Artificial Intelligence in Robotics

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***Abstract*—Artificial intelligence plays a key role in robotics. The artificial intelligence in a robot makes its actions autonomous and improves the efficiency of the robot. This advancement in robotics has had considerable influence in the modern world. There are primitive robots which have no artificial intelligence implemented in them, but they follow a predetermined set of instructions which may not be the optimal set of instructions. Robotics are involved in almost every field of work and the majority of them use artificial intelligence or machine learning. In this paper we will discuss the various fields robotics with artificial intelligence are being used and how these robots operate. We will also discuss the influence the artificial intelligence in robotics has had in society and the ethical questions and dilemmas that have been raised by this technology.**

***Index Terms*—Artificial intelligence, Neural network, Robot;**

I. Introduction

Artificial intelligence in robotics has long been a subject of science fiction novels. These science fiction novels display robots as man-like machines who display intelligence like humans would or mimic some cognitive function of the human brain. The most famous science fiction writer who wrote about robots was Isaac Asimov, who established in his book the Three Laws of Robotics, which are 1. A robot may not injure a human being or, through inaction, allow a human being to come to harm; 2. A robot must obey the orders given to it by human beings except where such orders would conflict with the First Law; 3. A robot must protect its own existence as long as such protection does not conflict with the First or Second Law [1]. Robotics, however, is not exactly like this although there are robots who are being developed to act like humans. Before we see what artificial intelligence is, we will discuss what robotics is. Robotics is the study of robots and it is a branch of technology that deals with designing, construction, and applications of robots. Robots are machines, which are used to do repetitive or tasks that may be dangerous for humans. Most of the robots nowadays are doing their job themselves without any specific directions while other robots must have a person telling them what to do [2]. Before we look at the implementations of artificial intelligence in robotics, we will discuss artificial intelligence as a concept. Artificial intelligence is intelligence proved by machines, which is able to perform various tasks for the needs of human intelligence. Some activities of computers with artificial intelligence are learning, speech recognition, problem-solving and planning [2]. Artificial intelligence describes the work processes of machines that would require intelligence if performed by humans. The term 'artificial intelligence' thus means 'investigating intelligent problem-solving behavior and creating intelligent computer systems'. There are two kinds of artificial intelligence: 1. Weak artificial intelligence: The computer is merely an instrument for investigating cognitive processes – the computer simulates intelligence; 2. Strong artificial intelligence: The processes in the computer are intellectual, self-learning processes. Computers can 'understand' by means of the right software/programming and are able to optimize their own behavior on the basis of their former behavior and their experience. This includes automatic networking with other machines, which leads to a dramatic scaling effect [3]. Artificial intelligence is a very powerful technology which with a large amount of data and computing power it can do various actions that humans do in a fraction of the time. The aforementioned actions that artificial intelligence can perform fit perfectly to what a robot should do such as speech recognition, face recognition, problem solving etc. From [2], we can define five functions which the robot ponders and makes a decision about which steps to take about an activity. They are planning, acting, perceiving, monitoring, and goal reasoning. In planning, the agent (robot) deliberates with the help of the combination of prediction and searches which are used for synthesizing a trajectory in an abstract space with the help of predictive models of feasible action and environment. The function of acting is based on implementing an online close-loop feedback function. In order to refine and control the achievement of planned actions, this function processes streams of sensory stimulus to actuators commands. In perceiving, the agent can extract the features of the environment for identifying the events and the states, and other situations which are relevant to the tasks. It also combines bottom-up sensing from sensors to meaningful data, with top down focus mechanisms, planning for gathering information and sensing actions. The monitoring function combines and observes the differences between predictions and observations. It also performs trigger recovery actions and diagnosis. With goal reasoning, the agent combines and observes the differences between predictions and observations. It also performs trigger recovery actions and diagnosis. From aforementioned discussions we can see that artificial intelligence and robotics work really well together and we will see this collaboration in working fields where robotics is being used.

