Retail Imager

Flexible Retail-Object Recognition System Utilizing 3D (without Machine Learning)
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INTRODUCTION
Utilize 3D characteristics and 2D image features to quickly and automatically identify individual retail items in a cluttered box of products. Rather than require workers to specifically orient products for automated identification and sorting (i.e., barcodes showing), or exhaustively training machine learning models, our system is able to identify products regardless of orientation and to add new products with minimal setup time.

GOAL
Improve efficiency in the picking and sorting of pick-up/delivery orders for retail stores.

Why not use Machine Learning?
- