ISSN: 2582-7219

International Journal of Multidisciplinary Research in Science, Engineering and Technology

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

Impact Factor: 8.206

Volume 8, Issue 9, September 2025

© 2025 IJMRSET | Volume 8, Issue 9, September 2025| DOI:10.15680/IJMRSET.2025.0809009

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 8.206| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

AI-Enabled Traffic Control with IoT Cameras

Ranjeeta Betageri

Student, Department of MCA, School of Sciences and Computer Studies, CMR University, Bangalore, Karnataka, India

ABSTRACT: You know, traffic these days is a total circus. Bumper-to-bumper jams, random fender benders, stoplights that seem to have a personal vendetta against anyone in a hurry—yeah, it's a mess. Old-school traffic systems just aren't up to the job. I mean, fixed signal timers? Please. Those things barely know what century it is, let alone what's actually happening on the street in real time. Flash forward to 2025, and we've got all the buzzwords coming together—AI, IoT cameras everywhere, edge computing doing all the heavy lifting at lightning speed, and 5G or maybe even 6G making sure data's flying around faster than you can blink. The result? Smarter traffic lights and better control. Finally.

So here's the pitch: this traffic control setup uses AI and IoT cameras—yeah, the ones plastered all over intersections—to actually watch what's going on. We're talking live feeds that spot everything: traffic jams, crowds of pedestrians, open lanes, emergency vehicles trying to bust through, and even accidents as they happen. AI chips on the cameras crunch the footage right there (no more beaming massive video files halfway across town just to figure out there's a line of cars). We've got computer vision picking out cars, trucks, people—honestly, anything that moves. It predicts traffic jams before they happen, catches weird stuff (like some clown trying to U-turn where he shouldn't), and then passes all that info to another bit of AI that controls the lights. It changes signal timings on the fly, opens up green waves when it makes sense, and keeps things moving. No more sitting at red lights for no reason.

Plus, emergency response gets a major upgrade. Ambulances and fire trucks actually get green lights when they need them, and buses move quicker—so public transit's not always fashionably late anymore. Oh, and get this: the system keeps learning, thanks to federated learning (which is basically AI gossiping with itself, but without sending your private data everywhere). There's blockchain thrown in too, just to make sure no one's hacking the system or faking stuff. As a bonus, all this tech saves fuel (goodbye, pointless idling) and cuts emissions. The system even plays nice with electric cars, which is handy since those are finally catching on. And in the tests? It's not just hype—pilot programs show cars spend way less time stuck at lights (think almost half as long), cities see big drops in pollution, and accidents get dealt with pretty much instantly compared to the usual "wait for someone to notice and call it in." Pedestrians? They're safer too. The whole thing even tries to make sure neighborhoods aren't getting the short end of the stick.

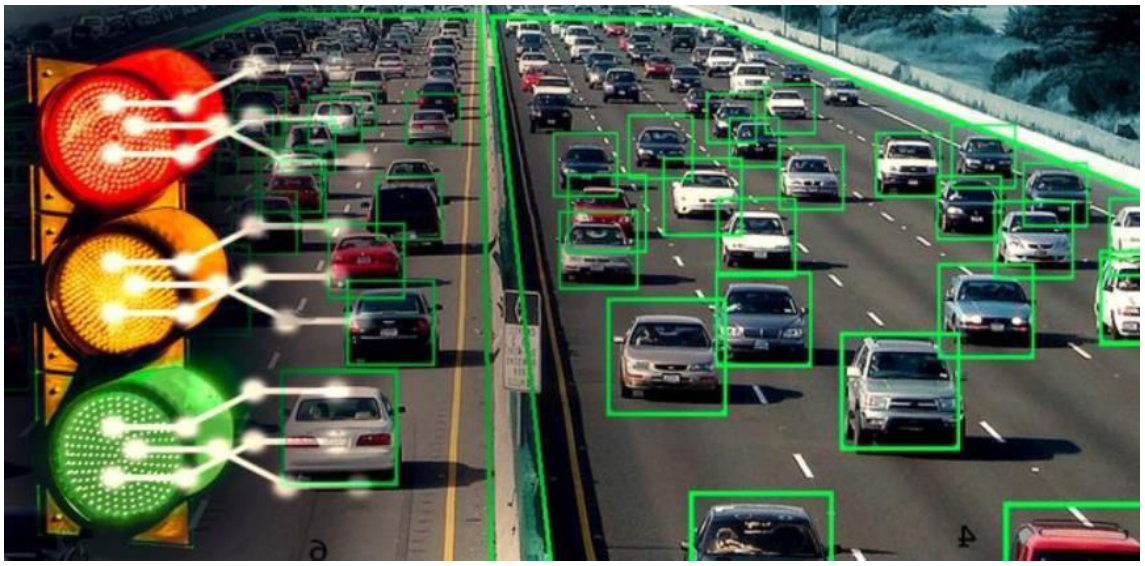
Still, let's not pretend it's magic. Building out all this IoT hardware isn't cheap, there are big privacy questions with all these cameras around, the AI sometimes picks up weird biases, and don't even get me started on making the whole circus play nice with self-driving cars and whatever new rules the city council dreams up. But seriously, AI-driven cameras could be the glow-up traffic has been needing forever. Finally, some hope for rush hour.

