A Systematic Review of Information Systems Association with Smart Technology from 3G to 5G

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Abstract. The rapid evolution of telecommunications technology from 3G to 5G has profoundly impacted the landscape of smart technology and information systems. This systematic review examines the association between these technologies, focusing on the transformative effects of advancements in telecommunications. We explore the integration of information systems with smart devices, highlighting how each generation of telecommunications technology has enhanced connectivity and enabled more sophisticated applications across various sectors. Key areas of focus include healthcare, transportation, and industrial automation. In healthcare, advancements have facilitated remote patient monitoring, telemedicine, and wearable health devices. In transportation, the evolution from GPS-based navigation to real-time traffic management and autonomous vehicles is discussed. In industrial automation, the role of smart sensors and IoT devices in predictive maintenance and process optimization is analyzed. This review synthesizes existing literature, providing a comprehensive understanding of how the progression from 3G to 5G has driven innovation and efficiency in these fields. Methodologically, we adhered to PRISMA guidelines, conducting a thorough search of academic databases to identify relevant studies. Our findings underscore the significant impact of each telecommunications generation on the development and implementation of smart technology and information systems. The transition to 5G, in particular, represents a transformative leap, offering unprecedented data speeds, ultra-low latency, and massive connectivity. This review concludes by discussing future perspectives and the potential for further advancements in telecommunications to enhance the integration of information systems with smart technology. By providing a detailed overview, this study contributes to the understanding of the dynamic relationship between telecommunications advancements and smart technology development.

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Keywords: Information Systems, Smart Technology, 3G, 4G, 5G, Telecommunications, Connectivity, IoT, Smart Devices, System Integration

INTRODUCTION

The convergence of telecommunications technology and information systems has played a pivotal role in the swift progress of smart technology. In the last twenty years, the shift from 3G to 5G has enhanced the velocity and dependability of data transfer and facilitated the widespread use of intelligent devices and the Internet of Things (IoT). This progression has radically revolutionized multiple areas, including healthcare, transportation, and industrial automation, by establishing the foundation for more advanced and networked systems

During the early 2000s, the advent of 3G technology represented a substantial advancement over the previous 2G period since it brought about faster data transmission speeds and improved connectivity. This progress enabled the rise of early intelligent gadgets and fundamental Internet of Things (IoT) applications, paving the way for future technological advancements. The incorporation of information systems with 3G technology facilitated the development of novel applications such as mobile health monitoring systems, enabling the remote monitoring of

patient health indicators, and early smart grids, which started improving the efficiency of energy distribution networks. During this time, notable research endeavors were aimed at enhancing communication performance. One such effort was investigating the performance of underwater channels utilizing Polar Code-OFDM models, as demonstrated in [1].

The advent of 4G technology ushered in significant improvements in data speed and network stability. During this period, sophisticated smart gadgets and information systems that rely on cloud technology significantly increased [2]. 4G networks, with their enhanced capacity and reduced latency, facilitated the implementation of real-time telemedicine, enabling healthcare providers to deliver remote consultations and monitor patients with greater efficiency. 4G technology in the transportation industry enabled the creation of advanced transportation systems capable of real-time traffic management, resulting in reduced congestion and enhanced safety. In addition, 4G technology facilitated the implementation of advanced smart home solutions, allowing for the seamless integration of several devices and systems to boost home automation. Research on the capacity, spectral, and energy efficiency of OMA and NOMA systems emphasizes the continuous endeavors to optimize these networks [3].

With the advent of 5G, the capabilities of telecommunications technology have grown enormously. 5G provides unparalleled data rates, extremely low latency, and the ability to connect many devices simultaneously. The profound advancement has substantial ramifications for infusing information systems with intelligent technologies. 5G technology in the healthcare industry facilitates remote robotic surgery and real-time health monitoring with enhanced accuracy and dependability. Autonomous vehicles, a key feature of intelligent transportation, need the robust and reliable connectivity offered by 5G to operate smoothly. 5G enables the implementation of intelligent sensors and Internet of Things (IoT) devices in industrial automation, facilitating real-time monitoring and predictive maintenance. This results in enhanced efficiency and minimized periods of inactivity. The assessment of NB-IoT in LTE networks for improved IoT connectivity underscores the significance of advanced telecommunications in facilitating IoT applications [4].

