Educational Administration: Theory and Practice
2024, 30(7), 25-28
ISSN: 2148-2403
https://kuey.net/

Research Article

'A Novel Technique For Dynamic Pothole Detection & Mapping AlongWith An Alert System'

Gaurav Patil[1*], Gurunathan R[2], Hari Prasad P[3], Harsha V[4], Ms Swetha R[5]

[1*]Dept. of ECE,PES University, Bangalore,India, gauravp.business@gmail.com
[2]Dept. of ECE PES University, Bangalore,India, gurunathanr2002@gmail.com
[3]Dept. of ECE PES University, Bangalore,India, hariprasad1000.hp@gmail.com
[4]Dept. of ECE, PES University, Bangalore,India, harshavgowda24@gmail.com
[5]Dept. of ECE, PES University, Bangalore,India, swethar@pesu.edu.in

Citation: Gaurav Patil et al. (2024), 'A Novel Technique For Dynamic Pothole Detection & Mapping Along With An Alert System', Educational Administration: Theory and Practice, 30(7), 25-28
Doi: 10.53555/kuey.v30i7.6424

ARTICLE INFO

ABSTRACT

The widespread problem of potholes poses signif- icant threats to road safety and infrastructure integrity as our global society increasingly relies on robust transportation net- works. Potholes, which are depressions that form on surfaces like highways, often start as small cracks but can escalate into significant hazards if neglected. This endangers both road users and the structural integrity of the roads themselves. In countries such as India, where potholes are not only common but also have serious consequences, the issue is particularly pronounced. Shockingly, incidents related to these road defects lead to over 3000 deaths annually, underscoring the urgent need for comprehensive efforts to mitigate their impact. De- spite having only 2% of the world's motor vehicles, India ac- counts for approximately 12% of global traffic accident fatali- ties. Addressing this disproportionate toll requires a thorough examination of the factors influencing the severity of the situa- tion. The prevalence of potholes during the monsoon season and adverse weather conditions, which obscure them from drivers' view, worsens the problem. Establishing a robust mon- itoring system capable of closely tracking these road risks is essential for proactively addressing this serious issue. Such a system should not only identify potholes promptly but also disseminate this crucial information to the public, providing early warnings that can mitigate the harm caused by these hazardous road conditions until proper repairs can be carried out. To enhance road safety and preserve infrastructure in- tegrity, this study delves into the complexities of the pothole problem in India, examining its impacts and causes while proposing a framework for an effective monitoring system.

I. INTRODUCTION

The driving force behind this initiative stems from the urgent need to tackle the widespread and life-threatening issue of potholes, particularly prevalent in nations like India. With an annual toll surpassing 3000 fatalities and a significant im- pact on road safety, there is

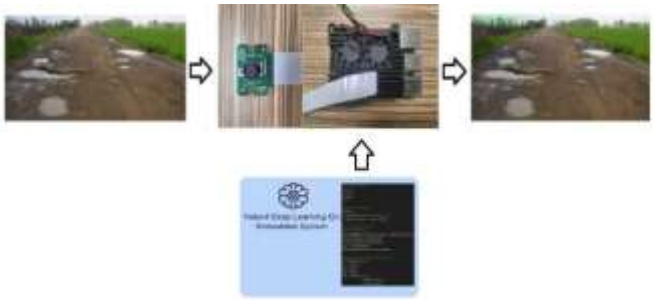


Fig 23. Pothole Detection

an immediate need for a proactive monitoring system capable of promptly alerting the public to these dangers.
The objective is to minimize the harm caused by potholes and promote a safer and more resilient transportation infrastructure. Grounded in the belief that innovative solutions can save lives andpreserve the integrity of our roads, this project is committed to implementing effective measuresto address the pothole problem.

