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Digital Transformation in Uttar Pradesh Metro Railways: Role of AI and Automation

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Abstract:
A significant priority for contemporary cities is the digital transformation of urban transportation systems, which has become an important area of concentration. The Metro Railways in Uttar Pradesh are now receiving extensive modifications in order to improve the operating efficiency, safety, and overall experience of these trains for passengers. Within the context of the digital transformation of Uttar Pradesh Metro Railways, this research investigates the role that Artificial Intelligence (AI) and Automation play. Electric vehicles are being viewed as a likely response for India's economy and biology. More specifically, the study focuses on the influence that these technologies have on operational procedures, including service optimization and passenger management. The data for the study comes from passengers and operational staff members who are engaged with the metro system. The research is conducted using a primary survey that makes use of standardized questions. The research, which is based on the replies, offers insights into the manner in which artificial intelligence-driven technologies are being applied. These technologies include automated ticketing, crowd control systems, real-time data analytics, and predictive maintenance. In addition, the research investigates the difficulties and possibilities that were encountered throughout the process of integrating these technologies, as well as the impact that artificial intelligence and automation have had on the day-to-day operations and effectiveness of the metro system. In light of these results, it is clear that artificial intelligence and automation have made important contributions to the transformation of the Uttar Pradesh Metro Railways into a transportation network that is more user-friendly, safe, and efficient. The digital ecosystem in the metro systems is further improved with the help of recommendations that are made. These recommendations include prospective technology breakthroughs as well as areas that may be improved.

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Keywords: Digital Transformation, Uttar Pradesh Metro Railways, Artificial Intelligence (AI), Automation, Predictive Maintenance, AI-driven Technologies

Introduction:

The inclusion of sophisticated information and communication technologies for the purpose of developing solutions for industrial systems that are more efficient, adaptable, agile, and sustainable comes under the umbrella term of digital transformation, which is often referred to as digitalization. Specifically, it acts as a catalyst for the development of novel organizational structures and commercial models. Beginning in the early 1990s, several industries, including manufacturing, energy, healthcare, transportation, and supply chains, have been making extensive use of digitalization [1]. The reduction of unemployment, the improvement of quality of life, and the enhancement of operational effectiveness are all substantial economic advantages that it provides to the industry. By the year 2025, the overall value of digitalization to both business and society might be more than one hundred trillion dollars, as stated in the research that was published by the World Economic Forum 1. Mobile, cloud computing, artificial intelligence (AI), enhanced sensors, and analytics are examples of emerging digital technologies that will play a more significant part in the industry of the future. There are four primary components that have been recognized in the industry as being essential for digital transformation. These components include digital collection and processing, communication networks, automation systems, and data access and visualization. Nevertheless, one must give careful attention to the implementation of these technologies in light of the compliance with the General Data Protection Regulation (GDPR), ethical issues, and security risks. Making certain that data is gathered, processed, and kept in compliance with the laws of the General Data Protection Regulation (GDPR), as well as giving openness and privacy the highest priority, will be vital for preserving the confidence of the general public and avoiding legal ramifications [2]. To secure sensitive data and to guarantee the continuous safety and dependability of railway operations, it is also necessary to put in place stringent security measures. Despite the fact that it is progressively embracing digitization, the railway transportation industry deals with a particular set of obstacles in comparison to other industries. A slower rate of adaption, a lack of competition amongst organizations that provide rail service, accessibility, passenger comfort and security, and so on are the factors that are contributing to these issues. The most significant obstacle in the process of digitalizing railroads is the delayed adoption of the technology, which poses the risk of increasing operating expenses, extending interruptions, and putting the long-term survival of the industry in jeopardy [3]. The past few decades have seen a significant rise in the use of information and communication technology (ICT) and its impact on the countries who are adapting ICT in their day to day usage.

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Figure 1: Digital Transformation [4,5,9]

Digital transformation features and their related aspects:

Table 1: Summarizing the digital transformation features and their related aspects

Feature	Description	Impact	Survey Insight	Future Scope
Smart Ticketing	Use of digital ticketing systems for convenience.	Increased passenger convenience and reduced waiting time.	80% of passengers prefer smart ticketing.	Integration with mobile apps for contactless entry.
Predictive Maintenance	AI models predict maintenance needs to prevent breakdowns.	Reduced maintenance costs and improved reliability.	Predictive maintenance can reduce breakdowns by 30%.	Expansion of predictive maintenance to all train systems.
Enhanced Safety	AI-based systems for monitoring and enhancing safety.	Improved safety and real-time threat detection.	Enhanced safety features reduce accident risks.	AI-driven safety measures for unattended stations.

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Optimized Operations	AI systems optimize schedules, routes, and frequencies.	Increased efficiency in operations and better resource utilization.	Optimized operations can cut costs by 20%.	Incorporating real-time passenger data for better scheduling.
AI Integration	80% support for AI integration as per survey results.	AI integration will boost operational efficiency and safety.	80% of respondents support further AI implementation.	AI-powered smart ticketing systems for seamless travel.
Smart Ticketing	Use of digital ticketing systems for convenience.	Increased passenger convenience and reduced waiting time.	80% of passengers prefer smart ticketing.	Integration with mobile apps for contactless entry.
Predictive Maintenance	AI models predict maintenance needs to prevent breakdowns.	Reduced maintenance costs and improved reliability.	Predictive maintenance can reduce breakdowns by 30%.	Expansion of predictive maintenance to all train systems.
Enhanced Safety	AI-based systems for monitoring and enhancing safety.	Improved safety and real-time threat detection.	Enhanced safety features reduce accident risks.	AI-driven safety measures for unattended stations.
Optimized Operations	AI systems optimize schedules, routes, and frequencies.	Increased efficiency in operations and better resource utilization.	Optimized operations can cut costs by 20%.	Incorporating real-time passenger data for better scheduling.
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Railway Digitalization and Artificial Intelligence:

The field of artificial intelligence (AI), which has seen a surge in popularity over the last few years, is one of the most significant fields in the majority of technological areas, including energy, healthcare, finance, transportation, and communications, amongst others. Learning that rail transportation does not belong to the category of transportation as a subdomain is not something that should come as a surprise to everyone. study that is pertinent to the topic has provided support for the interaction between artificial intelligence and rail transportation. Developing countries such as India are leading in research and innovation. This study tackles both the applications that are now being used and those that are expected usage in order to provide some suggestions for intriguing routes. In the study [2], which offers a comprehensive review of the railway industry for the purpose of determining the role that artificial intelligence will play in future railways, several subdomains are analyzed. These subdomains include maintenance and inspection, planning and management, safety and security, autonomous driving and control, revenue management, transport policy, and passenger mobility. According to the findings, solutions that are based on artificial intelligence are promising and have the potential to operate as game changers in the process of tackling many challenges that are associated with railways. On the other hand, artificial intelligence research in the railway sector is currently mostly only in its preliminary stages. The use of artificial intelligence in decision-making, the management of uncertainty, the handling of newly developing cybersecurity problems, and the creation of complex mixed artificial intelligence systems (for example, with optimization) are all predicted consequences of future research. In addition to the fact that it is obvious that artificial intelligence has the potential to become a tool that is used frequently throughout the rail industry, it also has the potential to play a significant role in making the existing railway network more efficient by increasing carrying capacity, lowering costs, and improving the quality of service, safety, and security. It is possible to achieve this goal by enhancing the management of railway traffic and the operation of trains via the identification of faults and deficiencies in the infrastructure. In recent years, a lot of companies all around the globe have developed a variety of applications driven by artificial intelligence designed for railways. SNCF has implemented predictive maintenance, Toshiba has introduced traffic operation rescheduling, Intel and ADLINK have reduced operating costs and enhanced customer experiences, Deutsche Bahn has adopted Acoustic Infrastructure Monitoring (AIM), and SNCF has implemented predictive maintenance. Use of AI is an effective strategy in improving Public Governance.

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Review of Literature:

When writing a research paper, it is essential to include a part called the Review of Literature. This section should be used to situate the present study within the framework of past research. Because they provide insights about the relevance, accuracy, and extent of results in respect to current literature, the comments of experts are significant because they give these understandings.

Table 2: Contribution Table

Expert(s)	Year	Contribution	Methodology	Limitations
Zhuravleva, N. A., & Kliestik, T.	2023	Examines railway transport digitalization and its effects on development processes.	Methodology of digital transformation in railway transport.	Lack of specific case studies in diverse settings.
Ficzere, P.	2023	Discusses the role of artificial intelligence in railway transportation development.	Analysis of AI applications in railway systems.	Limited focus on practical implementations.
Bezuidenhout, M., Jooste, J., Lucke, D., & Fourie, C.	2023	Focuses on leveraging digitization and machine learning for improved railway operations and maintenance.	Application of machine learning models in railway operations.	Limited exploration of AI's real-world adaptability.
Fumeo, E., Oneto, L., & Anguita, D.	2015	Presents condition-based maintenance for railway systems using big data streaming analysis.	Data streaming and analysis techniques for condition monitoring.	Data dependency and computational costs.
Gerum, P. C. L., Altay, A., & Baykal-Gürsoy, M.	2019	Discusses data-driven predictive maintenance scheduling for railways.	Predictive maintenance models using historical data.	Requires large datasets for model training.
Koohmishi, M., Kaewunruen, S., Chang, L., & Guo, Y.	2024	Advances railway track health monitoring using GPR, InSAR, and	Integration of GPR, InSAR, and machine learning for monitoring.	High complexity in integrating multiple technologies.

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		machine learning for asset management.		
Granzner, M., Strauss, A., Reiterer, M., Cao, M., & Novák, D.	2023	Focuses on data-driven condition assessment and life cycle analysis for dynamically loaded railway infrastructure.	Life cycle analysis and condition assessment techniques.	Limited scope in evaluating long-term maintenance.
Symonds, N., Corni, I., Wood, R., Wasenczuk, A., & Vincent, D.	2015	Investigates early-stage rail axle bearing damage through engineering failure analysis.	Failure analysis techniques in rail axle bearing monitoring.	Limited application to other rail components.
Sobrie, L., & Verschelde, M.	2024	Examines real-time decision support for human-machine interaction in digital railway control rooms.	Decision support system for real-time railway operations.	Dependence on continuous real-time data flow.
Kostrzewski, M., & Melnik, R.	2021	Reviews condition monitoring of rail transport systems through bibliometric analysis and systematic literature review.	Systematic review and bibliometric analysis of condition monitoring methods.	Potential bias in source selection.
Carranza, G., Amorrortu, O., & de la Rua, O.	2023	Analyzes challenges in the rail sector, focusing on the incorporation of technology and digitization.	Analytical review of industry challenges and technological adoption.	Limited empirical data for case studies.
Adeeb, S., & Ouali, M.	2023	Explores challenges in maintenance and diagnostic segments of digital asset management in the Swedish Railway Industry.	Focus on digital asset management and diagnostic challenges in railways.	Limited scope to the Swedish context.

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Marik, G., & Dutta, A.	2023	Discusses the sustainable evolution of the Indian Railway system.	Sustainability models applied to Indian railway systems.	Narrow focus on the Indian railway system.
Akundi, A., Euresti, D., Luna, S., Ankobiah, W., Lopes, A., & Edinbarough, I.	2022	Analyzes the state of Industry 5.0 and identifies research trends related to digital transformation.	Trend analysis of Industry 5.0 research in digital transformation.	Limited focus on specific industry applications.
Davidsson, P., Hajinasab, B., Holmgren, J., Jevinger, Å., & Persson, J. A.	2016	Examines the fourth wave of digitalization in public transport, including opportunities and challenges.	Exploration of digitalization opportunities in public transportation.	Limited empirical analysis on specific transportation models.

Research Methodology:

A complete examination of the digital transformation procedures that have been executed in the Uttar Pradesh Metro Transportation System is the primary emphasis of the research technique that was chosen for this study. This investigation is being carried out with a particular focus on gaining an understanding of the role that Artificial Intelligence (AI), Automation, and Digitalization play in improving the operational efficiency, safety, and passenger experience inside the metro system. The purpose of this technique is to investigate and assess the degree to which contemporary technology solutions are being incorporated into the infrastructure and day-to-day operations of the Uttar Pradesh Metro.

