BUILDING A DEPTH SENSOR BY COMBINING COMPUTER VISION AND LIDAR

A PREPRINT

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ABSTRACT

Building a Depth Sensor by Combining Computer Vision and LIDAR explores combining a machine learning computer vision model and a low-cost LIDAR sensor to create a reliable depth sensor.

Keywords Depth sensor · LIDAR · Computer Vision · Machine Learning · Google Tensorflow

1 Introduction

Depth Sensing with Computer Vision and LIDAR aims to create a reliable depth sensing system using computer vision and LIDAR. This project spanned 2018 Winter and Spring terms at Oregon State University. Special acknowledgement to Kevin McGrath, who supplied equipment and technical guidance.

This project's motivation came from an annual robotics competition at Oregon State University, my client noted that all the robots had been designed and tested indoors. This later proved to be an issue because when the robots were brought outside for a competition, their guidance systems failed to work as the IR cameras were inherently subject to interference from the Sun's ambient light. As the prevalence of automation in our daily lives increases, such as autonomous cars or robots, a cheap and scalable depth sensing system that is resistant to common interferences is necessary. The goal of this project is to create a reliable depth sensing system using computer vision and LIDAR. Such a system that combines these two technologies will be more reliable than infrared depth sensing because cameras and LIDAR devices are less prone to interference from ambient light or anomalies.

2 Design

The Logitech Brio webcam provides a high-resolution, two-dimensional image but lacks depth perception. The LIDAR provides accurate depth measurement in a horizontal dimension but lacks vertical perspective. This project proposes bridging the utility of both devices by securing them in stationary positions, then using software to combine their outputs. This involves using the M16 LIDAR to get depth sensing information and using computer vision to recognize objects. The result is a scalable and reliable depth sensor that will not be affected by natural light, and can be further improved by training a better computer vision model or adding more sensors. This project hopes to achieve a proof of concept design to be showcased in a live demo at Oregon State University's 2018 Undergraduate engineering expo. This live demo shall consist of the full system pointed at the project booth's audience.

Figure 1 illustrates different dimensions measured by the M16 LIDAR and Brio Webcam. The red cube represents the Logitech Brio webcam and M16 LIDAR secured in stationary positions. The flat purple triangle represents the M16 LIDAR's horizontal range detection. The transparent green rectangle in front of the person represents the computer vision model recognizing that there is a person in-front of the sensor. The transparent teal pyramid represents the Brio webcam's field-of-view.

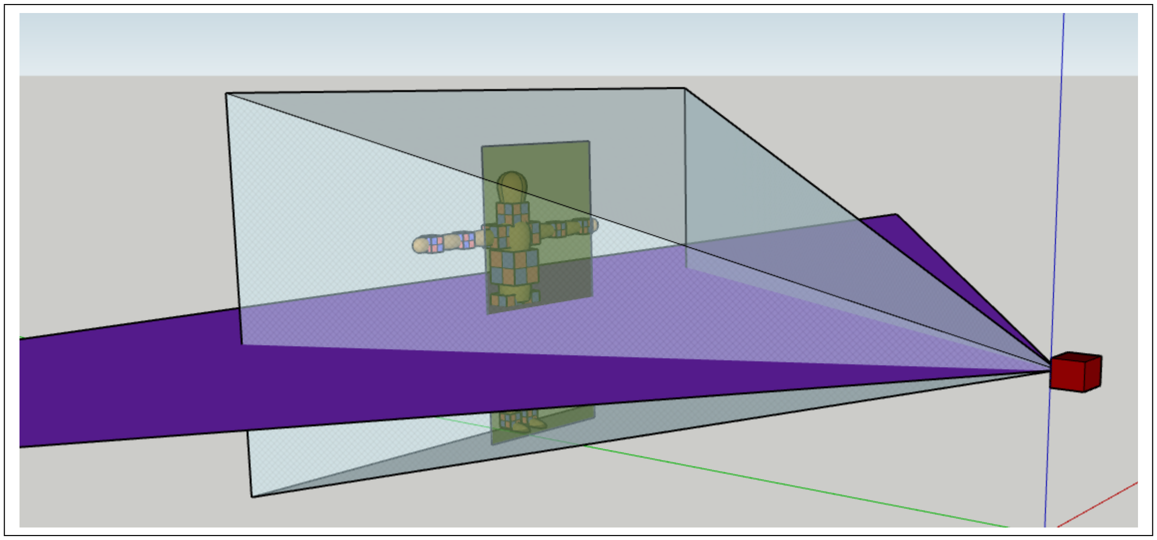

Figure 1: Visualizing different dimensions measured by the LIDAR and Brio Webcam.

2.1 Headings: second level

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2.1.1 Headings: third level

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3 Examples of citations, figures, tables, references

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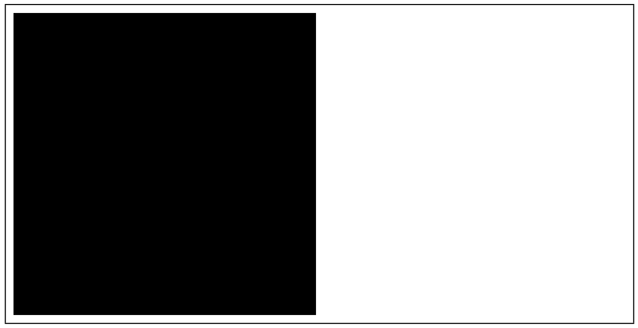

Figure 2: Sample figure caption.

The documentation for `natbib` may be found at

`http://mirrors.ctan.org/macros/latex/contrib/natbib/natnotes.pdf`

Of note is the command `\citet`, which produces citations appropriate for use in inline text. For example,

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\citet{hasselmo} investigated\dots
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produces

> Hasselmo, et al. (1995) investigated...

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3.1 Figures

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3.2 Tables

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See awesome Table 1.

3.3 Lists

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[1]Sample of the first footnote.

Table 1: Sample table title

Part		
Name	Description	Size (μm)
Dendrite	Input terminal	$\sim$100
Axon	Output terminal	$\sim$10
Soma	Cell body	up to 10^6

References

[1] George Kour and Raid Saabne. Real-time segmentation of on-line handwritten arabic script. In *Frontiers in Handwriting Recognition (ICFHR), 2014 14th International Conference on*, pages 417–422. IEEE, 2014.

[2] George Kour and Raid Saabne. Fast classification of handwritten on-line arabic characters. In *Soft Computing and Pattern Recognition (SoCPaR), 2014 6th International Conference of*, pages 312–318. IEEE, 2014.

[3] Guy Hadash, Einat Kermany, Boaz Carmeli, Ofer Lavi, George Kour, and Alon Jacovi. Estimate and replace: A novel approach to integrating deep neural networks with existing applications. *arXiv preprint arXiv:1804.09028*, 2018.