Introduction

- Laser sensors are widely used in mobile robot navigation. It assumes perfect diffuse surfaces as shown in the figure.
- It fails to detect glass walls and reflective surfaces as glass surfaces reflect 8% of the light and transmit 92% of the light.

This study aims to solve this problem of sensor limitations using computer vision techniques.

Methods

1. Image Classification
2. Template matching

Support Vector Machines (SVM)

Data

- For the image classification, RGB-D images are obtained by navigating the robot around the hallways using rosbag record on the rgb and depth registered topics.

Training:

- Regions of Image are labelled as wall (class 1) and not wall (class 0) pixels.
- Each feature vector is of dimensions 676(13x13x4) and contains information of RGB-D pixels of a 13x13 region.
- 1000 Feature vectors, 500 of each class are used for training.

Results

- 88% accuracy is obtained

<table>
<thead>
<tr>
<th>True Positive</th>
<th>10</th>
</tr>
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<tbody>
<tr>
<td>True Negatives</td>
<td>30</td>
</tr>
<tr>
<td>False Positives</td>
<td>42</td>
</tr>
<tr>
<td>False Negatives</td>
<td>18</td>
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</tbody>
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Template Matching

- For template matching, the images are recorded using a regular camera under different lighting conditions.
- A rectangular template is used to find reflection.

Algorithm

- RGB image is converted to HSV
- Channel Thresholding is done.
- Green rectangle is extracted
- It is matched against a template.
- Normalized cross-correlation between the image and template is shown in the image.

Conclusions

- Image classification in most fails to differentiate between glass pixels and not glass.
- Though the template matching works better than image classification, it does not work at long distances and all lighting conditions.

Future Work

- Template matching method can be made more robust to occlusion and illumination
- Angle of the robot and distance from the glass can be detected using hierarchical template matching.

References: