

# Involvement of Wireless Communication in Transferring Information from Your Controller to a Robot without them being Physically Connected to the Controller

Mohammad Musthak Ahammad <sup>1\*</sup>, Dr.M.Aruna Safali <sup>2</sup>

<sup>1</sup> Associate Professor in Mechanical Engineering Department, Deccan College of Engineering and Technology, India.

<sup>2</sup> IDET, JNTUK, India.

\*Corresponding Author Email: <sup>1</sup> mushtakahmed@deccancollege.ac.in

---

## Abstract

*The entire study is based on wireless communications in robots and the involvement of technologies in making wireless communications. Wireless communications is about the connection in which physical connection is not occurred. Different kinds of technologies such as infrared, radio frequency, Wi-Fi, Bluetooth, satellite connection and telecommunications are mostly used in robotics technologies for making wireless communications. Infrared technology was used in robots for wireless communications in the initial stage. Controller and receiver, these two devices are used in infrared to establish wireless communications. Radio frequency was also used in the beginning steps of wireless communications. Transmitter and receiver are the devices used in radio frequency technology to establish wireless communications. In the current situation, quick response and wide range are essential to operate robots wirelessly.*

*The Internet has developed to make quick wireless communications and in the development of internet Wi-Fi has a great role. This technology is capable of establishing quick wireless communications and for this reason mostly it is used in robots to make it. On the other hand, artificial intelligence and machine learning have made it possible through their involvement in robotics technology. These technologies are able to make algorithms based on information and provide comments to robots for doing activities through the algorithms. The robots are able to provide accurate outcomes as per the comments and for this reason different kinds of sectors such as industrial and healthcare are largely used. Number of engaged robots in manufacturing industry is rising rapidly due to its benefit in manufacturing activities. On the other hand, in various healthcare activities such as monitoring elderly population, providing treatment and taking care of chronic patients for long time, wireless robots are used. Secondary qualitative data has been collected for this study. Journal, article and websites have been approached as the sources of secondary qualitative data. The entire discussion of the proposed study has been done by secondary qualitative data.*

## Keywords

*3G, 4G, 5G, artificial intelligence, Bluetooth, DTMF, infrared, IoT technology, machine learning, radio frequency, satellite connection, telecommunications, and Wi-Fi.*

---

## INTRODUCTION

Wireless communications is about transferring information from one to another device without physical connection. In robotic technology wireless communications are used to operate it smoothly to enhance its usability. In the modern era technology is developing and along with it communication systems are also improving. Robots are the impactful technology in this modern era for its usability. In various works robots are used to fulfill demands of humans. Different kinds of robots such as service robots and industrial robots are used to fulfill human's demand. Service robots are mostly in the hospitality, retail and healthcare sectors to assist human workers to improve service quality of these sectors. However, industrial robots are mainly used in the manufacturing industry to boost manufacturing activities and also to improve quality of manufacturing. In the current situation, communication technology has developed much more as compared to the traditional communication system. Robots are operated by transferring information and for this

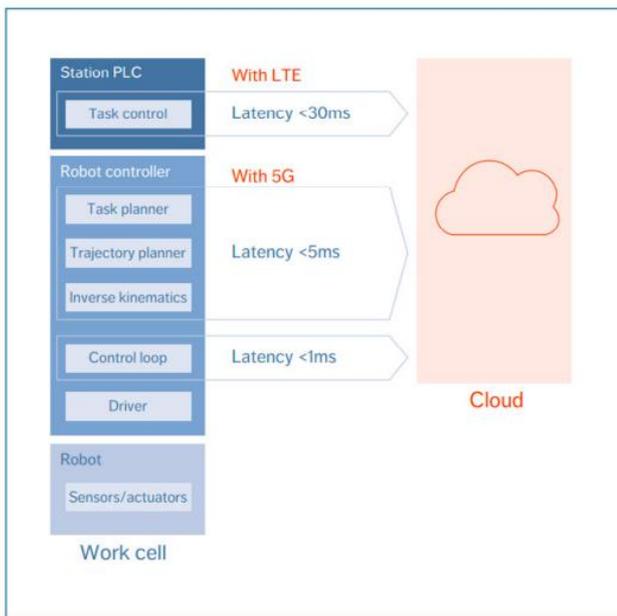
reason communication systems and information technology have a great role to modernize robotics technology. Development of modern technologies have boosted to promote modernized robotics technology and its usability in manufacturing and healthcare and various industries. Different kinds of technologies such as artificial intelligence, machine learning, telecommunications are involved in robotic technology and development of these advanced technologies helps to improve usability of it. In recent times, telecommunications technology plays an important role to boost communication in various technologies and robotic technology is one of them. Most telecommunications technology is used to transfer information from one device to another device. 5G technology has been introduced in telecommunications technology that has provided boosting in transferring information from device to device. These technologies are used to transfer information in robots wirelessly that helps to increase usability of it. Development of 5G technology has accelerated information transfer and for this reason operating robots has improved a lot. In this study,

