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Two Wheeler Vehicle Modification Detection System

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***Abstract*:- This paper explores the development of a machine learning-based system designed to detect unauthorized modifications in two-wheeler vehicles. By analyzing uploaded images of vehicle parts, the system identifies deviations from standard specifications to help enforce regulatory compliance. The ultimate goal is to streamline modification detection and potentially assign penalties for non-compliance, offering a robust solution for automated vehicle inspection.**

***Keywords*:- Machine learning, CNN, ResNET, YOLOv5**

I. INTRODUCTION

In recent years, the popularity of vehicle modifications among two-wheeler owners has surged, driven by desires for personalization, improved performance, and enhanced aesthetic appeal. However, unauthorized modifications can significantly compromise safety, violate regulatory standards, and lead to environmental non-compliance, presenting considerable challenges for regulatory bodies tasked with enforcing vehicle regulations. These unauthorized alterations, such as modifications to exhaust systems or structural components, can create safety hazards not only for the vehicle operators but also for other road users. Traditional methods of detecting such modifications rely heavily on manual inspections, which are often time-consuming, labor-intensive, and prone to human error, thereby creating an urgent need for innovative solutions that enhance efficiency and reliability in the detection process.

Our system aims to address this gap by developing an automated image-based system that leverages advancements in machine learning and computer vision to detect deviations from standard specifications in two-wheeler vehicle parts and components. By training on a diverse dataset of images featuring both modified and stock vehicles, the proposed system seeks to enhance the accuracy and efficiency of modification detection, ultimately providing regulatory authorities with a robust tool for enforcement. The implementation of this system has the potential to streamline inspection processes, reduce the time and resources required for manual inspections, and facilitate quicker decision-making. Additionally, by potentially automating penalty assignments for non-compliance, this research aspires to contribute to a safer, more responsible, and regulated environment for two-wheeler modifications, promoting a culture of compliance among vehicle owners.

II. LITERATURE REVIEW

In paper[1], An improved vehicle detection model, YOLOv5-CBAM, is proposed for complex traffic scenarios. The model enhances YOLOv5 by incorporating a Cross-Stage Partial (CSP) network for better feature extraction and a Convolutional Block Attention Module (CBAM) to focus on critical features. An additional detection head enhances the identification of modified vehicles, demonstrating effectiveness in real-time detection of moving and static objects.

In paper[2], A system for detecting scratches on cars utilizes the AlexNet convolutional neural network (CNN) architecture through transfer learning. By fine-tuning a pre-trained CNN, the model classifies car sections as scratched or unscratched using a dataset generated from segmented vehicle images. The method allows for efficient real-time inspections despite challenges such as lighting conditions and potential misclassification.

In paper[3], The application of ResNet architectures is explored for fine-grained vehicle classification. The study investigates the performance of ResNet-18, ResNet-34, and ResNet-50, incorporating Spatially-Weighted Pooling (SWP) and a localisation step to enhance accuracy. The modified ResNet-50 surpasses traditional CNNs, although the introduction of localisation presents challenges for real-time applications due to reduced processing speed.

In paper[4], This review focuses on deep learning-based anomaly detection in images, particularly in medical imaging. It examines methods such as autoencoders, GANs, and CNNs for detecting anomalies across various datasets. The review highlights advantages like improved accuracy and automation but also notes challenges such as data imbalance and the difficulty of distinguishing noise from actual anomalies. Future research is suggested to address these issues.

In paper[5], A system automates trademark similarity

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detection using deep learning with pretrained CNNs, specifically ResNet-50 and VGG-16, for feature extraction followed by PCA for dimensionality reduction. Similarity is measured using Euclidean distance, retrieving visually similar trademarks from a large dataset. The system improves the accuracy and efficiency of trademark registration processes while facing challenges with text interpretation and computational demands.

III. PROBLEM STATEMENT

The increasing prevalence of vehicle modifications among two-wheeler owners presents a unique challenge for regulatory authorities worldwide. Modifications are frequently pursued to enhance a vehicle's aesthetic appeal, performance, or functionality, yet not all modifications comply with regulatory standards. Unauthorized or excessive modifications, such as changes to exhaust systems, lighting, or body structures, can lead to a range of issues, from compromised vehicle safety and increased accident risks to environmental non-compliance due to higher emissions. Traditional methods for detecting these unauthorized modifications rely heavily on manual inspections carried out by regulatory personnel. While effective in limited cases, manual inspections are time-consuming, resource-intensive, and prone to inconsistencies due to human error, making it difficult to keep pace with the rapid increase in modified vehicles on the road. Given the scale of the issue and the limitations of existing methods, there is a growing need for automated solutions that can quickly and reliably identify modifications in two-wheeler vehicles. We proposes the development of a machine learning-based system capable of analyzing images to detect deviations from standard specifications in two-wheeler vehicle parts and components. Such a system would address the shortcomings of manual inspections by enabling systematic and scalable modification detection, thereby assisting regulatory bodies in enforcing compliance, streamlining inspection processes, and potentially automating penalty assignment for non-compliance. Ultimately, this approach aims to foster a safer and more responsible environment for vehicle modification, aligning vehicle usage with safety and environmental standards.

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