International Research Journal on Advanced Engineering and Management
https://goldncloudpublications.com
https://doi.org/10.47392/IRJAEM.2026.0309
e ISSN: 2584-2854
Volume: 04 Issue: 05
May 2026
Page No: 2131 – 2138

Smart Surveillance for Smarter Cities: Scope for Improving Civic Amenities Through Technology with Special Reference to Patna

Unnati Singh[1], Shivanshu Gupta[2], Tanwi Duggar[3], Prashant Kumar[4], Dr. Kalpana Kumari[5]
[1,2,3,4]UG – BBA (International Business), St. Xavier's College of Management & Technology, Patna.
[5]Assistant Professor, Department of Economics, Xavier University, Patna.
Email ID: *unnati31march@gmail.com[1], shivanshu12gupta@gmail.com[2], tanviduggar@gmail.com[3], Prashantvats1234@gmail.com[4], kalpanakumari651@gmail.com[5]*

Abstract
There has been a significant increase in the use of digital surveillance systems in big cities all over India. And this is growing very quickly. Smart surveillance mainly means using technologies like Closed-Circuit Television (CCTV) systems, sensors, and real-time monitoring to watch public places and manage city activities. In cities like Patna, these systems are now quite common, especially in traffic areas, where they are mostly used for monitoring rule violations and issuing fines. So in a way, people mostly notice these systems when some rule is being checked or enforced. At the same time, this growing use also brings some issues. There seems to be a gap between where these systems are installed and how they are actually used. Even though the systems are present in many places, they are mainly used for enforcement and control, and not really for solving daily problems like potholes, broken roads, drainage issues, or cleanliness. This creates a kind of imbalance, where the system is active, but still the use is limited in a practical way. Also, the data collected from these systems is not always used properly, or may not be fully used. So the effectiveness becomes moderate, not very high. In a way, the system is working, but not fully working. There is, therefore, a need to improve how these systems are being used, maybe by better planning, proper use of data, and more focus on civic improvement rather than only monitoring and control. This research paper is based on primary data collected through questionnaires, and it tries to analyze the current use of Closed-Circuit Television systems in Patna, along with understanding people's views and the gap between present use and possible use. So overall, the study tries to understand what is happening now and what could be done better, maybe in a more practical sense.

Keywords: *Closed-Circuit Television, Civic Amenities, Urban Governance, Surveillance Systems, Infrastructure, Patna.*

1.Introduction
India's Smart Cities Mission (SCM) was launched in June 2015 with 100 selected cities, including Patna, each required to establish an Integrated Command and Control Centre (ICCC) connecting traffic, utilities, and emergency services. By 2024, more than one lakh CCTV cameras had been installed across these cities, and most ICCCs were operational, covering traffic, environment, emergencies, and civic management. [1] In practice, most Patna residents associate these cameras with a single experience: receiving a challan. The same infrastructure that records every speeding vehicle could equally detect a broken road or a blocked drain, yet those capabilities remain unused. Patna is a particularly suitable case for this study: it is Bihar's state capital, experiencing rapid urban growth, placing significant strain on roads, drainage, and waste systems, and crime concerns in crowded public spaces are well-documented. These are exactly the conditions that a functioning smart surveillance system should address. [1], [4]

2.Literature Review
The MoHUA's ICCC Maturity Assessment Framework (IMAF 2.0) specifies that ICCCs should coordinate transport, utilities, emergency services, and public safety in real time, meaning the technology is equally capable of supporting civic monitoring and law enforcement. However, cities in