impact of these technologies to occur wireless communications in robots are to be discussed.

**LITERATURE REVIEW**

**Discussion on involved technologies for wireless communications**

Technologies are developing and along with it involvement of robots is increasing in various Industries. Telecommunications has a vital role to operate robots wirelessly and mostly mobile phones are used to operate robots in the manufacturing industry. Demand for smart manufacturing is increasing immensely and industrial robots are capable of delivering smart manufacturing [1]. Possibility of error is reduced in manufacturing as the accuracy of robots is high as compared to human workers. In smart manufacturing the possibility of error must be determined minimum and for this reason mostly robots are used in smart manufacturing. 5G technology has developed communication between various devices and for this reason transferring information to robotic technology wirelessly has become a smooth operation. On the other hand, information plays a vital role to operate robots and this kind of development helps to improve wireless communications for robotic technology. Infrared, radio frequency, Wi-Fi, Bluetooth, voice control and cellular and satellite communications are used in robotics for wireless communications. Light is the medium to transfer signals from device to device.



**Figure1** : Cloud robotic technology of 5G  
(Source: [1])

Two devices are used in this process to transfer information and one is controller and other is receiver. Controller sends a signal and the receiver captures the signal and the system works as per the signs of the controller. In the beginning, infrared technology was used in robots to control

the entire technology wirelessly. Radio frequency is also an important technology that is used to make wireless communications among devices [2]. Two electronic components such as receiver and transmitter are used in radio frequency to deliver information wirelessly. The two electronic devices make communications through electronic waves. Transmitter creates electronic waves and signals are sent to the receiver through the electronic waves. Receiver holds the signals and gives order to the devices as per the signals. In robotic technology radio frequency is used to make wireless communications for operating the entire system. Transferring data through radio frequency is considered as the beginning technology that has been used in various technologies such as robots to transfer information wirelessly.

In the current time, mostly robots are controlled by the internet and Wi-Fi is one of the greatest technologies in the world of internet. Wireless networks transform data or information into digital data and the data is sent to the receiver. In robotic technology information is transformed into digital data and the network sends the digital data to robots that help to operate the technology. The technology is able to transfer information quickly and for this reason operating robots has been more quick and effortless through using Wi-Fi technology. Bluetooth is also a wireless technology that is capable of transferring information for short distances [3]. In robots Bluetooth technology is used to operate it within a short distance. This technology is able to transfer data or information in short distances and it does not require a line of signals. The latest development is cell phone controlled robots, two technologies are used to operate robots through mobile phones, one is voice controlled and another is DTMF.

Information is transferred from mobile phones through the internet to robots and the robots operate as per the information. In the present time development of technologies such as AI, ML helps to operate robots wirelessly [4]. The technologies are capable of making algorithms based on digital information and robots are operated as per the algorithm. However, artificial intelligence technology is used to mark algorithms on voice orders, considering the fact this technology is used in robots to understand the voice commands. Much more development in artificial intelligence has provided accuracy algorithms based on voice commands. Mostly robots are operated through voice commands and for this reason making algorithms through voice commands is essential. On the other hand, machine learning technology is also capable of making algorithms based on databases and for this reason machine learning technology is also used in robots to operate it smoothly.

**Impact of wireless communications in robotic technology**

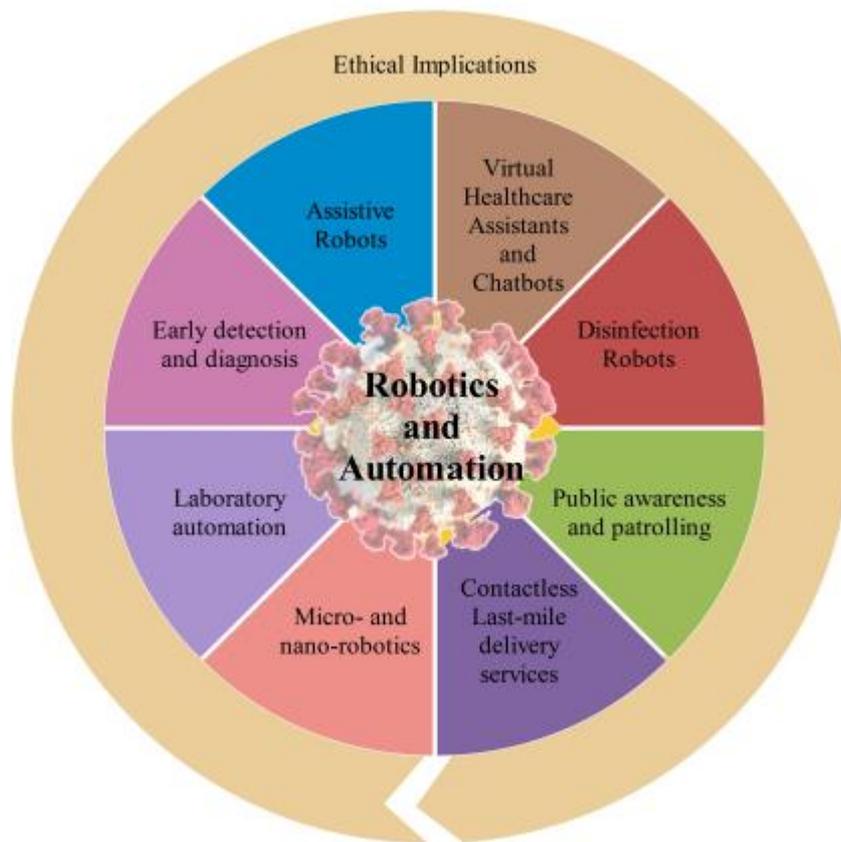
Wireless communications helps time robots smoothly and for this reason the usability of it has increased. In manufacturing automation technologies are considered beneficial to manage manufacturing smoothly. Robots are also under automation. Technologies such as big data, IoT

and smart factories are used to handle automation systems [1]. In smart production automation systems have a great role to operate the activities of smart production. In the manufacturing industry smart manufacturing is considered vital to fulfill demand of modern trends of consumer. Trends of mobile phone operated robots are increasing and in the previous time 3G and 4G were not enough capable to transfer data to robots quickly and for this reason the usability of mobile phone-based robots was not much more. In recent times 5G technology has developed and this technology is much more capable of transferring data to robots.

Operating this automation system in manufacturing is easier and for this reason smart manufacturing activities are boosted through the robots. Development in robots helps to increase communications ability with humans and for this reason usability of this technology would be improved. Wireless connectivity helps to increase flexibility of this technology that plays an important role to increase capability. Robots are mostly operated through wireless connectivity and for this reason flexibility of this technology has improved [5]. It helps to provide flexibility in production also and as

results smart production has improved. In the healthcare sector, robots are used largely. In the year 2020 Covid pandemic hit countries from all over the world. Infection has spread rapidly among people and most of the people were in isolation conditions.

Digital technology has been used in this situation to counter the bad impact of the pandemic. Wireless connection in robots helps to operate different kinds of work in the healthcare sector. Monitoring infection, indoor, outdoor and service to the infected patients. Automation systems are largely used in these tasks to tackle the bad impact of the pandemic. Robots are also considered as automation systems and mostly this technology has been used in the healthcare sector during the pandemic for these tasks [6]. Wireless communications among robots helps to monitor infection through maintaining social distancing. However, indoor and outdoor monitoring are done through robots which are operated wirelessly. Different kinds of technologies are used in robots to operate wirelessly. For example, mobile phone and Bluetooth technologies are able to manage the activities of robots wirelessly.



