Application of Artificial intelligence Assisted Robots to Improve the Educational Outcome for Special Children in Disability Education

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Abstract

Artificial intelligence (AI) is flourishing in the environment of the digital era, and its integration into economic life is a natural and unavoidable trend for the future of society. The promotion of technology and science is also crucial to students' academic development. The development of AI has entered a stage of extraordinary rapid expansion, altering every facet of human existence. The state required a thorough curriculum, but there is no mention of how to arrive at Artificial Intelligence + Curriculum. Artificial intelligence (AI) technology has created computational tools for performing a variety of tasks, modeling the clever approach to problem-solving employed by humans. One of the most promising areas for the use of AI technology is in the area of SEN education. The widespread adoption of AI has disrupted long-established approaches to education. In recent years, artificial intelligence (AI) has emerged as one of the most widely used technical tools in special education due to its ability to improve the transmission of knowledge and the long-term retention and transferability of newly acquired abilities. Researchers and practitioners both gain valuable insight by being aware of the state of and trends in their respective fields. Intelligent tutoring systems (ITS), smart learning (SL), and social robots (SR) all owe a great deal to AI. AI is having a positive effect on educators by easing their burden and boosting special education students' access to relevant information. Naturally, there aren't many educators who don't see AI as having at least some bearing on their own professional growth. The value of AI is not lost on educators. Almost six in ten educators (60.9%) believe AI is useful for their own professional growth as educators. Therefore, active research and education on artificial intelligence exemplifies the cultivation of lifelong learning ability, the development of rich teaching skills, the accumulation of experience, the enhancement and pruning of appropriate change programs, and the promotion of the rapid growth of higher education in the context of artificial intelligence.

Keywords: Artificial intelligence (AI); social robots (SR); smart learning (SL); intelligent tutoring system (ITS); Special education (SE).

1. Introduction

Computer science education (CSed) should be made available to all learners in Special Education settings. The "CS for All" movement in Special Education classrooms, as well as the general public, agrees on this fundamental idea. Perspectives on equity among education stakeholders have an impact on how CS is taught and mastered in classrooms. There are some parallels between this seminal decision, which defined equality as equal opportunity for all learners, and an explanation of equity that focuses on redressing past societal injustices; nonetheless, the distinctions between these two conceptions of equity are easily reflected in various approaches to and policies for education. For instance, the definition of "equity" has significant implications for its application in the classroom. Since computer science is still in its infancy in SPECIAL EDUCATION classrooms, it is vital to take into account the various definitions of equality. For instance, we could check to see what aspects of equality are being met by current initiatives and what aspects still need work.

About 190 million people, or 15% of the global population, have a handicap of some kind, as reported by the World Health Organization [1]. The advancing age of the global population and the prevalence of chronic diseases are said to be driving this trend, according to the same source. Disabilities can range from being temporary to being permanent, encompassing a wide variety of accommodations, modifications, and health concerns. Degenerative diseases including Parkinson's, amyotrophic lateral sclerosis, also known as (ALS), and Alzheimer's, as well as physical, mental, visual, and auditory impairments, and long-term, non-communicable conditions, all fall under this category. Conditions can also arise as a natural consequence of aging, a time when the prevalence of certain impairments is highest [1].

//3 The progress made in the field of artificial intelligence in recent years is very promising. Conferences, studies, and contests in the field of artificial intelligence may now be found in every corner of the globe. Both the technology and its uses have grown and evolved fast in recent years. On top of that, the ongoing development of smart devices has brought about great improvements in people's ability to learn, work, and live. Many AI concepts have been spawned by robotics study, and there are techniques that can be applied to AI study in order to construct models of the world's states and characterize the process by which states change [2]. Given robotics' prominence and impact on AI, it makes sense to incorporate hands-on topics like robot programming as well as behavior development into AI curricula. This will make learning to code more enjoyable and rewarding for future AI experts. Simultaneously, it has a deeper comprehension of AI concepts and tools [3].

Services, products, techniques, strategies, and procedures that help people with disabilities or impairments do more with less effort are all included in the umbrella term "Assistive Technology" [4]. Individual choice, improved well-being, and full participation in community life are essential goals. Hearing aids, memory aides, eyeglasses, wheelchairs, pill the organizers, etc communication aids are all examples of Assistive Technology. Integrating Assistive Technology with AIoT (from now on known to as AIoT) devices & machine learning has come a long way [5]. Machine learning and other forms of Artificial Intelligence are applied to the massive amounts of data produced by IoT devices in order to find patterns that may then be used to inform decisions and improve outcomes [6].Figure 1 shows some of the most common uses of AI today.

Figure 1. Applications of AI in Education

When AIoT is applied to assistive technology, it paves the way for the creation of a wide variety of innovative approaches to the disability issue. Such solutions include, but are not limited to: medicine dispensers, wheelchairs, exoskeletons, etc.; navigation systems for the blind; voice assistants for people with disabilities; remote monitoring of health conditions; telemedicine and tele health; communication systems based on sign language; additional storage for people with cognitive disabilities; and so on. According to Mary Pat Radabaugh (who headed IBM's National Support Center for Individuals with Disabilities in 1988), these are only a few of the many helpful apps available. "Technology facilitates the lives of those who do not have any physical limitations. Technology enables independence for those with disabilities" [7].

Due to the critical nature of the advancement of AIoT used for Assistive Technology, this comprehensive review of the literature seeks to determine the AI models utilized in the various studies conducted on the subject. Due to the paucity of literature reviews on the suggested topic compared to the volume of relevant research already done, it is crucial that the results and evidence from recent studies be presented in a logical and consistent manner. Figure 2 depicts the steps involved in the special education process.

Figure 2. Special Education Process Findings

The remaining paper is organized as follows:

2. Literature Survey

The social model of disabilities [8], developed in the UK in the 1970s, will be used throughout this discussion. UPIAS (Union of Physically Impaired Against Segregation) described disability in their document Fundamental Principles of Disability [9] not as a physical or mental impairment, but as a "relationship between people with impairment & a discriminatory society." Capital, in which Karl Marx characterized capital and labor not as entities but as relationships, has had a significant impact on UPIAS and the labor movement more generally. That is, the social framework suggests that society is to blame for people's disabilities, not the people themselves, due to the fact that society is not inclusive.

//7 Artificial intelligence (AI) refers to computer systems that can mimic human intelligence. The difference between human and animal intelligence is that one has consciousness and emotions and the other has not. In 1955, John MsCarthy coined the term artificial intelligence (AI) and provided its original definition: "making a machine operate in ways that could be called intelligent if an individual were so behaving" [10]. The idea that computers could eventually mimic human thought was popularized by Alan Turing in 1950 [11]. He anticipated that in the not-too-distant future, computers would perform calculations that people simply couldn't be bothered with.

The underlying concern is how binary computations will have human meanings, given that computing machines operate on binary digits. The earliest attempts at teaching computers to think like humans were having them play games and prove theorems. The term "artificial intelligence" (AI) is commonly used to describe robots with the ability to learn and solve problems in ways similar to the human brain [12]. An artificial agent is a machine that can learn from experience and make decisions that increase the likelihood of success in achieving set objectives [13]. Since the activities they perform have become second nature, along with the technology they utilize, they have been dubbed the "artificial intelligence effect" [14], despite the fact that they require intelligence. Intelligent machines that can successfully grasp human speech are a product of AI [15]. High-level strategic game assistants, autonomous vehicles, and similar devices also fall under the umbrella term "artificial intelligence" [16]. Knowledge representation, planning, learning, processing, and object utilization are at the heart of artificial intelligence research [17]. Statistics-based modeling and machine learning are only two examples of the many methods used to advance the field of artificial intelligence. Artificial intelligence (AI) influences numerous disciplines beyond computer science, including engineering, mathematics, linguistics, and many more [18].

Artificial intelligence (AI) is a rapidly developing field that blurs the lines between many different academic disciplines, including but not limited to mathematics, engineering, computer science, philosophy, and language. Since AI spans so many fields, scholars in the field have struggled to settle on a single definition as well as comprehension [19]. There will be many potential uses for this research as it develops. It helps with making good choices in games and other contexts, and it also has educational and pedagogical uses. The presence of AI and the accompanying tools and services has been observed in the world of higher learning. Despite its obvious significance, breadth, and composition, many educators remain clueless about it [20]. This study intends to further investigate the uses of AI in education, the breadth of these uses, and their impact on teaching and learning in light of the aforementioned problem.

3.Intelligent Education robots for Disability Children:

//9 Several studies have been published that explore the use of intelligent machines in preschool and kindergarten settings. Most of the reported study methods make use of robots in an educational or medical environment. Robots may also find use in domestic settings. Methods for gathering and assessing interaction data are just one example of the broad areas of study related to robot-child interaction. Interesting methods aimed at helping kids with disabilities have also been discussed.

Robots are typically utilized for educational entertainment in the classroom. Robots can be a great resource for teaching and learning for kids [21]. Children study robots because, according to certain forecasts, this technology will soon be commonplace in most households. Robots have the potential to serve as educational aids, facilitating both academic and social development. Long-term interactions between children and robots have shown that youngsters may come to view robots as peers [22]. An significant question is raised by children's long-term contact with robots. The question is whether or not the kid will continue to be fascinated by the robot. There is a high probability that kids will be fascinated by robots when they are first introduced to early childhood settings. Eventually, as kids get used to having robots around, they can lose interest in them. As a result, features guaranteeing a lively and rich interaction between children and robots should be incorporated by robot designers and robot fulfilled and service suppliers.

Robots that have contact with youngsters may take pictures or video. Teachers may use this information in the students' electronic portfolios. Teachers might utilize them in a variety of ways, including as a means of assessment, as a means of documenting students' progress, as a means of introducing themselves to their students' parents in person, or as a means of making information about their children available to them remotely through the Internet. The robot might be able to recognize and categorize children's faces with the use of clever technologies that are specifically designed for this task. Using a specialized Web-based environment, children (with the help of their teachers and parents) might keep track of recorded data (e.g., data relating free playtime activities). As in[23], robots in schools could transmit classroom activity records to parents online so they can keep tabs on their kids' schoolwork. Obviously, home robots might be utilized to keep track of kids' activities and share that information with their educators and peers. Therefore, robots might be used to bridge the gap between families and schools. For students with specific needs, robotics technology may prove helpful. Robotic technology may prove useful in adapting teaching techniques and classroom settings for young kids with special needs. Young children with visual impairments, mobility impairments, and autism [24] have shown promise in published research.

Robots may play a number of important functions in the future of healthcare. They may aid in therapy and make it possible to identify impairments. In general, robots can be used to capture data from children's visits to physicians or therapists that might have been difficult, impossible, or time-consuming to record using traditional techniques [25].

The iRobot iQ is a lightweight (about 7 kg) tiny robot [26]. The Korean firm Yujin Robot Co., Ltd. was responsible for its creation. It's helpful for communicating emotions and gestures between humans and robots. It uses a combination of the LCD-based eye units and the LED in the area around the mouth to express facial emotions, and it has two arms. A video camera is installed in its skull for communicating visually. The software relies on a built-in computer that can process audio and video. Speech recognition, name call acceptance, source of sound recognition, clap detection and response, and voice synthesis are all examples of what can be done with the human voice [26]. Face identification, object recognition, and even gesture recognition are all within its visual ken. The robot's ability to sense touch in many locations makes it possible for it to communicate with humans. The main body of iRobiQ features a touch-screen LCD display that serves as a multimedia-based interface to the robot's many features. It can move around on its own utilizing the wheels at the bottom of its feet and avoid obstacles along the way. Network connections allow it to communicate with servers and offer content and services. For lighthearted social contact, meet Sponge Robot [27], a little humanoid robot. The Robovie-X platform, created by ATR Robotics with Vstone Co., Japan, serves as the foundation for this system. It stands 37 centimeters tall and weighs 1.4 kg. As a result, the robot has a form like that of a human infant. It may be picked up and played with by a human. There are a total of thirteen (13) degree of freedom between its head, neck, arms, legs, and feet. KT Robotics in Korea created Porongbot, a miniature robot made especially for kids. Its target audience is pre-schoolers, and its goal is to deliver "emotional edutainment" [28]. It has two ears, a swiveling head, and wheels for feet. The robot is equipped with an LCD touch display, touch sensors, microphones, and buttons for youngsters to use. Porongbot's head, ears, and feet can shift colors at will. It has an LCD screen and a speaker for output. Porongbot communicates with a server to retrieve educational media.

NEC Corporation created the robot known as PaPeRo. It is a little robot, standing about as tall as a young toddler. PaPeRo was developed with classroom interaction with students and educators in mind. PaPeRo uses eye cameras to collect classroom-related video and still images. Children's facial expressions are included in this data set since the robot's height places the eye camera at the same level as theirs. It receives commands from faraway users via Internet-sent text messages and touch controls. Data in the right format can be transmitted to users in other locations. In [23], parents may give PaPeRo instructions and get information about their kids through their mobile phones. Introduced in [29], Kibo is a social robot. It stands at around 0.5 m in height and weighs 7 kg. Kibo's primary function is to provide amusement. With twenty-two (22) joints, it may potentially walk and dance. It could potentially respond to human voice and motions. It might learn to identify human emotions and even mimic them with blinking eyes and moving mouth. The robot's distributed processing units allow it to react to events instantly. Wireless local area network (LAN) connections allow computers inside the robot to talk to its internal components. Two humanoid robots, named Troy and Trevor, are designed in [30] to help with autism treatment in clinical settings. They both meet the criteria for autism treatment. They have limited autonomy and are guided by the therapist via a custom interface. Therapists may have access to predetermined sequences of interventions that have been preprogrammed. Their arms might be used to move things.

Troy, a humanoid robot with a humanoid upper body, is about the extent of a child of four. It consists of a computer screen for a face, a huge base to keep it stable, and two arms with several degrees of freedom. The robot's expression can be altered via the therapist's computer screen. Trevor is a LEGO Mindstorms creation. It's about the extent of a human toddler, and it has a face and hands. Tito is an interacting socially robot that is roughly 60 cm in height [31] and is designed to seem like a person. It's controlled from a distance using a wireless remote and it's meant to aid autistic kids. Wheels allow it to roll along. Its head and limbs might wiggle, too. It has the potential to make voice requests and incorporate behavior patterns that have been pre-programmed.

To move around, the robot in a Roball is encased in a ball [32]. Toddlers are the intended audience. Therefore, Roball can navigate through spaces where toys and other items present a variety of challenges. Since most children already know how to deal with spherical items like balls, Roball fits requirements of child-robot interaction because it is lightweight, small, and inexpensive, its vulnerable elements are covered inside the shell, communication is simple and safe, and so on. Roball's ease of use, lack of distractions, and capacity for touch-based communication between children and robots make it a great tool for autistic children as well. Sony spent a long time perfecting QRIO, a humanoid robot that is smaller than children. It can learn, walk, run, jump, dance, sing, play soccer, and do a variety of other things on its own [21]. It can also imitate human speech and movement in real time. Has three central processing units. In addition, its built-in wireless LAN system can be used to take advantage of remote computers functioning as "remote brains." Young children that interact with it view it as an equal, according to studies described in [21], [22].Figure 3 depicts an instance of a child's interaction with a robot used in special education.

Figure 3. Interaction of students with Robots

4. **Robots and Disability Children with Special Needs**

//9 In [33], a method is provided for teaching young children how to operate a force-feedback joystick while seated on mobile robots. Infants having special needs who are not yet walking independently are the primary target of this method. A child's quality of life suffers when their mobility is impaired, as this prevents them from exploring their environment and making new friends. A mobile robot, sensors, plus a force-feedback joystick were the experimental hardware. On average, the toddlers in the study were 30 months old. Both generally developing toddlers (n=10) and toddlers with specific needs (n=2) participated in driving studies. The two disabled children were a three-year-old suffering cerebral palsy and a two-year-old with spina bifida. The first child's hand-eye coordination was superior to that of the second, who lacked the first's ability to walk & balance himself. All subsets of toddlers showed promising outcomes. In particular, after five days of training that were not consecutive, the toddlers with exceptional needs were capable to learn to turn and follow lines. Several days after training, and in a somewhat different setup, the new behavior was observed.

Preliminary testing results in a clinical setting and the needs for robots in autism therapy are discussed in [30]. The specified specifications for robots & user interfaces are meant to serve as recommendations for the creation of robots that can efficiently aid therapists working with children diagnosed with autism. The established requirements for robot design focus on the robot's usefulness, appearance, security, and autonomy. Robot design requirements allow a robot to carry out required therapy actions, and different robot types exhibit varied traits, advantages, and downsides. Regarding autonomy, it is important to note that therapists require some degree of control over the robot in order to effectively use it. The interface should be user-friendly, responsive, and flexible for therapists, and it should be managed via a (ideally tiny) handheld device. Researchers created two humanoid robots (named Troy and Trevor) that met all of the criteria they were given. They report first findings from the Troy trial. Both a four-year-old boy & a three-year-old girl with typical development have been used to test Troy. The outcomes for the kids' social interactions with Troy and the physician were encouraging. Positive first findings with two autistic children are also provided. The two kids engaged more with the therapist and exhibited more enthusiasm during sessions when Troy was there.

In [34], mobile, socially engaging robots like Tito and Roball are introduced. A psycho-educator, for instance, ran research with four autistic five-year-olds using Tito. Tito keeps track of the elapsed time between each of a child's encounters with it. Preliminary findings indicate that the child is motivated by Tito.

In [35], concerns about the application of social robots to the study, treatment, and diagnosis of autism are broached. The discussion draws on the author's three years of experience working closely with a Yale Child Study Center clinical research group that specializes in assessing children for autism. Autistic people have trouble interacting with others and communicating with others. Eye contact, facial expression, body language, and gestures are all taken into account when making a diagnosis of social impairment in a child. Multiple studies have shown that interacting with a robot may inspire and captivate young learners. There is a counterargument to the study, however, which suggests that autistic people might not behave normally with robots. This is a factor that needs investigation and consideration. For instance, a pilot research was conducted using ESRA, a straightforward robot capable of generating facial expressions, to examine how typically developing and autistic preschoolers interacted with the robot. Children's responses were analyzed in two scenarios involving robots: a contingent scenario vs a non- contingent scenario. In contrast to autistic children, typically developing youngsters paid attention to the robot only in the conditional condition. To address issues with autism diagnosis, the study also adds quantitative, objective measurements of social response. Metrics may include both non-active and active watching.

Social robots are capable of passive sensing, with key metrics including gaze direction detection, position tracking, and vocal prosody analysis. The use of socially connected robots with a degree of autonomy allows for the efficient collection of data on children's social behavior. It would take a lot of effort for a clinician to find information comparable in quality and quantity. Blind preschool-aged children were pre-oriented with and interacted with a robotic dog in [36]. Sony Aibo robots were adapted for use with the visually impaired. The findings shown that even very young blind children were able to control the robot. Connecting and disconnecting the robot's recharger is a challenging task for visually impaired robot operators. This issue was resolved by employing a texture that stands out. Interaction with the robot sparked greater activity, excitement, and participation in playful learning activities among blind preschoolers. The findings validate the potential of robots in the classroom, particularly as aids for students with special needs. Language & text presentation are crucial for those with limited eyesight. Accessibility can be improved by the use of robots as a human-computer interface in this setting. People who are blind or confined to a wheelchair may one day be transported independently by robots in autonomous vehicles.

A robot-assisted monitoring system for autistic youngsters was created in [36]. The software was designed for use in a special needs kindergarten. There are six pet robots, a mobile phone (e.g., a PDA) for inputting observation data, video cameras plus microphones for recording, and a distant server to store and organize the data. The experiments were run for a total of three months at the rate of three each week. Data was relayed from the robots' interactions with autistic children to a database. Information is processed quickly, and analysis is simplified (via, for example, the generation of statistical charts). The surveillance system proved its worth in a trial run in a kindergarten, and more data analysis facilities might be made available. Figure 4 depicts an example of the interaction between a robot and a child with special needs. Children with autism share a fondness for robots with children without the disorder, according to studies. Repeatedly and reliably, robots can provide the same answers. They are very helpful to children with autism because they are repetitive and consistent. These are just a handful of the many reasons why youngsters on the autistic spectrum may find interacting with a robot more comforting than a human teacher.

However, when an activity is predictable, constant, and socially demand-free, children with autism are more likely to participate. Young people have a natural affinity for and interest in technology. There are cases where kids demonstrate exceptional proficiency with tablets and computers well before their peers. This kind of participation can be the key to a fruitful class session.

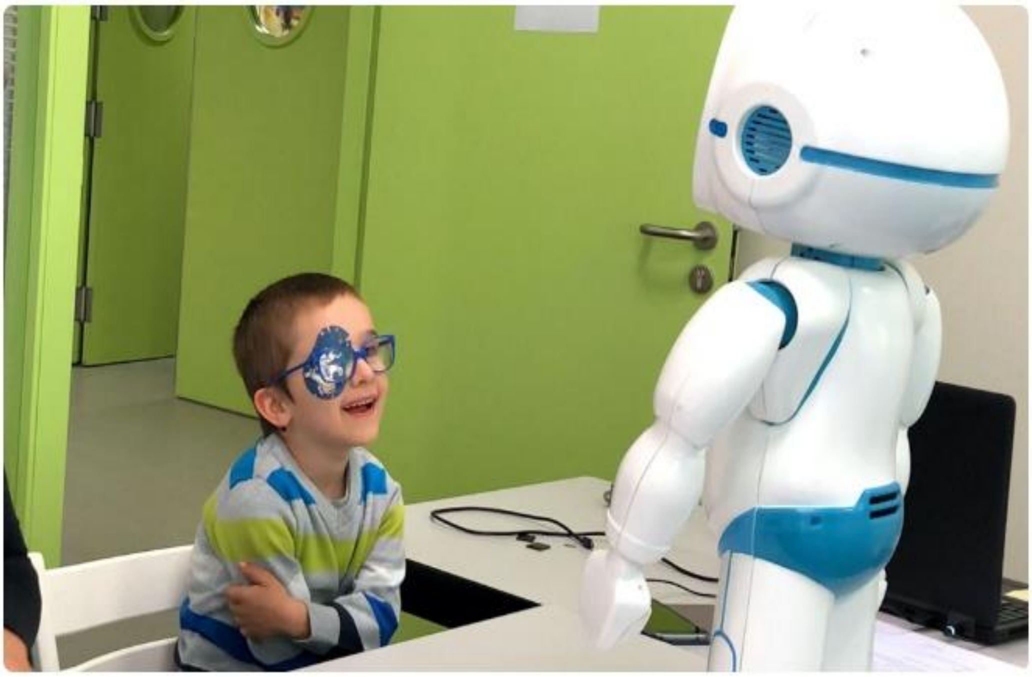

Figure 4. Interaction of Robots with Special children

5. Improved educational outcome

All of these factors contribute to the beneficial effects of employing a robot in special needs schooling and for the benefit of children with autism. It is clear that the use of robots in the classroom can improve instruction and learning in a number of ways, including: increasing students' interest; decreasing their nervousness; boosting students' motivation and teamwork; giving students more opportunities for organized practice on a regular basis.

