IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 1, February 2024

Littering Management - Survey on Algorithms

Mutyala Navya[1], Sagar K C[2], Vimuktha Evangeleen Salis[3]
Professor, Department of Information Science and Engineering [3]
Undergraduate Students, Department of Information Science and Engineering[1,2]
Global Academy of Technology, Banglore, India.
navyamutyala23@gmail.com[1], sagarchandregowda7@gmail.com[2], dr.vimuktha@gat.ac.in[3]

Abstract: *This literature review critically examines the utilization of CCTV cameras and real-time object detection to address the issue of littering from moving vehicles. The paper explores the core objective of identifying waste disposal instances, focusing on sophisticated image processing techniques for accurate license plate details capture. Through the integration of technology, the review discusses how the system detects and documents littering, facilitating the imposition of fines on registered vehicles. The strategic fusion of CCTV cameras and advanced image processing is analyzed for its effectiveness in deterring irresponsible waste disposal and reinforcing anti-littering regulations. The literature review contributes to a comprehensive understanding of this approach's impact on fostering a cleaner and more environmentally conscious urban environment.*

Keywords: Littering Management, Artificial intelligence, CNN, Object Detection, Yolo, Waste Management.

I. INTRODUCTION

The persistent problem of littering, particularly from moving vehicles, remains a significant challenge impacting the environment and community aesthetics. In response, our project introduces an advanced Littering Management System that employs cutting-edge technology to detect waste objects discarded from moving vehicles. This system integrates real-time object detection using CCTV cameras and employs image processing techniques to identify license plate information. Through this seamless integration, the system aims to identify instances of littering and impose fines on registered vehicles, fostering responsible waste disposal practices and enforcing anti-littering regulations.This paper provides an in-depth exploration of the methodology behind our Littering Management System, highlighting the use of advanced algorithms for precise waste object detection and image processing for extracting license plate details. The primary goal is to establish a proactive approach to address littering incidents, ensuring swift and effective enforcement actions against registered vehicles engaged in this detrimental behavior.Moreover, the proposed system places a strong emphasis on community involvement through a user-friendly interface. This feature encourages citizens to actively participate in reporting and monitoring littering incidents, cultivating a shared sense of responsibility for maintaining the cleanliness of public spaces.In summary, our Littering Management System signifies a significant technological advancement in tackling the challenges associated with littering from moving vehicles. By discouraging littering behaviors through efficient detection and enforcement, our aim is to contribute to the creation of cleaner, more visually appealing communities and a sustainable environment.

II. LITERATURE SURVEY

[1] Object Detection Based Garbage Collection Robot (2021):

The March 2018 publication in the International Research Journal of Engineering and Technology (IRJET) details the creation of the "E-Swachh" garbage collection robot[1].Utilizing ultrasonic and IR sensors for obstacle avoidance, the robot employs an ARM for waste collection and is managed by a Raspberry Pi 3B. It operates on solar panel and battery power, features a metal base with four wheels, and incorporates image processing for object detection, minimizing wildlife interaction.Potential future enhancements for the E-Swachh robot include improved object detection, autonomous navigation, integration of AI and machine learning, environmental sensing, sustainability, collaboration with smart city initiatives, enhanced user interface, and regulatory compliance.These developments aim to

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 1, February 2024

refine waste type identification, optimize robot navigation, and bolster environmental monitoring capabilities. Advantages of the E-Swachh garbage collection robot encompass automation, reduced environmental impact, improved health and safety, image processing, efficient operation, energy efficiency, waste segregation, and decreased occupational hazards[1]. Despite these benefits, the robot encounters challenges such as insufficient waste management, disregard for Supreme Court guidelines, health risks for workers, environmental concerns tied to low budget allocations and public awareness, reliance on human intervention, potential wildlife threats, limited garbage collection scope, and dependence on solar power.[1]