**Figure 2:** Robots and automation  
(Source: [6])

Implementation of wireless technology has made robots more practical for use in different kinds of industries such as manufacturing, retail, healthcare and logistics. Technologies such as Wi-Fi and Bluetooth have helped robots to increase their use on a large scale. Users can operate this technology

from long distance and as a result multiple works are possible at the same time by using wireless robots. Bluetooth is low-cost technology that can operate robots wirelessly. Considering the fact of low cost in many cases it is used in robots as wireless communications systems. Economically,

the low cost of Bluetooth helps to operate robots at a low cost and for this reason overall cost of robots is decreased, which makes it more affordable for buyers. Affordability of robots increases usability that helps to increase demand of robots in various industries along with works.

Most buyers consider this technology to increase their productivity and for this reason overall industrial growth is to be possible. Mostly robots are used in material handling, painting, picking, arranging and assembling. Wireless communications systems help to operate the robots in these works smoothly. Physical capabilities of robots are much more as compared to human workers [7]. That is the reason for considering this technology in painting, picking, packing, arranging and in material handling. Responses of robots are quick and that helps to increase productivity. In industry, quick response helps to accelerate productivity that plays an important role in economic growth. Wireless communications in robots helps to operate the technology from long distances and for this reason in manufacturing industries this development helps to reduce time consumption. It has a significant role to boost productivity that is important for financial growth.

### **METHODOLOGY**

Research methodology is used as a plan and procedure that can define choosing of research elements. Data collection method and data analysis method in research methodology are important parameters which are used to collect data. Both secondary and primary data collection methods are included in methodology. Surveys and interviews are used in primary data collection to gather required data [8]. Human participants are involved in surveys and interviews to collect responses for data collection. More budget and time are required in both survey and interview. On the other hand, possibility bias is present in primary data collection methods due to involvement of human participants. Possibility of bias decreases effectiveness of study outcomes and for this reason primary data collection method has been avoided for this study.

Online journals, articles, magazines, reports and websites are the sources of secondary data collection. Secondary qualitative data is collected from these sources. Huge number of journals and articles are available in google and google scholar and the sources of data are easily accessible [9]. This benefit helps to collect from the sources easily and for this reason researchers need less time and effort as compared to primary data collection. Wide range of data is available in the sources of secondary qualitative data that helps the researchers to collect data as per their requirements. It provides opportunities to make discussion on study based on the data according to their view point. Less time is consumed in data collection due to easy availability that plays an important role to complete the entire study with less budget as compared to primary research.

Different kinds of views on study topics are available in secondary qualitative data collection and this kind of

flexibility is provided by it to researchers. On the other hand, secondary data has been in previous research and found and mostly provided effective results. Secondary data is cleaned and structured as the data used in previous study [10]. Cleaned and structured data provides better quality and on the other hand, primary data are not used in previous studies. Possibility of quality issues is present in primary data. However, human participants are not involved in secondary data and for this reason there is no possibility of bias that enhances effectiveness of study. Considering the advantages, a secondary qualitative data collection method has been used in this study. Google scholar and google have been used to collect secondary qualitative data.

Journal and articles related to study have been considered for collecting data for this study. Technology is developing and modern technologies such as artificial intelligence, machine learning are widely used in robotic systems to enhance its performance. Journal related to involvement of modern technologies such as AI and ML have been approached to collect data about the effective implementation of these technologies. Wireless communications systems are improving the capabilities and usability of robots [11]. Articles and journals related to wireless communications in robotic technology have been considered and needed information has been collected from the considered articles and journals. Current trends of using wireless robots in different kinds of industries related journals and articles have been searched in google scholar and google. Information on it has been gathered from the journal and articles. Collected information related to the use of wireless robots helps to make proper discussion.

Several challenges are involved in developing wireless robots and journals and articles have been collected from google scholar. This initiative helps to identify the challenges which have a great impact on wireless robots. In making discussion the information helps to enhance quality of discussion and from the discussion proper conclusion has been analyzed. Different kinds of wireless technologies are implemented in robotic technology to make wireless communications. Articles and journals related to wireless communications technologies which are implemented in robots have been approached. Authentic information plays an important role in effective study [12]. Authentic information from the journals and articles have been collected that has helped to make discussion on it. Benefits which are provided by implementing wireless communications technologies in robots are to be analyzed in the discussion part. Information related to the benefits have been collected from the articles and journals. Discussion is to be developed based on the collected information that have been collected from secondary qualitative data sources.

### **DISCUSSION**

Rapid development is happening with wireless monitoring systems and robots. The usability of wireless systems such as robots is increasing in the healthcare sector. In most of the

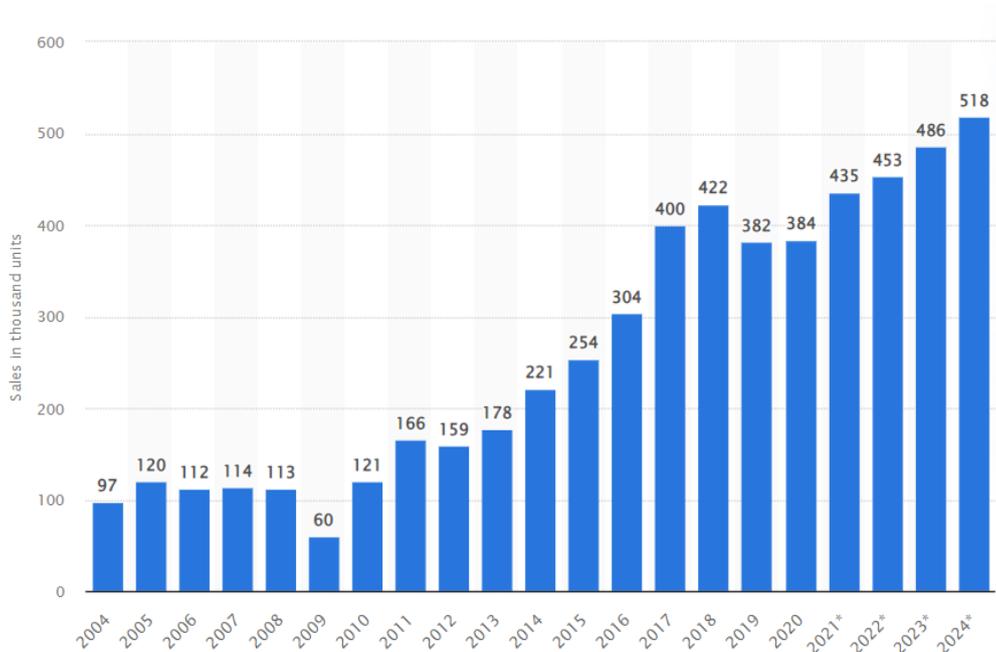
cases these robots are used for monitoring and taking care of elderly population in various countries. Human workers are not sufficient to take care of elderly people for a long time and robots are capable of taking care of elderly population for a long time. Considering these benefits, robots are used in most countries for taking care of elderly population. Mostly taking care is required for psychological and chronic patients [13]. Nurses are not able to take care of this kind of patients for a long time and considering the fact, wireless robots are used to deal with this kind of patients. In recent times, mobile healthcare robots are largely used in the healthcare sector.

Artificial intelligence systems are used in robots and by this technology robots can be superior through learning from medical experts [14]. In the treatment and diagnosis process, the robots can be used effectively and, in most cases, it is found that the robots are more efficient as compared to human caregivers. Various sensors are connected with healthcare robots. Smart phones are connected with these robots and mostly these are operated with smartphones. Several cameras are added with these kinds of robots that are used for monitoring the indoor environment of the healthcare sector, especially care receivers. Rapid development of internet of things technology has boosted the improvement of this robotics technology. Capabilities have been developed due to adoption of IoT technology and as a result usability has increased immensely. Service quality of robots has improved and presence of it in the healthcare sector has increased. Most people prefer service robots in the healthcare sector to get better quality of service specially for the elderly population.