II. Related Work

Robotics, information technology, communication technology, and artificial intelligence have all become more interwoven since the dawn of the artificial intelligence era. After a long evolution in the electrical and digital eras, robots are entering into a new era of intelligence. Three components of the entire process are reflected: To begin with, traditional industrial technologies such as the controller, servo motor, and reducer have evolved into artificial intelligence technologies such as computer vision, natural language processing, and deep learning; second, robots have become more deeply

integrated into human society, attracting attention from both industrial and commercial, family, and individual users. Finally, what were formerly mutually autonomous human-robot connections are being replaced by a bond of collaboration and interaction [2]. John McCarthy is the man who came up with the concept of AI in 1955, assuming that every component of learning and other domains of intelligence can be characterized so precisely that they can be mimicked by a machine. However the phrases 'artificial intelligence' and 'intelligent human behavior', are not well defined [3]. People often imagine a robot rolling across the floor responding automatically when they think of artificial intelligence robotics. And, undoubtedly, the humanoid robot is thrilling and popular. However, there are numerous types, forms, and uses of artificial intelligence in robots that are transforming our business landscape [4]. So what is an artificial intelligence robot? Artificial intelligence robots combine AI and robotics by incorporating AI software into robot systems. The most advanced robots are those controlled by AI that can learn from their environment and experience and then build on their capabilities based on that knowledge. A survey has been made on 12,000 experts and members of the interested public to share their opinions on the likely future of the Internet by Aaron Smith and Janna Anderson conducted between November 25, 2013, and January 13, 2014 [5]. By 2025, the clear majority of respondents expect robotics and artificial intelligence will pervade many aspects of daily life, with significant ramifications for areas such as health care [6], transportation and logistics [7] [8], customer service [9], and home maintenance [10]. They are significantly divided on how improvements in AI and robotics will affect the economy and employment situation over the next decade, despite being fairly consistent in their projections for the future of technology itself. The point of discussion in [11] is how the application of artificial intelligence onto the robotics of manufacturing could lead to a new type of manufacturing called intelligent manufacturing. In a published article Ethics of Artificial Intelligence and Robotics is debated about issues that arise with certain uses of the technologies which would not arise with others. Main debates in this article are about Privacy Surveillance, Manipulation of Behavior, Opacity of AI Systems, Bias in Decision Systems, Human-Robot Interaction, Automation and Employment and Artificial Moral Agents [12]. In [13] we see the results of 3D-printed habitats for Martian or Lunar space missions using artificial intelligence and robotics. In [14] it is shown the specifics of the Pepper robot. In [15] we see the way the Shadow Dexterous Hand works. In [16] it is discussed about the potential and the challenges being faced with the emergence of artificial intelligence-assisted surgery. In [17] it is being shown a robotic hand solving a Rubik's cube.

III. Implementations of AI in robotics

A. Fourth industrial revolution

The fourth industrial revolution is a new chapter in human development which is a product of technological advances. It is going to represent the fundamental change in our daily work routine, the way we live and interact with others and how robots and the progress of AI will substitute a lot of labor work. The digital, physical, and biological worlds are all altering as a result of the fourth industrial revolution. It is offering us new possibilities and promising a brighter future. Artificial intelligence, machine learning, augmented reality, and virtual reality are just a few of the technologies that make up the fourth industrial revolution. Machine learning is already present in our daily lives, unlocking our phones with a peek or a touch, recommending music we enjoy, and teaching automobiles to drive themselves. The proliferation of data is at the heart of it all. Data is expanding at a breakneck pace. Manufacturing is no longer the same as it was some decades ago. We are seeing greater automation with production lines consisting of various machines mixed in amongst fewer workers, rather than factories overflowing with busy workers. In today's production sector, industrial robots have grown extremely ubiquitous. There has been a decline in the workforce for manual labor in recent years, particularly for skilled positions. Robotic automation bridges the labor and skills gap, avoiding costly delays and downtime caused by labor shortages. Robotic automation is becoming increasingly accessible to more businesses as the cost of robots has decreased and robotic technology has advanced. Today's robot prices are much more reasonable, and there is also the option of purchasing a secondhand robot.

