Chapter 5

New Trends in Artificial Intelligence

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Abstract

Nowadays, with society 5.0, where technology has reached its highest level and smart societies have been formed, artificial intelligence has entered our lives in almost every field. With artificial intelligence, which is related to many disciplines, machines that resemble the human thinking and learning system are produced. In this way, artificial intelligence is used in cases where workforce and potential processing capacity are insufficient. In this study, the development process of artificial intelligence, new trends with artificial intelligence technologies are presented and the areas of use of artificial intelligence are included with examples. Finally, information about the future of artificial intelligence is given. It is expected that this study, which explains the basic principles of artificial intelligence, will be useful to its readers.

1. INTRODUCTION

In today's world, computers, despite being machines that make life easier for humans and take on their workload, fall short in solving complex problems. At this point, artificial intelligence aims to enhance the capabilities of computers in complex situations such as thinking and problem-solving like humans, where computers prove to be insufficient. Artificial intelligence is related to various disciplines such as computer engineering, philosophy, cognitive science, and electronic sciences. It encompasses theories, methods, and applications related to mimicking and advancing human intelligence for solving problems or issues in various fields (Shi and Zheng, 2006, p.810). It includes various methods and tools, ranging from speech recognition and robotic applications to expert systems and natural language processing (Niu, Tang, Xu, Zhou, and Song, 2016, p.1).

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https://doi.org/10.58830/ozgur.pub389.c1616

To be called artificial intelligence, a system must possess four distinct features: the ability to act like a human, the ability to think like a human, the ability to act rationally, and the ability to think rationally (Russell and Norvig, 2010).

The development of artificial intelligence began with Turing machines in 1950 and has now become a part of our lives in almost every aspect, from health to security, from shopping to social media. With technologies such as machine learning, deep learning, natural language processing, and genetic algorithms, artificial intelligence now enables dialogue between machines and humans through chatbots.

With the continuous advancement of artificial intelligence, it is expected that virtual reality and augmented reality applications will become even more widespread in the future. Moreover, digital humans will progress further, possessing not only text and voice-based communication skills but also interacting through various modalities such as facial expressions, body language, emotions, and physical interactions, going beyond the capabilities of mere text and voice-based communication.

2. ARTIFICIAL INTELLIGENCE

John McCarthy, widely regarded as the father of artificial intelligence, defined artificial intelligence in 1956 as the "science and engineering of making intelligent machines" (Gupta, 2017). Today, artificial intelligence is recognized as a system that operates with advanced technology, generally possessing the abilities to mimic, understand, evaluate, and make superior interpretations by bringing together previously learned information (Nabiyev, 2012). The goal of artificial intelligence is to mimic human intelligence through computer means. Artificial intelligence is defined in various ways in the literature (Pirim, 2006: 81-93).

- "Artificial intelligence is the replication of behaviors termed intelligent when performed by humans, but executed by machines."
- "A theory attempting to demonstrate how the human mind works. The goal of artificial intelligence is to mimic human intelligence through computer means."
- "Artificial intelligence seeks to understand the structure of intelligence by creating computer programs that control intelligent machines."

The concepts of artificial intelligence, deep learning, and machine learning have become intertwined and are sometimes even used interchangeably. However, machine learning is a subset of the artificial intelligence discipline,

and deep learning is an area that needs to be examined under machine learning. This situation is illustrated in Figure 1. (Öztemel, 2020).

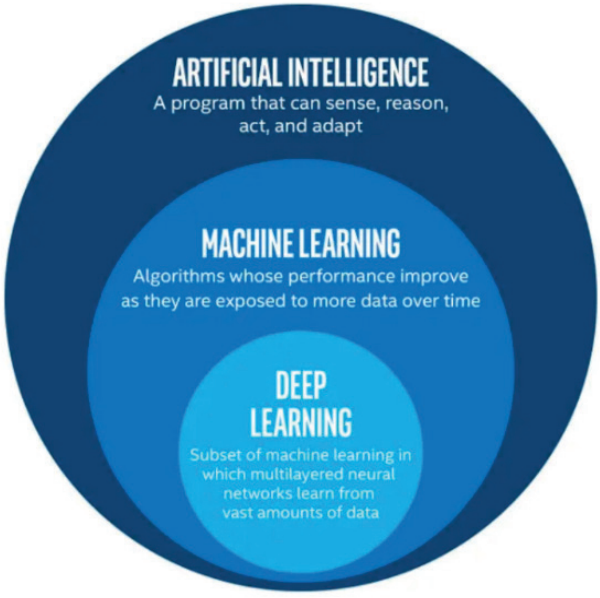

Figure 1. Artificial Intelligence, Machine Learning and Deep Learning Relationship

