

Usage Of The Internet Of Things (Iot) In Intelligent Transportation System (Its)

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Abstract

The transportation industry has been greatly impacted by the Internet of Things (IoT) technology's rapid advancements, which have a wide range of effects. The Internet of Things (IoT) has the potential to revolutionise how people and products move across cities, and Intelligent Transportation Systems (ITS) have emerged as one of these applications. This paper seeks to provide a complete examination of IoT integration in ITS, stressing its advantages, difficulties, and possibilities in the future. This paper analyses the different facets of IoT-enabled ITS, including smart traffic management, vehicle-to-infrastructure communication, data analytics, and real-time monitoring, through a thorough literature review and case study analysis. Data security, scalability, and privacy issues are also covered in the study. The research's conclusions aid in a better understanding of the advantages and disadvantages of using IoT to develop effective and sustainable transportation systems.

The term "Internet of Things" (IOT) refers to objects and systems that can be represented on an internet-like structure and are each individually identifiable. A coordinated application of science, roads, people, and vehicles make up an intelligent transportation system (ITS). Technology-wise, ITS includes cutting-edge sensor technologies like RFID (Radio Frequency Identification Devices). Information technology includes computer processing technology, network technology, automatic control technology, DSRC (Dedicated Short Range Communication), VPS (Vehicle Positioning System), GPS, and more. There are already a number of Intelligent Transportation System concepts that are broadly recognised by society. Meanwhile, some ITS (intelligent transportation systems) disadvantages have become apparent. Intelligent Transport Systems can be developed using a fresh strategy thanks to the Internet of Things. In order to increase the use of technology for transportation, our study aims to ascertain whether Internet of Things can be integrated into Intelligent Transportation Systems. Consumers must be able to assess the various transit options in an effective manner, and here is where Internet of Things infrastructure might be useful.

Keywords: IOT, Intelligent Transportation System, Technology, GPS.

Introduction

The capacity to link with one another and have sensors added to more and more objects is a result of technological innovation. The means by which information is exchanged are evolving as the outer physical world turns more and more into an information system. The goal of the Internet of Things (also known as IOT) is to somehow connect the physical objects we see all around us to a network. The main subjects covered in the conversation include GPS (Global Positioning Systems), RFID (Radio Frequency Identification), infrared sensors, and scanners. Both interacting with the real world and gathering data are made possible through them.

Emergence of internet of things:

The Internet of Things is made up of networks of commonplace items we use every day. It involves the use of wireless sensors to provide information to each object and the people in charge of it. The phrase "internet of things" was first used by the creators of MIT's "Auto ID centre" 10 years ago. The term "auto id" refers to a broad category of

technologies used in industry to help automate, decrease error, and increase productivity. These technologies include smart cards, sensors, speech recognition, and biometrics. Since 2003, technologies have been identified by using RFID (Radio Frequency Identification) tags and EPC (Electronic Product Code), with RFID tags used for item tracking and EPC acting as a data link. The definition of the internet of things has expanded since then. Using sensors and sensor networks, it is possible to clearly note more details about the objects and environment. Even in today's digital world, we still need to come up with our own solutions to problems, like how to record a video. Our society will be built on items from the future rather than on our thoughts and knowledge, which are not the primary reasons for its survival. Software built into the object makes it possible for computers to analyse, think, feel, and sense data without human assistance, maximising the use of sensor technologies like RFID rather than limiting it to only sensing barcodes. The Internet of Things' long-term goals include the management of enormous data sets where users will be more connected to one another. All around Europe, numerous Internet of Things projects are being developed.

ITS (Intelligent Transportation Systems)

Transportation management systems use a variety of advanced sensor technologies to create an information, intelligence, and socialisation transportation integrated management and control system, including RFID (Radio Frequency Identification Devices), DSRC (Dedicated Short Range Communication), VPS (Vehicle Positioning System), information technology, network technology, automatic control technology, computer processing technology, cloud computing, and GPS. The operation of the transportation infrastructure is optimised by the intelligent transportation system. The technology was created in the US in the 1980s, and other nations are actively working to further develop it. As a result of the development of the Internet, smart communication technology, sensor networks, and other new kinds of technology, IOT has taken shape in Intelligent Transportation Systems and will have significant growth potential in the years to come.

Intelligent transportation system

Intelligent transportation is based on a well-balanced application of computer science, people, vehicles, and physical infrastructure. In order to balance transportation users, cars, and constrained roadways, we can determine the time of the next vehicle's arrival, the availability of empty seats, the best route, and avoidance of congested routes. We will be able to detect the vehicle brake in front of you and prevent an accident by adopting procedures in the future transportation system. The first and most important step in creating an intelligent transportation system is therefore gathering data. By installing sensors throughout the system, transportation managers can get real-time transportation data, enabling them to monitor and regulate traffic flow. The traffic police can exchange traffic information about the area at any time utilising radio frequency tags and GPS in cars to gather reliable transportation data to direct vehicles to alter or improve travel routes. In a sense, intelligent transportation is the application of IOT technologies to the transportation industry. The joint evolution of people, automobiles, and roads, which is the basis of intelligent transportation systems, is the ideal embodiment of the idea of transportation IOT.

Intelligent transportation and IOT

Intelligent Transportation Systems may be one of IOT's strategic initiatives. The introduction of automated driving is made possible by the intelligent transportation system, which also enables the tracking of all forms of transportation in order to ensure transportation safety, smart urban transportation management, the collecting of significantly more vehicle transportation data, and much more.

In reality, specific applications of IOT in the transportation sector can be observed in daily life, including non-stop electronic tolls on highways, intelligent transportation systems, mobile emergency command and scheduling, mobile law enforcement by transportation police, monitoring of traffic violations by vehicles, vehicle anti-theft systems, and more. The network is far from complete, and this is just the beginning. With the help of the Internet of Things (IOT), we may envision a massive intelligent transportation system in the future that connects cars, people, and roads to alleviate traffic congestion, pollution, and safety issues.

Technologies and applications of IOT

The gathering and processing of information data is at the heart of IOT. The secret to getting around Information interchange between cars and between the road and the vehicle is made possible by vehicle network technology. Without a doubt, wireless technology is involved the main position. Application of DSRC (dedicated narrow range communication) and VPS (vehicle positioning system) technologies, as well as current vehicle location, communications, and tolls. Electronic toll collection is the major function of DSRC. GPS and GSM together make up VPS. Voice conversations and auto navigation use it more frequently. Additionally extensively employed are infrared and ultrasonic technologies, which are straightforward and environmentally safe. Radio frequency identification devices (RFIDs), video detectors, magnetic sensors, wireless sensors, the Global Positioning System (GPS), Internet and wireless communications, and industrial application are further key technologies for intelligent transport systems software for applications. The advancement of the underlying chip-embedded devices, which are driving the development of the industry as a whole, is the most significant of these technologies. Existing products will be improved, services will be more intelligent, and remote devices can be managed, scheduled, and maintained thanks to the combination of IoT and embedded systems.

The heart and soul of IoT applications is software. Major software firms have made significant investments in related software's R&D and middleware (SaaS, SOA, cloud computing, etc.). In Transport IOT, the proposed cloud computing paradigm is crucial. Because each mode of transportation is uncertain, transportation is a difficult science. Utilising "on-demand services" over the Internet, cloud computing, a highly scalable computer technique, makes resources available to consumers. It "uses on demand, charges, and does not use after completion." meet the demanding standards for transportation The following technologies are essential for the development of Transport IOT: (1) technology for detecting the driving condition of a vehicle; (2) DSRC short-range communication technology; (3) technology for driver assistance; (4) technology for detecting the performance of infrastructure and the environment; and (5) new generation transport control system.

IOT technology in intelligent Transportation system

RFID-based electronic licence plate system functionalities are needed in order to implement IOT in the development of intelligent transportation systems. E-tag, also referred to as RFID (Radio Frequency identifying), is a non-contact automatic identifying system. HF signal target recognition for autonomous data acquisition. Without human intervention, it can function in challenging conditions. Fast and simple identification of many tags and quickly moving objects is made possible by RFID technology. RFID is a straightforward wireless technology with just two fundamental parts. To control, detect, and track things, the system is employed. An interrogator (or reader) and several transponders (or tags) make up the system. It uses frequency RF to enable non-contact data communication in two directions between the reader and RF card in order to identify the target and exchange data. The primary duties of an RFID-based electronic number plate system in transportation management are: - Licence Information Management: At a road intersection and as the vehicle passes by, a radio frequency identification device can successfully collect licence information and compare it to the Number Plate Information Centre Information Database. Your car will automatically be forced to perform the necessary actions if your licence runs out or it fails the yearly vehicle inspection. Without the requirement for a fixed site, vehicle control services can also be offered using electronic licence plates. On both small and large frequency identification terminals in the city, drivers can do this. The vehicle's IC card is automatically updated and updated in the database as soon as the vehicle passes the terminal. As a result, it performs inspection job more effectively and saves both the driver and management a significant amount of time and resources.

Inspection of Mobile / Specific Road Vehicles: In order to maintain safe and orderly transportation on the road with legally driven vehicles, no overspeeding, and no stopping on the road, traffic police typically conduct vehicle inspections to check for the execution of traffic laws and regulations. The Management of Vehicle Specific Information and Statistical Transportation Data: It is for security and illegal operation. In order to provide smooth and efficient transportation, it provides reliable transportation flow statistics for streets and highways as well as the foundation for such planning.

Driving without a licence and related vehicle monitoring: employing mobile RFID terminals, traffic managers can actively regulate the driving safety of vehicles on the road in addition to employing stationary radio frequency identification equipment to monitor traffic on arterial highways. It is feasible to execute. Dynamically keep an eye on the traffic on a certain road, especially the speeding cars, and take the necessary precautions to ensure safe driving. Security badges, dangerous products and freight vehicle services, key management, and RFID technologies are all used in these applications. To identify unsafe and unlawful cars, radio frequency identification devices are put at significant entrances and exits. Vehicles recognise and manage access in designated frequency channels. Compared to manual detection, this is both quicker and more effective. The use of car driver detection systems was very important during the Shanghai World Expo since there was a requirement for vehicle management in and around the event. The streets near the exposition have been designated as zones for traffic management. Key control sites have RFID placed to keep an eye on the nearby vehicles. The information will be sent back to the transportation control centre for Expo, which will run continuously. If an exceptional circumstance arises, the centre can take over the transport right away by sending a transport control order to the traffic police at various locations. Associated traffic-control measures. To look for strange licence plates, the automatic alarm system was activated in the meantime. It is advised for suspicious cars to halt right away. Take the necessary steps if your licence plate does not satisfy your criteria. Taking tolls without forcing vehicles to stop: The majority of toll booths on interstates and highways are utilised to collect tolls without halting cars. Automatic radio frequency identification technology automatically scans the IC card of passing vehicles to deduct charges and levies. The management of IC cards is, of course, also offered. B. Processing, replacement, and recharging of IC cards. The toll service will function much more effectively as a result, and the vehicle can continue to run without interruption. Additionally, you can save money and resources by drastically lowering the price itself.

Automated parking control: The use of intelligent electronic licence plates is thoroughly explained in the Transport Management section above through the function of automatic parking management. The assertion is not repeated here as a result.

Police traffic control and administrative control are used in traffic flow monitoring to make decisions. These are sources of transportation data in addition to radio frequency identification methods, including GPS (Global Positioning System), GIS (Geographic Information System), and other methods of data collecting. GPS must be used to determine the dynamic positioning of the vehicle position and to gather the essential data about a specific vehicle. A geographic information system is mostly used to gather data regarding fixed route segments, such as: B. Data on the road network, transport flows, and fixed peak section numbers.