6. Conclusion:

Several studies in the last ten years have focused on AI systems' potential role in mainstream classrooms for kids with disabilities. In this age of intelligence, technology has led to the creation of artificial intelligence. There are currently a number of corporate divisions conducting preliminary research in this area and racing to push a new line of intelligent products. Universities, as the backbone of the country's scientific research, have an unwavering obligation to advance the field of artificial intelligence. In an effort to stay ahead of the curve, some educational institutions are introducing AI programs. If you're a teacher, you probably already know how to use and understand AI. The concept of continuing education for educators both at both home and abroad has been studied and refined for some time. There will be shifts in the classroom as a result of technological improvements. The most widely used AI products today are those used in the classroom, and this has had an effect on the way that we teach. This publication drew on the most widely-cited research that address key challenges in diagnosis and treatment. In the field of special education, AI application technologies have been used to great effect to address and resolve issues. Research given below suggests that more resources should be made available to assist educators, parents, and therapists in providing adequate care for learners with special educational needs, especially in the areas of evaluation and treatment. The use of AI computational tools can help us save money and time, increase the effectiveness of early diagnosis and intervention, and provide better learning environments. However, there is still a large amount of ground to cover in special education due to the vast variety of challenges and the varying requirements of each student. In order to reduce stress for educators and parents, there needs to be more investigation into the whole spectrum of learning disabilities and resolution of issues related to nationally controlled modifications of diagnostic tools.

References

1. WHO. World Report on Disability; WHO: Geneva, Switzerland, 2011. Available online: https://apps.who.int/iris/handle/10665/ 44575 (accessed on 14 September 2022).
2. S. Makridakis, "The forthcoming artificial intelligence (AI) revolution: its impact on society and firms," Futures, vol. 90, no. jun., pp. 46–60, 2017.
3. P. Fernandez, ""Through the looking glass: envisioning new library technologies" how artificial intelligence will impact libraries [J]," Library Hi Tech News, vol. 33, no. 5, pp. 5–8, 2016.
4. E. Vickers, "The strange child: education and the psychology of patriotism in recessionary Japan by Andrea Gevurtz Arai," Monumenta Nipponica, vol. 72, no. 1, pp. 146–152, 2017.
5. M. Garcia, "Racist in the machine: the disturbing implications of algorithmic bias," World Policy Journal, vol. 33, no. 4, pp. 111–117, 2016.
6. A. I. Review, "About the authors," Artificial Intelligence Review, vol. 15, no. 6, pp. 1–6, 2016.
7. J. P. Davis and W. A. Price, "Deep learning for teaching university physics to computers," American Journal of Physics, vol. 85, no. 4, pp. 311-312, 2017.
8. Shakespeare, T.: Social models of disability and other life strategies. Scand. J. Disabil. Res. 6(1), 8–21 (2004)
9. UPIAS: Fundamental Principles of Disability. UPIAS, London (1976)
10. McCarthy, J.; Minsky, M.L.; Rochester, N.; Shannon, C.E. A proposal for the Dartmouth summer research project on artificial intelligence. AI Mag. 1955, 27, 12–14.
11. Turing, A.M. Computing machinery and intelligence. Mind 1950, 59, 433–460.
12. Legg, S.; Hutter, M. A Collection of Definitions of Intelligence. Front. Artif. Intell. Appl. 2007, 157, 17–24.
13. Russell, S.J.; Norvig, P. Artificial Intelligence: A Modern Approach, 2nd ed.; Prentice Hall: Upper Saddle River, NJ, USA, 2003; ISBN 0-13-790395-2.
14. Hackernoon. How AI Is Getting Groundbreaking Changes in Talent Management and HR Tech.
15. Schank, R.C. Where's the AI. AI Mag. 1991, 12, 38.
16. Allen, G. Department of Defense Joint AI Center—Understanding AI Technology. AI.mil—The Official Site of the Department of Defense Joint Artificial Intelligence Center. 2020. Available online: (accessed on 20 January 2021).
17. Kolata, G. How Can Computers Get Common Sense? Science 1982, 217, 1237–1238.
18. Kurzweil, R. The Singularity Is Near; Penguin Books: London, UK, 2005; ISBN 978-0-670-03384-3.
19. Tegmark, M. Life 3.0: Being Human in the Age of Artificial Intelligence; Penguin Books: London, UK, 2018.
20. Hinojo-Lucena, F.-J.; Aznar-Díaz, I.; Cáceres-Reche, M.-P.; Romero-Rodríguez, J.-M. Artificial Intelligence in Higher Education: A Bibliometric Study on Its Impact in the Scientific Literature. Educ. Sci. 2019, 9, 51
21. Tanaka F, Fortenberry B, Aisaka K, Movellan JR (2005) Plans for developing real-time dance interaction between QRIO and toddlers in a classroom environment. In: Proceedings of the 4th IEEE International Conference on Development and Learning, pp. 142-147. IEEE Press, New York.
22. Tanaka F, Cicourel A, Movellan JR (2007) Socialization between toddlers and robots at an early childhood education center. PNAS 104:17954-17958.
23. Kawata H, Takano Y, Iwata Y, Kanamaru N, Shimokura K, Fujita Y (2008) Field trial of asynchronous communication using network-based interactive child watch system for the participation of parents in day-care activities. In: Proceedings of the IEEE International Con- ference on Robotics and Automation, pp. 2558-2563. IEEE Press, New York
24. Giullian N, Ricks D, Atherton A, Colton M, Goodrich M, Brinton B (2010) Detailed re- quirements for robots in autism therapy. In: Proceedings of the IEEE International Confer- ence on Systems, Man and Cybernetics, pp. 2595-2602. IEEE Press, New York
25. Natarajan, V. A., Kumar, M. S., Tamizhazhagan, V., & Chevdumoi, R. M. (2022). Prediction Of Soil Ph From Remote Sensing Data Using Gradient Boosted Regression Analysis. Journal of Pharmaceutical Negative Results, 29-36.
26. Kumar, M. Sunil, et al. "Deep Convolution Neural Network Based solution for Detecting Plant Diseases." Journal of Pharmaceutical Negative Results (2022): 464-471.
27. P. Sai Kiran, and M. S Kumar. "Resource aware virtual machine placement in IaaS cloud using bio-inspired firefly algorithm." Journal of Green Engineering 10 (2020): 9315-9327.