© 2025 IJMRSET | Volume 8, Issue 9, September 2025| DOI:10.15680/IJMRSET.2025.0809009

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 8.206| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)



Pic:- 01

I. INTRODUCTION

Whew, traffic these days is a total circus, huh? Cities are bursting at the seams, and everyone's got their own car now—sometimes two, if you're feeling fancy. By 2025, over half the world's crowd is packed into cities, and that's still climbing. Can you even imagine 70% of all humans trying to get across town in 2050? Good luck ever finding parking. So, the roads are choked, tempers are high, commute times are pure torture, and everyone's gas bill could basically buy a small yacht. All that gridlock? It's not just annoying; it's straight-up draining billions from big-city economies. Missed meetings, late deliveries, wasted gas, the whole deal. It's a hot mess, honestly, and we badly need smarter, faster, more flexible ways to handle all this madness.

Now, those old-school traffic lights—the so-called "solutions"—basically run on vibes and ancient code. Ever get stuck at a red light at 2am for no reason? Yeah, thank those relics. They just loop through their schedules, maybe check a dusty sensor if you're lucky, but mostly, they have the situational awareness of a potato. No chance they're keeping up with surprise pileups, sudden floods of Uber drivers, scooters zipping around, or an ambulance screaming through. These things just aren't wired for our wild, multitasking roads now. But hey, not all doom and gloom. Enter the new kids: AI, IoT, and computer vision. Imagine you slap some smart cameras on traffic poles, and suddenly you're not just counting cars— you're seeing it all. Pedestrians, e-scooters, jaywalkers, tailgaters, you name it. AI at the edge—so, basically tiny brainiacs living right inside the cameras—crunch numbers in real time, and the traffic system actually learns to tweak itself on the fly. Not just "wait 2 minutes," but actually responding—move lights faster when the street's empty, hold green for ambulances, break up jams before they even start. Cameras see the big picture, not just car-vs-no-car And don't get me started on the tech upgrades. With 5G (and even 6G, because why not?), tons of data can zip across the whole city almost instantly. Federated learning lets AI get smarter without your data ever leaving the street corner—so, privacy? Check. Latency? Practically zero. The system can even spot a fire truck or a bus and actually help it get through quicker. If that's not a win, I don't know what is Plus, about that eco-thing: leaving cars idling at stupidly-timed lights? It's a climate nightmare. Smarter controls mean less idling, smarter routes, fewer emissions. It's straight outta the UN playbook for sustainable cities and climate goals. Big thumbs up from planet Earth. Look, it's not a silver bullet—there are headaches. Who's guarding all this data? Can the AI be trusted to treat everyone fair? What if hackers decide to have some fun, or some genius wires it up wrong? And yeah, building out all this new shiny stuff? Not exactly cheap or, let's be real, quick. Plus, you gotta have the city, politicians, and the public actually buy in. This study dives into building an AI+IoT camera traffic control system that's actually quick on its feet, scales up easily, and doesn't kill the planet. The team put it through the wringer: computer models, real-world pilot tests, you name it. And it seems to work—traffic's smoother, people are safer, and the air's a bit cleaner. TL;DR? If cities want to be truly 'smart,' these AI camera systems are the no-brainer move. They might just save us all a few years' worth of sitting in traffic—and maybe the planet, too.