The timely availability of transportation flow data can also be utilised to monitor traffic, identify illegal driving, and take immediate action in the event of an accident. The monitoring gadget is often installed on a gantry near High levels of data accuracy, vast quantities of data, and regular updates are essential components of efficient transportation decisions. The use of contemporary network communication technology greatly helps with this. Access to transport data can be quickly passed between transport networks due to the prevalence of modern GSM networks in use. Furthermore, there are no constraints on transmission, and accurate data transmission may ensure quality. Database technology can be used in the information centre to manage a sizable volume of databases. Computers are capable of processing and storing massive amounts of data quickly. When needed, data can be searched for and obtained. The data is also updated on a regular basis because it is important for decision-makers in the transportation industry and is related to accuracy, which transportation managements will base their decisions on. Using cloud computing technology, a lot of data can be employed for the simulation in the information centre, leading to a presumed scientific and logical conclusion. Decision-makers should base their decisions on these findings. On the other hand, the driver must also make use of traffic data, such as route selection. Based on current and historical data about the traffic flow in the area, drivers can select the optimum route. Today's accessibility to new communication channels offers tools for learning features.

Monitoring and management of drunk driving: Driving is dangerous after having a drink. It is, nevertheless, extremely challenging to handle. To monitor driving on the road, radio frequency identification technology is

employed. The vehicle will be skimmed and monitored using image analysis tools to further evaluate whether the vehicle is drunk driving and by the exchange of real-time information if it is discovered to be uneven or not parallel to the road. After servicing the car's equipment, tell the police patrol to administer an alcohol test.

Challenges of internet of things

The Internet of Things faces several obstacles, but one of the largest ones is society and ethical issues. How does IOT technology affect people's skills, whether they are enabled or controlled by it, and how does this affect their capacity to meet numerous accountability requirements? The capabilities of IOT technology should be viewed as controlling accountability characteristics including visibility, accountability, and control transparency and predictability. Nowadays, there are at least two connected objects per person, making the Internet of Things widely prevalent. The protection of privacy is one of the main issues driving this innovation. Three major obstacles stand in the way of IoT development: unifying standards, the creation of, and the transition to the new IPv6 energy source development for a variety of sensors challenges with another structure IOT is a means to integrate all software systems despite the absence of a standardised software architecture. Platform architecture for popular software. If you produce a lot of data, there might be a digital twin on the cloud, which is the first immediate threat to this regularly produces updates. Reaching the messaging volume is made simple by this anywhere from 100 to 10,000 per individual. According to Internet of Things research currently available implementation in transportation networks is not adequately researched.

Automobile sensors: At each vehicle's entrance and exit are sensors determines the amount of available seats in a specific vehicle. If short-range radio technologies like active RFID are used, the sensor will be feasible. Battery-powered active RFID reads beyond 300 feet. Active RFID has the advantage over passive RFID in that it can deliver signals automatically sends a signal in response to RF energy received from the reader. Using BLE sensors (Bluetooth Low Energy) is an improved alternative. The price of these sensors and the cost of electricity are greatly reduced. This data is inputted into the car's integrated device.

Embedded devices: The bus's embedded gadgets gather data about the bus based on time, place, and speed place data is obtained from GPS satellites and is necessary for the creation of "timestamps" for each place. Details are also transferred to the cloud server every minute via the industry-standard protocol used by 3G and 4G telecommunications services to guarantee data freshness.

Satellites: Satellites quickly deliver signals to moving vehicles on the ground. Atomic Block offered this citation. Synchronised satellites give information to guarantee that precise information is delivered at the same time. There are three basic sub-divisional parts in the architecture of the global positioning system.

1)GPS Ground Segment (GS): This component is in charge of ensuring that every aspect of the Global Positioning System operates as it should, including the replacement of malfunctioning satellites. Additionally, it aids in the operation and performance of the GPS system within a particular spectrum of functions. is charge of system security problems.

2) The GPS Space Segment (SS) is made up of GPS satellites. There are 24 GPS satellites with eight circular orbits, all of which were designed with GPS. Each orbital angle difference for a satellite in orbit around the earth is 30, 105, 120, and 105 degrees.

3) USA GPS User part: This part consists of GPS receivers acquire GPS to find the precise location and time, send a signal and solve the navigational equation. Precise has two different kinds of users: military personnel users of both specialised and general location services.

