Low Cost Optical Positioning System for Small Scale Robots
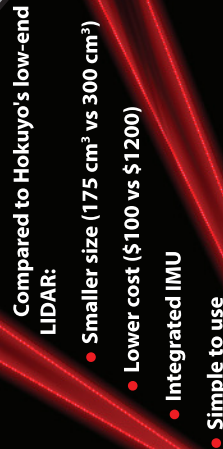
Design goals

- To provide reasonable accuracy optical sensing for the hobbyist and educational markets
- Allow for easy autonomous mapping and navigation
- Low cost, lightweight, and integrated system
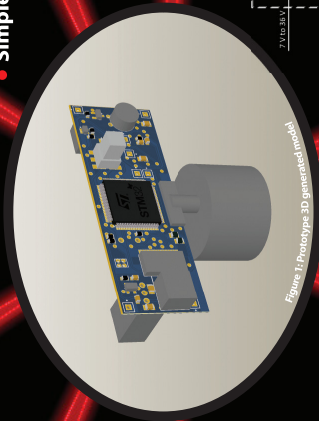- Must be user friendly and customizable

Advantages over similar products

Compared to Hokuyo's low-end LIDAR:

- Smaller size (175 cm³ vs 300 cm³)
- Lower cost ($100 vs $1200)
- Integrated IMU
- Simple to use

[1] I. Baranov, S. Kazi, N. Hilal, J. Godson, Low Cost Optical Positioning System for Small Scale Robots, University of Waterloo, 2013.

Sensing design alternatives

Kinect:
- Requires high processing power
- Large in size

Ultrasonic/Infrared:
- High level of noise
- Low precision

Background

- Modern robotics requires localization and mapping to be useful
- Current optical sensing solutions target high cost, high performance industrial markets [1]

Design and Implementation

Figure 4: System level block diagram

Figure 1: Prototype 3D generated model

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Testing and Verification

- Tested with 6 cm separation between the camera and laser
- Range: 15 cm to 2 m
- Resolution: 0.5 cm
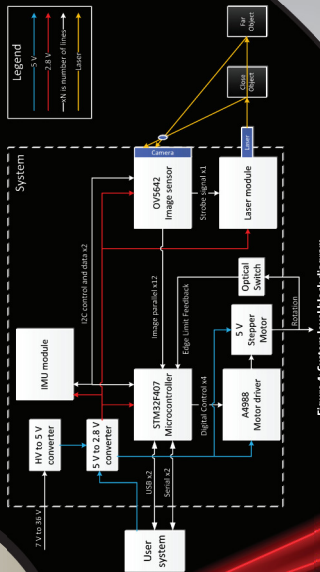- For accurate and robust detection, the algorithm looks for a combination of white and red pixels
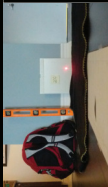
Figure 2: Algorithm detection of laser

20 cm
40 cm
60 cm
80 cm
100 cm
120 cm
140 cm
160 cm
180 cm
200 cm

Figure 3: Algorithm detection at different distances