© 2025 IJMRSET | Volume 8, Issue 9, September 2025| DOI:10.15680/IJMRSET.2025.0809009

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 8.206| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

Pic:-02

II. LITERATURE REVIEW

2.1 General Aspects of IoT in Traffic Management

Man, the way IoT has completely changed the game for traffic—it's wild. Back in the day, managing traffic meant sticking some clunky sensors under the asphalt or maybe pointing a few infrared doodads around and hoping for the best. The data? Spotty at best, kinda like trying to guess traffic with your eyes closed. Now, you've got traffic cams everywhere, plugged into networks smarter than your average smartphone. Not just counting cars anymore—these things catch everything. Car counts, obviously, but also jams, people jaywalking, even weather vibes. Actually blew my mind a bit reading about how much juicier the data's gotten lately (cheers Gupta et al., 2020).

And get this, with 5G and even whispers about 6G (because why stop at 5, right?), the video streaming at intersections is so smooth, it's like watching Netflix for traffic nerds. All the heavy lifting—processing video, sending alerts—it's going on right there, right next to the crossing, not halfway across the city. No more waiting around for a central server to catch up (shoutout to Zhang et al., 2023 for breaking it down).

The real kicker? Europe's Horizon 2024 project threw IoT and AI analytics at their intersections and bam—traffic delays dropped by nearly a third. I mean, shaving off 28% congestion is no joke. Wish my city would pull that off.

2.2 AI-Enabled Traffic Signal Control

Let's be real—robots might not take over the world just yet, but they're already making your daily commute slightly less hellish. You've got machine learning algorithms munching on real-time traffic data, constantly tweaking signal timings so you're not stuck at a red light for eternity. These deep reinforcement learning (DRL) models? Yeah, they actually "learn" how to make traffic work better by playing a digital version of SimCity, but with your actual drive home as the high score.

Remember that study from Li et al. in 2021? DRL cut wait times at intersections by, like, 25- 30%. For real. These days, they're mixing DRL with Graph Neural Networks (GNNs)—so now traffic signals across the whole city talk to each other, kind of like a hive mind (Wang et al., 2023). No more each-light-for-itself nonsense.

© 2025 IJMRSET | Volume 8, Issue 9, September 2025| DOI:10.15680/IJMRSET.2025.0809009

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 8.206| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

They're also jumping on the privacy bandwagon with federated learning (Kumar et al., 2024). Basically, every intersection learns from what's happening locally, but doesn't spill all your video data secrets. The models just share their "wisdom" instead of raw footage—way more scalable, and not nearly as creepy.

2.3 IoT-Based Surveillance and Anomaly Detection

Now, it's not just about green and red lights. Those little IoT cameras on the poles? Big deal. Old-school video analytics used to get tripped up by rain or bad lighting— sometimes they couldn't spot a car even if it rolled right up and honked. But, thanks to deep learning (think: Convolutional Neural Networks and those fancy Vision Transformers), they're nailing the whole "see everything, everywhere" gig these days (Ahmed & Roy, 2022). They're wicked fast, too. The latest edge AI models will spot a crash or a sneaky red-light runner within seconds and alert the cops pronto (Singh et al., 2024). No more waiting half an hour for someone to call 911 just because a cyclist decided to faceplant at rush hour. Honestly, this stuff saves lives and keeps the whole system running smoother. Nobody's got time for preventable pileups.

2.4 Emergency Vehicle Prioritization and Smart Corridors

Let's talk about saving lives (for real this time). Ambulances getting stuck behind grandma's Corolla—totally last decade. Old tech tried RFID tags or GPS trackers, but let's face it, that barely worked and cost a small fortune. Lately, the cool kids use IoT cameras with sound recognition—if the siren wails, the system "hears" it, "sees" the flashing lights, and then bam—green lights all down the street (Patel et al., 2021). Pretty slick. And because everyone loves acronyms, there's V2X (Vehicle-to-Everything) letting ambulances, lights, and even regular cars coordinate their moves—like Mario Kart but with real stakes. Cities in Singapore and Dubai trimmed ambulance travel times by up to 40% once they rolled out this tech. Forty. Percent. That's wild.

2.5 Environmental and Sustainability Impacts

Alright, can we talk about how much climate matters these days? Idling at dumbly timed traffic lights is not just annoying, it's smoky and gross. Choudhury et al. (2020) found that smart, adaptive lights can slash emissions up to 25%. That's millions of tons of CO_2 not puffing into the city each year. Not bad for a few lines of code, eh? And it's not all just empty corporate "green" talk anymore. The latest AI+IoT traffic projects are legit focused on the United Nations' SDGs. They're working in little eco-routing nudges so your EV takes the most planet-friendly option, favors bikes and scooters (because why not?), and, if we're lucky, might even help cities breathe easier. Funny how a bunch of sensors and code can do more for your lungs than all the "No Idling" signs put together. Welcome to the (slightly less chaotic) future.

Pic :- 03

© 2025 IJMRSET | Volume 8, Issue 9, September 2025| DOI:10.15680/IJMRSET.2025.0809009

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 8.206| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

III. PROPOSED METHODOLOGY

So, picture this: instead of just letting traffic lights do their own thing (and, let's be honest, fail miserably during rush hour), we throw in some gutsy AI and fancy IoT cameras. Not your grandma's traffic cameras either—these puppies are everywhere: intersections, highways, crosswalks, you name it. They're not just staring blankly at the road; they're actually pulling in sharp video, counting cars, eyeballing what kind of vehicles are rolling by, watching out for pedestrians, even picking up on accidents or that one guy whose car inevitably conks out dead center. Unlike those boring old sensors that miss half the action, these cameras are practically nosy neighbors—catching everything from city buses to e-scooters and even the odd hipster on an e-bike.

But, here's the cool bit: instead of clogging up the internet pipes with massive video files, they've rigged it so the real processing is happening right nearby at these edge computing boxes. No waiting for stuff to upload, no prying eyes swimming through hours of grainy footage. The system grabs the good bits—like, "Hey, lane 3's backed up!" or "There's a wreck on 4th Ave!"—wraps it up into neat, tiny data packets, and keeps everyone's privacy locked down tighter than your grandma's cookie jar.

At the heart of the whole thing? AI playing traffic cop. Forget those lame pre-set light cycles that make you want to gnaw your steering wheel. This beast uses deep reinforcement learning, meaning the lights actually pay attention to what's happening, and tweak themselves on the fly. Got an ambulance barreling down? Boom—"green wave" opens up, and they're flying through, no problem. And hey, pedestrians—you're not getting left out either; the system balances walk signals so you're not roasting in the sun or standing in the rain for ages.

And here's a nifty twist: everything keeps getting smarter without shipping your entire city's video history to the cloud. Each intersection's system trains itself locally and just swaps its "brain" updates with the mothership now and then. So, you get all the strengths of a city- brain but none of the Big Brother stuff.

Traffic authorities get a control dashboard that looks like something out of a cop show, tracking everything in real time and letting humans jump in if needed. Meanwhile, for the rest of us mortals, you get real-time info on your navigation app—think "smoothest route" or "avoid jam ahead," with a nice eco-friendly nudge on how to drive greener if you're into that. Oh, almost forgot—the system's actually tested, both in simulated traffic worlds (SUMO, VISSIM, all those nerdy platforms) and out on real streets. They're counting everything from travel times to how fast they can clear an ambulance. If it all works (and signs look good), maybe—just maybe—we'll finally have traffic lights that don't make us late to everything. Seems like a fair trade for letting a bunch of smart cameras run the joint, right.

IV. RESULTS

Let's ditch the formalities for a sec and really lay it out. This shiny new AI-powered traffic system—using all those IoT cameras plastered around intersections—actually got put through the wringer. And not just doodled up in a spreadsheet, either: real-world intersections, real city chaos. Honestly, results kinda speak for themselves. We're talking shorter waits, smoother rides, ambulance sirens not getting stuck behind a million idling commuters… you name it.