Conclusion

We can conclude that using just one technology is insufficient if we want to take advantage of all the features of the Intelligent Transportation System. In particular, we should use a lot of IOT technology, particularly the global

positioning system, geographic information systems, and full use of radio frequency identity technology for clever delivery control so that we can make a qualitative leap. More advanced packages of intelligent transportation that are entirely based on IOT may become available as IOT technology advances. Developing an extension from a guide transportation control device to an intelligent transportation system might be quite important. The stakeholders inside the gadget will benefit greatly as a result, in many ways. Human travellers can receive information about the road's environmental popularity to make their journeys as efficient as possible.

In order to maximise community transit and improve road safety, significant application of road infrastructure can be made using control and scheduling systems. Assuming we achieve the objective—better software possibilities—by using IOT technology: In order to reduce petrol consumption and carbon dioxide residual emissions, people will be more aware of how to avoid traffic jams and travel along the shortest route to their destinations. Travellers can get timely weather information. In order to ensure driving comfort, drivers can always utilise a mobile car pilot to find the nearest parking space. While travelling, customers can take use of top-notch online entertainment options. Although IOT offers real potential for ITS, it is ultimately just another way for the Internet to grow. In order to increase the range of products and carry the industrial value, it must be combined with current business. The IOT's technical properties allow it to be properly incorporated into the smart transportation sector. An extensive range of commercial programmes may be put into practise via intelligent transport system, and intelligent transport system in city place will experience a qualitative leap with the further advancement of IOT era and the development of intelligent transport device in big cities. Determining the viability of using the Internet of Things in the development of an Intelligent Transportation System was the goal of the research, which were conducted in this manner.

This study aims to provide important insights to researchers, practitioners, policymakers, and stakeholders interested in utilising IoT technology to develop smarter, safer, and more effective transportation networks by conducting an extensive investigation into the integration of IoT in Intelligent Transportation Systems.

References

1. Yorio, Z., Oram, R., El-Tawab, S., Salman, A., Heydari, M. H., & Park, B. B. (2018, April). Data analysis and information security of an Internet of Things (IoT) intelligent transit system. In 2018 Systems and Information Engineering Design Symposium (SIEDS) (pp. 24-29). IEEE.
2. Thommandru, A., Espinoza-Maguiña, M., Ramirez-Asis, E., Ray, S., Naved, M., & Guzman-Avalos, M. (2023). Role of tourism and hospitality business in economic development. *Materials Today: Proceedings*, 80, 2901-2904.