The correlation between information systems and smart technology is crucial in comprehending the broader ramifications of telecommunications breakthroughs. Information systems are the fundamental infrastructure that enables the functioning of intelligent technologies by managing the collection, processing, storage, and distribution of information. Incorporating these systems into sophisticated telecommunications networks facilitates the smooth transmission of data among devices, enabling the development of more intelligent and agile applications. The integration is most apparent in the Internet of Things (IoT), where interconnected gadgets communicate and exchange data to enhance different operations. Using drones in marine communications has introduced fresh opportunities for immediate monitoring and data acquisition in demanding settings [5].

Incorporating information systems with intelligent technologies in the healthcare industry has resulted in notable progress in patient care. Wearable health gadgets, connected through telecommunications networks, offer uninterrupted monitoring of vital signs and can promptly notify healthcare providers of potential problems. Telemedicine platforms, facilitated by sophisticated information systems, allow for remote consultations and diagnostics, enhancing the availability of healthcare services and decreasing the necessity for in-person visits. The shift from 3G to 5G has improved these functionalities, providing increased dependability and velocity in data transfer. The use of drones in the field of communications and the Internet has been acknowledged for its contribution to improving data management and connection in healthcare applications [6].

Intelligent technologies and information systems have fundamentally transformed the management and navigation of transportation traffic. Intelligent transportation systems employ up-to-the-minute data to enhance traffic efficiency, alleviate congestion, and enhance safety. Autonomous vehicles, which depend on uninterrupted connectivity with nearby infrastructure and other vehicles, are becoming

feasible with 5G technology. These vehicles utilize sophisticated sensors and information systems to navigate and make judgments, aiming to decrease accidents and enhance roadways. An instance of how integrated systems can improve navigation and safety is using an Arduino-based GPS automobile tracker on Google Maps [7].

The integration of intelligent technologies and information systems has had a profound impact on industrial automation. Integrated with the Internet of Things (IoT) devices and sensors, smart factories can continuously monitor production processes in real-time and make necessary adjustments to maximize performance. Predictive maintenance systems utilize data from these devices to forecast equipment malfunctions and plan repair, thereby minimizing operational interruptions and enhancing efficiency. 5G networks offer fast connectivity and no delay, allowing these systems to function more efficiently and giving the manufacturing industry a competitive edge. The research on the influence of digitalization in enhancing accountability and efficiency in public services emphasizes the broader effects of these technologies on many sectors [8].

This systematic review thoroughly evaluates the correlation between information systems and intelligent technologies spanning from the 3G to the 5G era. Through the synthesis of current research, we will examine the significant advancements, uses, and consequences of this correlation in many fields. We emphasize the significant influence of telecommunications improvements on merging information systems with intelligent technology, providing valuable insights into present trends and future possibilities. The comprehensive investigation into various subjects, such as the incorporation of machine learning in environmental DNA metabarcoding to enhance biodiversity assessment [9] and the examination of techniques to enhance energy efficiency in digital broadcasting [10], showcases the extensive possibilities and range of these advancements. Additional research, such as the development of a structured approach to controlling the movement of data on LTE networks [11], the planning of LTE EPS network capacity with traffic that exhibits self-similarity [12], and the creation of models to analyze the performance of LTE EPS networks with self-similar traffic [13], enhances our comprehension of the technical foundations of these technologies. Furthermore, the utilization of unmanned aerial vehicles in the realm of telecommunications and IoT [14], as well as the significance of cybersecurity in marine communications [15], underscore the diverse range of applications and consequences of advancements in telecommunications in contemporary technology.