[2] Advanced Traffic Violation Control andPenalty System using IoT and ImageProcessing Techniques(2020) :
The paper explores a comprehensive traffic violation control system by integrating Radio Frequency Identification (RFID) and image processing techniques.The system addresses issues like heavy traffic congestion, violation detection, accountability, and efficient traffic rule enforcement[2]. RFID is utilized for unique vehicle IDs, and image processing detects license plates, enabling effective monitoring of traffic signal violations.Automated penalties are imposed via alert messages to vehicle owners, enhancing traffic management and reducing violations. Advantages include enhanced monitoring, reduced violations, and efficient resource utilization, with ongoing improvement possibilities[2]. Challenges involve implementation costs, varying infrastructure, privacy concerns, technological hurdles, maintenance issues, and potential user resistance. The research gap focuses on overcoming passive RFID limitations through integration with image processing.The proposed method, incorporating RFID, image processing, and GSM technology, proves effective for prompt and reliable penalty enforcement, offering a promising solution to traffic management challenges with potential for further advancements[2].

[3]License Plate Detection And Recognition Based On YOLOV3(2020):
The document explores the complexities of license plate detection and recognition, utilizing the YOLOv3 model and introducing the Improved License Plate Recognition Net (ILPRNET)[3]. Performance evaluation involves the Intersection over Union metric, and diverse license plate datasets are employed, referencing related works in the field. YOLOv3 effectively addresses position detection issues, while ILPRNET excels in character localization and recognition in challenging backgrounds[3]. The research identifies a gap, suggesting improvements such as handling rotating plates, accommodating varying character lengths, incorporating a feedback mechanism, and expanding datasets through GAN networks. Despite their advantages in addressing localization and recognition challenges, both models acknowledge potential drawbacks, including lower recognition rates for rotating plates and fixed character counts[3]. The proposed two-stage algorithm demonstrates promising results but emphasizes the need for further enhancements to boost accuracy across diverse scenarios.

[4]Two-Wheeler Vehicle Traffic Violations Detection and AutomatedTicketing for Indian Road Scenario(2022):
The document underscores the critical necessity for automated detection and ticketing of two-wheeler traffic violations in India, proposing an advanced system that leverages AI technologies like YOLOv4 and Tesseract[4]. This system aims to autonomously identify violations such as helmet non-compliance, phone usage, triple riding, wheeling, and illegal parking. Overcoming challenges like limited labeled data and variable CCTV footage quality, the methodology offers notable benefits, including heightened efficiency, enhanced road safety, and precise violation detection and number plate extraction. The system's real-time capabilities and potential for deriving safety policies are highlighted advantages. However, challenges such as computational costs and diverse number plate formats indicate areas for improvement. The research gap identifies opportunities for further exploration, such as addressing rotating plates and expanding datasets using GAN networks[4]. While acknowledging potential refinement needs, the document overall presents a robust automated system with significant advantages for tackling two-wheeler traffic violations in India[4].

[5]Solid Waste Management Scenario in India and Illegal DumpDetection Using Deep Learning: An AI Approach towards theSustainable Waste Management (2022):
The article extensively explores the landscape of solid waste management (SWM) in India, underscoring the imperative need for technological solutions, particularly the integration of deep learning to combat illegal dumping[5]. Unfolding

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 1, February 2024

in four segments, it provides a comprehensive understanding of municipal solid waste, offers a statistical analysis of waste generation, identifies prevalent issues in current SWM services, and proposes a multipath convolutional neural network (mp-CNN) as a countermeasure against illegal dumping. The study employs diverse techniques, including statistical analysis, surveys, and the creation of a bespoke dataset for training and testing the mp-CNN model[5]. Noteworthy advantages include a technological remedy for illegal dumping, insightful data analysis, considerations for sustainable urban development, and prospects for practical applications. However, limitations encompass the absence of a benchmark dataset, potential biases in survey-based analyses, and challenges associated with the practical implementation and scalability of technological solutions[5]. Recognized research gaps underscore the need for predictions on future waste generation, the scarcity of data analytics tools, inefficiencies in waste collection, and issues like the unavailability of web portals and real-time monitoring in the current SWM system. Conclusions draw attention to the significant impact of urbanization on waste generation, outline major issues in SWM services, propose a technological solution, and emphasize the importance of dataset construction for model training. In essence, the study accentuates the pivotal role of deep learning in tackling the intricate challenges of solid waste management, particularly the pervasive problem of illegal dumping in the Indian context[5].