B. Transport and Logistics

Part of the reason for the automation and modernization of production processes in industrial plants is to improve transportation operations inside the industry itself. One of the most significant advancements in the automation of transport operations in manufacturing, assembly lines, and storage is the introduction of autonomous robots. These are autonomous service robots that move using an automatic control system, which is usually powered by a battery or an electric motor. The robot employs sensors on its infrastructure to receive information on the vehicle's location and velocities, which the control system then uses to transmit the right commands to the vehicle, allowing it to follow the proper paths. The application of autonomous service robots for logistics involves transport, handling, packaging, sorting and delivery of products. These robots are typically found in industrial plants, where they are used to transport working materials, such as boxes, pallets, and tools, from one machine to another, as well as between shipping areas and storage areas. Apart from their employment in the automation of transport operations in manufacturing, service robots are also utilized in offices, hospitals, post offices, airports, and other public institutions where the transportation and delivery of various items is required. The United Nations Economic Commission for Europe (UNECE) and IFR began working on terminology unification in 1995, and the outcome was the new ISO-Standard 8373 definition, which went into force in 2012. This classification divided the service robots in two groups: service robots for personal/domestic use and service robots for professional purposes. Given that the service robots for transportation and logistics are classified in the group for professional use, we will state their usage in real world problems. This group of robots are included in: military service robots, field robots (agriculture, cattle breeding, forestry, etc.), logistics service robots, medicine service robots, professional cleaning service robots, inspection and maintenance service robots, rescue and monitoring service robots, underwater systems, mobile platforms for general use, public relations service robots etc [18]. An article posted from the International Federation of Robotics (IFR) on Oct 28, 2020 states

that the sales value of professional service robots increased by 32% to USD 11.2 billion worldwide (2018-2019). The COVID-19 pandemic will further boost the market. High demand for robotics disinfection solutions, robotic logistics solutions in factories and warehouses or robots for home delivery are examples of this trend.

Figure 1. Annual supply of service robots for professional use

1) Pick-it-Easy Robot: The Pick-it-Easy Robot is an automated single-item picking robot that can also be used to induct items from pre-picked batch containers into overhead or sorting systems. The Pick-it-Easy Robot's various grippers, AI-based item recognition – the so-called Covariant Brain – and grasp point specification allow it to handle a wide range of articles for a variety of applications in various industries. The Pick-it-Easy Robot knows just where to grasp objects with shiny surfaces and gently deposits them where they belong. It is designed using a system that is always learning and improving as it works.

2) RUNPICK: RUNPICK stands for Robotic Universal Picker and was created specifically for the food retail industry. The completely automated system is capable of handling a wide range of products. Large handling units of fast-, medium-, and slow-moving fresh and shelf-stable items are picked and palletized by the robot. RUNPICK builds mixed pallets and roll containers, making it ideal for offering businesses with a variety of structures.

3) Automatic palletizing and depalletizing: Because of the heavy lifting involved, loading and unloading pallets is a physically demanding duty for workers. As part of creative automation solutions, robots can substantially lighten the work here. They depalletize totally mechanically and prepare the articles for storage in the goods-in area. They assemble stable pallets for shipping in goods-out. Robots can also fully automate the stacking and de-stacking of cartons and standard handling units, as well as the loading of dollies. This complete automation relieves staff of their responsibilities while also increasing productivity.

4) Open Shuttle: Open Shuttle is an autonomous mobile robot which connects different areas within facilities quickly and efficiently, bringing materials and components where they are needed. They act completely autonomously, do not require any assistance, and are completely safe for people thanks to their innovative technology. Furthermore, they are adaptable and simple to use.

5) Self-Driving cars: Autonomous driving is the most exciting, and at the same time, most controversial of implementing Artificial Intelligence in transportation. Today we don't have fully automated driving systems, rather we have driver-assistance systems that support the driving which reduces the workload on the driver. Although no carmaker currently sells a fully driverless vehicle, others are pursuing the technology. One such project is Waymo, a Google-owned company, which is testing autonomous driving vehicles in Phoenix.

6) Commercial motor vehicles: Another interesting potential about the AI are self driving trucks, especially truck platooning. Truck platooning is the process of syncing multiple trucks in a convoy by using connective technologies and automated driving systems. It allows the trucks to travel at the same speed as dictated by the leader of the convoy. When the truck in front slows down, it sends an immediate signal to the platoon to automatically brake. The autonomous system's reaction time would theoretically be five times faster than that of a human driver, allowing for substantially shorter following distances.