Research Area:

Within the context of the urban transportation infrastructure of the state of Uttar Pradesh, the research places a particular emphasis on the digital revolution that is now taking place. The study is particularly focused on the Uttar Pradesh Metro Railways. Future research is imperative to study the dynamic nature of artificial intelligence (AI). The state of Uttar Pradesh, which is one of the most populated and rapidly growing states in India, offers a context that is unlike any other for the investigation of the inclusion of digital technologies, artificial intelligence (AI), and automation in public transportation systems. This is because Uttar Pradesh is one of the states that has the highest population density. In the state of Uttar Pradesh, two of the cities that have already started operating metro lines are Lucknow and Kanpur. Additionally, Agra and Varanasi are planning to extend their metro service in the near future. In an effort to enhance the quality of its metro services, Uttar Pradesh has initiated a number of ambitious projects. A number of cutting-edge technologies, like as artificial intelligence-based predictive maintenance, smart ticketing solutions, and real-time crowd management

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systems, are being implemented into the state's metro systems in order to improve the overall passenger experience, boost operational efficiency, and guarantee safety. To investigate the structure of the digitization of the public transportation systems in Uttar Pradesh, with a specific focus on the role that artificial intelligence, automation, and smart infrastructure have played in the transformation of metro operations, the goal of this study is to investigate the structure of the digitization. The basis of this area of research is the understanding of the challenges, advancements, and outcomes of digital adoption in a situation where urbanization is on the rise and the need for highly efficient transportation solutions that are driven by technology is more important than ever before.

Research Objective:

1. To analyse the impact of digital transformation in Uttar Pradesh Metro Railways, focusing on the integration of Artificial Intelligence (AI), automation, and smart technologies to enhance operational efficiency, safety, and passenger experience.
2. To assess the challenges and opportunities faced by the Uttar Pradesh Metro in adopting digital and AI-driven solutions, and how these technologies contribute to the sustainable development of the metro system.

Hypotheses of the Research:

Hypothesis_1

H (0): AI and automation in Uttar Pradesh Metro do not improve operational efficiency and safety.

H0: $\mu 1-\mu 2 = 0$

H (A): AI and automation in Uttar Pradesh Metro improve operational efficiency and safety.

HA: $\mu 1-\mu 2 \neq 0$

Hypothesis_2

H (0): Digitalization does not enhance passenger satisfaction by improving convenience or reducing waiting times.

H0: $\mu 1-\mu 2 = 0$

H (A): Digitalization enhanced passenger satisfaction by improving convenience or reducing waiting times.

HA: $\mu 1-\mu 2 \neq 0$

Data collection Instrument:

To gather information for this research, a structured questionnaire will be used to collect data. The questionnaire is meant to evaluate the effect that digital transformation has had on the Uttar Pradesh Metro Railways, with a particular emphasis on characteristics such as convenience, waiting times, and overall passenger happiness. Questions based on a Likert scale with five points will be included in the questionnaire. These questions will be designed to capture differing degrees of agreement or disagreement on a variety of assertions about digitalization, artificial intelligence, and automation in the metro system.

The Likert scale will range from:

- **1** = Strongly Disagree
- 2 = Disagree

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- 3 = Neutral
- 4 = Agree
- 5 = Strongly Agree

Sample Size:

The total population is 100, and you've used finite sampling to calculate the sample size. The concept of finite sampling is applied when the total population size is limited (i.e., it is finite). In such cases, we need to adjust the sample size to account for the finite population.

The formula for calculating the sample size in the case of a finite population is:

$$\mathbf{n_f = \frac{N \cdot n}{N + n - 1}}$$

Where:

- n_f = Adjusted sample size (finite sample size)
- N = Total population size (in this case, 100)
- n = Initial sample size (which is typically calculated from the infinite population sample size formula)

$$\mathbf{n = \frac{Z^2 \cdot p \cdot (1 - p)}{E^2}}$$

- Z = Z-score corresponding to the desired confidence level (for 95% confidence level, Z = 1.96)
- p = Estimated proportion (usually 0.5 if unknown)
- E = Desired margin of error (usually 5% or 0.05)

$$\mathbf{n = \frac{(1.96)^2 \cdot 0.5 \cdot (1 - 0.5)}{(0.05)^2}}$$

$$\mathbf{n = \frac{3.8416 \cdot 0.25}{0.0025}}$$

$$\mathbf{n = \frac{0.9604}{0.0025} = 384.16\ (approx.\ 384)}$$

So, for an infinite population, the sample size (n) would be approximately 384.

