Object Classification Using RGB-D Data for Vision Aids

Apples and Oranges

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Motivation

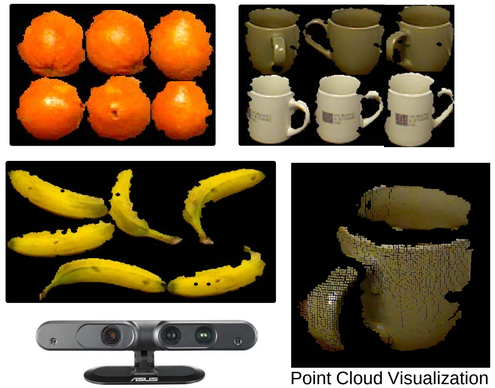
- Using augmented reality, allow a visually impaired patient to identify household objects
- Collect data using an RGB-D sensor and convert to textured point cloud
- Compute 3D descriptors (VFH and SHOTCOLOR)
- Train an SVM classifier using training set and test on experimental data

Experimental Results

Training Data

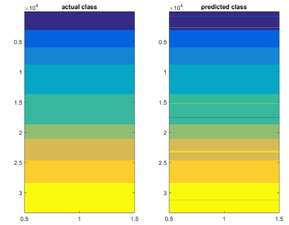
- RGB-D Object Dataset [4]
- Pre-segmented point clouds captured on a turntable with multiple viewing angles
- Calculate descriptors using PCL

Test Data

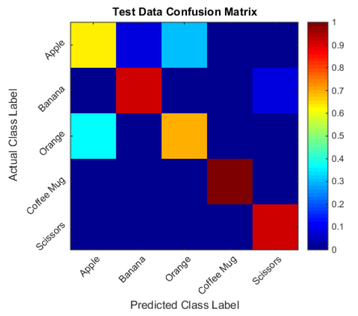


Point Cloud Visualization

- Use calibrated RGB-D sensor (Asus Xtion)
- Auto-segment textured point clouds using background subtraction
- Calculate descriptors using PCL

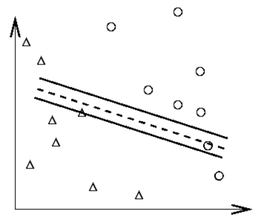


Cross Validation Accuracy

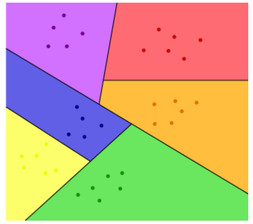


SVM

Linear SVM Classifier using LIBLINEAR [1]



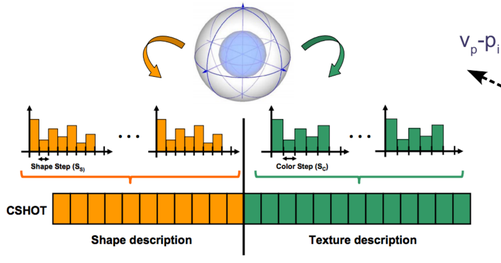
Linear SVM in 2 dimensions [2]



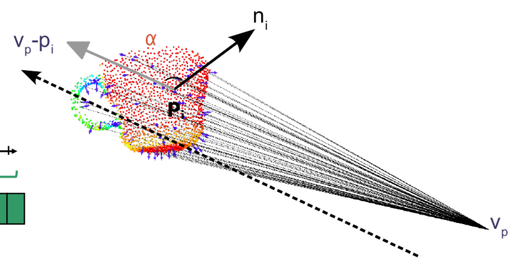
Multiclass SVM in 2 dimensions [3]

Descriptors

- Viewpoint Feature Histogram (VFH)
- Signatures of Histograms of Orientations w/ Color (SHOT COLOR)



SHOTCOLOR [5]



VFH [6]

References

[1] Fan, Rong-En, Kai-Wei Chang, Cho-Jui Hsieh, Xiang-Rui Wang, and Chih-Jen Lin. "LIBLINEAR: A library for large linear classification." *The Journal of Machine Learning Research* 9 (2008): 1871-1874.

[2] Hsu, Chih-Wei, Chih-Chung Chang, and Chih-Jen Lin. "A practical guide to support vector classification." (2003).

[3]"Multi-class Classification." The Shape of Data. June 4, 2013. Accessed December 8, 2015. https://shapeofdata.wordpress.com/2013/06/04/multi-class-classification/.

[4] Lai, Kevin, Liefeng Bo, Xiaofeng Ren, and Dieter Fox. "A large-scale hierarchical multi-view rgb-d object dataset." In *Robotics and Automation (ICRA), 2011 IEEE International Conference on*, pp. 1817-1824. IEEE, 2011.

[5] Tombari, Federico, Samuele Salti, and Luigi Di Stefano. "Unique signatures of histograms for local surface description." *Computer Vision–ECCV 2010*. Springer Berlin Heidelberg, 2010. 356-369.

[6] Rusu, Radu Bogdan, et al. "Fast 3d recognition and pose using the viewpoint feature histogram." *Intelligent Robots and Systems (IROS), 2010 IEEE/RSJ International Conference on*. IEEE, 2010.