System for Fusing Visible and Thermal Camera Images for an Unmanned Vehicle's Perception

1. Technology:

The proposed invention provides a system for fusing a visible camera image and a thermal camera image for an unmanned vehicle's perception. The system includes memory and a processor. The processor enhances a quality of a visible camera image and a corresponding thermal camera image by adjusting the contrast of the visible camera image and the thermal camera image. The processor automatically selects one or more control points for the visible camera image and the thermal camera image by identifying the points that are similar in both the visible camera image and the thermal camera image using a control point selection technique. The processor will automatically generate a transformation matrix by matching the control points of the visible camera image with the control points of the thermal camera image for a pixel-wise transformation of the visible camera image to match the control points of the thermal camera image. The processor will automatically generate a pixel-wise transformed visible camera image by transforming the visible camera image in pixel-wise to match dimensions and the control points of the thermal camera image based on the transformation matrix. The processor will automatically generate a fused image by fusing the pixel-wise transformed visible camera image with that of the thermal camera image using an image fuse and blending technique.

IMAGE BEFORE FUSION

IMAGE AFTER FUSION

2. Problem Addressed:

The National Highway Traffic Safety Administration has reported nearly 392 accidents involving semi-autonomous vehicles, including those made by Tesla, Ford, and Toyota, primarily due to inaccurate perception. One tragic example is the fatal pedestrian accident involving an Uber vehicle, where the camera failed to detect the pedestrian at night. Accurate environmental perception is a critical requirement for unmanned vehicles. The vision of any Autonomous/Unmanned vehicle solely depends

on accurate perception. Though various exteroceptive sensors such as RGB Camera, LIDAR, and RADAR were utilized with fusion, the perception lacks accuracy. Camera is an inevitable sensor used in the Autonomous Road vehicles for detecting traffic lights, signs, and Pedestrians. But the camera lacks accuracy during sunny, snowy, and low illumination conditions. For these reasons, LIDAR has been extensively used to capture the three-dimensional environment around the vehicle. But the cost and complexity of the LIDAR pose a serious issue. By improving the perception of the Visible Imaging Camera, the need for LIDAR can be eliminated for Autonomous/Unmanned vehicle. The accuracy of the Visible Imaging Camera's perception can be increased with the fusion of Thermal Imaging Camera as these sensors operate passively for which they do not depend on the time of flight thereby reducing overall computational time. The resultant fused image will have more segmentation features for semantic segmentation to be performed rather than Standalone Visible Imaging Camera Image. Based on the literature survey it was found out that the available fusion methodologies were based on encoder and decoder deep learning techniques or complex Algorithms either which will take more processing time and computational power, thus posing its limitations for its adaptability in real driving conditions for Autonomous/Unmanned Vehicles.

3. Industrial Applications:

The proposed Novel method can be adopted in any Autonomous/Unmanned vehicles for the enhanced perception. The future vehicle system will be semi-autonomous or autonomous vehicle like Tesla, Google Waymo car etc. The proposed invention is having large scope of commercialization globally.

4. Patent Application Number: 202341065830