International Research Journal on Advanced Engineering and Management
https://goldncloudpublications.com
https://doi.org/10.47392/IRJAEM.2026.0309
e ISSN: 2584-2854
Volume: 04 Issue: 05
May 2026
Page No: 2131 – 2138

practice have relied on these systems mainly for traffic violation detection. Nair and Sharma identified this as a 'governance readiness gap': the hardware exists, but institutional willingness to use it broadly does not. [5], [6] Research on AI and urban surveillance has similarly concentrated on traffic and fine enforcement. The NITI Aayog AI framework treats violation detection as the primary use case for camera-based AI, and studies such as Kumar et al. have confirmed that neural networks can read traffic density from CCTV footage with over 90% accuracy. A smaller body of work has examined civic applications: Gupta et al. tested cameras that detected illegal dumping and sent automatic alerts to municipal staff, while Patel and Mehta demonstrated that road damage detection via existing CCTV networks is both practical and affordable. Patna Smart City Limited has floated tenders for a civic surveillance system called 'Nagar Netra', though its operational status remains unclear. [7], [8], [9], [11], [12] On safety, Rajendran and Srivastava found that visible CCTV reduces anti-social behaviour in Indian cities, and Roy and Chatterjee established that women are more willing to use public transport in areas where cameras are present. Both studies noted the same caveat: public support for surveillance depends on residents perceiving that the system works for them, not merely against them. When cameras are experienced only as penalty machines, trust erodes. [13], [14]

3.Research Gap

Existing literature reveals three clear gaps. First, a conceptual gap: no study has examined the use of ICCC cameras for civic maintenance, such as pothole or drain detection, within an actual Indian smart city context, despite the technical feasibility being well established. Second, a contextual gap: most research focuses on large metropolitan areas rather than fast-growing Tier-2 cities like Patna. Third, a citizen-voice gap: residents are rarely consulted on what they want from urban surveillance systems. This study attempts to address all three. [9], [12]

4.Objectives of The Study

- The study aims to examine how CCTV systems are currently deployed and used in Patna with reference to traffic management, fine enforcement, and civic administration.
- To assess resident perceptions of CCTV's contribution to civic outcomes such as road quality, drainage, cleanliness, and public safety.
- To identify the gap between what surveillance infrastructure is currently doing and what it is technically capable of doing for civic problem detection.
- To understand citizen attitudes on surveillance effectiveness and desired future applications.
- To offer practical policy recommendations for expanding the civic usefulness of existing surveillance infrastructure in Patna.

5.Research Methodology

This study adopts a descriptive research design, which is appropriate when the objective is to document and understand current conditions rather than test a theory. Primary data were collected through an 18-questions Google Form survey administered between February and March 20261, covering CCTV awareness, traffic and safety experience, civic service quality, and resident preferences for expanded surveillance use. The survey was distributed to adult residents of Patna, including students, workers, homemakers, commuters, and self-employed individuals, via WhatsApp, Instagram, and LinkedIn using convenience sampling. Approximately 160–163 complete responses were received. All responses were anonymous. Secondary data were drawn from MoHUA documents, NCRB reports, NITI Aayog publications, and peer-reviewed academic research. [16] The analytical approach relied on descriptive statistics: percentage distributions and frequency counts, presented through charts, tables, and figures. No advanced inferential tests were applied, as the goal was to describe patterns rather than establish causal relationships. Each finding is discussed in terms of what it reveals about the current and potential use of CCTV for civic purposes in Patna. The combination of primary survey data with secondary institutional evidence allows the study to situate local resident experiences within the broader national policy and technical context of India's Smart

International Research Journal on Advanced Engineering and Management
https://goldncloudpublications.com
https://doi.org/10.47392/IRJAEM.2026.0309
e ISSN: 2584-2854
Volume: 04 Issue: 05
May 2026
Page No: 2131 – 2138

Cities Mission. [16]

6.Discussion

The findings below are drawn from approximately 160 survey responses from Patna residents. They cover four themes: what people think CCTV is for, how well it is working, where it is failing, and what residents actually want. Table 1 presents the key numbers. Figures 1 to 11 show the full results. Also shown in Table 1.