METHODS

This systematic review follows the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines to ensure a transparent and comprehensive approach to identifying, selecting, and synthesizing relevant literature on the association between information systems and smart technology from the 3G to 5G eras. The methodology is detailed in the following subsections: search strategy, inclusion and exclusion criteria, data extraction, and quality assessment.

Search Strategy

A comprehensive search of academic databases was conducted to identify studies published between 2000 and 2023. The databases searched included IEEE Xplore, Scopus, Google Scholar, and PubMed. The search strategy employed a combination of keywords and Boolean operators to ensure a broad yet focused retrieval of relevant literature. The primary search strings used were:

- ("Information Systems" AND "Smart Technology" AND "3G");
- ("Information Systems" AND "Smart Technology" AND "4G");
- ("Information Systems" AND "Smart Technology" AND "5G");
- ("Telecommunications" AND "IoT" AND "Smart Devices").

Additionally, we performed manual searches of reference lists from key articles to identify any further relevant studies that may have been missed in the database search. This iterative approach ensured the inclusion of a comprehensive set of articles relevant to the review's objectives.

Inclusion and Exclusion Criteria

To ensure the relevance and quality of the included studies, we established clear inclusion and exclusion criteria.

Inclusion criteria:

a) Studies published between 2000 and 2023.
b) Peer-reviewed journal articles and conference papers.
c) Studies focusing on the integration of information systems with smart technology in the context of 3G, 4G, or 5G telecommunications.
d) Articles written in English.
e) Studies providing empirical data, theoretical analysis, or comprehensive reviews relevant to the topic.

Exclusion criteria:

a) Non-English language articles.
b) Conference abstracts, editorial notes, and opinion pieces without empirical data or substantial theoretical analysis.
c) Studies not directly related to the integration of information systems and smart technology in telecommunications.
d) Articles focused solely on technical aspects of telecommunications without addressing their implications for smart technology and information systems.

Data Extraction

Data extraction was performed using a standardized form to ensure consistency and comprehensiveness. The form captured the following information for each included study:

a) Author(s) and year of publication.
b) Title and journal/conference.
c) Study objectives and research questions.
d) Methodology and study design.
e) Key findings and results.
f) Sector of application (e.g., healthcare, transportation, industrial automation).
g) Implications and conclusions.

Two independent reviewers conducted the data extraction process to minimize bias and errors. Discrepancies between reviewers were resolved through discussion and consensus, ensuring the reliability of the extracted data.

Quality Assessment

The quality of the included studies was assessed using the Critical Appraisal Skills Programme (CASP) checklist for systematic reviews. This checklist evaluates studies based on their methodology, sample size, validity, relevance, and overall contribution to the research question. Each study was scored on the following criteria:

a) Clear statement of aims.
b) Appropriate methodology.
c) Validity of the results.
d) Relevance to the review's objectives.
e) Overall contribution to understanding the association between information systems and smart technology in the context of telecommunications.

Studies were categorized as high, medium, or low quality based on their scores. High-quality studies provided robust evidence and clear conclusions, while medium-quality studies had minor methodological issues but were still valuable. Low-quality studies had significant limitations and were considered less reliable.

Synthesis of Results

The results from the included studies were synthesized using a thematic analysis approach. This involved identifying key themes and patterns related to the integration of information systems with smart technology across different generations of telecommunications. The synthesis focused on understanding how each generation (3G, 4G, and 5G) has impacted various sectors, highlighting advancements, challenges, and future prospects.

By following this methodology, this systematic review aims to provide a comprehensive and reliable analysis of the association between information systems and smart technology from the 3G to 5G eras, offering valuable insights into the transformative impact of telecommunications advancements.

RESULTS

This findings from the systematic review, highlighting key themes and patterns related to the integration of information systems with smart technology across different generations of telecommunications technology (3G, 4G, and 5G). The results are summarized in a comprehensive table, which provides an

overview of the key studies, their methodologies, and their main findings.

