Teleoperated semi-autonomous mobile robot with monocular vision-based obstacle avoidance

R.N Ranaweera[1], K.A.D.K. Madushanka[2] , D.H.S Maithripala[1]

[1]Sri Lanka Technological Campus, Padukka 10500, Sri Lanka.

[2]CodeGen International(Pvt) Ltd, Bay 1-5. Trace Expert City, Colombo 10, Sri Lanka.

Abstract

This research work presents a practical implementation of conceptual methods for obstacle avoidance, based on monocular vision with off-board processing and teleoperated control.

The performance tested remotely with very less latency. The implemented method uses a lightweight protocol to send commands to the mobile robot over a local or public network for manual control. The video feed can be transferred to the remote user with a considerable less latency. There is very minimal hardware present in the robot. However, since the computation happens inside a remote computer, it brings the advantage of adding more processing power to the application at a low cost.

Currently, there are two main methods tested for obstacle avoidance, which are an optical flow based detector with IMU integration and an edge-based detector. However, using optical flow has several drawbacks. A major drawback is when an obstacle is at the center view of the robot (focus of expansion of the flow field) the flow becomes zero making it unable to detect the obstacle. Also, robot motion is essential to generate the optical flow which means there is no possibility of detecting obstacles if the robot is not moving. The optical flow method requires more processing power even if it can be made more accurate. However, the edge detection based detector has used a simple histogram-based filtering method in identifying the major obstacle points such as cupboard edges, furniture legs etc which is more applicable to indoor robot platforms. Meanwhile, edge detection consumes very less processing power while generating a similar output to the optical flow.

However, both of these methods are prone to environmental conditions such as darkness and glare. These methods were tested separately to verify their performance along with some filtering techniques. In the future, it is planned to fuse these methods to create more accurate results and initial steps are currently in progress.

Keywords: Obstacle avoidance, Monocular vision, Teleoperated