Definitions of artificial intelligence are categorized into four groups: machines that think like humans (thinking humanly) (Belman, 1978), machines that act like humans (acting humanly) (Kurzweil, 1990), machines that think rationally (thinking rationally) (Winston, 1992), and machines that act rationally (acting rationally) (Nilsson, 1998).

2.1. The Development Process of Artificial Intelligence

The emergence of Artificial Intelligence (AI) dates back to 1945 when the term Robotics was coined. The development of AI, along with significant milestones up to the present day, can be outlined as follows (Gupta, 2017; Ayyıldız and Yılmaz, 2021; Akbulut, 2023):

1950: Alan Turing introduced the Turing Test for evaluating intelligence and published "Computing Machinery and Intelligence." Claude Shannon published "A Detailed Analysis of Chess Playing" (Turing, 1950).

1956: John McCarthy coined the term "Artificial Intelligence" and presented the demonstration of the first AI program created at Carnegie Mellon University.

1958: John McCarthy developed the LISP programming language for AI.

1964: Danny Bobrow's thesis at MIT demonstrated that computers could accurately understand algebraic word problems in natural language.

1965: Joseph Weizenbaum at MIT created ELIZA, a natural language processing computer program capable of sustaining a dialogue in English.

1969: Scientists at Stanford Research Institute developed Shakey, a robot with motion, perception, and problem-solving capabilities.

1973: The first AI research center in Europe was established at the University of Edinburgh.

1979: Stanford Cart, the first computer-controlled autonomous vehicle, was created.

1985: Harold Cohen created and showcased the drawing program Aaron.

1990: Significant progress was made in all areas of AI, including machine learning, case-based reasoning, multi-agent planning, timing, data mining, web crawling, natural language understanding and translation, vision, virtual reality, and gaming.

1997: Deep Blue Chess Program defeated the reigning world chess champion, Garry Kasparov.

2000: Interactive robotic pets were introduced to the market. MIT created Kismet, a robot expressing emotions.

2005: The humanoid robot Asimo, equipped with artificial intelligence, was introduced.

2011: Apple introduced Siri, a virtual assistant capable of executing voice commands.

2012: Google tested self-driving cars in traffic.

2016: Google's AlphaGo defeated a top Go player in the world. The same year, Hanson Robotics introduced Sophia, a humanoid robot recognized as the first "robot citizen," with a realistic human appearance, the ability to perceive and mimic emotions, and communication skills.

2021: OpenAI released DALL-E, a project capable of generating images based on textual descriptions.

2022: ChatGPT, known to be created by OpenAI, was launched. (GPT-2 was developed in 2019, and GPT-3 Beta in 2020.)

March 2023: Google Bard, a chat robot utilizing the large language model called LaMDA, was opened to a limited user base.

2.2. Applications of Artificial Intelligence

Artificial intelligence (AI) has become widely prevalent in various fields today. AI and intelligent software are actively used in numerous sectors and activities, ranging from health, law, entertainment, tourism, finance, banking, security, engineering, education, socio-cultural activities, to manufacturing and storage (Komalavalli et al., 2020; Apaydın et al., 2023). Below are examples encompassing common application areas:

Health: AI utilizes data to predict diseases and provide accurate treatments, actively contributing to the healthcare sector.

Finance: AI facilitates quick access to reports that data analysts could spend hours generating in the financial sector.

Shopping: Online shopping platforms collect and store information about your preferences. Google Analytics can provide insights into your online activities, including the time spent on specific pages, location, browser, device, and even mouse usage.

Social Media: AI, employed by social media platforms like Facebook, Twitter, and Instagram, considers your past searches, interactions, and behaviors to enhance user experience.

Autonomous Vehicles, Drones, Autopilot: Autonomous vehicles, including self-driving cars, are prime examples of how AI influences the automotive industry. They use visual recognition systems and real-time modeling to predict static and moving obstacles and determine actions based on objectives.