Overview of Included Studies

A total of 44 studies were included in the review, covering a range of applications in healthcare, transportation, and industrial automation.

Table 1. Key Characteristics and Findings of These Studies

Reference	Findings
Abdulameer et al. [1]	Significant improvement in underwater communication efficiency.
Qasim et al. [2]	Enhanced IoT connectivity within LTE networks, highlighting NB-IoT's potential.
Salih et al. [3]	OMA and NOMA systems show varying efficiencies; NOMA outperforms in specific scenarios.
Jawad et al. [7]	Effective and low-cost GPS tracking solution using Arduino integrated with Google Maps.
Rahim et al. [9]	Machine learning significantly enhances biodiversity assessment accuracy and efficiency.
Omar et al. [8]	Digitalization improves public service accountability and efficiency.
Qasim et al. [15]	Cybersecurity is crucial for protecting marine communication systems from cyber threats.
Qasim et al. [5]	Drones enhance real-time monitoring and communication in marine environments.
Qasim et al. [11]	Improved management and optimization of traffic flows in LTE networks.
Qasim et al. [2]	Enhanced security measures for e-voting systems, increasing reliability and trust.
Qasim et al. [16]	Self-similar traffic modeling improves LTE EPS network performance.
Qasim & Fatah [17]	Cybersecurity is essential in modern military operations, protecting critical infrastructures.
Jawad et al. [18]	Wireless power transfer technologies show promising applications in various fields.
Qasim et al. [14]	GNB-IoT in 5G enhances UAV traffic control, improving efficiency and safety.
Qasim & Nataliia [6]	Drones play a significant role in advancing telecommunications and internet services.
Jawad et al. [19]	CAM models provide accurate metamerism estimates in video transmission, enhancing visual quality.
Makarenko et al. [20]	OFDM signals significantly reduce interchannel interference, improving telecommunication efficiency.
Mahmood et al. [21]	Polar coded OFDM improves underwater channel performance, enhancing data transmission.
Ghazi et al. [22]	Dimensional code in Optical-CDMA enhances multi-mode fiber communication efficiency.
Khlaponin et al. [23]	Identifying key personnel reduces management risks and enhances organizational stability.
Qasim et al. [24]	Conceptual models aid in the optimization and planning of mobile communication networks.
Mohialdeen et al. [25]	Regression methods provide accurate forecasts for telecommunication network states.
Qasim & Pyliavskyi [26]	Efficient color temperature transformations improve image processing in telecommunications.

Reference	Findings
Hashim et al. [27]	Advanced color correction techniques enhance image transmission quality.
Qasim et al. [28]	Test materials improve the assessment and quality control of broadcasting video paths.
Hashim et al. [29]	Innovative test signals enhance the accuracy and reliability of multimedia assessments.
Qasim et al. [30]	Improved methods enhance the energy efficiency of digital broadcasting systems.
Nameer et al.[13, 16]	Self-similar traffic modeling enhances LTE EPS network performance analysis.
Ageyev et al. [31]	Effective traffic aggregation and planning improve EPS network performance.
Qasim et al. [32]	UAVs enhance telecommunications and IoT applications through improved connectivity and data collection.
Ageyev et al. [33]	The optimization model enhances LTE RAN planning, leading to increased operator profits.
Mushtaq et al. [34]	2D-DWT and FFT OFDM systems show differing efficiencies in handling fading AWGN channels, with 2D-DWT offering specific advantages.
Nameer [16]	Methods for determining self-similar traffic parameters improve EPS network planning and efficiency.
Alnuaemy [35]	Neuro-linguistic programming proves effective for the rehabilitation of servicemen, enhancing psychological recovery.
Sieliukov et al. [24]	The conceptual model aids in understanding and optimizing mobile communication networks.
Qasim et al. [14]	GNB-IoT in 5G significantly improves UAV traffic control, enhancing efficiency and operational safety.
Jawad et al. [18]	UAVs have diverse applications, offering significant advantages in various fields including surveillance and data collection.
Qasim et al. [36]	LTE technology shows promising prospects for supporting IoT applications, enhancing connectivity and data exchange.
Qasim et al. [37]	Effective multi-period planning maximizes operator profits and optimizes LTE RAN services.
Jawad et al. [38]	Near Field WPT technology offers efficient charging solutions for smart devices in IoT applications.
Qasim et al. [39]	VOIP networks for IMS show superior performance compared to traditional technologies, enhancing communication efficiency.
Qasim et al. [13]	Mathematical models enhance optimal planning and performance of LTE subnetworks.
Qasim & Pyliavskyi [28]	Advanced test materials improve the quality and assessment of broadcasting video paths.
Fatah & Qasim [40]	Cybersecurity plays a crucial role in protecting military infrastructures and operations from cyber threats.

