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DRIVE-ON POTHOLE AND ROAD SIGN DETECTION

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Abstract: In regions like India, where road maintenance is a significant challenge and potholes pose a severe threat to drivers, the need for automated detection solutions is paramount. This paper addresses this challenge by creating a new dataset comprising 1500 images of Indian roads and annotating it for training a deep learning model using YOLO v7. Despite the lack of existing pothole datasets specific to India, leveraging convolutional neural networks (CNNs) proves effective in detecting these hazards. By harnessing the power of deep learning, this approach offers a cost-effective and efficient solution for identifying potholes,and important road signs which contributing to improved road safety and accident prevention in high-risk areas like India.

Index Terms - CNN, Pothole , Road safety, Deep learning.

Introduction

Obstacle detection has been the subject of extensive research in the past, with different methods for avoiding various types of impediments in diverse environments being tested. However, the focus has been mostly on autonomous agents avoiding impediments, which has been confined to extruding obstacles. As a result, the detection mechanism became exceedingly system-specific and unsuitable for widespread use. Road transportation has been very simple and cost-effective, albeit the comfort of the ride is determined by the state of the road. Potholes on roadways are a big source of frustration for people who travel by car. Accidents and loss of human lives are caused by potholes generated by severe rainfall and heavy vehicle activity.[1] As a result, potholes are becoming a significant concern to drivers, who risk accidents and car damage. Unexpected humps and ditches on the road could lead to more collisions. As a result, the potholes must be filled to make the ride more comfortable and to eliminate potential hazards. As a result, the suggested system employs the YOLO (You Only Look Once) v7 Algorithm to detect Manually examining and evaluating visual pavement data is a time-consuming and costly process, and the findings are heavily impacted by the subjectivity and experience of evaluations.[5] The primary objective of this system is to detect the potholes present on the road through deep learning approach which helps automate the task of detecting potholes and helps one to easily understand that they are heading towards a pothole present on the road. The following is discussed in the rest of the paper: Section 2 discusses some of the related projects or literature review. Section 3 provides the methodologies used. The technical components used is presented in Section 4. Section 5 presents the implementation and Section 6 presents the comparative analysis between CNN (Convolutional Neural Networks) and YOLO v7 of the proposed system and Section 7 describes the conclusion and further research work.

I. LITERATURE REVIEW

[1] Vision-based traffic sign recognition and detection systems, focusing on algorithms, image recognition techniques, and their application in improving road safety. Significant progress in the visual perception of the environment, particularly in vehicle recognition and detection, contributing to improved traffic sign recognition systems.Analyzing factors like pedestrian crossings and vehicle speed helps assess safety risks in road accidents.Highlighting the importance of accurate traffic sign recognition systems in mitigating potential hazards.

[2] Detecting traffic signs by classifying images using CNN on the GTSRB and Indian datasets, aiding electric or self-driving cars in efficient recognition.Comprises of two parts: traffic sign detection and classification based on CNN. YOLO v3-v4 and BLOB detection methods are used for traffic sign detection .Aims to leverage advanced computer vision and machine learning techniques to address these challenges and contribute to the development of ITS for fully autonomous vehicles.

[3] Enhance road safety by providing real-time support for identifying and adhering to traffic signs through automated detection and classification. Utilize Convolutional Neural Network (CNN) trained on German Traffic Sign Dataset (50,000 images) and Indian Traffic Sign Dataset (2,000 images) to classify various traffic sign designs. YOLO v5 for efficient detection and classification of multiple traffic signs simultaneously Optimize processing efficiency using YOLO v5 and other techniques to meet real-time processing needs and provide timely information to the driver

[4], Systematic review investigates applications of computer vision (CV) combined with sensor technology for Automated Road Defect and Anomaly Detection (ARDAD). Future implications based on analysis of 116 selected papers between 2000 and 2023. Identifies popular open-access datasets (18) and research trends to accelerate the application of sensor technology in ARDAD and CV. Survey artefacts aim to improve traffic conditions and safety by assisting the scientific community in advancing ARDAD technologies

[5],Develop and compare traffic sign recognition algorithms based on ResNet and CNN models to enhance road safety and efficiency. Utilize a dataset of traffic sign images from Kaggle to design ResNet-based and CNN-based architectures capable of capturing complex features of traffic signs. Achieve a recognition accuracy of 99% for the ResNet-based model and 98% for the CNN-based model on the test set, demonstrating the effectiveness of the proposed approach