C. Construction and manufacturing industry

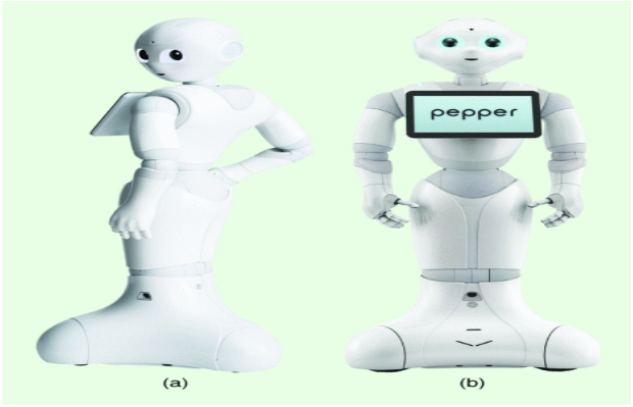
In construction and in manufacturing, robots are being used for doing precision work or jobs that are dangerous for a human being to perform. In Fig. 1 we can see the amount of money being invested in the United States of America in field robots. It is evident that the investment being made in field robots is not at the same level as logistic and medical robots but the investment in field robots for construction and manufacturing is rising. The projection for 2022 is that the amount of money being invested in field robots will be 2 billion dollars which is more than 200 million dollars from 2021. One example of a robot using artificial intelligence being used in construction is the Site Monitoring Robot by Scaled Robotics [4]. The purpose of this robot is to monitor the progress of a construction site. This robot scans the site and makes a detailed survey of the very same site and then analyzes the data it has collected which it then sends it to a cloud platform to compare to the building model inorder to see the progress. Users can also examine the issues on a special color-coded 3D model. This process helps you prevent costly errors and even shows you Health or Safety problems, such as holes in edge protection. This robot is a very powerful tool for a construction project as it lowers the time being spent for inspection by a human and it ensures a more reliable quality assurance of the project. A big role in construction and manufacturing will play 3D printing. This technique in construction and manufacturing works very well with robotics and artificial intelligence. This construction type is already being used for habitats that will be used in future space missions. In [13], the paper discusses the results of the 2015 3D-Printed Habitat (3DPH) competition, which was a competition to develop housing solutions for extended-duration missions on planetary surfaces using advanced additive construction technology. The projects entered in the competition used robotics with artificial intelligence to construct habitats autonomously. In 2015, Foster + Partners competed in Phase 1 of the NASA Centennial 3D-Printed Habitat Challenge, securing second-place for their proposal that used an array of semi-autonomous robots with artificial intelligence to 3D-print habitats for eventual human occupation [13]. One of the winners of the competition , AI Space Factory, saw that this technology could be used in the very expensive con-

struction industry on our planet. AI SpaceFactory recognized that by addressing off-grid power, autonomous construction, and in situ resource utilization for Mars, it had developed technologies that can be directly applied to the construction industry on Earth. The other winner of the competition, The Pennsylvania State University, had designed a different solution to the challenge. Penn State's research approach was to model and coordinate the complex interrelationship between multiple and associated variables, including those related to material properties, printing system, and design. BIM technology and AI techniques were used to encode this model and concurrently design the operation logistics, the printing system and setup, the toolpath and printing process, as well as the design of the habitat. This approach permits identifying optimized solutions for both Earth and Mars. The challenge demonstrated processes and equipment for large-scale vertical autonomous construction using robots, diversity and innovation in viable designs for realistic planetary habitats, and of new software and artificial intelligence control algorithms for depositing material in a non-two-dimensional layer. In the manufacturing industry, the automation process is being improved by artificial intelligence. The automation process is a combination of robotics and equipment performing an activity with a predefined set of instructions and a small number of fail safe scenarios. However, robotic machines implemented with artificial intelligence don't just follow the rules but intelligently understand and recognize patterns within the data, learn from past experiences and improve future performance. Therefore, artificial intelligence enables the same set of robots and equipment to identify solutions to complex issues within a given solution space. Intelligent manufacturing is a new manufacturing model and the technical means by which new information and communication technology, intelligent science and technology, large manufacturing technology (including design, production, management, testing, and integration), system engineering technology, and related product technology are integrated with the whole system and lifecycle of product development. Artificial intelligence is applied in the field of intelligent manufacturing through the intelligent manufacturing system. An intelligent manufacturing system is characterized by autonomous intelligent sensing, interconnection, collaboration, learning, analysis, cognition, decision-making, control, and execution of human, machine (robot), material, environment, and information in the whole system and life cycle [11].