Table 1 Summary of Key Survey Findings (n ≈ 160)

#	Survey Parameter	Key Finding	% Share
Q1	Primary use of CCTV, as noticed by respondents	Fine/penalty collection	28.8%
Q2	Frequency of observing CCTV for fine collection	Very Often	64.4%
Q3	CCTV improves traffic discipline	Strongly Agree + Agree	67.9%
Q4	CCTV improves overall public safety	Strongly Agree + Agree	69.3%
Q5	CCTV contributes to accident reduction	Agree	45.0%
Q6	CCTV improves safety for women	Agree + Strongly Agree	69.8%
Q7	Civic amenity contribution rating (scale 1–5)	Rating 1 (Very Low)	30.7%
Q8	CCTV used to detect civic issues	No – Never Observed	80.4%
Q9	Improvements needed in CCTV use	All of these (comprehensive)	66.7%
Q10	Desired applications for CCTV expansion	All of these (multi-purpose)	74.2%
Q11	Can better CCTV improve daily life in Patna?	Yes	81.1%

6.1.Primary Perceived Use of CCTV

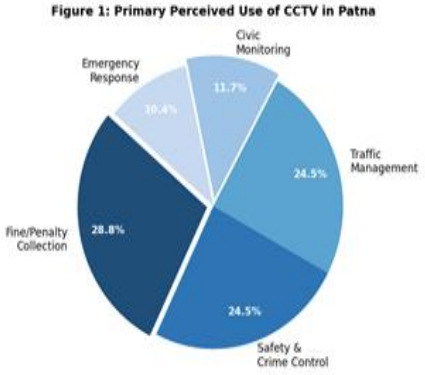

Figure 1 Primary Perceived Use of CCTV in Patna (n ≈ 160)

Figure 1 shows what people in Patna think CCTV cameras are mainly used for. The top answer, at 28.8%, is fine and penalty collection. Another 24.5% say crime and safety, meaning about 53% of residents see CCTV as a tool for punishing people. Civic monitoring is cited by only 11.7% of respondents, and emergency response by 10.4%. Most people see cameras as enforcement tools, not service tools.

6.2.Frequency of CCTV Fine Collection

Figure 2 shows how often people see CCTV used for fines. Nearly 64.4% say 'very often' and another 25.8% say 'sometimes', meaning over nine in ten residents regularly experience CCTV as something that catches and penalises them. When that is the

International Research Journal on Advanced Engineering and Management
https://goldncloudpublications.com
https://doi.org/10.47392/IRJAEM.2026.0309
e ISSN: 2584-2854
Volume: 04 Issue: 05
May 2026
Page No: 2131 – 2138

dominant experience, it becomes difficult for residents to trust the system or support its wider application. As shown in Figure 2.

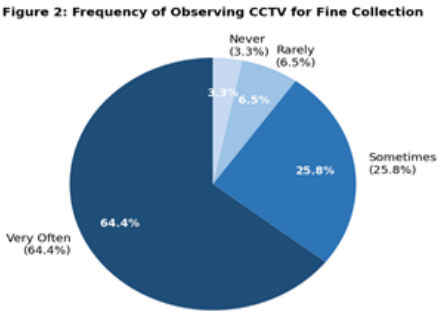

Figure 2 Frequency of Observing CCTV for Fine Collection (n ≈ 160)

6.3.Traffic Discipline

Figure 3 shows that 67.9% of respondents agree or strongly agree that CCTV has improved traffic discipline on Patna's roads, with only 8.6% disagreeing. The enforcement side of the current system is therefore delivering results. The more important question is whether enforcement alone represents the limit of what the infrastructure should achieve. As shown in Figure 3.

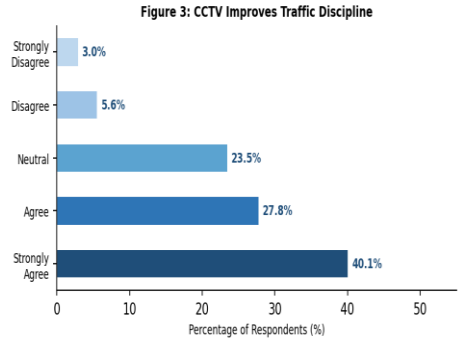

Figure 3 CCTV Improves Traffic Discipline (n ≈ 160)

6.4.Contribution to Public Safety

Figure 4 shows that 69.3% of respondents feel CCTV makes their area safer overall, with only 6.8% disagreeing. This is a strong finding, though it is worth distinguishing between cameras actively deterring crime and residents simply feeling reassured by visible surveillance. Both effects have value, but they carry different implications for how infrastructure is designed and managed. [13] As shown in Figure 4.