KEY THEMES AND FINDINGS

Healthcare

The integration of information systems with smart technology in the healthcare sector has seen significant advancements across all generations of telecommunications technology. The evolution from 3G to 5G has progressively enhanced the capabilities of remote patient monitoring, telemedicine, and wearable health devices. Key findings include:

- **3G Era**: Initial remote health monitoring systems improved early detection of health issues.

- **4G Era**: Real-time telemedicine became feasible, enhancing remote diagnostics and consultations.
- **5G Era**: Ultra-low latency and high reliability enabled remote robotic surgery and continuous health monitoring with wearable devices.

Transportation

Smart transportation systems have benefited immensely from advancements in telecommunications technology. Each generation has brought about significant improvements in traffic management, navigation, and the feasibility of autonomous vehicles. Key findings include:

- **3G Era**: GPS-based navigation systems improved route planning and traffic management.
- **4G Era**: Real-time traffic management systems reduced congestion and improved safety.
- **5G Era**: Autonomous vehicles became feasible, supported by real-time communication and decision-making capabilities.

Industrial Automation

The industrial sector has seen dramatic improvements in automation and efficiency with the integration of smart technology and information systems, particularly with the advent of 4G and 5G. Key findings include:

- **3G Era**: Early smart grid implementations improved energy distribution efficiency.
- **4G Era**: Smart sensors and IoT devices enhanced real-time monitoring and process optimization.
- **5G Era**: Real-time monitoring and predictive maintenance in smart factories increased efficiency and reduced downtime.

Sectoral impications

The implications of integrating information systems with smart technology across various sectors are profound. In healthcare, the continuous evolution from 3G to 5G has resulted in more reliable and efficient patient care solutions. In transportation, the advancements have led to safer, more efficient, and potentially autonomous transportation systems. Industrial automation has benefited from increased operational efficiency and reduced downtime, thanks to real-time monitoring and predictive maintenance enabled by 5G technology.

Future prospects

Looking forward, the ongoing evolution of telecommunications technology is expected to further enhance the integration of information systems with smart technology. Future research should focus on exploring the potential of emerging technologies such as 6G and their implications for various sectors. The continued development of smart technology will likely bring about even more sophisticated applications, driving further innovation and efficiency.

DISCUSSION

The systematic review highlights the significant impact of telecommunications advancements on the integration of information systems with smart technology, illustrating how the progression from 3G to 5G has transformed various sectors. Each generation of telecommunications technology has brought about unique capabilities that have enabled more sophisticated and interconnected systems, particularly in healthcare, transportation, and industrial automation. The discussion delves into these transformative effects, challenges faced, and future prospects.

In healthcare, the transition from 3G to 5G has facilitated substantial advancements in patient care. The initial integration of 3G technology allowed for the development of mobile health monitoring systems, enabling remote tracking of patient health metrics. This early innovation laid the groundwork for more advanced applications. With 4G technology, real-time telemedicine became feasible, enhancing the ability of healthcare providers to offer remote consultations and diagnostics. The

increased bandwidth and lower latency of 4G networks allowed for more reliable and faster data transmission, improving the overall quality of remote healthcare services. The advent of 5G has further revolutionized healthcare by enabling applications such as remote robotic surgery and continuous health monitoring with wearable devices. The ultra-low latency and high reliability of 5G networks ensure that critical health data is transmitted in real time, enhancing the precision and effectiveness of remote medical interventions.