D. Assistance

The invention of robotics and its improvement over the years have significantly influenced our society. It has improved the effectiveness and efficiency of various fields which assist in our lives or provide some sort of service in our lives. With the emergence and astronomical rise of artificial intelligence, robotics are now even more capable to assist in our lives as they now possess the ability to recognise and solve a problem autonomously. In the previous sections we have discussed the assistance robotics have made in our lives in fields such as transportation, logistics, manufacturing etc, while in this section we will discuss the assistance in more niche areas of our everyday lives.

Figure 2. The appearance of the Pepper robot



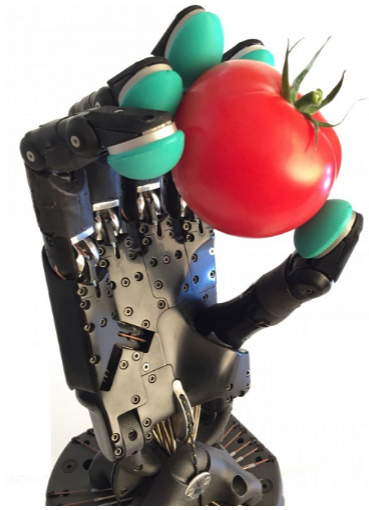
One robot that provides a service in day-to-day activities of humans is the robot Pepper. Pepper is an industrially produced humanoid robot launched in June 2014 that was first created for Buissness-to-Buisness needs and later adapted for Business-to-Consumers purposes. The Pepper robot is capable of exhibiting body language, perceiving and interacting with its surroundings, and moving around. It can also analyze people's expressions and voice tones, using the latest advances and proprietary algorithms in voice and emotion recognition to spark interactions. The robot is equipped with features and high-level interfaces for multimodal communication with the humans around it [14].

In Fig. 2 we can see the appearance of the robot. Pepper is four feet tall, has a tablet (that displays information) in the center of its chest, can gesticulate and talk in several languages. The robot has no sharp edges, there are soft parts of the cover, and the center of mass is at the base to keep the robot from falling over. The Pepper robot has 20 degrees of freedom (DoF) for motion in the whole body (17 joints) and omnidirectional navigation (three wheels). The DoFs include two in the head, two in each shoulder (left and right), two in each elbow (left and right), one in each wrist (left and right), one in each hand (five-fingered left and right hands), two in the hips, one in the knee, and three in the base. The actuators of the robot are DC motors and a magnetic rotary encoder-based sensor The robot has a system that ensures its autonomy. The whole system was designed to balance the software and hardware loads and achieve a battery life of up to 12 h. In addition, a specifically designed docking station for autonomous charging was developed. The Pepper robot is equipped at both the hardware and software application programming interface (API) levels to provide good functionality for perceiving humans. The multimodal perception components are primarily intended to discern people's presence and avoid collisions with the environment during body movement. The NAOqi's (The operating system of the robot) People Perception module provides a list of in-built APIs to help in the development of high-level reasoning and behavioral capabilities [14].

Figure 3. Shadow Dexterous Hand

The artificial intelligence implemented in the robot enables the robot to make a dialog-based interaction with humans and recognise an emotion of the human it converses with.

Artificial intelligence in robotics could help in the pharmaceutical and agricultural sector and could potentially improve the lives of the physically disabled people. One such example



is the Shadow Dexterous Hand. This robotic hand can grasp objects like human would and it is being used for delicate work in pharmaceutical environments which are harmful to humans and it is being used for soft picking fruits in agriculture because of its precision and delicacy. In [15], it is being proposed an adaptive, compliant grasping strategy using only tactile feedback. Using artificial intelligence, the Shadow Dexterous Hand can grasp objects of varying shapes, sizes and weights without having a priori knowledge of the objects. In Fig. 3 we can see the Shadow Dexterous Hand.