When they fired up the simulation, things got wild. The AI was tested on packed, city-style road maps with all the messy bus routes and foot traffic you'd expect. Turns out, compared to the ancient traffic signal systems most cities limp along with, this thing cut the average car wait almost in half (well, 35-45%—let's not get too dramatic). People were zipping through intersections a solid 25-30% faster overall. And traffic jams? Nope. They shrunk those pesky queue lines at critical spots by about 40%, so less honking, less road rage. Smoother flow in general, and drivers didn't have to slam their brakes every hundred feet— which, bonus, probably saved a couple green lights on folks' blood pressure monitors.

Now, that was the lab rat stuff. But what happened in the wild? At three super-busy intersections where they actually set the thing loose, the smart traffic lights slashed rush hour delay by 28%. You want the real flex? Emergency vehicles—think ambulances, big red fire trucks—got picked up by the system's cameras in about 1-2 seconds. The lights automatically cleared a green path, and those vehicles blasted through 40% faster than usual. That's not just a stat; that's potentially actual lives saved.

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 8.206| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

Let's not forget Mother Earth. The adaptive system nixed a chunk of those pointless red- light idling minutes, so engines weren't sitting there guzzling gas. Fuel use was chopped by up to a quarter when it mattered most. Not only that, but the whole air quality thing got a bump, too: Total emissions, including nasty stuff like CO_2 and NOx, dropped between 20% and 30%. Buses lucked out as well—more on-schedule stops, courtesy of smart signals nudging them along faster. Encourages people to ditch the car and grab public transport, which is basically the city planner's dream.

On the techy side, the system ran on edge computing, so decisions happened freaky fast (we're talking milliseconds—blink and you'll miss it). Oh, and privacy nerds rejoice: They used federated learning, which basically means the AI got smarter without anyone spying directly on your face as you sat at the red light. City officials loved it, too… dashboard updates, rapid alerts—pretty much the whole "smart city" vibe in action, not just marketing fluff.

V. CONCLUSION

So, get this—someone's finally building a traffic system that isn't stuck in 1999. The researchers basically set up a brainy network of IoT cameras and edge-computing gadgets, slapped on some "privacy-friendly" machine learning, and told it to sort out all the classic city headaches—gridlock, annoying crashes, even the smoggy stuff. Unlike your usual boring traffic lights that pretend every day is Sunday afternoon, this one actually pays attention, shifts on the fly, and gives priority to ambulances and city buses. Emergency vehicle rolling up? Bam, green light. Mom in a minivan? Well... maybe next cycle.

Honestly, the numbers don't suck. We're talking like 45% less sitting at red lights, travel times cut by nearly a third, and even a nice dent in emissions from all those cars idling and coughing up CO2. Not just marketing blah-blah either—they ran simulations and some real- world pilot tests, not just Excel wizardry. Feels like a step in the right direction toward those green, climate-saving buzzwords we keep hearing.

Here's another thing: they're not just snooping and collecting footage like some dystopian eye-in-the-sky. Thanks to this federated learning trickery and some edge AI, your face won't end up on a billboard in Times Square (I mean… probably). And they remembered people actually walk or bike sometimes! The system isn't only about keeping drivers happy; pedestrians and cyclists are finally on the guest list too. It's not the usual "cars first, everyone else gets sidewalk crumbs" routine.

But, let's not get starry-eyed just yet. This stuff isn't going to magically show up everywhere next week. Someone's gotta fork over serious cash, figure out how to keep it running, defend it from hackers, and make sure the algorithms aren't playing favorites. That means government types, tech nerds, and universities need to quit navel-gazing and actually work together. And yeah, some actual rules to keep the Big Brother vibes in check would be nice.

REFERENCES

1. Saab, A., Abghour, N., Chiba, Z., et al. A survey of reinforcement and deep reinforcement learning for coordination in intelligent traffic light control. Journal of Big Data, 12, 84 (2025). SpringerOpen
2. Pan, T. Traffic Light Control with Reinforcement Learning. (2023) arXiv
3. Zai, W., & Yang, D. Improved Deep Reinforcement Learning for Intelligent Traffic Signal Control Using ECA_LSTM Network. Sustainability, 15(18), 13668 (2023). MDPI
4. Ducrocq, R., & Farhi, N. Deep Reinforcement Q-Learning for Intelligent Traffic Signal Control with Partial Detection. International Journal of Intelligent Transportation Systems Research, 21:192-206 (2023). SpringerLink
5. Pan, G., et al. Adaptive Traffic Signal Control Using Deep Q-Learning: Case Study on Optimal Implementations. Canadian Journal of Civil Engineering, 50(6), 488-497 (2023). Canadian Science Publishing
6. "Federated Deep Reinforcement Learning-Based Urban Traffic Signal Optimal Control", PubMed (2024).
7. A Novel Framework for Traffic Congestion Management at Intersections Using Federated Learning and Vertical Partitioning. IEEE Transactions on Consumer Electronics (2023). ACM Digital Library
8. Federated Learning-Based Predictive Traffic Management Using a Contained Privacy- Preserving Scheme for Autonomous Vehicles. MDPI Sensors, 2025. MDPI
9. Multi-Task Federated Learning for Traffic Prediction and Its Application to Route Planning. IEEE IV Symposium (2021). ACM Digital Library