II. PROBLEM STATEMENT

Inefficient and subjective methods for detecting potholes on roadways pose significant risks to drivers and infrastructure, leading to accidents, vehicle damage, and discomfort for road users. Traditional manual inspection methods are time-consuming, costly, and prone to human error, while existing automated systems lack widespread applicability due to their system-specific nature. Therefore, there is a critical need for a robust and scalable solution that utilizes deep learning techniques to accurately and efficiently detect potholes on roads, ultimately improving road safety and driving experience.

III. PROPOSED SYSTEM

System helps to increase more accurate detection of potholes and road signs. There is an extra feature added in system that the road signs can be detect. it helps to increase safety.The main advantages of YOLO v7 is its speed.It can process images at a rate of 155 frames per second. Allows us to identify potholes and signs in an image or video. Average potholes present in a specific path can be detected by adding the video of path.

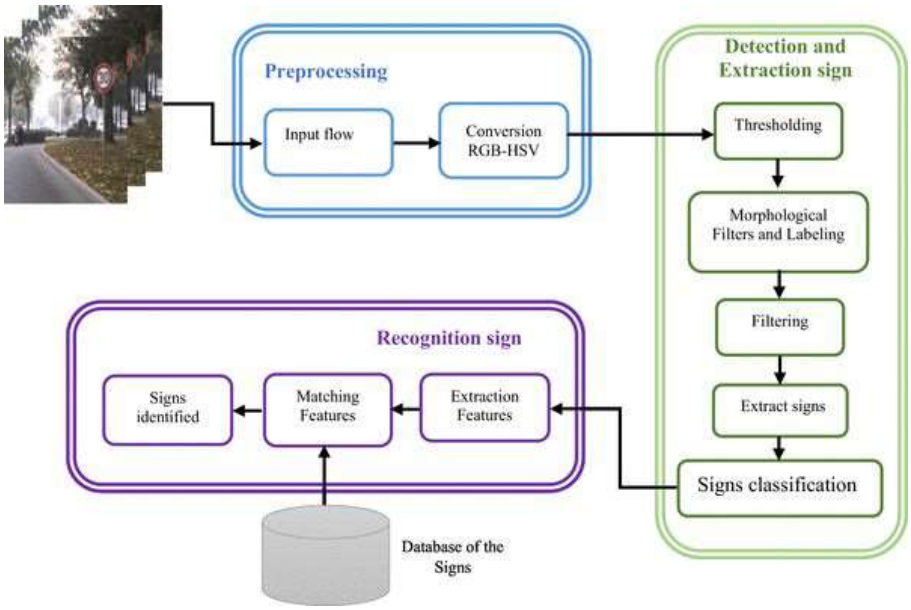

Fig.1 : system architecture

1. **Detect Signs:**This module is responsible for detecting potholes present on the road using the YOLO (You Only Look Once) Algorithm. It analyzes visual pavement data to identify potholes accurately
2. **Data Inputs:**This module manages the input data required for pothole detection, including visual pavement data obtained from cameras or other sensors mounted on vehicles or roadside infrastructure.
3. **Preprocessing:**Prior to pothole detection, this module preprocesses the input data to enhance its quality and suitability for analysis. It may involve tasks such as noise reduction, image enhancement, or normalization.
4. **Pothole Detection Algorithm:**This module implements the pothole detection algorithm, leveraging deep learning techniques like YOLO v7. It identifies potential potholes within the preprocessed visual data.
5. **Feature Extraction:**After detecting potential potholes, this module extracts relevant features from the detected regions to characterize them further. These features aid in classification and analysis.
6. **Classification:**Based on the extracted features, this module classifies the detected regions as either potholes or non-potholes. It distinguishes between different types of road surface irregularities to accurately identify potholes.
7. **Post Processing:**Once potholes are classified, this module performs post-processing tasks to refine the results and remove false positives. It may involve filtering out noise or validating detections based on contextual information.
8. **Visualization and Reporting:**Finally, this module visualizes the detected potholes on a map or graphical interface, providing users with a clear representation of pothole locations. It also generates reports summarizing the detected potholes and their characteristics for further analysis or action.