Travel: Google Maps, powered by AI algorithms, scans route information and determines the most suitable path for biking, driving, bus, train, or walking. AI, through chatbots, is rapidly changing the travel industry, facilitating interactions that include travel suggestions, optimal reservation prices, and quick response times.

Smart Devices: AI-supported devices, such as smart lights that change intensity and color over time, and thermostats that adjust temperature according to user preferences, are increasingly common. Automated voice assistance systems like Alexa and Siri also exemplify AI's role in enhancing daily life.

Music: AI, based on data obtained from millions of conversations, can assist musicians in creating themes and generating various musical elements. Tools like SOUNDRAW, which uses AI to create royalty-free music, allow users to choose length, tempo, mood, genre, and theme to generate music with a click of a button.

Food: AI is utilized to make recommendations based on food compatibility and assist in developing recipes.

Security: AI's ability to analyze security camera footage using facial and voice recognition technologies is more efficient and practical than requiring humans to monitor streams from multiple cameras simultaneously.

Internet of Things (IoT) and Robotics: Technologies based on AI-driven systems, focusing on device communication and creating autonomous physical agents, encompass both the Internet of Things and robotics. They use AI to identify signals, determine responses, and manage their current situations.

2.3. Artificial Intelligence Technologies

There are various techniques and technologies employed in Artificial Intelligence (AI). Below are some of the most commonly used methods (Sağıroğlu and Sinanc, 2013):

Machine Learning (ML): Machine Learning is a subset of AI that utilizes various methods to analyze past data, make inferences, generate solutions, and make predictions for the future. It has two main types: Supervised, Unsupervised, Semi-supervised, and Reinforcement Learning. Supervised learning is result-oriented, aiming to reach and conclude goals by accessing information from data. It uses labeled datasets to train the model. Unsupervised learning, on the other hand, focuses on exploring patterns using unlabeled datasets.

Deep Learning: Deep Learning, which had a significant impact on the scientific community in 2012, is a branch of machine learning that performs complex tasks through artificial neural networks. It often requires large amounts of data and high computational power but has achieved significant success in areas such as visual recognition, speech recognition, and natural language processing. Deep learning encompasses computation models with multiple processing layers to represent data at multiple abstraction levels.

Natural Language Processing (NLP): NLP is a technology that enables computers to understand human language. It includes various applications such as search engines, virtual assistants, text classification,

text summarization, text translation, sentiment analysis, and entity name recognition.

Evolutionary Algorithms: Evolutionary algorithms seek solutions by modeling natural genetic structures. They are used to find solutions in problems where information is incomplete. These algorithms are built on a random process and are generally applied to optimization problems.

Support Vector Machines (SVM): SVM is a supervised learning algorithm used for classification or regression tasks. It creates an n-dimensional hyperplane that optimally separates data into two categories. SVM models are closely related to artificial neural networks, featuring a two-layer, feedforward artificial neural network using a sigmoid kernel function. They divide data with limiting hyperplanes, thus distinguishing classes.

Clustering Algorithms: Clustering algorithms divide datasets into groups with similar characteristics. There are various clustering algorithms in the literature, and the choice of which one to use depends on the goal and data type. Main clustering methods include Partitioning methods, Hierarchical methods, Density-based methods, Grid-based methods, and Model-based methods.

Genetic Algorithms: Genetic Algorithms mimic biological evolution processes and are probabilistic, robust, and intuitive search algorithms based on evolutionary principles to reach specific goals. They are applied in problems related to optimization.

These technologies collectively contribute to the diverse and evolving field of artificial intelligence, enabling advancements in various applications and industries.

3. ARTIFICIAL INTELLIGENCE- NEW TRENDS

3.1 Artificial Intelligence with Augmented and Virtual Reality

The combination of artificial intelligence, augmented reality, and virtual reality has the potential to revolutionize the world with its immense functionalities.

3.1.1. Virtual Reality (VR): VR involves the fusion of reality and imagination through digitally created scenarios. It is considered the most advanced technology that integrates computer graphics, simulation technology, artificial intelligence, sensor technology, and parallel network processing achievements. VR is acknowledged as

a highly sophisticated simulation system generated by computers (Chavez & Bayona, 2018).