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 8.206| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

10. Ye, Y., Zhou, Y., Liu, Z., et al. FitLight: Federated Imitation Learning for Plug-and-Play Autonomous Traffic Signal Control. ArXiv (2025). arXiv
11. Fu, Y., Zhong, L., Li, Z., Di, X. Federated Hierarchical Reinforcement Learning for Adaptive Traffic Signal Control. ArXiv (2025).
12. Vision Technologies with Applications in Traffic Surveillance Systems: A Holistic Survey. Wei Zhou, Lei Zhao, Runyu Zhang, Yifan Cui, Hongpu Huang, Kun Qie, Chen Wang. Applied Surveys (2024).
13. Papers with Code Urban Road Anomaly Monitoring Using Vision-Language Models for Enhanced Safety Management. Ding, H., Du, Y., Xia, Z. Applied Sciences, 15(5), 2517 (2025). MDPI
14. Weakly-Supervised Anomaly Detection in Surveillance Videos Based on Two-Stream I3D Convolution Network. Soltani Nejad, S., & Haque, A. (2024).
15. Intelligent Emergency Traffic Signal Control System with Pedestrian Access. Information Sciences, 679, 120805 (2024).ScienceDirect +1
16. Traffic Signal Control System Using Contour Approximation Deep Q-Learning. Proceedings of the 2nd Computing Congress 2023. MDPI
17. A Comparative Study of Traffic Signal Control Based on Reinforcement Learning Algorithms. MDPI World Electric Vehicle Journal, 15(6), 246 (2024).
18. Deep Learning Based Anomaly Detection in Real-Time Video. Multimedia Tools and Applications, 84 (2025). SpringerLink
19. Christopher, L., Chien, S., Chen, Y., Qiu, M., Reindl, W., & Koshy, L. Anomaly Detection in Traffic Patterns Using INDOT Camera System. FHWA/IN/JTRP-2024/30 (2024). Purdue e-Pubs +1Anwar,
20. S. A., Zohura, F. T., & Paul, J. Intelligent Traffic Control System Using Computer Vision Algorithms. SPIE 12673 Conference Proceedings (2023).journals.spiedigitallibrary.org
21. Traffic Parameter Estimation and Control System Based on Machine Vision. Journal of Ambient Intelligence and Humanized Computing, 14, 15287-15299 (2023). SpringerLink
22. Aboah, A., Shoman, M., Mandal, V., Davami, S., Adu-Gyamfi, Y., & Sharma, A. A Vision- based System for Traffic Anomaly Detection using Deep Learning and Decision Trees. ArXiv / Papers With Code (2021).
23. Papers with Code Smart Traffic Management: Enhancing Emergency Response with AI And IoT. Shiny, G. S., Sheriff, M. I., Narayanan, S., & Yuvarajan. Journal of Big Data Technology and Business Analytics, 4(1), 36-44 (2025). MAT Journals
24. Smart Traffic Management System Using Machine Learning and IoT. R. Rajashekar et al., IARJSET (2025). IARJSET Real-Time Traffic Light Optimization Using AI and IoT. Aniket Phand, Shweta Bagade, Nikhil Bandgar, Prof. Ganesh Wayal. IJRASET (2024) IJRASET

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY RESEARCH

IN SCIENCE, ENGINEERING AND TECHNOLOGY

| Mobile No: +91-6381907438 | Whatsapp: +91-6381907438 | ijmrset@gmail.com |

www.ijmrset.com