Wireless robots are the key technology of autonomous underwater vehicles. Demand for underwater autonomous vehicles is increasing rapidly and for this reason the

possibility of developing maritime industry is high level. In different kinds of activities AUVs are used and for this reason demand for this kind of technology is increasing. AUVs are used in commercial, environmental, defense, scientific and oceanographic. Commercial activities such as underwater mapping, archaeological survey, offshore construction, monitoring harbor. Demands of AUVs are increasing in these works and for this reason the maritime industry is developing. This rapid development of the industry plays a significant role in increasing demands of autonomous underwater vehicles. Wireless robots are an important technology of these AUVs. Improvement of maritime industry plays a key role to boost demands of wireless robots. In studies it is found that the market of maritime industry is to be expected to be 1638 million by the year 2025 [15]. Huge development of the maritime industry helps to increase demands of robots mostly for commercial purposes in underwater autonomous vehicles.

In environmental purpose demands of AUVs is rising for monitoring water quality and baseline environmental management. Wireless communications have increased usability of robots as mostly communications occur through machine to machine that has provided smooth operating experience to users. IoT plays an important role to ensure wireless communications in robots. Development is happening in IoT technology and for this reason the capability of robots in wireless communications is also developing and for this reason usability in industry and human daily life is rising. Particularly in industry wireless communications in robots helps to provide financial benefits. Market of industrial robots has grown rapidly. It is expected that the number of industrial robots is to be around 518000 by the year 2024 [16].



**Figure 3:** Usages of industrial robots  
(Source: [16])

Japan, USA and China are the leading countries where mostly wireless robots are used in industrial activities.

In different kinds of industrial activities such as manufacturing automobile components and assembling, these kinds of robots are used. Considering the advantages, usage of robots is increasing and on the other hand, threats from these technologies are also rising. In this wireless communications method for robots, exchange of data from machine to machine is necessary. On the other hand, there is not enough security for the wireless robots to interface with humans to machines. IoT infrastructure does not allow any kind of security in data exchange and for this reason mostly IoT technology is not able to provide protection to robots from the harmful software [17]. This kind of software can make the wrong exchange of data from machine to machine and in this case the interface of humans can be affected. Irrespective use of communication technologies is one of the other issues of wireless robots.

Number of co-operating units is rising due to rapid technological growth. This development increases problems in wireless communications of robots that can be big threats to humans for using this technology in their needs. Different kinds of technologies are used to make wireless communications with robots and the technologies are such as infrared, radio frequency, Wi-Fi, Bluetooth and satellite connection [18]. In both infrared and radio frequency two devices such as controller and receiver. In infrared light is used as a medium to transfer signals from controller to receiver. In the initial stages infrared technology was used in robots to make wireless communications. Radio frequency works through electronic waves, transmitter sends electronic waves to receiver and it captures it as information. In the beginning time this technology was used for wireless communications for robots. In the present time the internet is largely used to make wireless communications. Wi-Fi is an advanced and modern technology which is largely used to establish wireless communications among robots.

### CONCLUSION

Different kinds of wireless communications technologies are used in robots to operate. Wi-Fi, infrared, radio frequency, telecommunications and satellite communications are the technologies which are used in robots to make wireless communications. In the current situation, the internet is mostly used by robots for making wireless communications. Wi-Fi plays an important role to make internet connection in robots that helps to operate the entire technologies as per the requirements. Radio frequency technology was used in the beginning stage of wireless communications. Two types of electronic devices are used in radio frequency, one is the transmitter and other is the receiver. Bluetooth is also used for making wireless communications in robots to improve its usability.

In the discussion it is found that Bluetooth technology is capable of covering short distances and on the other hand, Wi-Fi has the ability to operate robots from a wide range of

distances. This kind of development in wireless communications has increased the usability of robotics technology in various fields. In the present time robots are mostly used in the healthcare sector to improve its quality of caring service. From discussion it is found that long time caring is necessary for the psychological and chronic patients. Human nurses are not efficient enough to take care of these patients for a long time. On the other hand, service robots of the healthcare industry are able to provide car service for a long time.

However, modern robots are capable of learning medical treatment from medical experts and this learning helps the robots to provide better treatment to the patients. In most of the countries, wireless service robots are used to take care of elderly population. Monitoring elderly population is necessary and mobile healthcare robots are used to monitor elderly population in several countries. Technological development has boosted usability of robots as the development has provided wireless communications with the robots. In the current situation mostly, robots are controlled by smartphones. Voice controlled and DTMF are the two technologies which are used to make communications with robot's wireless of smartphones. On the other hand, development of artificial intelligence and machine learning help to analyze the entire process of wireless communications effortlessly. These technologies make algorithms based on input information and the entire system of robots operate as per the characteristics of the algorithm.