3. Voumik, L. C., Islam, M. A., Ray, S., Mohamed Yusop, N. Y., & Ridwan, A. R. (2023). CO2 emissions from renewable and non-renewable electricity generation sources in the G7 countries: static and dynamic panel assessment. *Energies*, 16(3), 1044.
4. Bhargava, A., Bhargava, D., Kumar, P. N., Sajja, G. S., & Ray, S. (2022). Industrial IoT and AI implementation in vehicular logistics and supply chain management for vehicle mediated transportation systems. *International Journal of System Assurance Engineering and Management*, 13(Suppl 1), 673-680.
5. Rakhra, M., Sanober, S., Quadri, N. N., Verma, N., Ray, S., & Asenso, E. (2022). Implementing machine learning for smart farming to forecast farmers' interest in hiring equipment. *Journal of Food Quality*, 2022.
6. Al Ayub Ahmed, A., Rajesh, S., Lohana, S., Ray, S., Maroor, J. P., & Naved, M. (2022, June). Using Machine Learning and Data Mining to Evaluate Modern Financial Management Techniques. In *Proceedings of Second International Conference in Mechanical and Energy Technology: ICMET 2021, India* (pp. 249-257). Singapore: Springer Nature Singapore.
7. Pallathadka, H., Leela, V. H., Patil, S., Rashmi, B. H., Jain, V., & Ray, S. (2022). Attrition in software companies: Reason and measures. *Materials Today: Proceedings*, 51, 528-531.
8. Sharma, A., Kaur, S., Memon, N., Fathima, A. J., Ray, S., & Bhatt, M. W. (2021). Alzheimer's patients detection using support vector machine (SVM) with quantitative analysis. *Neuroscience Informatics*, 1(3), 100012.
9. Mehbodniya, A., Neware, R., Vyas, S., Kumar, M. R., Ngulube, P., & Ray, S. (2021). Blockchain and IPFS integrated framework in bilevel fog-cloud network for security and privacy of IoMT devices. *Computational and Mathematical Methods in Medicine*, 2021.
10. Ray, S. (2020). How COVID-19 changed dimensions of human suffering and poverty alleviation: economic analysis of humanitarian logistics. *Вестник Астраханского государственного технического университета. Серия: Экономика*, (4), 98-104.
11. Akbar, A., Akbar, M., Nazir, M., Poulouva, P., & Ray, S. (2021). Does working capital management influence operating and market risk of firms?. *Risks*, 9(11), 201.
12. Dutta, A., Voumik, L. C., Ramamoorthy, A., Ray, S., & Raihan, A. (2023). Predicting Cryptocurrency Fraud Using ChaosNet: The Ethereum Manifestation. *Journal of Risk and Financial Management*, 16(4), 216.
13. Polcyn, J., Voumik, L. C., Ridwan, M., Ray, S., & Vovk, V. (2023). Evaluating the influences of health expenditure, energy consumption, and environmental pollution on life expectancy in Asia. *International Journal of Environmental Research and Public Health*, 20(5), 4000.
14. Sajja, G. S., Jha, S. S., Mhamdi, H., Naved, M., Ray, S., & Phasinam, K. (2021, September). An investigation on crop yield prediction using machine learning. In *2021 Third International Conference on Inventive Research in Computing Applications (ICIRCA)* (pp. 916-921). IEEE.
15. Ali, N. G., Abed, S. D., Shaban, F. A. J., Tongkachok, K., Ray, S., & Jaleel, R. A. (2021). Hybrid of K-Means and partitioning around medoids for predicting COVID-19 cases: Iraq case study. *Periodicals of Engineering and Natural Sciences*, 9(4), 569-579.
16. Gupta, S., Geetha, A., Sankaran, K. S., Zamani, A. S., Ritonga, M., Raj, R., ... & Mohammed, H. S. (2022). Machine learning-and feature selection-enabled framework for accurate crop yield prediction. *Journal of Food Quality*, 2022, 1-7.

