Designing of Vision- Based Simultaneous Localization and Mapping (SLAM) of Mobile Robot in an Enclosed Environment

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Abstract:

Sensors have been used in Robotics, but although the accuracy of the sensors has improved, the usage is becoming obsolete. As robots are made to mimic human perception, we need to change 'how the robots sense' to 'how robots see and estimate. Thus, SLAM based idea come in existence.

There have been number of attempts at 3D SLAM, for developing a SLAM based mobile robots for navigation. But these systems use multiple laser scanners mounted at different angles to register a 3D map of the environment or a dedicated 3D laser range scanner working on the principle of Time-Of-Flight range measurements for navigation. Using a laser scanner is not a cost-effective option as a typical Laser Range Scanner costs up to 2000 USD (2D scanner). Microsoft's Kinect is available at a much lower price and has the benefit of providing colour intensity values. However, the primary disadvantage of Kinect is its range of operation (50-180 cm). Typical Laser range scanners can obtain range data as long as 80 m. However, the use of Kinect works well in indoor environments. SLAM implementation using Kinect has been done successfully in the past. Individual attempts to use Kinect for object detection have also been accomplished. In fact, this was the theme for the Solutions in perception challenge.

Thus, this project aims at combining these attempts to create a novel functionality out of them. The Product Functions of Mobile Autonomous Robot are, Capable of mapping in an unknown (indoor) environment, Detecting the Objects, Finding the distance from the camera to the object, navigating by avoiding the obstacle, create an abstract semantic map representing the detected objects in Raspberry-Pi. The Implementation is carried out in ROS Platform.

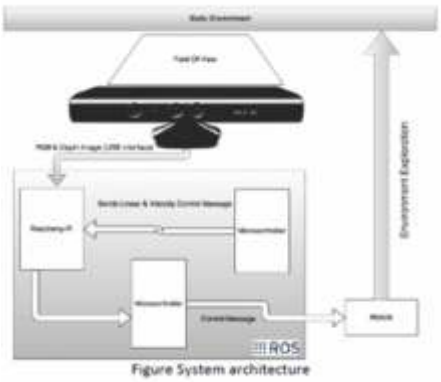

Figure System architecture

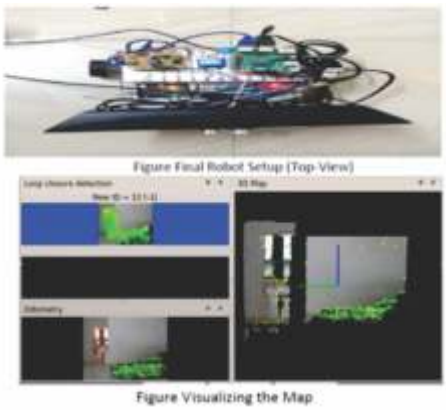

Figure Final Robot Setup (Top View)

Figure Visualizing the Map

Conclusion: The designed robot is intended to test in multiple indoor in various trajectories. The various results that got will establish inferences in performance of the robot. Ideally, the map should contain any object that is present in the environment as this will result in an accurate representation of the environment. However, objects that are further away from the range of Kinect (200 cm) will be missed unless the robot moves closer to it. Further, the more the robot moves around in the environment, more area of the map is covered, however, because of limited battery power, there has to be a trade-off.