



Vision-Based Distance Estimation for Robotic Collision Avoidance

Project topic for Oberseminar 2025/2026

Description:

A fundamental challenge in robotics is enabling autonomous systems to perceive their environment for safe navigation. This project addresses the complex task of depth perception—calculating the distance to objects—using only the input from a single standard RGB camera (monocular vision). The primary objective is to develop a purely software-based solution that can generate a dense depth map, providing a distance value for every pixel in the camera's image.

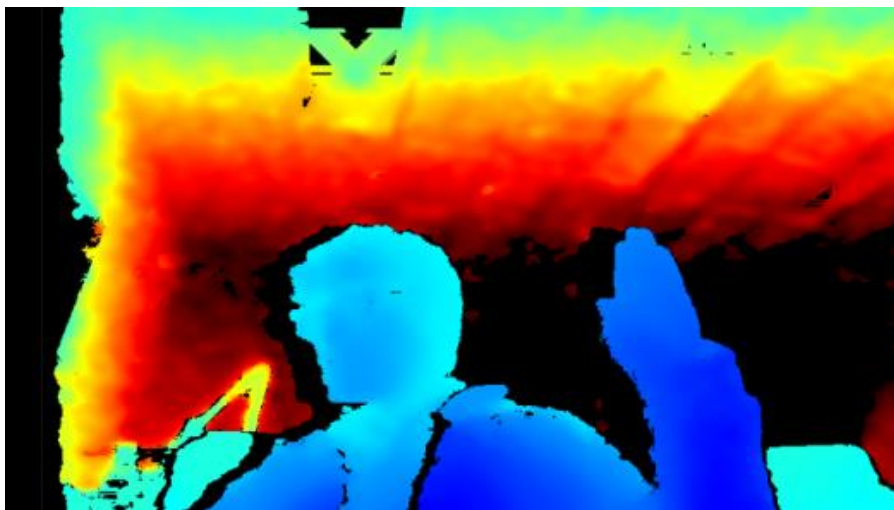
This capability is crucial for detecting potential obstacles, such as objects or people, and allowing a robot to automatically adjust its position to maintain a safe distance and prevent collisions. The core scientific challenge lies in extracting 3D information from a 2D image without the aid of stereo cameras,

LiDAR, or other depth sensors. This project requires a thorough investigation of existing concepts and algorithms, from traditional computer vision techniques to modern deep learning-based approaches, to implement and test a robust system.

The focus is entirely on software development and algorithmic implementation. No new sensor hardware needs to be designed; instead, an existing camera will be used as the sole input source.

Tasks:

- Conduct a comprehensive review of state-of-the-art algorithms for monocular depth estimation. Analyze and compare different approaches to select the most suitable concept for the application.
- Develop and implement the chosen algorithm in a software module capable of processing a live video stream from an RGB camera in real-time.
- Integrate the depth estimation software with a robotic platform to provide the system with real-time environmental perception.
- Design and execute a series of tests to evaluate the accuracy, robustness, and performance of the developed system in realistic scenarios involving static and dynamic obstacles.



Keywords: Computer Vision, Robotics, Depth Estimation, Monocular Vision, Obstacle Avoidance, Machine Learning, Deep Learning

Language: German, English

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