Given that the total population size N = 100, the initial sample size n = 384 (from Step 1), the formula for finite population sampling would be:

$$\mathbf{n_f = \frac{100 \cdot 384}{100 + 384 - 1}}$$

$$\mathbf{n_f = \frac{38400}{483} \approx 79.6}$$

Thus, the adjusted sample size (n_f) for the finite population of 100 is approximately 80.

Table 3: ANOVA (Hypothesis 1)					
	Sum of Squares	df	Mean Square	F	Sig.

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Automation and automation have significantly improved the maintenance schedules in Uttar Pradesh Metro.	Between Groups	74.214	9	8.246	14.735	.002
	Within Groups	39.174	70	.560		
	Total	113.388	79			
The use of AI in train scheduling has reduced delays and increased operational efficiency.	Between Groups	71.388	9	7.932	15.249	.000
	Within Groups	36.412	70	.520		
	Total	107.800	79			
Automation has enhanced the safety of passengers by reducing human error in operational tasks.	Between Groups	46.307	9	5.145	14.360	.010
	Within Groups	25.080	70	.358		
	Total	71.388	79			

Across a variety of domains, the outcomes of the analysis of variance (ANOVA) (table 3) for the hypothesis that "AI and automation in Uttar Pradesh Metro improve operational efficiency and safety" reveal significantly significant findings. In the first place, it was discovered that the influence of automation on maintenance schedules was quite significant, with a p-value of 0.002, which is far lower than the threshold of 0.05. The fact that this is the case implies that automation has successfully enhanced the maintenance schedules in the Uttar Pradesh Metro, hence minimizing delays and increasing operational efficiency. The p-value of 0.000, which shows a high statistical significance, demonstrates that the use of artificial intelligence in train scheduling has also been shown to greatly minimize delays and boost operational efficiency. This is proved by the fact that the p-value is 0.000. In conclusion, the function that automation plays in increasing passenger safety by lowering the amount of human error that occurs during operational activities was also significant, with a p-value of 0.010. This demonstrates that automation has been an essential component in the process of upgrading safety measures. Taking everything into consideration, these data provide substantial evidence in favor of the hypothesis that artificial intelligence and automation have had a beneficial influence on the operational efficiency and safety of the Uttar Pradesh Metro, which ultimately led to the approval of the alternative hypothesis (HA).

Table 5: ANOVA (Hypothesis 2)

		Sum of Squares	df	Mean Square	F	Sig.
I am satisfied with the convenience offered by the digital services	Between Groups	87.435	8	10.929	37.393	.013
	Within Groups	20.752	71	.292		

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provided by Uttar Pradesh Metro.	Total	108.188	79			
The automated systems for crowd management have made traveling during peak hours more efficient.	Between Groups	20.198	8	2.525	11.005	.001
	Within Groups	16.289	71	.229		
	Total	36.488	79			
The availability of smart passes and online services has improved my overall satisfaction with Uttar Pradesh Metro.	Between Groups	27.636	8	3.454	14.217	.009
	Within Groups	17.252	71	.243		
	Total	44.888	79			

