9) In healthcare and Medical
10) Agriculture and Farming
11) Self driving cars

AI-enabled manipulation and grasping:

Difficult task for robots is being used to help robots with grasping items. With help of AI, a robot can reach out and grasp and object without need of human controller. A robot in manufacturing can actually develop better ways to mechanically interact with world. A robot using AI in developing the best, most efficient ways to utilize its moving parts. Most application of AI in robotics, the bulk of work done in this area is don't long before the robot is operating in factory floor and it's a part of machine learning phase.

AI-enhanced navigation and motion control using machine learning

Through enhanced machine learning capabilities, robots gain increased autonomy, reducing the need for human to plan and manage navigation path and process flow. It is an essential task for a mobile robot system is navigate and motion control. The characteristics of perception required by environment modeling or motion control are very different and this basically obtained by using sensors. A set of rules determines the dynamic structure and behavior of system using data acquisition, modeling, planning, and motion control subsystem. For example, if you have a robotic vacuum in house, it explores its surroundings, learning more about location, obstacles, navigation and challenges it will

need to overcome in order to accomplish the task. Once a robot learns where it can go and what it needs to do then there is always the option of preprogramming in different situations where learning might not be a best approach.

Finance

Banks and big organizations are using AI system to organize operations, invest in stocks, and manage properties, calculate holding and loan amounts. In August 2001, robots beat human in simulated financial trading competition. Financial institutions have been using ANN system to detect charges or claim norms. Artificial intelligence can free up personnel, improve security measures and ensure that the business is moving in the right technology-advanced, innovative direction. There are some examples where AI is getting often used in finance sector:

1) Risk assessment
2) Risk management
3) Fraud detection, management and prevention
4) Credit decision
5) Trading
6) Preventing cyberattacks
7) Managing finances/personalized banking
8) Financial advisory service
9) Better predict and access loan risks
10) Enabling 24/7 customer interactions
11) Reducing false positives and human error

Healthcare and Medicine

AI is becoming progressively sophisticated at performing tasks that humans do, with more accuracy and efficiency, quickly and at less cost. From finding new links between genetic codes to making robotic-assisted surgery, AI simplifies the lives of patients, doctors and hospital administration. AI and robotics have vast transformative capabilities for healthcare. Many healthcare organizations are leveraging AI-driven computers to make decisions with less human intervention. May be in future, these programmed systems will make difficult decisions on their own without any interaction of human. Due to continuing inventions and innovations in technology, biopharmaceutical companies are taking quick notice of efficiency, accuracy and knowledge that AI provides. Since many of pharmaceutical companies are using AI to produce and identify new medicines.AI-enabled robots can assist surgeons in conducting precise surgical procedures. AI platforms have already established their credibility as expert systems for advising medical practitioners on the diagnosis of diseases like cancer and recommending treatments. Other use cases for AI include early identification of potential pandemics and tracking disease incidence to contain spread, and image processing and diagnostics for radiology and pathology. Such assistive and augmentative applications of AI play a critical role in enhancing efficacy, particularly that of less experienced practitioners. In addition, they make healthcare accessible to a wider stratum of the society. Few advantages of AI and Robotics in Healthcare:

1) Reducing error rate / improving accuracy
2) Precise diagnosis
3) Remote treatment
4) Improving patients' health
5) Strengthening decision making
6) Reinvigorating end of life care
7) Supporting mental health and daily tasks

Customer service

Kind of AI that many people have encountered in their daily lives is the Customer service AI implementation known as Chatbot. These are the automated service agents for websites that can help with simple, frequent, repeatable requests that don't require human interference. These chatbots can give information about basic queries, delivery situations ad many more. Other side of customer service coin is for employee is called as Cobots. As they cooperate with human users, such as assembling and then handling off a component to a human inspector. Cotbots operations are flexible and less rigidly defined than other robots in manufacturing and processing, more and more they relying on AI to do more difficult tasks. The nature of cotbots allows for them to use for many purposes, from answering questions to provide remote telepresence to management or off-site employee.

Similar techniques may be used in answering machines of call centers, such as speech recognition software to allow computers to handle first level of customer support, text mining and natural language processing to allow better customer handling, agent training by automatic mining of best practices from past interactions, support automation and many other technologies to improve agent productivity and customer satisfaction.