28. Balaji, K., P. Sai Kiran, and M. Sunil Kumar. "Power aware virtual machine placement in IaaS cloud using discrete firefly algorithm." Applied Nanoscience (2022): 1-9.
29. Kumar, M. Sunil, et al. "Applying The Modular Encryption Standard To Mobile Cloud Computing To Improve The Safety Of Health Data." Journal of Pharmaceutical Negative Results (2022): 1911-1917.
30. T. Pavan Kumar, and M. Sunil Kumar. "Efficient energy management for reducing cross layer attacks in cognitive radio networks." Journal of Green Engineering 11 (2021): 1412-1426.
31. Davanam, Ganesh, T. Pavan Kumar, and M. Sunil Kumar. "Novel Defense Framework for Cross-layer Attacks in Cognitive Radio Networks." International Conference on Intelligent and Smart Computing in Data Analytics. Springer, Singapore, 2021.
32. Walde, R.B., Prakash, O., Kumar, M.S., Sule, B., Nabilal, K.V. and Pawar, U.C., 2023. Ranking Based Security Scheme with Attack Detection and Improved Network Security. International Journal of Intelligent Systems and Applications in Engineering, 11(3s), pp.35-41.
33. Yadav, S.S., Maan, M.K., Kumar, M.S., Kumarnath, J., Pund, S.S. and Rathod, M., 2023. A Secure IoT Smart Network Model for the Contributory Broadcast Encryption for the Text Policy Management Scheme. International Journal of Intelligent Systems and Applications in Engineering, 11(3s), pp.42-48.
34. Kumar, A., Kumar, M. S., Vikhar, P. A., Ghodke, V., Waghulde, R. R., & Rathod, M. (2022). Improving the Software Privacy in the OFDM 5G Communication Integrated with License Key in the Hardware Communication Parameters. International Journal of Intelligent Systems and Applications in Engineering, 10(2s), 236-240.
35. Davanam, Ganesh, T. Pavan Kumar, and M. Sunil Kumar. "Efficient energy management for reducing cross layer attacks in cognitive radio networks." Journal of Green Engineering 11 (2021): 1412-1426.