Table 1. Experiments conducted with the hand

Objects	Type	Pass	Fail	Success
Cup	Cylinder	4	1	80
Glass	Cylinder	4	1	80
Football	Sphere	3	2	60
Softball	Sphere	4	1	80
Sugar	Cuboid	2	3	40
Electronic box	Cuboid	4	1	80

In Table 1. we can see results of the experiments conducted in [15]. The success field is expressed in percentage. For every object the Shadow Dexterous Hand had 5 attempts to grasp the given objects. With the cylinders like the cup and the glass it only failed once which means it has an 80% success. With the spheres it had an average of 70% success because the hand failed twice to grasp the football as opposed to softball, which it failed once. The worst success the Shadow Dexterous Hand had with the sugar, which it failed three times, because of its unique surface. With the cuboid shapes it had an average success percentage of 60%.

In the proposed work from [15] they developed a simple closed-loop formulation to grasp and manipulate an object with just tactile feedback using Shadow Dexterous Hand with BioTac Tactile sensors. They achieve a human-like form factor without compromising on the accuracy. This shows promise in the advancement of the robotic hand along with the artificial intelligence.

The Shadow Dexterous Hand can also solve complex puzzles such as the Rubik's cube. In [17] it is demonstrated that models trained only in simulation can be used to solve a manipulation problem of unprecedented complexity on a real robot. This is made possible by two key components: a novel algorithm, which we call automatic domain randomization (ADR) and a robot platform built for machine learning. In Fig. 4 it is visualized the movements the Shadow Dexterous Hand would make to solve the Rubik's cube. The most important field in which robotics with artificial intelligence plays a part is medicine. Surgeries require extreme steadiness, patience and the surgeon being impervious to the pressure of life and death situations.

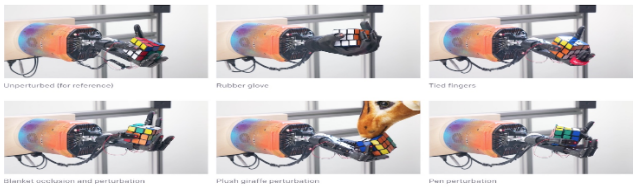


Figure 4. A five-fingered humanoid hand solves Rubik's cube

Robots fit these requirements and surgeries in advanced countries have been robotically assisted. In recent years, robot assisted surgeries have become the preferred approach in developed countries such as the United States and the United Kingdom; have attracted considerable attention in many other parts of the world. In order for the robot with artificial intelligence to assist in surgeries it requires access to comprehensive data in a sensor-enhanced operating room and enrichment of those data with surgical knowledge by annotation to make them usable for machine learning methods that provide AI assistance to the surgeon. Artificial intelligence may also change practice in robot-assisted surgery towards cognitive surgical robotics. Today, clinically used surgical robots are mere telemanipulators without any autonomous activity. In research, robotic systems have been developed for situation-aware automatic needle insertion [16].

IV. Ethics

As robotics technology improves, ethical considerations grow in importance: If this is even possible, should robots be trained to obey a code of ethics? Is it dangerous to build emotional relationships with robots? What impact will robotics have on society and ethics? The ethics of AI and robotics are frequently centered on various "concerns," which is a common reaction to new technologies. Some technologies, such as nuclear power, automobiles, and plastics, have sparked ethical and political debate as well as considerable regulatory initiatives to limit their trajectory, usually after some damage has been done. New technologies, in addition to "ethical issues," challenge present norms and conceptual frameworks, which is of particular interest to philosophy. As the robots have been developed more and more, philosophy was also applied to robotics. One of the first publications addressing and setting the foundation of robot ethics was "Runaround", a short science fiction story written by Issac Asimov which featured Three Laws of Robotics. In a series of scenarios, Asimov demonstrated how, despite their hierarchical organization, conflicts between these three rules will make it difficult to apply them. In this section we will discuss the ethical use of AI and robotics that can be more or less autonomous. We will look into the benefits or issues that we can receive from developing this kind of machines. The first general discussion that we will mention will be about privacy and surveillance in information technology. By 2025,

it is expected that 75 million smart linked gadgets will be in use in our homes, offices, and elsewhere, each having the ability to sense, analyze, and make decisions on their own. It is self-evident that security, privacy, and surveillance standards must be prioritized throughout the creation and implementation of all new technology. In today's society, our data is collected at remarkable rates and in unexpected ways. A lot of data appears to be collected in exploitative methods, abusing human flaws and addictive tendencies, in some of the largest and most popular firms such as Amazon, Google, Apple, Facebook, and Microsoft. At this exact moment there are no worldwide laws and regulations regarding privacy and surveillance in the world of Artificial Intelligence. But the EU, US and other countries have already begun with this imperative process.