17. Gupta, S., Geetha, A., Sankaran, K. S., Zamani, A. S., Ritonga, M., Raj, R., ... & Mohammed, H. S. (2022). Machine learning-and feature selection-enabled framework for accurate crop yield prediction. *Journal of Food Quality*, 2022, 1-7.
18. Ma, W., Nasriddinov, F., Haseeb, M., Ray, S., Kamal, M., Khalid, N., & Ur Rehman, M. (2022). Revisiting the impact of energy consumption, foreign direct investment, and geopolitical risk on CO2 emissions: comparing developed and developing countries. *Frontiers in Environmental Science*, 1615.
19. Shukla, S. (2017). Innovation and economic growth: A case of India. *Humanities & Social Sciences Reviews*, 5(2), 64-70.
20. Soham, S., & Samrat, R. (2021). Poverty and financial dearth as etiopathogen of psychotic and neurotic diseases. *Заметки ученого*, (4-1), 568-578.
21. Park, J. Y., Perumal, S. V., Sanyal, S., Ah Nguyen, B., Ray, S., Krishnan, R., ... & Thangam, D. (2022). Sustainable marketing strategies as an essential tool of business. *American Journal of Economics and Sociology*, 81(2), 359-379.
22. Роков, А. И., Дубаневич, Л. Э., & Рэй, С. (2021). Повышение экономической эффективности труда за счет изменения системы оплаты. *E-Scio*, (9 (60)), 53-62.
23. Ray, S. (2021). How Emotional Marketing can help better understand the Behavioral Economic patterns of Covid-19 pandemic: Economic Judgments and Falsifications from India Samrat Ray-Alagappa University, Tamil Nadu, India. samratray@rocketmail.com. *Вестник МИРБИС*, (2), 26-34.
24. Ravi, S., Kulkarni, G. R., Ray, S., Ravisankar, M., krishnan, V. G., & Chakravarthy, D. S. K. (2023). Analysis of user pairing non-orthogonal multiple access network using deep Q-network algorithm for defense applications. *The Journal of Defense Modeling and Simulation*, 20(3), 303-316.
25. Priya, P. S., Malik, P., Mehboodniya, A., Chaudhary, V., Sharma, A., & Ray, S. (2022, February). The relationship between cloud computing and deep learning towards organizational commitment. In *2022 2nd International Conference on Innovative Practices in Technology and Management (ICIPTM)* (Vol. 2, pp. 21-26). IEEE.
26. Ray, S., & Leandre, D. Y. (2021). How entrepreneurial university model is changing the Indian COVID-19 Fight?. *Путеводитель предпринимателя*, 14(3), 153-162.
27. Inthavong, P., Rehman, K. U., Masood, K., Shaukat, Z., Hnydiuk-Stefan, A., & Ray, S. (2023). Impact of organizational learning on sustainable firm performance: Intervening effect of organizational networking and innovation. *Heliyon*, 9(5).
28. Rajendran, R., Sharma, P., Saran, N. K., Ray, S., Alanya-Beltran, J., & Tongkachok, K. (2022, February). An exploratory analysis of machine learning adaptability in big data analytics environments: A data aggregation in the age of big data and the internet of things. In *2022 2nd International Conference on Innovative Practices in Technology and Management (ICIPTM)* (Vol. 2, pp. 32-36). IEEE.
29. Elkady, G., & Samrat, R. (2021). An analysis of Blockchain in Supply Chain Management: System Perspective in Current and Future Research. *International Business Logistics*, 1(2).
30. Korchagina, E., Desfontaines, L., Ray, S., & Strelakova, N. (2021, October). Digitalization of Transport Communications as a Tool for Improving the Quality of Life. In *International Scientific Conference on Innovations in Digital Economy* (pp. 22-34). Cham: Springer International Publishing.
31. Kumar, A., Nayak, N. R., Ray, S., & Tamrakar, A. K. (2022). Blockchain-based Cloud Resource Allocation Mechanisms for Privacy Preservation. In *The Data-Driven Blockchain Ecosystem* (pp. 227-245). CRC Press.
32. Gaidhani, S., Arora, L., & Sharma, B. K. (2019). Understanding the attitude of generation Z towards workplace. *International Journal of Management, Technology and Engineering*, 9(1), 2804-2812.
33. Arora, L., Singh, P., Bhatt, V., & Sharma, B. (2021). Understanding and managing customer engagement through social customer relationship management. *Journal of Decision Systems*, 30(2-3), 215-234.
34. Arora, L., & Mail, B. K. S. (2018). Influence of review quality, review quantity and review credibility on purchase intention in context of high involvement products. *European Journal of Applied Business and Management*, 4(4).
35. Choubisa, L., & Babel, H. (2018). Morphometric study of pedicles of dried adult human lumbar vertebrae in Udaipur zone. *Int J Anat Res*, 6(3.3), 5660-66.
36. Paliouras, K., & Siakas, K. V. (2017). Social customer relationship management. *International Journal of Entrepreneurial Knowledge*, 5(1).
37. Irshad, M., Ahmad, M. S., & Malik, O. F. (2020). Understanding consumers' trust in social media marketing environment. *International Journal of Retail & Distribution Management*, 48(11), 1195-1212.
38. Arora, L., & Dhingra, R. (2006). Unusual nerve supply of biceps from ulnar nerve and median nerve and a third head of biceps. *Indian Journal of Plastic Surgery*, 39(02), 172-174.
39. Singh, P., Arora, L., & Choudhry, A. (2022). Consumer Behavior in the Service Industry: An Integrative Literature Review and Research Agenda. *Sustainability*, 15(1), 250.
40. Maharshi, N., Arora, L., & Chaturvedi, R. (2013). Management Education in India: From Challenges to Opportunities. *Asia Pacific Journal of Management & Entrepreneurship Research*, 2(1), 72.
41. Kalyani, P., & Arora, L. (2014). CMAT an Ambitious tool of AICTE, Contemporary State of Management Education in Rajasthan after Courts Decision about MBA. *Gobal Journal of Commerce and Management Perspective*, 3(1).