[6]A Deep Learning-Based Intelligent Garbage Detection SystemUsing an Unmanned Aerial Vehicle (2022):
The paper delves into the creation of an intelligent waste detection system using deep learning and Unmanned Aerial Vehicles (UAVs) to efficiently manage waste in challenging landscapes like hilly and coastal areas. Propelled by Convolutional Neural Networks (CNN), the system strives to offer a cost-effective, precise, and user-friendly solution for addressing waste management complexities in remote settings. By incorporating symmetry theory and employing a meticulously curated dataset, the system identifies various waste categories, spanning plastic, agricultural, biomedical, construction, household, and electronic waste[6]. While extolling the virtues of affordability, speed, accuracy, and user-friendliness, the document is silent on explicit drawbacks. Although the research underscores the transformative potential of the CNN-based UAV system in waste management, especially in geographically intricate terrains, it refrains from delineating specific research gaps. Overall, the paper underscores the importance of deep learning and UAV technology in surmounting waste detection challenges and propelling advancements in waste management methodologies[6].

[7] Moving Vehicle Registration Plate Detection (2022):
The study concentrated on developing a sophisticated system for identifying moving vehicle registration plates using video surveillance tools[7]. By leveraging advanced technologies like Wpod-Net for license plate detection and a Convolutional Neural Network (CNN) model for character extraction, the system demonstrated high accuracy in recognizing number plates. Stored in a database for future reference, the detected plates underscored the significance of cutting-edge detection technologies and deep learning algorithms for precise and effective plate detection from video recordings[7]. The study advocated ongoing advancements in detection algorithms, real-time processing, and integration with state-of-the-art technologies to enhance adaptability, security, and reliability across diverse environmental conditions. While acknowledging the benefits of reducing human operator dependence and offering practical solutions, the research highlighted challenges such as complexity, cost, privacy concerns, and the need for regular maintenance in deploying these technologies. In essence, the study emphasized the crucial role of technological innovation in advancing vehicle registration plate detection systems through video surveillance, ensuring heightened accuracy and dependability in various operational scenarios[7].

[8] Advanced Traffic Violation Control And Penalty System (2023):
The document underscores the urgent need for an advanced traffic violation control and penalty system in India, prompted by the elevated average number of road accidents. It introduces the E-Challan system as a transformative solution, leveraging IoT technology, image processing, RFID, GSM, Open GTS, and Mongo DB. Targeting real-time violation detection, accurate identification, prompt notification, and enhanced efficiency, the system aspires to serve as a deterrent and furnish data-driven insights for informed decision-making in traffic management. Noteworthy advantages include seamless integration with existing infrastructure, although specific disadvantages are not explicitly stated[8]. Despite comprehensive evaluation, research gaps are identified, such as assessing system robustness under extreme conditions, incorporating advanced AI/ML algorithms, conducting a long-term impact assessment, scrutinizing

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 1, February 2024

temporal variations in e-challans, and optimizing the system's response time[8]. The conclusion affirms the system's effectiveness, showcasing high accuracy, real-time functionality, and practical viability, while acknowledging potential avenues for improvement through advanced image processing techniques and additional features[8].

[9] A Yolov3 Based Grabage Detection System (2023):