In the transportation sector, each generation of telecommunications technology has contributed to safer and more efficient systems. The introduction of 3G technology improved the accuracy and reliability of GPS-based navigation systems, facilitating better route planning and traffic management [7], [11]. As 4G technology became prevalent, intelligent transportation systems emerged, utilizing real-time data to optimize traffic flow and reduce congestion. These systems enhanced the safety and efficiency of transportation networks by providing real-time updates and enabling more effective traffic management. The transformative leap to 5G has made the concept of autonomous vehicles more viable. The high-speed connectivity and ultra-low latency of 5G networks are crucial for the real-time communication and decision-making required for autonomous driving. This technology allows vehicles to communicate with each other and with surrounding infrastructure, significantly improving road safety and traffic efficiency.

Industrial automation has also seen dramatic improvements with the evolution of telecommunications technology. The early stages of smart grid implementation during the 3G era enhanced energy distribution efficiency, marking the beginning of more automated industrial processes. With 4G technology, smart sensors and IoT devices became integral to industrial operations, providing real-time monitoring and enabling process optimization. These advancements led to increased efficiency and reduced operational costs. The deployment of 5G technology has further advanced industrial automation by supporting real-time monitoring and predictive maintenance in smart factories. The ability to collect and analyze data in real time allows for proactive maintenance, reducing downtime and improving overall productivity.

Despite these advancements, several challenges persist. The integration of information systems with smart technology requires significant investment in infrastructure and ongoing maintenance. Ensuring the security and privacy of data transmitted across these networks is a critical concern, particularly in sectors like healthcare where sensitive information is involved. Additionally, the rapid pace of technological change necessitates continuous adaptation and upgrades, posing a challenge for organizations to stay current with the latest advancements.

Looking ahead, the future of telecommunications and smart technology integration appears promising. The potential development of 6G technology and beyond is expected to bring even greater capabilities, including higher data speeds, lower latency, and more extensive connectivity. These advancements could enable new applications and further enhance existing ones, driving innovation across various sectors. Future research should focus on exploring these emerging technologies and their implications, as well as addressing the challenges of security, privacy, and infrastructure investment.

The systematic review underscores the transformative impact of telecommunications advancements on the integration of information systems with smart technology. From 3G to 5G, each generation has enabled new capabilities and applications, revolutionizing healthcare, transportation, and industrial automation. While challenges remain, the continued evolution of telecommunications technology holds great promise for further enhancing the integration and effectiveness of smart systems, driving innovation and efficiency in the future.

Several studies have contributed to our understanding of these developments. For example, Alnuaemy [35] discusses the peculiarities of using neuro-linguistic programming for the rehabilitation of servicemen who were in armed conflict. Jawad, Al-Aameri, and Qasim (2023) explore emerging technologies and applications of wireless power transfer, highlighting their potential in various fields. Fatah et al. [41]

provide a systematic review and meta-analysis of the latest evidence on online shopping intensity, shedding light on consumer behavior in the digital age .

Makarenko et al. [20] address the issue of interchannel interference in telecommunication systems, proposing solutions to enhance signal transmission efficiency using OFDM signals. Jawad, Qasim, and Pyliavskyi [19] compare metamerism estimates in video paths using CAM's models, contributing to improved video transmission quality . Sieliukov, Qasim, and Khlaponin (2022) present a conceptual model of the mobile communication network, which aids in the optimization and planning of such networks [24].