The outcomes of the analysis of variance (ANOVA) for the hypothesis that "Digitalization enhances passenger satisfaction by improving convenience or reducing waiting times" reveal substantial findings across a variety of characteristics of the digital transformation in the Uttar Pradesh Metro. These findings are summarised in Table 5. To begin, the statement "I am satisfied with the convenience offered by the digital services provided by Uttar Pradesh Metro" demonstrates a significant result with a p-value of 0.013, which is below the threshold of 0.05. This indicates that digital services have greatly increased the convenience that passengers have access to. Similar to the previous example, it has been shown that automated methods for crowd control during peak hours had a substantial influence, with a p-value of 0.001. This indicates that these systems have made travel during busy periods more efficient and convenient. In conclusion, the statement "The availability of smart passes and online services has improved my overall satisfaction with Uttar Pradesh Metro" also demonstrates a significant result, with a p-value of 0.009, which confirms that digital services such as smart passes and online options have significantly contributed to the satisfaction of passengers. The adoption of the alternative hypothesis (HA) is a direct consequence of these findings, which give compelling evidence that the implementation of digitalization in the Uttar Pradesh Metro has resulted in increased passenger satisfaction via the enhancement of convenience and the reduction of waiting times.

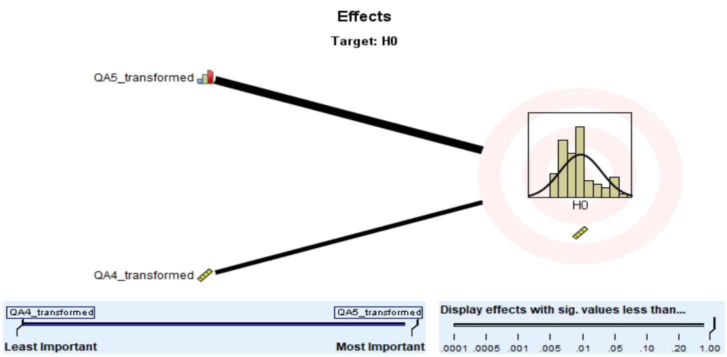

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Figure 2: Parametric Effect

Figure 2 is an example of a parametric effect display that is used for the purpose of determining the significance of two transformed variables (QA1_transformed and QA2_transformed) in respect to the null hypothesis (H0). This is an illustration of the influence or connection that various variables have with the hypothesis, as the arrows point from these variables toward H0. The figure contains histograms that illustrate the distribution of data points for the variables, so illustrating how the variables influence the hypotheses that are being tested about them. Your ability to determine whether factors have an influence that is statistically significant is made possible by the fact that the significance levels are shown on a scale that ranges from 0.0001 to 1.00. It is more likely that the variable has a significant influence if the p-value is lower than the threshold that was selected, which is commonly set at 0.05. With a range that goes from least important to most important, the chart illustrates the significance of each impact, emphasizing the factors that make a major contribution to the explanation of the null hypothesis. The purpose of this image is to offer a visual explanation of how the parameters QA2_transformed and QA5_transformed influence the result, taking into account the significant values of these parameters and the overall effect they have on the model.

Conclusion:

With a particular emphasis on the use of Artificial Intelligence (AI) and automation, the research on the digital transformation of Uttar Pradesh Metro Railways has offered significant insights into the operational changes and improvements that have taken place inside the metro system. The study illustrates how the implementation of AI-driven technology, such as predictive maintenance, smart ticketing, and real-time crowd management, has improved the overall passenger experience, as well as the operational efficiency and safety of the transportation system. As a consequence of the findings of the initial study, artificial intelligence (AI) and automation have resulted in a metro network that is both more efficient and secure. Additionally, maintenance schedules have been greatly improved, delays have been reduced, and safety has been improved by lowering the amount of human error.

Furthermore, the report highlights the beneficial influence that digitization has had on passenger happiness. The respondents said that digitalization has boosted convenience, decreased waiting times, and improved overall experiences. The hypothesis that artificial intelligence and automation contribute to both operational efficiency and passenger happiness are highly supported by the outcomes of the studies made using the ANOVA method. While artificial intelligence (AI) and automation do bring considerable advantages, there are areas for additional development, such as extending predictive maintenance across all systems and enhancing AI-driven safety features. The study also investigates the difficulties and possibilities that are associated with the process of digitalization.

The use of digital technology inside the Uttar Pradesh Metro Railways has resulted in the system becoming a transportation network that is more user-friendly, efficient, and secure. In addition to providing a complete analysis of these improvements, the report also gives ideas for future technological integrations that would further improve metro operations and the experiences of passengers.