The research paper introduces an effective garbage detection system utilizing the YOLOv3 real-time object detection algorithm to automate waste identification, collection, and recycling through artificial intelligence. By leveraging two datasets covering glass, plastic, and paper waste, along with the globally published Trashnet dataset, the YOLOv3 network model demonstrates commendable accuracy across diverse waste classes, showcasing competitive performance. Stressing the crucial role of a comprehensive dataset for training AI models, the paper asserts that the newly created waste dataset significantly enhances the field. Employing artificial intelligence, deep learning, and image processing technologies, the system utilizes YOLOv3 for real-time object detection, complemented by sensors, microcontrollers, and communication modules for waste monitoring and alerting[9]. While explicit disadvantages are not delineated, the paper explores avenues for future research, including enhanced waste categorization, integration with sensor modalities, and the deployment of robotic systems for autonomous waste collection. The YOLOv3-based system's standout features include real-time capabilities, high object detection rates, and accuracy, presenting advantages over traditional machine learning algorithms and proving its efficacy in waste management applications. The paper underscores the paramount importance of dataset quality and automation in waste management, providing valuable insights for future research at the convergence of waste management and AI-based detection systems[9].

[10] Implementation Of Number Plate Detection System For Vehicle Registration Using Iot And Recognition Using CNN(2023):

The document explores the extensive applications of Automatic License Plate Recognition (ALPR) technology in intelligent transportation systems, covering areas like traffic control, security, e-payment, law enforcement, vehicle registration, autonomous vehicles, speed detection, traffic surveillance, and parking management. Employing image processing, artificial intelligence, IoT, and Convolutional Neural Network (CNN), the number plate detection system for vehicle registration is underscored for tasks such as license plate extraction, image preprocessing, character segmentation, and recognition[10]. Future research prospects in this domain are outlined, emphasizing IoT integration, real-time data processing, security enhancements, adaptability to diverse conditions, integration with autonomous vehicles, and ethical considerations. While benefits include automation, heightened security, increased efficiency, and adaptability, potential drawbacks encompass privacy concerns, maintenance, cost implications, security risks, and environmental impact[10]. The conclusion underscores the pivotal implementation of an ALPDR system using IoT and CNN in intelligent transportation systems, highlighting a four-step process involving License Plate Extraction, Image Pre-processing, Character Segmentation, and Character Recognition. A comparative analysis favors CNN for its superior performance across various conditions, showcasing advancements in methodology and overall system capabilities[10].

[11] Detection Of Traffic Rule Violation In University Campus Using DeepLearning Model (2023):

The research paper delves into the application of a deep learning model for identifying traffic rule violations within a university campus, employing surveillance cameras strategically positioned at intersection points[11]. The system encompasses three integral sub-systems: vehicle and rider identification, classification of two-wheelers to ascertain rule adherence, and automatic number plate recognition. Capitalizing on the YOLOv8 model's capabilities, the system excels in pinpointing two-wheelers with triple riders, while incorporating diverse deep learning models for tasks such as helmet detection, license plate recognition, and assessing helmet usage compliance. Emphasizing real-time implementation and data accrual through live recordings, the proposed system streamlines the enforcement of traffic rules, diminishing the reliance on manual oversight[11]. Despite its merits, challenges persist, including the need for more pertinent datasets, potential object occlusion impacting detection precision, and a call for advancements in real-time video surveillance to optimize system efficiency. The study underscores the potency of deep learning in fortifying traffic management within a campus setting, highlighting the imperative to address prevailing gaps for a more nuanced solution[11].

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 1, February 2024

[12] Real-Time Detection Of Littering From Vehicles In Traffic Surveillance Videos (2023):
The document introduces an innovative system based on machine learning for the real-time detection and prevention of littering from vehicles in traffic surveillance videos. By utilizing the advanced YOLOv2 network and narrowband Internet of Things (NBIoT) technology, the system aims to effectively tackle the issue of littering during driving, providing a comprehensive solution to improve public safety and urban cleanliness[12]. Employing the Selective Search algorithm for efficient video frame processing and NBIoT for swift notifications to authorities upon litter detection, the system ensures a prompt response. The Deep-Residual Network-Leveraged Vehicle-Thrown Waste Identification (DRN-VTWI) Method facilitates real-time object classification in traffic video streams. The proposed system offers potential advantages such as enhanced public safety, sustainable transportation, efficient waste management, and integration of advanced technologies[12]. However, challenges like accuracy concerns, environmental factors, and privacy considerations necessitate careful attention for successful implementation and compliance with regulatory standards. Future research directions could explore ways to improve accuracy, integrate additional sensors, analyze driver behavior, and enhance public awareness through educational initiatives, contributing to urban sustainability and cleanliness[12].