### REFERENCE

- [1] Temesvári, Z.M., Maros, D. and Kádár, P., 2019. Review of Mobile Communication and the 5G in Manufacturing. *Procedia Manufacturing*, 32, pp.600-612.
- [2] Haas, H., Elmirghani, J. and White, I., 2020. Optical wireless communication. *Philosophical Transactions of the Royal Society A*, 378(2169), p.20200051.
- [3] Zeadally, S., Siddiqui, F. and Baig, Z., 2019. 25 years of Bluetooth technology. *Future Internet*, 11(9), p.194.
- [4] Manickam, P., Mariappan, S.A., Murugesan, S.M., Hansda, S., Kaushik, A., Shinde, R. and Thipperudraswamy, S.P., 2022. Artificial intelligence (AI) and internet of medical things (IoMT) assisted biomedical systems for intelligent healthcare. *Biosensors*, 12(8), p.562.
- [5] Wan, S., Gu, Z. and Ni, Q., 2020. Cognitive computing and wireless communications on the edge for healthcare service robots. *Computer Communications*, 149, pp.99-106.
- [6] Khamis, A., Meng, J., Wang, J., Azar, A.T., Prestes, E., Takács, Á., Rudas, I.J. and Haidegger, T., 2021. Robotics and intelligent systems against a pandemic. *Acta Polytechnica Hungarica*, 18(5), pp.13-35.
- [7] Belanche, D., Casaló, L.V., Schepers, J. and Flavián, C., 2021. Examining the effects of robots' physical appearance, warmth, and competence in frontline services: The Humanness-Value-Loyalty model. *Psychology & Marketing*, 38(12), pp.2357-2376.
- [8] Nayak, M.S.D.P. and Narayan, K.A., 2019. Strengths and weaknesses of online surveys. *Technology*, 6(7), pp.0837-2405053138.
- [9] Gusenbauer, M., 2019. Google Scholar to overshadow them

- all? Comparing the sizes of 12 academic search engines and bibliographic databases. *Scientometrics*, 118(1), pp.177-214.
- [10] Roh, Y., Heo, G. and Whang, S.E., 2019. A survey on data collection for machine learning: a big data-ai integration perspective. *IEEE Transactions on Knowledge and Data Engineering*, 33(4), pp.1328-1347.
- [11] Wan, S., Gu, Z. and Ni, Q., 2020. Cognitive computing and wireless communications on the edge for healthcare service robots. *Computer Communications*, 149, pp.99-106.
- [12] Mheidly, N. and Fares, J., 2020. Leveraging media and health communication strategies to overcome the COVID-19 infodemic. *Journal of public health policy*, 41(4), pp.410-420.
- [13] Wan, S., Gu, Z. and Ni, Q., 2020. Cognitive computing and wireless communications on the edge for healthcare service robots. *Computer Communications*, 149, pp.99-106.
- [14] Lee, D. and Yoon, S.N., 2021. Application of artificial intelligence-based technologies in the healthcare industry: Opportunities and challenges. *International Journal of Environmental Research and Public Health*, 18(1), p.271.
- [15] Hoeher, P.A., Sticklus, J. and Harlakin, A., 2021. Underwater optical wireless communications in swarm robotics: A tutorial. *IEEE Communications Surveys & Tutorials*, 23(4), pp.2630-2659.
- [16] Statista.com, 2021. Industrial robots - worldwide shipments 2004-2024. Statista. Available at: <https://www.statista.com/statistics/264084/worldwide-sales-of-industrial-robots/> [Accessed on 25th December, 2022]
- [17] Iskhakova, A., Iskhakov, A., Meshcheryakov, R. and Jharko, E., 2019. Method of verification of robotic group agents in the conditions of communication facility suppression. *IFAC-PapersOnLine*, 52(13), pp.1397-1402.
- [18] Islam, M. and Jin, S., 2019. An overview research on wireless communication network. *Networks*, 5(1), pp.19-28.