# **DECLARATION**

We hereby declare that this submission is our work and that, to the best of our knowledge and belief, it contains no material previously published or written by another person nor material which to a substantial extent has been accepted for the award of any other degree or diploma of the university or other institute of higher learning, except where due acknowledgment has been made in the text.

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| Date      Signature: | : |
| Name | : Vivek Agarwal |
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# **CERTIFICATE**

This is to certify that *Project Report entitled ―* “Helmet Verify: AI Detection System for Safety Check” which is submitted by Pratham Sherawat (2100681520028), Aryan Barar (2100681520011), Vivek Agarwal (21006815200057) in partial fulfilment of the requirement for the award of degree B. Tech. in Department of Computer Science and Engineering (Artificial Intelligence) of Dr. A.P.J. Abdul Kalam Technical University, U.P., Lucknow., is a record of the candidates own work carried out by them under my supervision. The matter embodied in this Project report is original and has not been submitted for the award of any other degree.

**Date:** **Supervisor**

# **ACKNOWLEDGEMENTS**

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We also do not like to miss the opportunity to acknowledge the contribution of all faculty members of the department for their kind assistance and cooperation during the development of our project. Last but not the least, we acknowledge our friends for their contribution to the completion of the project.

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# **ABSTRACT**

Road safety is a crucial issue worldwide, with motorcycle-related accidents accounting for a significant percentage of fatalities. Studies indicate that wearing helmets can reduce the risk of severe head injuries by up to 69% and decrease the probability of death by 42%. However, enforcing helmet compliance remains a challenge due to inefficiencies in manual monitoring methods. Traffic police inspections are labour-intensive, inconsistent, and often ineffective, particularly in areas with high motorcycle traffic. To address this issue, "Helmet Verify" introduces an AI-powered helmet detection system that automates compliance enforcement using deep learning-based object detection. This project employs the YOLOv11 (You Only Look Once version 11) model, a state-of-the-art deep learning framework designed for real-time object detection with high precision. YOLOv11 enhances previous YOLO models by introducing adaptive anchor boxes, an improved loss function, and an optimized backbone architecture to deliver superior accuracy and efficiency. The model is trained on a custom dataset of 1200 annotated images, incorporating diverse environmental conditions, varying helmet types, and different lighting scenarios to ensure robust performance. Advanced data augmentation techniques such as rotation, scaling, and contrast adjustments further enhance generalization.

To maximize enforcement efficiency, Helmet Verify integrates YOLOv11 with Arduino Uno, allowing the system to enforce helmet compliance actively. The detection system operates through live video feeds from surveillance cameras or embedded onboard cameras on motorcycles. When a non-helmeted rider is detected, the Arduino-based safety mechanism prevents vehicle ignition or alerts law enforcement in real-time. This automation minimizes human intervention and ensures continuous enforcement, significantly reducing helmet violations and improving overall road safety.

Extensive testing demonstrates that the Helmet Verify system achieves an impressive mean Average Precision (mAP) of 0.978, an F1-score of 0.96, and real-time processing speeds suitable for deployment in intelligent transport systems. Comparative evaluations of existing helmet detection frameworks indicate superior recall and precision, with minimal false positives and negatives. The system's robust performance ensures reliable operation across various road conditions, lighting environments, and helmet styles.