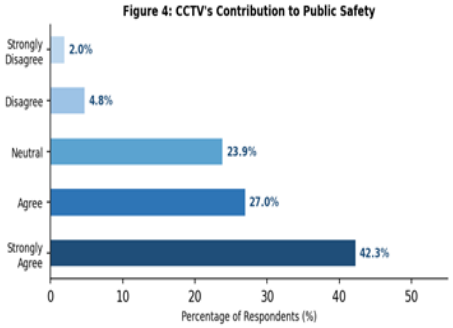

Figure 4 CCTV's Contribution to Public Safety (n ≈ 160)

6.5.Accident Reduction

Figure 5 presents a more qualified picture: only 45% agree that CCTV reduces road accidents, while 25.6% actively disagree. Cameras can deter reckless driving, but they cannot fill a pothole, repair a broken road sign, or illuminate a dark street. Residents appear to recognise this distinction clearly, separating the deterrence function from the physical infrastructure failures that most directly cause accidents. As shown in Figure 5.

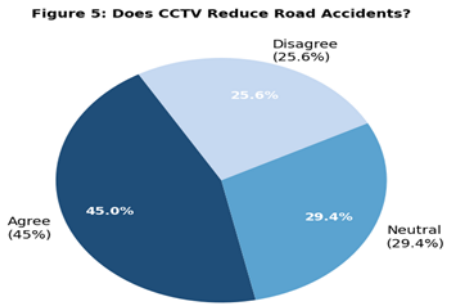

Figure 5 Does CCTV Reduce Road Accidents? (n ≈ 160)

6.6.Women's Safety

Figure 6 records the highest level of agreement in the entire survey: 69.8% of respondents agree that CCTV makes public spaces safer for women, with only 13% disagreeing. This is consistent with Roy and Chatterjee's finding that women are more willing to

International Research Journal on Advanced Engineering and Management
https://goldncloudpublications.com
https://doi.org/10.47392/IRJAEM.2026.0309
e ISSN: 2584-2854
Volume: 04 Issue: 05
May 2026
Page No: 2131 – 2138

use public transport where cameras are visible. The data suggest that for women navigating public space in Patna, the presence of surveillance has a meaningful and tangible effect. [14] As shown in Figure 6.

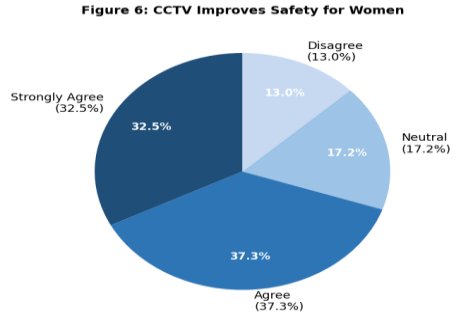

Figure 6 CCTV Improves Safety for Women (n ≈ 160)

6.7.Civic Amenity Rating

Figure 7 reveals a sharp drop in ratings when respondents are asked specifically about CCTV and civic amenities. On a scale of 1 to 5, 30.7% gave a rating of 1 and 19.6% gave a rating of 2, meaning over half (50.3%) placed CCTV at the bottom two points for civic contribution. Roads remain broken, drains stay blocked, and rubbish accumulates. The cameras, in residents' experience, do nothing about any of this. As shown in Figure 7.

