CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

5.1. Conclusions

Based on the research findings that have been conducted, it can be concluded that:

1. The HG680P Set-Top Box was successfully analyzed and implemented as an edge computing device to run the YOLOv11n model. Test results indicate that the system is capable of achieving an average processing speed of 3.9 FPS with an average inference time of 312 ms. Furthermore, the utilized model attained strong accuracy in detecting vehicle and pedestrian objects, with a precision value of 95% and a recall of 92%. These results demonstrate that the use of the ONNX format and the YOLOv11n architecture allows the ARM Cortex-A53-based HG680P to execute inference processes efficiently despite possessing hardware resource limitations.
2. The automatic accident prevention system on bicycles was successfully designed and implemented by integrating an ESP32, ultrasonic sensor, camera, HG680P Set-Top Box, and a servo actuator serving as the automatic braking mechanism. The system operates using a sensor fusion approach, which combines object detection results from the YOLO model with distance data from the ultrasonic sensor prior to issuing a braking command. Test results demonstrate that the system is capable of responding to the presence of hazardous objects in accordance with predefined criteria, and no inappropriate braking activations were observed during testing. The architecture that distributes tasks between the HG680P as the AI processing unit and the ESP32 as the sensor and actuator controller is proven to yield a system that is efficient, modular, and holds the potential for further development in IoT-based transportation safety applications.

5.2. Recommendations

1. To enhance the performance of the HG680P Set-Top Box as an edge computing device, future research can conduct further model optimization, such as through quantization and pruning processes, or by utilizing lighter models. Additionally, the training dataset can be expanded with variations in lighting conditions, weather, viewing angles, camera quality, and a more diverse range of object types to improve the model's accuracy and generalization capabilities..
2. For the development of the automatic accident prevention system, supporting sensors such as LiDAR or radar can be integrated to enhance distance measurement accuracy and detection reliability across various environmental conditions. Subsequent research can develop braking algorithms that consider bicycle speed, object distance, and collision risk levels so that the system is able to provide a more adaptive and optimal response in real-world usage scenarios.