3.1.2. Augmented Reality (AR): Augmented Reality is defined as the enhanced real-time perception of a physical real-world environment through the addition of computer-generated information. It enriches the live or indirect physical view of the environment and its contents by integrating information generated by a virtual computer. This includes sound, images, graphics, and GPS data. AR is essentially the alteration and enhancement of reality by computer technology. The concept of Augmented Reality involves the technological adaptation and design of solutions to real-life problems (Carmigniani et al., 2011). The products and services of Augmented Reality are referred to as the Metaverse.

3.1.3. Metaverse: A Fusion of Reality and Virtual World. Metaverse can be defined as a 'digital world' where real and virtual worlds merge in a science fiction-inspired environment (Zhao et al., 2022). It is a digital and online space that encompasses the digital twins of humans, objects, and spaces, featuring 3D visuals (Moro-Visconti, 2022). In this 'world,' people can transition between different electronic devices and communicate in a virtual environment. Metaverse is the next-generation internet, a "digital place where the digital representations of people and objects live."

Current modern prototypes of Metaverse applications can be categorized into 'games,' 'social experiences,' 'online collaboration,' 'simulation and design,' and 'creative economy' (Y. Wang et al., 2023). Below are a few examples of potential applications in Metaverse:

Enhanced Learning: New ways of education and teaching that provide a more comprehensive learning experience are possible. Metaverse is expected to create a new learning environment for higher education and military training institutions, addressing the challenges and costs associated with real-world training areas.

Virtual Events: Virtual events, which have transformed the essence of business life since the pandemic, can be more integrated and interactive in Metaverse. Virtual concerts, launch meetings, entertainment environments, and various other formats may become possible.

Retail Sector: Opportunities may arise for the retail sector to increase customer interaction with virtual stores and offer new forms of shopping experiences. Introducing products and services, conducting demos, and

interacting with users, such as trying on new clothes or test-driving a product, can be facilitated.

Corporate Interactions: Companies and organizations will seek ways to not only engage with customers but also enhance interaction and collaboration with employees in Metaverse.

3.1.4. Digital Humans: Digital humans can be envisioned as 3D versions that respond to actions and reactions in a virtual world, similar to the virtual assistants used today. Brands can hire these digital humans to assist customers in shopping, guide them through a process, or answer questions as a customer support representative. To perform such functions, they will need to include AI-supported understanding capabilities, sustain a conversation, provide recommendations, engage in social conversations and jokes, and exhibit some emotional responses like a human. Brands will find endless ways to use these characters not only to acquire customers, sell products, and provide support but also to hire employees, encourage company participation, and increase loyalty (Şeker, 2023).

3.2.Artificial Intelligence in Robotics

Robotics is taking over industries worldwide with its versatile functionalities. Robots, powered by artificial intelligence, excel in performing successful surgeries, showcasing dance moves, protecting workers in hazardous environments, and various other activities (Kurtuluş, 2023). With Industry 4.0, countries aim to enhance both efficiency and quality in production in the coming years using robots, sensors, and the analysis of the data they generate (Kaygusuz, 2023).

3.3.Ethical Artificial Intelligence

Major companies like Google, Microsoft, Apple, Facebook, and others are working on ethical artificial intelligence by following an ethical framework that includes four essential principles: fairness, reliability, transparency, and explainability. This trend is gaining popularity as it provides stakeholders with an internal look into their systems. Ethical artificial intelligence raises various ethical, legal, and social issues related to the social interactions of AI-based robots, opening up different perspectives for ethicists, sociologists, and legal experts in the futuristic scenarios presented in science fiction (Doğan, 2023).

3.4. Explainable Artificial Intelligence (XAI)

As deep learning models become increasingly complex, the need for "Explainable Artificial Intelligence" (XAI) has emerged to allow humans to understand and interpret the outputs generated by these models (Terzi, 2021). XAI provides a general explanation of how artificial intelligence models and machine learning work internally to produce meaningful business predictions and forecasts for the future. While companies are required to provide complete transparency with a full explanation, concerns arise in competitive markets where companies may not want to disclose all their steps and processes to the public due to patent reasons. Explainable AI provides explanation maps showing the infrastructure of the system's decisions. By examining explanation maps, humans can detect potential mistakes made by the machine, preventing incorrect actions (Kırat & Aydın, 2023).

3.5. Predictive Analytics

Artificial intelligence-based predictive analytics is achieved through the use of predictive analytical models and automated tools in AI-based auditing. Predictive analytics allows businesses to understand customer trends for better consumer behavior in current scenarios, using personalized data collected over an extended period to predict potential responses from target audiences (Ng and Alarcon, 2020).