III. CONCLUSION

In conclusion, implementing a system that identifies and fines vehicles for littering based on their number plates is a proactive measure for maintaining a clean environment. The use of technology to pinpoint and penalize offenders not only discourages littering but also fosters a heightened sense of responsibility among vehicle owners. This automated approach shows significant promise in improving litter management and contributing to environmental conservation efforts.

REFERENCES

[1]. Khandare, Shobhit, Sunil Badak, Yugandhara Sawant, and Sadiya Solkar. "Object detection based garbage collection robot (E-Swachh)." *International Research Journal of Engineering and Technology (IRJET)* (2018).

[2]. Asoba, Shreya, Shreya Supekar, Tushar Tonde, and Juned A. Siddiqui. "Advanced traffic violation control and penalty system using IoT and image processing techniques." In *2020 2nd International Conference on Innovative Mechanisms for Industry Applications (ICIMIA)*, pp. 554-558. IEEE, 2020.

[3]. Zou, Yongjie, Yongjun Zhang, Jun Yan, Xiaoxu Jiang, Tengjie Huang, Haisheng Fan, and Zhongwei Cui. "License plate detection and recognition based on YOLOv3 and ILPRNET." *Signal, Image and Video Processing* 16, no. 2 (2022): 473-480.

[4]. Charran, R. Shree, and Rahul Kumar Dubey. "Two-Wheeler Vehicle Traffic Violations Detection and Automated Ticketing for Indian Road Scenario." *IEEE Transactions on Intelligent Transportation Systems* 23, no. 11 (2022): 22002-22007.

[5]. Shahab, Sna, and Mohd Anjum. "Solid waste management scenario in india and illegal dump detection using deep learning: an AI approach towards the sustainable waste management." *Sustainability* 14, no. 23 (2022): 15896.

[6]. Verma, Vishal, Deepali Gupta, Sheifali Gupta, Mudita Uppal, Divya Anand, Arturo Ortega-Mansilla, Fahd S. Alharithi, Jasem Almotiri, and Nitin Goyal. "A deep learning-based intelligent garbage detection system using an unmanned aerial vehicle." *Symmetry* 14, no. 5 (2022): 960.

[7]. B. Sri Lakshmi Prasanna, A. Baby Vyshnavi, K. Dakshayani, B. Jyoshna, and Mrs. D. Kiranmayi. "Moving Vehicle Registration Plate Detection." International Research Journal of Modernization in Engineering Technology and Science, vol. 04, no. 06, June 2022, p. 5726.

[8]. Asoba, Shreya, Shreya Supekar, Tushar Tonde, and Juned A. Siddiqui. "Advanced traffic violation control and penalty system using IoT and image processing techniques." In *2020 2nd International Conference on Innovative Mechanisms for Industry Applications (ICIMIA)*, pp. 554-558. IEEE, 2020.

[9]. KARACA, Dilara, U. Z. U. N. Süleyman, and Sezgin KAÇAR. "A Yolov3-Based Garbage Detection Systems." *Journal of Smart Systems Research* 4, no. 2 (2023): 160-176.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 1, February 2024

[10]. Jawale, M. A., P. William, A. B. Pawar, and Nikhil Marriwala. "Implementation of number plate detection system for vehicle registration using IOT and recognition using CNN." *Measurement: Sensors* 27 (2023): 100761.

[11]. Chaturvedi, Pooja, Kruti Lavingia, and Gaurang Raval. "Detection of traffic rule violation in University campus using deep learning model." *International Journal of System Assurance Engineering and Management* 14, no. 6 (2023): 2527-2545.

[12]. Prakash, K., & Manimozhi, S. "Real-Time Detection of Littering from Vehicles in Traffic Surveillance Videos." *International Journal of Research Publication and Reviews*, vol. 1, www.ijrpr.com, 2021, pp. 1-10. ISSN 2582-7421