Heavy Industry

Today's industrial robot work in wide range of industries from semiconductors and automobile to plastic processing and metal forging. There is great jobs for robots in hazardous or difficult for human. The application of robots in manufacturing industries is particularly valuable. Robots have been used for high-volume operations, but as the technology advances and cost of industrial robots got declined because of more options and opportunities are opening for medium and small-sized operations. At the same time, these robots are helping manufacturers address many of the key challenges they face, including tight labor pools, global market competitiveness and safety Advantages of Industrial robots:

1) Better quality and consistency
2) Maximum productivity and throughput
3) Greater safety
4) Reduced direct labor cost

Transportation

AI is in the spotlight as one of the emerging fields transforming the transport sector. AI is used in prediction & detection of traffic accident and conditions, it is used in resolving control and optimization problems, Autonomous Trucks have been initiated all over world. Autonomous trucks will save costs, lower emission and improve safety as compared to traditional trucks with human drivers. AI in transportation & infrastructure can collect traffic data to reduce congestion and improve the scheduling of public transport. AI will allow streamlined traffic patterns; smarter traffic light algorithm and real-time tracking can control higher and lower traffic patterns. The transportation can use AI in mission-critical tasks such as self-driving vehicles carrying passengers, and used to predict the oaths of pedestrians and cyclist, it will decrease traffic accident and injuries, it will allow for more diverse transportation usage and an overall reduction in emission. Transportation problems arise when system behavior is too difficult to model according to a predictable pattern, affected by things such as traffic, human errors, or accidents, In such cases, the unpredictability can be aided by AI, AI can use observed data

to make or predict decisions appropriately, NNs & GAs are perfect AI methods to deal with these types of unpredictability. Machine learning could soon be used to predict and prevent traffic jams, Artificial intelligence improves public safety, Safety of citizens when traveling by public transport in urban areas is improved by tracking crime data in real time, This will allow the police to increase its efficiency by patrolling & keeping the citizens safe. Artificial intelligence can be applied to traffic management & decision-making systems to enhance and streamline traffic management and make our roads smarter, Traffic management systems can recognize the physical & environmental conditions that can lead to heavier traffic flow & congestion, they can automatically suggest alternate routes to relieve any traffic that has been formed. Advantages of AI and Robotics in transportation:

1) Traffic management
2) Heavy goods transportation
3) Ride-sharing
4) Route planning
5) Alternative sources of mobility

National security and defence

AI finds application in the fields of defence and security as well. It can be leveraged to protect economic sectors and infrastructure such as airports and power plants that are vulnerable to attacks. Anomalous behaviour detection in individuals and infrastructure disruption prediction (natural/man-made causes) powered by the use of distributed sensors and pattern recognition are just a few examples of the potential use cases of AI in this sector. Along with AI applications in defence, robots can be used to perform jobs which are unsafe for humans—such as recovering explosives, detecting mines, space exploration, deep water probes, scouting for hostile territories and capturing video feed, to name a few. The usage of AI and robots in defence and military began with unmanned aerial vehicles (UAVs) and unmanned ground systems (UGS) guided bombs and missiles. Future applications of AI and robotics in unmanned systems are likely to include: • Target identification and classification using image processing and interpretation • Expert systems used to diagnose weapon systems like radars and missiles • Precision targeting systems for ammunitions leading to improved accuracy • Trajectory analysis, impact zone and kill zone evaluation using computerized simulations

Aviation:

As artificial intelligence (AI) continues to evolve and expand, companies are seeing huge changes in the field of aviation. Big brands are investing in AI technology to enhance their products and services to better serve their customers. Artificial intelligence (AI) tools and technologies are used by some of the world's leading airliner service providers to deliver more personalized traveling experiences to their customers. AI, machine learning, machine vision, robotics and natural language processing are the future of the aviation industry. Predictive analytics, customer feedback analysis, auto-scheduling, pattern recognition and targeted advertising are all part of AI technology taking the aviation industry to a whole new level. AI technology is becoming more advanced and complex, and is finding applications in the aviation industry in multiple ways, including auto-pilot features. Due to factors like cost savings and shortage of qualified pilots, many companies have expressed an interest in reducing or even eliminating the number of pilots in the cockpit. There have been speculations that AI may someday replace human pilots. This article covers the various applications of AI in aviation and discusses how close AI is to replacing human pilots in the future. Different workflows in the aviation industry are characterized by dynamicity and are subject to disruptions. Such disruptions cost airlines loads of money. For example, unplanned maintenance leads to delays which in turn add expenses as a result of expedited transportation of parts, overtime compensation for crews, and compensation for travels. Most notable on this front is Airbus's Skywise open data platform which aims to improve aviation operational performance and business results. The platform has been used by easyJet for predictive maintenance. The process reduces delay-induced costs by predicting failures ahead of time.