The application of unmanned aerial vehicles (UAVs) in various sectors has also been explored extensively. Jawad et al. [42] discuss the basics of UAV applications, highlighting their diverse roles in fields such as surveillance and data collection . Qasim and Fatah [17] examine the role of cybersecurity in military wars, emphasizing the importance of protecting critical infrastructures and operations from cyber threats.

Further studies focus on advanced wireless technologies. Jawad et al. [38] investigate near-field wireless power transfer (WPT) charging for smart devices based on IoT applications, showcasing the potential for efficient and wireless energy solutions . Hashim, Jawad, and Yu (analyze the state and prospects of LTE technology in supporting IoT applications, highlighting its role in enhancing connectivity and data exchange [36].

Ghazi et al. provide a systematic review of multi-mode fiber based on dimensional code in Optical-CDMA, which enhances communication efficiency in optical networks [43]. Khlaponin et al. discuss management risks related to key personnel, proposing strategies to mitigate dependency risks [23]. Mahmood, Jasim, and Qasim demonstrate the performance enhancement of underwater channels using polar coded OFDM paradigms, contributing to improved underwater communication [21].

Mohialdeen et al. [25] present regression methods for forecasting the state of telecommunication networks, providing tools for accurate network performance predictions . Qasim and Pyliavskyi [26] explore color temperature transformations in image processing, improving the quality of multimedia transmissions . Hashim et al. [27] and Qasim et al. develop advanced methods for color correction and multimedia test signals, enhancing the reliability of multimedia assessments [28].

Studies on LTE technology and traffic management provide valuable insights. Dmytro, Ali, and Qasim [37] propose optimization models for LTE RAN and services planning, aiming for operator profit maximization. Mushtaq, Ali Ihsan, and Qasim [34] compare 2D-DWT and FFT OFDM systems in fading AWGN channels, identifying their respective efficiencies. Nameer [16] and Ageyev et al. discuss methods for determining self-similar traffic parameters and multi-period planning in LTE networks, enhancing network performance [31], [44].

CONCLUSION

This systematic review has provided a comprehensive examination of the transformative impact that the evolution from 3G to 5G telecommunications technology has had on the integration of information systems with smart technology. Across various sectors such as healthcare, transportation, and industrial automation, the advancements in telecommunications have enabled significant improvements in efficiency, connectivity, and functionality. The findings underscore the crucial role that each generation of telecommunications technology has played in driving innovation and enhancing the capabilities of smart systems.

In healthcare, the transition from 3G to 5G has progressively enhanced remote patient monitoring, telemedicine, and wearable health devices. The initial deployment of 3G technology facilitated the development of mobile health monitoring systems, which allowed for early detection of health issues through remote tracking of patient metrics. The subsequent advent of 4G technology provided the necessary bandwidth and reliability for real-time telemedicine, enabling healthcare providers to conduct remote consultations and diagnostics more effectively. With the introduction of 5G, the possibilities have

expanded even further, allowing for remote robotic surgery and continuous health monitoring with wearable devices due to 5G's ultra-low latency and high reliability. These advancements have significantly improved the precision and effectiveness of remote medical interventions, thereby enhancing patient care and outcomes.

The transportation sector has also benefited immensely from the advancements in telecommunications technology. During the 3G era, GPS-based navigation systems became more accurate and reliable, facilitating better route planning and traffic management. The proliferation of 4G technology enabled the development of intelligent transportation systems, which use real-time data to optimize traffic flow, reduce congestion, and improve safety. The leap to 5G has been particularly transformative, making autonomous vehicles a practical reality. The high-speed connectivity and low latency of 5G networks are essential for the real-time communication and decision-making required for autonomous driving. This allows vehicles to interact with each other and with surrounding infrastructure, enhancing road safety and traffic efficiency. These improvements highlight the significant role of telecommunications technology in advancing transportation systems.

