Louis Lumos - Traffic Safety Harness

Development of a Vehicle Detection System using Embedded Sensors and Machine Learning

Students



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Introduction: Visibility can be crucial in road safety to prevent accidents. Therefore, the industrial partner of this thesis wants to develop a device that visually alerts approaching vehicles. Our team was asked to develop such a system based on their proof-ofconcept. Their concept uses a machine learning model running on a single-board computer and sensors connected via USB. The main objective of this work was to minimise the existing system using low power microcontrollers and embedded sensors, while maintaining the performance of the original system.

Approach: Various vehicle detection options were evaluated and compared in terms of power consumption and performance. Based on these evaluations, a suitable sensor was selected and implemented on a custom design. In addition to the sensor, several other components such as power management and the central microcontroller were included as shown in Fig. 2. The signal from the sensor is processed and amplified and then compared to a fixed threshold. If the aignal is bipter than the threshold the

the signal is higher than the threshold, the microcontroller wakes up from deep sleep and processes the signal. Using a nearest neighbour approach, the signal is classified and if a car is detected, the light is switched on. This approach allows the signal to be detected at all times while significantly reducing the electrical power in the system.

Result: The developed hardware was successfully deployed, and the light alert effect is functioning as intended. Due to the limited resources of the microcontroller, the previously used machine learning model was too large. A suitable replacement was found that runs efficiently on the microcontroller. The

Fig. 3: Prototype of the PCB. Own presentment chosen nearest neighbor method works effectively, although a simpler model might also suffice. The proof-of-concept was successfully reduced in size while retaining its core functionality. Based on the insights gained, it is recommended that the industrial partner continues with the current approach and works towards bringing the product to market maturity.

Fig. 1: Functional concept, the system detects only the car and sends a visual alert. Own presentment



Fig. 2: All implemented subsystems with the signal processing on the bottom and the visual alert on the top. Own presentment





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