IV. RESULTS AND DISCUSSION

Results and discussion:The implementation of the proposed plan was beneficial in identifying signs and wells, thus increasing driver safety and awareness. The integration of the YOLO v7 algorithm helps analyze the important points of this path effectively and accurately. This feature facilitates safety and reduces the risk of accidents by ensuring drivers receive timely warnings about hazards, speed limits and other relevant information. This shows that there is a strong workforce. By analyzing the information on the road, it can detect wells of different sizes and shapes, even in harsh environments. This feature is particularly important in reducing the risks associated with accidents and vehicle damage on the lake, thus improving the overall road quality and user experience. The latter outperforms the CNN method in fast and accurate detection. YOLO v7's on-the-fly processing quickly identifies road markings and puddles, enabling timely responses to road changes and reducing driver distraction. Ability to adjust traffic flow by automatically searching for signs and reservoirs. Using deep learning technology, the system provides effective solutions to important road safety issues, ultimately improving travel and reducing accidents.

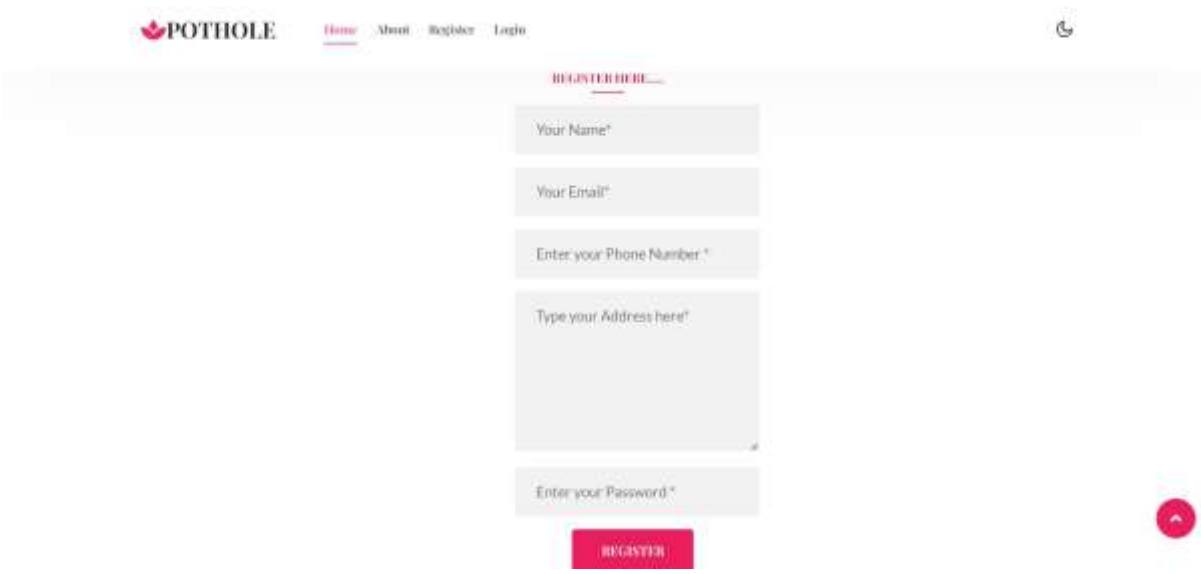

Fig 2 : GUI for registration

Fig 2.1 : Pothole Detection

Fig 2.2 : Road Sign Detection

V. CONCLUSION

Pothole detection systems, utilizing advanced technologies such as computer vision and machine learning, offer an efficient and automated approach to identify and locate potholes. This automation helps streamline the detection process, leading to faster response times and more effective maintenance effortsTimely Repairs: By promptly identifying and reporting potholes, authorities can take timely action to repair them. Pothole detection systems provide a means for both users and officers to report and address pothole issues, ensuring that repairs are conducted promptly to prevent accidents and further road damageProactive Maintenance: Pothole detection systems can aid in proactive road maintenance. By identifying and monitoring areas prone to potholes, authorities can proactively allocate resources for regular maintenance and repairs, minimizing the occurrence and severity of potholesRoad Safety Improvement: Potholes pose significant safety hazards for drivers, pedestrians, and cyclists. Detecting and repairing potholes helps enhance road safety by reducing the risk of accidents, vehicle damage, and injuries caused by these road defects.

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