Evaluating the Effectiveness of YOLOv11-Based Vehicular Accident Detection in the ImuSafe Mobile App: A Quantitative Study in Imus, Cavite

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ABSTRACT

Vehicular crashes in Imus City continue to create delays in emergency reporting and response, motivating the development of ImuSafe, a mobile-first accident recognition system that integrates real-time YOLOv11m-based detection with a web dashboard for the Imus Local Government Unit. Built using Agile development, the platform combines a Flutter mobile application, Firebase-backed services, and a FastAPI inference server hosted on AWS to support automated report submission, location capture, and incident monitoring. The study used 22,399 images, including 1,465 annotated local images and 20,934 pre-annotated external images, to train and evaluate the custom detector. The YOLOv11 model achieved a precision of 0.9305, recall of 0.8398, mAP@50 of 0.9229, and mAP@50–95 of 0.8144, indicating strong detection capability for accident scenes. User evaluation from 50 respondents under ISO 25010 produced an overall system quality score of 4.37 out of 5, with security, usability, and functional sustainability receiving the highest ratings. The findings suggest that ImuSafe is a feasible and practical tool for accelerating vehicular accident reporting and improving local emergency response coordination in Imus, Cavite.

KEYWORDS

vehicular accident detection, YOLOv11, mobile application, emergency response, computer vision, ISO 25010

1 INTRODUCTION

Road traffic crashes remain a persistent public safety concern, particularly when incident reporting is delayed and responders receive incomplete information. The ImuSafe project addresses this problem by pairing computer vision with mobile reporting so that accident scenes can be detected and relayed to local authorities in near real time.

2 SYSTEM DESIGN AND METHOD

ImuSafe was developed as a cross-platform mobile application with a corresponding web dashboard for the Imus Local Government Unit. The system follows an Agile workflow with iterative planning, implementation, testing, deployment, and review. On the client side, users can sign in, submit accident reports, and access emergency hotlines and safety tips. On the server side, a FastAPI service runs the YOLOv11m model and forwards validated reports to Firebase Firestore for dashboard monitoring. To improve model robustness, the training pipeline used augmentation strategies such as Mosaic, MixUp, HSV perturbation, rotation, translation, scaling, and horizontal flipping.

The evaluation set consisted of 22,399 images drawn from local and external sources, with local images obtained from the Imus LGU and additional annotated data gathered from public repositories. The study also gathered user feedback from 50 respondents, including drivers, commuters, emergency personnel, and local government stakeholders.

3 RESULTS

The custom YOLOv11 detector demonstrated strong predictive performance, with precision at 0.9305, recall at 0.8398, mAP@50 at 0.9229, and mAP@50–95 at 0.8144. These results show that the model can localize and classify accident scenarios with a high degree of reliability. In the user evaluation, the overall ISO 25010 score reached 4.37 out of 5, reflecting positive perceptions of the system's quality. Security obtained the highest mean rating, followed by usability and functional sustainability, while reliability was the lowest-rated category, indicating the need for further improvement under varied operating conditions.

4 CONCLUSION

ImuSafe demonstrated that a mobile-integrated, YOLOv11-based accident detection pipeline can support faster and more organized emergency response in a local government setting. The system is technically viable and well received by users, but future work should focus on improving reliability in diverse lighting and environmental conditions, as well as refining severity interpretation and response recommendations.