1. Methodology

1) Pothole Detection Process: During operation, a cam- era records an uninterrupted video stream, which is then systematically captured and segmented into individual frames. These frames, essentially snapshots extracted from the live video stream, are then sent to the processor for further analysis. The core component of this analyti- cal process is the YOLOv4 (You Only Look Once ver- sion 4) algorithm. YOLOv4, an innovative object detec- tion system, meticulously dissects each frame, scrutiniz- ing every visual element to identify and highlight any potholes present. Through this advanced analysis, the algorithm meticulously identifies specific characteristics and patterns indicative of potholes in every frame it ex- amines. Upon detecting a pothole, the application auto- matically overlays a clear marker onto the corresponding image, pinpointing the exact location of the detected pot-hole and providing a visual cue. This integrated solution enhances the efficiency of subsequent actions such as maintenance or alerts by automating the pothole identifi- cation process and offering a tangible, visual representa- tion of their positions. The combined capabilities of YOLOv4 analysis, camera feed recording, and frame-by-frame image transmission create a dependable solution for real-time pothole localization and identification.
2) Co-ordinate Mapping: The system employs the u-blox Neo 6M GPS module to automatically obtain the current GPS coordinates when it detects a pothole using the YOLO technique. Renowned for its accuracy and reliability, this module records the precise geographic location of the system at that moment. The latitude and longitude information derived from the GPS coordinates serve as crucial metadata, providing spatial context for the detected pothole
3) Displaying on the Maps: The Bokeh library enables the creation of interactive and visually captivating data visualizations, while the Google Maps API offers a ro- bust foundation for crafting intricate and customizable maps. By displaying pothole registration GPS coordi- nates in real-time on a map, interested parties can gain a comprehensive spatial understanding of the location and quantity of road defects in a specific area. This interac- tive map enhances data interpretability and provides a comprehensive visual representation of the identified potholes. Users can zoom in on specific areas, click on markers for additional details, and gain valuable insights into the geographic distribution of pothole occurrences- One essential component of the system's real-time opera- tion is the constant tracking of the car's GPS location. While driving along its path, the car's GPS coordinates are continuously compared with the database of previ- ously identified pothole locations by the system, which stays alert. An instant alarm mechanism is triggered by the system if it detects a spatial proximity or overlap between the vehicle's location and a registered pothole site. This alert serves as a preventative precaution towarn the driver or the onboard computer of the approach- ing collision with a recognized pothole. The driver canbe alerted about impending road irregularities in a timelymanner by means of haptic feedback systems, visual in- dicators on the dashboard, or even audio alerts through built-in speakers.

II. Results and analysis

A.) Detection: YOLO consistently demonstrates superior performance over other image processing methods cited in the literature, excelling in both accuracy and computation time.

No of samples	Image detection technique	Average of accuracy	Average of sensitivity	Average of specificity	Compute time
20	Thresholding	80.6090	64.0402	83.0482	2.046
20	K-means clustering	82.4790	87.1834	82.2017	0.2766
20	Fuzzy c-means clustering	82.4629	71.3947	83.6494	1.1028
20	YOLO	83.3782	75.1924	85.7867	0.6834

B.) Coordinate Mapping and Alerting: Upon detec- tion, new GPS coordinates are promptly uploaded and stored in a designated file for future reference. This file acts as a repository, preserving the locations of all identi-fied potholes over time. By efficiently retrieving and ana-

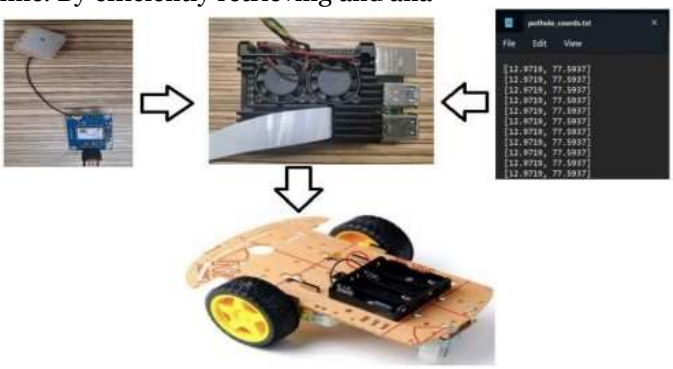


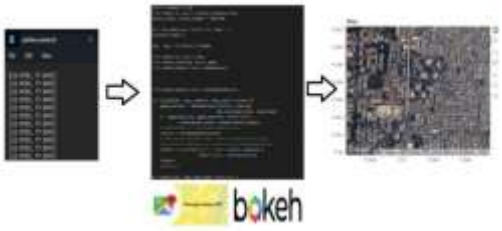
Fig 26. Pothole Alerting

lyzing these recorded coordinates later, this strategic storage approach yields valuable insights into the distri- bution and spatial patterns of potholes within a given area. Through meticulous data preservation, the system not only captures the immediate presence of potholes but also establishes a comprehensive database documenting their precise locations. Such information is crucial for conducting further analysis, identifying trends, and making informed decisions aimed at mitigating the im- pact of potholes on road infrastructure and safety.