Opacity of Artificial Intelligence (AI) Systems, also known as transparency of AI systems, is the idea that what happens inside AI algorithms, and how they arrive at their conclusions, is unknown to people who use the AI, but often even to the designers. This lack of transparency exists for a variety of reasons: human cognitive abilities simply cannot comprehend massive, complex algorithmic models and datasets; the inherent nature of self-learning algorithms, whose decision logic evolves without human input; a lack of appropriate visualization tools for mammoth-sized code and datasets; poorly structured code and data that effectively renders them impossible to read, and so on. This is important because if the code of the algorithm is not understandable by the user and the designer, an opacity even experts cannot penetrate, then bias like this simply cannot be controlled. In the EU, some of these issues have been taken into account with the (Regulation (EU) 2016/679), which foresees that consumers, when faced with a decision based on data processing, will have a legal "right to explanation"—how far this goes and to what extent it can be enforced is disputed. AI decision support systems and "predictive analytics" operate on data and create an "output" in the form of a decision. This output could be anything from "this restaurant matches your preferences" to "the patient in this X-ray has completed bone growth," "credit card application declined," "donor organ will be given to another patient," "bail is denied," or "target identified and engaged." In business, healthcare, and other industries, data analysis is frequently utilized in "predictive analytics" to predict future changes. Unfortunately, bias has been discovered in several AI decision-making systems. Amazon's automated AI system for recruitment, which was discontinued in 2017, is a significant example. Because Amazon had a history of discriminating against women in the recruiting process, when their ten-year hiring data was used to construct their AI algorithms, this bias was passed on to the AI system. Because human-robot contact is becoming more prevalent and will continue to become more widespread, we believe it is critical to address Human-Robot interaction (HRI) ethics. Robot ethics looks at how robots can help or hurt humans, how they can alter individual autonomy, and how they might affect societal justice. Humans are quick to ascribe mental traits to objects and empathize with them, particularly when the items' exterior appearance resembles that of live beings. This can be used to trick humans (or animals) into giving robots or AI systems more intellectual or even emotional significance than they deserve. Two examples are Care Robots and Sex Robots. Current systems include robots that assist human caregivers, robots that enable patients to complete some tasks on their own, and robots that are provided to patients as companions and comfort. It's not apparent whether there's a problem here, given that the conversation largely centers on the fear of robots dehumanizing care, yet the actual and anticipated robots in care are assistive robots for traditional technical work automation. Also it has been argued by several tech optimists that humans will likely be interested in sex and companionship with robots and be comfortable with the idea. Humans have long had deep emotional attachments to objects, so perhaps companionship or even love with a predictable android is attractive, especially to people who struggle with actual humans, and already prefer dogs, cats, birds, a computer or a tamagotchi.

V. Conclusion

In conclusion, AI, like all significant revolutionary events in human history, will undoubtedly have far-reaching consequences. However, with appropriate planning and following the proper ethics, these issues can be overcome. The benefits of AI in improving human lives will certainly outweigh the concerns in the short to medium term. Robots will help us with many things where we won't be needed. Every wave of automation and computerization has enhanced production without lowering employment in the past, and there is no reason to believe that this time will be any different. The new wave, in particular, is likely to boost our personal or professional productivity (e.g., self-driving cars), but not necessarily to eliminate jobs (e.g. chauffeur). While robots may eliminate certain manual tasks, the impact should be similar to that of past waves of automation in factories and other settings. Someone will, on the other hand, have to develop and build the new tools, which will almost certainly result in a new wave of innovations and jobs. Any big concept that has a broad impact on people's lives, if not handled appropriately, can be extremely dangerous.

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