Silesian University of Technology as a Center for Modern Education Based on Research and Innovation

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PBL – Project Based Learning	
Title:	**Unmanned Aerial System for Monitoring State Borders Using Thermal Imaging and Artificial Intelligence Algorithms**
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The project aimed to develop an unmanned aerial system intended to monitor border areas in terms of uncontrolled crossing of state borders by unauthorised persons in prohibited locations. The assumption of the project was to develop and construct a UAV system capable of flying above the tree line and detecting human silhouettes in challenging environmental conditions, i.e. with limited visibility resulting from operations in forest areas. For this reason, image processing techniques, particularly machine learning technology, were assumed. The image is obtained from a FLIR thermal imaging camera mounted on an unmanned aerial platform. Data and image processing solutions have been implemented to recognise people in a given area and determine their location. In this research work, the thermal YOLO object detection system was proposed as a smart human silhouette sensing system that should remain effective in all weather and harsh environmental conditions using an end-to-end YOLO deep learning framework. The system has been trained on large-scale thermal newly gathered novel datasets comprising more than 10,000 distinct thermal frames. The study further included deploying deep learning architecture on the edge and mobile devices, which can be interpreted as optimising a small network variant.

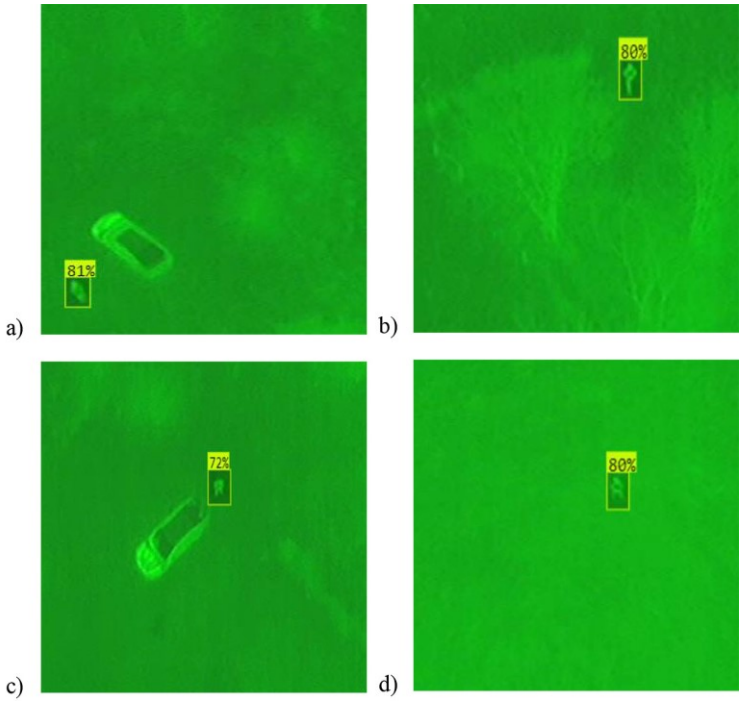

Fig. Thermal imaging with YOLOv8 algorithm detection, identifying a human at: a) 81% b) 80% c) 72% d) 80% confidence