As soon as the coordinates are acquired, Google Maps API is used to display them on the map. A visual depiction that gives a bird's-eye view of the road conditions is crucial for municipal planners, maintenance personnel, and decisionmak - ers. In addition to transforming raw GPS coordinates into an engaging visual story, this integration of the Google Maps API and Bokeh gives stakeholders a useful tool for strategic planning, financial allocation, and focused infrastructure improvements.Upon detection, the driver is promptly alerted via an LED light and buzzer. The LED blinks rapidly at a preprogrammed frequency, and the buzzer emits a brief sound

III. FUTURE WORK

Upon completion of the project, we have successfully demonstrated a functional system capable of utilizing a camera feed to detect potholes, store their locations, and alert users when their GPS coordinates approach these hazardous areas on the road. Through this integrated approach, road safety and driver awareness are signifi- cantly heightened. The project's success opens doors to exciting possibilities for further enhancement. One no- table enhancement involves integrating pothole alerts into real-time navigation maps. By seamlessly incorpo- rating pothole data into popular navigation apps like Google Maps or other GPS-based technologies, users can receive context-aware, real-time warnings about pot-



holes directly on their navigation interface. This dynam- ic integration ensures drivers receive timely information about their routes and are not only informed of pothole existence but also guided on how to avoid them. Addi- tionally, future iterations of the system may include route-dependent notifications alongside proximity-based alerts. By analyzing whether detected potholes align with the user's selected route, the alert system would be re- fined, offering users a more personalized and nuanced experience where alerts are triggered based on their in- tended path rather than just proximity

V. REFERENCES

1 K. Vigneshwar and B. H. Kumar, "Detection and counting of pothole using image processing techniques," 2016 IEEE International Conference on Computational Intel- ligence and Computing Research (ICCIC), Chennai, India, 2016, pp. 1-4, doi: 10.1109/ICCIC.2016.7919622.

2. Ahmed, S. Islam and A. Chakrabarty, "Identification and Comparative Analysis of Potholes using Image Processing Techniques," 2019 IEEE Region 10 Symposium (TENSYMP), Kolkata, India, 2019, pp. 497-502, doi: 10.1109/TENSYM-
3. P46218.2019.8971385
4. Akagic, E. Buza and S. Omanovic, "Pothole detection: An efficient vision based method using RGB color space image segmentation," 2017 40th International Con- vention on Information and Communication Technology, Electronics and Microelec- tronics (MIPRO), Opatija, Croatia, 2017, pp. 1104-1109, doi: 10.23919/MIPRO.2017.7973589.
5. Desai, A. Soni, D. Panchal and S. Gajjar, "Design, Development and Testing of Automatic Pothole Detection and Alert System," 2019 IEEE 16th India Council In- ternational Conference (INDICON), Rajkot, India, 2019, pp. 1-4, doi: 10.1109/INDI-CON47234.2019.9030271.
6. Prakash, S. Raadha, T. Swami and E. Mahalakshmi, "Sensor-based espial of potholes and humps on roads with instant notification alert using IoT," 2022 In - ternational Conference on Computer, Power and Communications (ICCPC), Chennai, India, 2022, pp. 281-285, doi: 10.1109/ICCPC55978.2022.10072130.
7. Chellaswamy, H. Famitha, T. Anusuya and S. B. Amirthavarshini, "IoT Based Humps and Pothole Detection on Roads and Information Sharing," 2018 International Conference on Computation of Power, Energy, Information and Communication (ICCPEIC), Chennai, India, 2018, pp. 084-090, doi: 10.1109/ICCPEIC.2018.8525196