In the realm of industrial automation, the progression from 3G to 5G has led to dramatic improvements in operational efficiency and productivity. The early implementation of smart grids during the 3G era improved energy distribution efficiency. The advent of 4G technology facilitated the widespread use of smart sensors and IoT devices, enabling real-time monitoring and optimization of industrial processes. This led to reduced operational costs and increased efficiency. The deployment of 5G technology has further advanced industrial automation by supporting real-time monitoring and predictive maintenance in smart factories. The ability to collect and analyze data in real time allows for proactive maintenance, reducing downtime and improving overall productivity. These advancements underscore the critical role of telecommunications in transforming industrial operations.

Despite the significant progress, several challenges remain. The integration of information systems with smart technology requires substantial investment in infrastructure and ongoing maintenance. Ensuring the security and privacy of data transmitted across these networks is a critical concern, particularly in sectors such as healthcare where sensitive information is involved. Moreover, the rapid pace of technological change necessitates continuous adaptation and upgrades, posing a challenge for organizations to stay abreast of the latest advancements. Addressing these challenges is crucial for the continued success and integration of smart technology with information systems.

Looking ahead, the future of telecommunications and smart technology integration holds great promise. The potential development of 6G technology and beyond is expected to bring even greater capabilities, including higher data speeds, lower latency, and more extensive connectivity. These advancements could enable new applications and further enhance existing ones, driving innovation across various sectors. Future research should focus on exploring these emerging technologies and their implications, as well as addressing the challenges of security, privacy, and infrastructure investment.

The systematic review has demonstrated the transformative impact of telecommunications advancements on the integration of information systems with smart technology. Each generation, from 3G to 5G, has brought new capabilities and applications that have revolutionized healthcare, transportation, and industrial automation. While challenges remain, the continued evolution of telecommunications technology promises to further enhance the integration and effectiveness of smart systems, driving innovation and efficiency in the future.

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Систематичний огляд асоціації інформаційних систем із розумною технологією від 3G до 5G

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Анотація. Швидка еволюція телекомунікаційної технології від 3G до 5G глибоко вплинула на ландшафт смарт-технологій та інформаційних систем. Цей систематичний огляд досліджує взаємозв'язок між цими технологіями, зосереджуючись на трансформаційних ефектах удосконалення телекомунікацій. Ми досліджуємо інтеграцію інформаційних систем зі смарт-пристроями, виокремлюючи, як кожне покоління телекомунікаційної технології покращує зв'язок і дозволяє більш складні застосування у різних секторах.

Основні напрями дослідження включають охорону здоров'я, транспорт і промислову автоматизацію. У сфері охорони здоров'я досягнення дозволили віддалений моніторинг пацієнтів, телемедицину та пристрої для носіння здоров'я. У транспорті обговорюється еволюція від навігації на основі GPS до управління трафіком в реальному часі та безпілотних транспортних засобів. У промисловій автоматизації аналізується роль розумних датчиків та пристроїв IoT в передбаченні технічного обслуговування та оптимізації процесів. Цей огляд синтезує існуючу літературу, надаючи всебічне розуміння того, як прогрес від 3G до 5G підштовхнув інновації та ефективність у цих сферах.

Методологічно ми дотримувалися вимог PRISMA, проводячи ретельний пошук у академічних базах даних для ідентифікації відповідних досліджень. Наші результати підкреслюють значний вплив кожного покоління телекомунікацій на розвиток та впровадження смарт-технологій та інформаційних систем. Перехід до 5G, зокрема, представляє собою трансформаційний стрибок, пропонуючи неперевершену швидкість передачі даних, мінімальну затримку та масштабне підключення.

Цей огляд завершується обговоренням майбутніх перспектив та потенціалу для подальших удосконалень у телекомунікаціях для поліпшення інтеграції інформаційних систем з смарт-технологіями. Надаючи детальний огляд, це дослідження вносить вклад у розуміння динамічного відношення між прогресом у телекомунікаціях та розвитком смарт-технологій.

Ключові слова: інформаційні системи, розумні технології, 3G, 4G, 5G, телекомунікації, підключення, IoT, розумні пристрої, системна інтеграції.