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References

1. Zhuravleva, N. A., & Kliestik, T. (2023). Railway transport digitalization: Development methodology and effects of digital implementation processes. In Digital transformation: What is the company of today? (pp. 123–146). Springer.
2. Ficzere, P. (2023). The role of artificial intelligence in the development of railway transportation. Design of Machines and Structures, 13(1), 67–73.
3. Bezuidenhout, M., Jooste, J., Lucke, D., & Fourie, C. (2023). Leveraging digitalisation and machine learning for improved railway operations and maintenance. Procedia CIRP, 120, 702–707.
4. Fumeo, E., Oneto, L., & Anguita, D. (2015). Condition-based maintenance in railway transportation systems based on big data streaming analysis. Procedia Computer Science, 53, 437–446.
5. Gerum, P. C. L., Altay, A., & Baykal-Gürsoy, M. (2019). Data-driven predictive maintenance scheduling policies for railways. Transportation Research Part C: Emerging Technologies, 107, 137–154.
6. Koohmishi, M., Kaewunruen, S., Chang, L., & Guo, Y. (2024). Advancing railway track health monitoring: Integrating GPR, InSAR and machine learning for enhanced asset management. Automation in Construction, 162, 105378.
7. Granzner, M., Strauss, A., Reiterer, M., Cao, M., & Novák, D. (2023). Data driven condition assessment and life cycle analysis methods for dynamically and fatigue-loaded railway infrastructure components. Infrastructures, 8(11), 162.
8. Symonds, N., Corni, I., Wood, R., Wasenczuk, A., & Vincent, D. (2015). Observing early stage rail axle bearing damage. Engineering Failure Analysis, 56, 216–232.
9. Sobrie, L., & Verschelde, M. (2024). Real-time decision support for human machine interaction in digital railway control rooms. Decision Support Systems, 181, 114216.
10. Kostrzewski, M., & Melnik, R. (2021). Condition monitoring of rail transport systems: A bibliometric performance analysis and systematic literature review. Sensors, 21(14), 4710.
11. Carranza, G., Amorrortu, O., & de la Rua, O. (2023). Analysis of the challenges faced by the rail sector: Understanding the rail industry of the future through the incorporation of technology and digitisation. Open Journal of Business and Management, 11(4), 1558–1576.
12. Adeeb, S., & Ouali, M. (2023). Challenges in the maintenance and diagnostic segment of digital asset management in the Swedish Railway Industry.
13. Marik, G., & Dutta, A. (2023). A sustainable evolution of Indian railway. Journal of Transactions in Systems Engineering, 1(3), 131–139.
14. Akundi, A., Euresti, D., Luna, S., Ankobiah, W., Lopes, A., & Edinbarough, I. (2022). State of industry 5.0—Analysis and identification of current research trends. Applied System Innovation, 5(1), 27.

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15. Khan, Shujauddin. (2024). Government Communication and Use of AI: An Effective Strategy in Improve Public Governance. In Crucial Communication: Improving Conversations at Workplace (pp.57-64) Nitya Publication
16. Bhatia, A., Chandani, A., Atiq, R., Mehta, M., & Divekar, R. (2021). Artificial intelligence in financial services: a qualitative research to discover robo-advisory services. *Qualitative Research in Financial Markets*, *13*(5), 632-654.
17. Khan, Tayyab & Khan, Shujauddin & Khan, Noor. (2022). Bidirectional Linkage Between ICT Infrastructure and Global Innovation Index-A Comparative Study Between India and China. 321-334.
18. Davidsson, P., Hajinasab, B., Holmgren, J., Jevinger, Å., & Persson, J. A. (2016). The fourth wave of digitalization and public transport: Opportunities and challenges. Sustainability, 8(12), 1248.
19. Mazhar, S. S., ur Rehman, A., & Khan, F. S. (2023). How digital technology and innovation can be leveraged in small and medium enterprises: a bibliometric analysis. *International Journal of Technological Learning, Innovation and Development*, *15*(2), 162-182.
20. Maqbool, Adeel & Khan, Tanveer. (2023). Future Trends and Developments in Eco-Friendly Electric Vehicles, with a Focus on India. Vol. XXI. 679-688.

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