Environment Perception System for Smart Vehicles

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About The Project

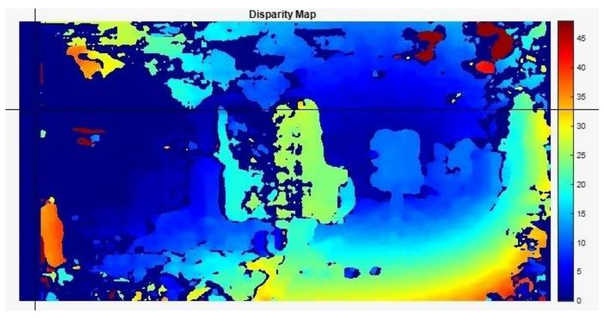
This project addresses the challenge of blind spots in vehicles, enhancing driver safety by providing real-time information on distances to nearby objects, revealing blind spots, and offering an improved perspective beyond traditional mirrors. By doing so, our system aims to enhance overall driving safety, reduce accidents, and improve the comfort of the driving experience.

Undistortion

We corrected distortions in a fisheye camera using advanced image processing. Through geometric correction algorithms, we transformed distorted fisheye images into rectilinear representations, mitigating barrel distortion. This is crucial for generating a bird's eye view, disparity map, and enhancing object detection accuracy.

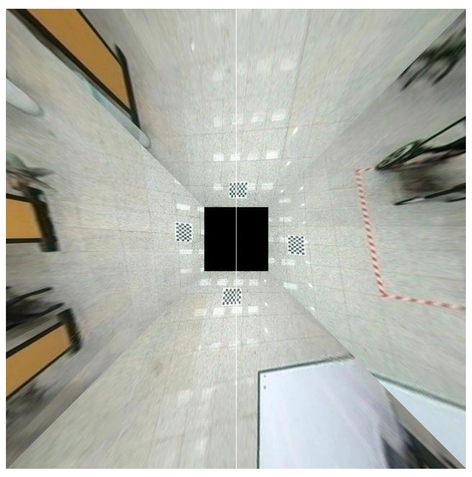
Distance Detection

Distance detection using stereo cameras involves capturing images from two offset viewpoints. The disparity between corresponding points, $d = x_{left} - x_{right}$, is calculated after rectifying the images. The depth Z is inversely proportional to d and the baseline B: $Z = \frac{f \times B}{d}$ This process produces a disparity map, facilitating accurate distance detection.



Bird's Eye View

To generate a bird's eye view around a vehicle, undistorted images were captured from the front, back, right, and left sides. These images underwent inverse perspective mapping and were then seamlessly stitched together to form a distortion-free top-down perspective. This method significantly improves situational awareness, benefiting applications such as autonomous driving and parking assistance.

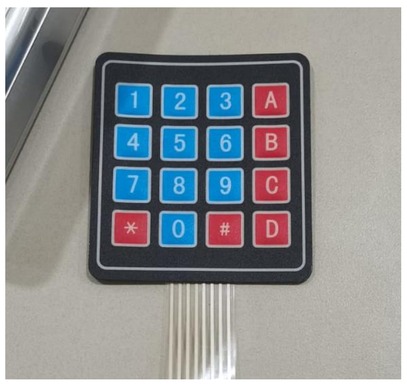


Object Detection

Utilizing the pre-trained YOLOv3-tiny model involves deploying a neural network optimized for real-time object detection. Trained on a diverse dataset, the model efficiently generates bounding boxes, class predictions, and confidence scores for recognized objects in input images. Balancing accuracy and speed.

User Interface

A keypad connected to an Arduino provides a simple and customizable control interface, enabling users to input commands or values with ease for a variety of applications.



Final product

The Arduino-connected keypad signals the Jetson Nano, toggling between undistorted feed coming from the four wide-angle stereo camera placed around the vehicle, bird's eye view, object detection, and distance detection.

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