AI not only can predict failures but also shorten the time required to find a fix. For instance, SynapseMX is an AI startup that supports maintenance teams to make quicker technical decisions. And Donecle, a Toulouse-based company, is developing autonomous aircraft inspection UAVs. They utilize the latest AI image analysis algorithms to identify defects on the aircraft's skin. Airlines are using a wide range of AI technologies to provide the best experience for their customers. Delta Airlines for example is investing in technologies that enhance airport experience by providing self-service solutions. Namely, it introduced face recognition technology to confirm a traveler's identity by matching their faces with passport photos. NLP can also be used to harvest and analyze customers' feedback. Air traveling can be stressful for many. One has to do various tasks like passing through security control, checking luggage, finding gates, waiting, and whatnot. If airlines can aggregate customers' feedback and extract patterns of discomfort or uneasiness, they will be able to enhance customer service promptly. Safety measures are among the top priorities in the aviation industry. No doubt that big improvements have been done so far, and with AI more is coming. Oreyeon, a Lebanese AI startup with offices in Portugal and Switzerland, specializes in developing airport solutions with a focus on aviation safety. Airlines are using advanced data analytics techniques and algorithms to maximize their profits and reduce their expenses. They crunch customers' data to estimate their willingness to pay and set dynamic pricing strategies for flights, fare class, and ancillary. They define destinations - or where to fly - by predicting demand from users' search data. They reduce the quantity of dumped food after each flight by analyzing historical food ordering data. They also reduce CO_2 emissions into the atmosphere. Robots have already made their way into airports. A number of them are already using robots for mundane processes like cleaning airport floors and providing information to flyers. As the technology becomes more advanced, robots will see a faster and increasing adoption at terminals across the globe. They are predicted to take over our airports by 2030, according to a recent study. Robots will automate and streamline most of the processes and procedures carried out at airports. Airport robots can become a common sight in the near future and completely change the way we travel. Robots can significantly reduce the time passengers spend at terminals and can streamline most of the current processes. Although robots will mostly prove beneficial to passengers, they will ultimately benefit airline companies and airport authorities as they will help attract more passengers towards air travel. Here are a few ways robots are going to simplify the procedures at the airport, proving beneficial to companies and consumers alike.

Advantage of AI and Robotics in Aviation:

1) Faster check-ins
2) Easier baggage handling
3) Better security
4) Personalized experience
5) Airport management
6) Journey management
7) Recommendation engine
8) Cost optimization
9) Fraud detection
10) Driving and take-off assistance

Top 15 AI companies that have the power and resources to shape our connected future.

1) Amazon
2) Apple
3) Banjo
4) DJI
5) Facebook
6) Google
7) HI Silicon
8) IBM
9) Intel
10) Microsoft
11) Nvidia
12) Open AI
13) Qualcomm
14) SenceTime
15) Twitter

A number of organizations are involved in active AI research in India:

1)Indian Institute of Technology, Chennai
2) Indian Institute of Technology, Delhi
3) Indian Institute of Technology, Kanpur
4) Indian Institute of Technology, Kharagpur
5) Indian Institute of Technology, Mumbai
6) Indian Institute of Science, Bangalore
7) Indian Institute of Management, Kolkata
8) Indian Statistical Institute, Kolkata
9) Tata Institute of Fundamental Research, Mumbai National Centre for Software Technology, Mumbai International Institute of Information Technology, Hyderabad
10) Central Electronics Engineering Research Institute (CEERI),
11) HP Labs India Electronic copy
12) Tata Infotech, Mumbai & Tata Research Development & Design Centre, Pune
13) CSI Special Interest Group in Artificial Intelligence (CSI-SIGAI)
14) Technology Development in Indian Languages (TDIL).

FUTURE OF AI

In spite of the many fundamental barriers highlighted above, the fields of AI and robotics are replete with many wonderfully inventive predictions, a domain where reality and science fiction often meet. Indeed, it is likely that in the next two decades we'll see more and better capabilities that we tend to attribute as awareness. However, it is unlikely that machines will ever have human awareness in the philosophical sense of the term, although they may come close in the long term. Rather, we can expect to see classical AI going on to produce more and more sophisticated applications in restricted domains, such as expert systems, chess programs and Internet agents. At the same time, the next 30 years will produce new types of animal-inspired machines that are more „messy" and unpredictable than any we have seen before – less rationally intelligent but more rounded and whole.

Summary

The field of AI robotics has created a large class of robots with basic physical and navigational competencies. At the same time, society has begun to move towards the incorporation of robots into everyday life, from entertainment to health care. Whereas robots were initially developed for dirty, dull, and dangerous applications, they are now being considered for personal assistants. Regardless of application, robots will require more intelligence, not less. AI technologies and techniques are in fact already at work all around us, although often behind the scenes. Many applications of AI technologies and techniques have become so commonplace that we may no longer consider those applications as involving AI.

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