Masters Dissertation Showcase
Year 2023

Department: Computer Science & Information Technology
Programme: Masters of Science
Specialization: Data Sciences

1	**Title of the Thesis** A ConvNet-based Object Detection for Unmanned Aerial Vehicles
2	**Abstract** Addressing object detection challenges in Unmanned Aerial Vehicle (UAV) images constitutes a significant task within computer vision. This research delves into these intricacies and technological advancements in the UAV domain. Notably, the research comprehensively evaluates the performance of object detection algorithms through a comparative analysis of YOLOv5s, YOLOv8s, and YOLO-NASs. The research explores the strategies employed by these algorithms to address challenges posed by scale variations, occlusions, complex backgrounds, and limited training data, often encountered in aerial imagery. The investigation highlights the optimized YOLO framework for real-time vehicle detection using UAV-captured real custom imagery taken in Karachi, Pakistan showcasing enhancements through pre-processing of images and augmentation techniques. Furthermore, the research dissects the architectural components of YOLO models, underscoring their application on UAV. The research culminates in a detailed evaluation of the models' performance using quantitative metrics and qualitative visualizations, revealing YOLOv8s as the frontrunner with a Mean Average Precision (mAP@50) score of 0.6608 leaving behind YOLO-NASs with mAP@50 score of 0.65 and YOLOv5s 0.647. Additionally, these advancements have practical implications across industries like remote sensing, transportation, and medicine. They drive the ongoing evolution of object detection capabilities in aerial imagery, providing effective solutions for real-world use.
3	**Impact on Sustainability of Urban Regions or SDG-11 "Sustainable Cities and Communities"** (min 400 words) Effective traffic management: In urban environments, the precise detection of vehicles, pedestrians, and other objects is a critical component of efficient traffic management. Effective traffic management can play a pivotal role in reducing traffic congestion, minimizing fuel consumption, and lowering greenhouse gas emissions. Traffic congestion is a pervasive issue in urban areas, leading to countless hours of lost productivity and frustration for commuters. Accurate object detection systems can monitor traffic conditions in real-time and respond dynamically to alleviate congestion hotspots. By rerouting vehicles and synchronizing traffic signals, they can ensure a more efficient flow of vehicles, reducing delays and shortening travel times. This improvement in traffic management not only benefits commuters by making their journeys more convenient but also has broader implications for the environment. This not only saves money for individuals but also contributes to a reduction in the overall carbon footprint of a city. Lower fuel consumption directly translates to a decrease in greenhouse gas emissions, making urban areas more environmentally friendly. The accurate detection of vehicles, pedestrians, and other objects in urban traffic scenarios is crucial for efficient traffic management. These

	algorithms can aid in reducing traffic congestion, minimizing fuel consumption, and lowering greenhouse gas emissions by enabling optimized traffic flow. Enhanced Safety: Accurate object detection in aerial imagery can contribute to improved road safety by identifying potential hazards, such as accidents or obstacles on the road. This can reduce the number of accidents, injuries, and fatalities, making urban areas safer for residents. Reduced Energy Consumption: Effective traffic management and reduced congestion can lead to lower energy consumption in urban regions. Efficient traffic flow means less time spent idling in traffic, resulting in reduced fuel consumption and lower emissions. Smart City Integration: Object detection algorithms can be integrated into smart city initiatives to monitor and optimize traffic, parking, and public transportation systems. This contributes to more sustainable and livable urban communities by reducing pollution and congestion. Disaster Management: The research also highlights the applications of object detection algorithms in disaster management. In urban areas, these algorithms can help authorities respond more efficiently to natural disasters, minimizing damage and aiding in recovery efforts. Efficient Resource Allocation: Accurate object detection can assist in the allocation of resources for urban development and infrastructure improvements. Cities can make informed decisions on where to invest resources based on real-time data and analysis. Data for Sustainable Urban Planning: The research data collected from UAVs can be used in urban planning to develop sustainable communities. It provides valuable insights into urban dynamics, traffic patterns, and land use, enabling city planners to make informed decisions for long-term sustainability. Reduced Environmental Impact: By optimizing traffic management and reducing congestion, these object detection algorithms can lead to fewer idling vehicles, resulting in decreased air pollution and a smaller carbon footprint in urban areas. Community Engagement: Object detection can support community engagement initiatives by providing data that empowers residents to make informed decisions about transportation, resource conservation, and disaster preparedness. Involving the community in sustainability efforts
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