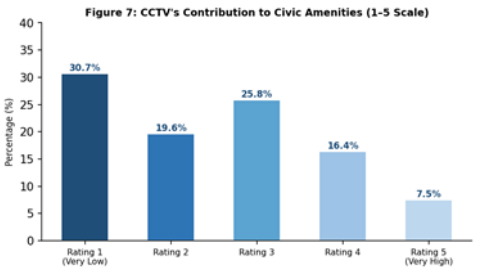

Figure 7 CCTV's Contribution to Civic Amenities, Rating 1–5 (n ≈ 160)

6.8.Civic Problem Detection

Figure 8 contains the study's sharpest finding: 80.4% of respondents report never having seen a CCTV camera used to detect or report a civic problem. No pothole flagged, no blocked drain identified, no waste site reported. Only 19.6% have ever witnessed this happen. AI tools capable of road and waste detection already exist and are functional on current hardware. The absence of these capabilities in Patna is therefore not a technology failure; it is a policy choice. [9], [12] As shown in figure 8.

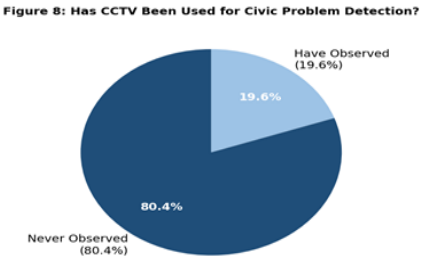

Figure 8 Has CCTV Been Used for Civic Problem Detection? (n ≈ 160)

6.9.Improvements Needed

Figure 9 shows that when asked what improvements are needed, 66.7% of respondents chose 'all of the above', selecting better planning, faster responses, and smarter use of data together. Residents treat these as a connected set of failures: poor data use leads to poor planning, and slow responses make any detection capability meaningless. All three dimensions need to be addressed simultaneously. As shown in Figure 9.

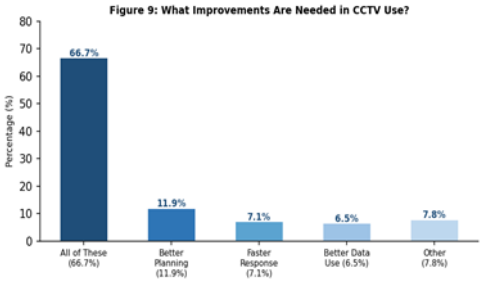

Figure 9 What Improvements Are Needed in CCTV Use? (n ≈ 160)

6.10. Desired Application Domains

Figure 10 shows what functions residents would like CCTV to serve. Again, 74.2% selected 'all of these', indicating that people want a fundamental expansion of the current model rather than incremental adjustments. Public safety (30.1%) and traffic management (20.9%) are the top preferences. Road maintenance (17.8%), cleanliness monitoring (15.3%), and drainage management (11%) also

International Research Journal on Advanced Engineering and Management
https://goldncloudpublications.com
https://doi.org/10.47392/IRJAEM.2026.0309
e ISSN: 2584-2854
Volume: 04 Issue: 05
May 2026
Page No: 2131 – 2138

attract strong support, despite none of these functions currently existing in Patna's ICCC. As shown in Figure 10.

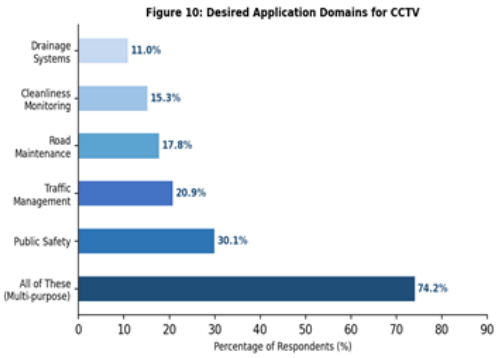

Figure 10 Desired Application Domains for CCTV (n ≈ 160)

6.11. Potential to Improve Daily Life

Figure 11 poses the study's final and most direct question: could better-managed CCTV improve daily life in Patna? A striking 81.1% say yes, with only 2.5% saying no. These are residents who primarily experience cameras as fine-collection devices and who rate CCTV at the bottom for civic value. Yet four out of five still believe the infrastructure could do better. They are not asking for cameras to be removed. They are asking for cameras that actually help. As shown in Figure 11.

