A Novel Low-Cost LiDAR-Based Car Collision Avoidance Solution

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In 2025, car crashes resulted in an estimated 1.2 million deaths globally (1). Of the 1.6 billion vehicles in the world, it is estimated that only between 350 and 500 million vehicles have some form of collision avoidance system (2). This research seeks to reduce the number of fatal car crashes by developing a low-cost, LiDAR-Assisted Collision Avoidance System, called LACAS, for world-wide adoption. This research started by conducting a trade study to identify feasible and cost-effective sensors. A LiDAR (Light Detection and Ranging) sensor was selected due to high technological maturity and low cost. LiDARs have experienced a 99% reduction in unit cost since 2015 due to volume production and a shift to solid-state technology (4). The LACAS consists of a front-facing LiDAR that provides range data of any vehicle in the car's path with a 250 Hz refresh rate. Signal processing is performed by using an ESP NOW to filter the processed data, computing velocity and acceleration, and transmits a Boolean expression to another ESP32 microcontroller situated inside the vehicle. A pre-set, and configurable, file inside the microcontroller alerts the driver with audio and visual effects. During developmental testing, the LACAS software was optimized to reduce signal processing latency from 895 µs to under 136 µs. During operational testing, the LACAS performed well in bright light, low-light, and no-light conditions and had degraded performance in fog and heavy rain conditions. The total cost of both parts of the LACAS is $36/unit.

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