3.6. Emotional Artificial Intelligence

Emotional artificial intelligence is a popular trend in 2021 as it can perceive, learn, and interact with multiple human emotions. This technology is known for taking human-robot communication to a new level. Emotional AI can understand customer behaviors through verbal and non-verbal signals. Service robots programmed with emotional AI codes are useful in superficial acting, as they greet and interact with customers. However, for a service environment to be complete for customer satisfaction, human elements are still necessary. The automation of the service process with AI offers additional opportunities for performance and productivity improvement (Wirtz et al., 2018). Emotional AI algorithms can monitor customer preferences in real-time, offering new ways for marketers to adjust marketing strategies based on customer preferences in social media content (Verma et al., 2021).

3.7. Conversational Artificial Intelligence

Since 2017, many companies have been using sophisticated chatbots and virtual assistants to provide information to users and perform various tasks.

The integration of emerging technologies such as augmented reality, virtual reality, and artificial intelligence is crucial for creating scalable and realistic virtual worlds (İrdem and Çobanoğlu, 2021). The fundamental technology behind these digital humans will be speech-based conversational artificial intelligence. One such AI application is ChatGPT, a conversational AI robot developed by OpenAI and released in November 2022. This application is built on large language models, fine-tuned using both supervised and reinforcement learning techniques (Küçüker, 2013; Wikipedia, 2023).

3.8. Artificial Intelligence in Cybersecurity

Artificial intelligence can instantly detect any unusual activity within existing systems and alert employees as quickly as possible. It also makes it more challenging for hackers and fraudsters to infiltrate the system. AI enriches cybersecurity with intelligent code analysis and configuration analysis. Cybersecurity solutions integrated with AI provide more effective, high-performance protection (Kuzlu et al., 2021).

3.9. Artificial Intelligence in Computer Vision

The integration of artificial intelligence into computer vision has transformed existing computer systems into intelligent computers. This approach (AI) can perform various operations such as analyzing human posture and movement, collecting data on people and vehicles for security forces, analyzing videos, and using facial recognition as needed. Computer vision, capable of performing processes like regression, classification, and segmentation, is also used in the diagnosis and treatment processes of diseases (Janiesch et al., 2021; Emmert-Streib et al., 2020).

3.10. Artificial Intelligence in IT

Artificial intelligence in IT is used in various areas, including safeguarding confidential data against possible threats and data breaches, overcoming software errors and assisting developers, undertaking tedious and repetitive tasks, predicting and identifying complex problems, delivering more benefits without human intervention, and ensuring top-level security in the quality of products and services (Tugay & Tugay, 2019).

3.11.Artificial Intelligence in IoT

The application of artificial intelligence to IoT allows smart devices to analyze data and make effective, intelligent decisions without human intervention. It is also used to enhance performance and optimize systems to meet the desires and needs of the target audience (Sinopoğlu et al., 2021).

4. THE FUTURE OF ARTIFICIAL INTELLIGENCE

There are numerous scenarios and predictions about the future of artificial intelligence (Karamustafa & Arsan, 2022; Taştan & Taştan, 2021; Öztemel, E., 2020):

- Artificial intelligence will become more widespread in various aspects of our lives, facilitating human tasks. Through automation and robotic systems, production processes will become more efficient, medical diagnostics and treatments will be more accurate and effective, autonomous driving will enhance safety, and overall human quality of life will improve.
- Artificial intelligence may lead to job losses for humans. Automation and robotic systems may render some jobs obsolete, leading to increased unemployment in certain sectors. Already, 31% of small businesses have started using AI tools, with 82% of them claiming that these tools have increased profits and reduced expenses. A McKinsey study predicts that AI will replace at least 30% of human labor by 2030.
- Artificial intelligence has the potential to violate individuals' privacy rights and pose security risks. AI systems can collect and analyze people's data, and if these data fall into the wrong hands, security risks may emerge.
- Artificial intelligence could take control of human lives and pose risks. Uncontrolled development of AI technology might lead to errors that could jeopardize human lives or be maliciously exploited by individuals with ill intent.
- Artificial intelligence has the capacity to alter human social relationships and influence societal structures. For instance, AI systems on social media platforms can analyze people's behaviors to deliver personalized content for advertising and political campaigns, thereby influencing individuals' thoughts and behaviors.

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