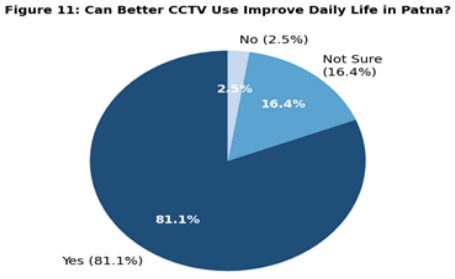

Figure 11 Can Better CCTV Use Improve Daily Life in Patna? (n ≈ 160)

7.Findings of The Study

In Patna, CCTV is perceived almost entirely as an enforcement tool. Fine collection and traffic monitoring are the primary associations residents hold, confirmed by more than 60% of the survey sample. Enforcement does produce genuine results: 67.9% report improved traffic discipline and 69.8% report greater safety for women in public spaces. However, these gains also reflect the limits of a system designed exclusively for control. The civic utility gap is severe: 80.4% of residents have never seen a camera used for a civic problem. This is a governance failure, not a technical one. Despite this, public faith in the technology remains strong. 81.1% believe that better-managed CCTV could improve their daily lives, and 74.2% support expanding it to roads, drains, waste, and safety. Civic amenity ratings are very low, with 50.3% of respondents placing CCTV at the bottom two points of a five-point scale for service contribution. The underlying obstacles are institutional: poor inter-departmental coordination, underused data, and slow response pipelines. Technology is not limiting the system. Governance is.

8.Policy Recommendations

AI tools that detect potholes, waterlogging, waste, and road damage already function on existing ICCC hardware. What is required is the institutional infrastructure: clear pipelines from camera-based detection to municipal action, assigned responsibility, and fixed response timelines. An inter-departmental data-sharing protocol should be established to mandate that the ICCC regularly transmits relevant data to the Roads Division, Drainage Authority, Solid Waste Cell, and Patna Municipal Corporation, addressing the current situation where detected information fails to reach the agencies that can act on it. [9], [12] A public civic performance dashboard, updated in real time, should display how many problems have been detected, reported, and resolved. Public visibility of this information creates institutional accountability and gradually reframes how residents understand what CCTV is for. Annual independent utility audits should assess ICCC performance on civic outcomes, not just enforcement metrics. Pothole resolution times, drain clearance rates, and resident satisfaction should carry equivalent weight to fine collection figures. If only enforcement is measured, only enforcement will improve. [5], [18]

Conclusion

This study set out to ask whether Patna's CCTV

International Research Journal on Advanced Engineering and Management
https://goldncloudpublications.com
https://doi.org/10.47392/IRJAEM.2026.0309
e ISSN: 2584-2854
Volume: 04 Issue: 05
May 2026
Page No: 2131 – 2138

investment is genuinely helping the people who live there. The answer is mixed. [19] Cameras have improved traffic discipline and made women feel safer in public spaces. Those are real and meaningful gains. But they have had no visible impact on the things many residents need most: better roads, functional drainage, and managed waste. The clearest finding in the study is that 80.4% of residents have never seen a camera used to report a single civic problem. That is not a technology failure. Patna's ICCC was designed and operated as a law enforcement tool, and the systems, workflows, and inter-agency agreements needed to make it useful for civic maintenance were never created. The most important finding may also be the simplest: 81.1% of residents, whose primary experience of cameras is fines and penalties, still believe that better-managed CCTV could improve their lives. That is a genuine expression of public trust, and it deserves a serious institutional response. Future research should track how attitudes evolve as the ICCC develops, compare findings across Tier-2 smart cities such as Ranchi, Bhopal, and Agartala, and conduct pilot tests of civic AI detection on live ICCC feeds. The privacy and ethical dimensions of expanded surveillance also warrant dedicated study.

Acknowledgment

The authors thank all Patna residents who participated in this survey. They also thank the faculties at St. Xavier's College of Management & Technology, Patna and Xavier University, Patna, for their guidance and support throughout this research. [20]

References

[1]. Ministry of Housing and Urban Affairs, "Year-end review 2024: Smart Cities Mission achievements," Press Information Bureau, Government of India, 2024. [Online]. Available: https://pib.gov.in/PressReleseDetailm.aspx?PRID=2086464

[2]. Ministry of Housing and Urban Affairs, "Smart Cities Mission dashboard and annual reports," Government of India, 2023. [Online]. Available: https://smartcities.gov.in

[3]. Patna Smart City Limited, "Integrated Command and Control Centre: Operational overview," Government of Bihar, 2025.

[4]. National Crime Records Bureau, "Crime in India 2022 (Vol. 1)," Ministry of Home Affairs, Government of India, 2023. [Online]. Available: https://ncrb.gov.in

[5]. Ministry of Housing and Urban Affairs, "ICCC Maturity Assessment Framework (IMAF) 2.0," Government of India, 2023. [Online]. Available: https://mohua.gov.in

[6]. R. Nair and P. Sharma, "Smart cities in India: Governance gaps and infrastructure paradoxes," Journal of Urban Policy and Planning, vol. 14, no. 2, pp. 45-63, 2021.

[7]. NITI Aayog, "Responsible AI #AIForAll: Approach document for India, Part 2: Operationalizing principles," Government of India, 2021. [Online]. Available: https://www.niti.gov.in

[8]. A. Kumar, V. Sharma, and R. Joshi, "Deep learning-based traffic density estimation using CCTV footage: A comparative analysis," International Journal of Engineering Research & Technology, vol. 12, no. 4, pp. 112-121, 2023.

[9]. S. Gupta, M. Singh, and D. Rao, "AI-enabled waste dumping detection through urban surveillance cameras," Smart Cities and Society, vol. 9, no. 1, pp. 78-89, 2022.

[10]. The Times of India, "Indian cities pilot AI-based street cleanliness monitoring systems," The Times of India, 14 Mar. 2023.

[11]. Patna Smart City Limited, "Tender for AI-based civic surveillance system (Nagar Netra)," 2025. [Online]. Available: https://www.smartpatna.co.in

[12]. H. Patel and A. Mehta, "Automated road damage assessment using computer vision," Journal of Transportation Engineering, vol. 149, no. 7, Art. no. 04023045, 2023.

[13]. K. Rajendran and N. Srivastava, "CCTV surveillance and urban crime deterrence: Evidence from three Indian metropolitan areas," Urban Studies and Public Policy, vol. 17, no. 3, pp. 210-228, 2022.

[14]. P. Roy and S. Chatterjee, "Gendered safety

International Research Journal on Advanced Engineering and Management
https://goldncloudpublications.com
https://doi.org/10.47392/IRJAEM.2026.0309
e ISSN: 2584-2854
Volume: 04 Issue: 05
May 2026
Page No: 2131 – 2138

perceptions and smart surveillance in Indian cities," Gender, Place and Culture, vol. 30, no. 5, pp. 703-721, 2023.

[15]. MDPI Urban Planning, "Smart crowd analytics from CCTV data for evidence-based urban design," Urban Planning, vol. 7, no. 2, pp. 198-215, 2022.

[16]. C. R. Kothari, Research Methodology: Methods and Techniques, 2nd ed. New Delhi: New Age International Publishers, 2004.

[17]. Ministry of Housing and Urban Affairs, "Climate Smart Cities Assessment Framework 2.0," Government of India, 2020.

[18]. M. Kaur and A. Bansal, "Urban governance and digital infrastructure in India: Bridging the policy-implementation gap," International Journal of Public Administration, vol. 45, no. 9, pp. 741-755, 2022.

[19]. T. Singh and R. Verma, "AI and urban surveillance: Ethical frameworks for responsible deployment in Indian smart cities," Technology in Society, vol. 74, Art. no. 102267, 2023.

[20]. Press Information Bureau, "Smart city data and surveillance infrastructure reports," Government of India, 2024. [Online]. Available: https://pib.gov.in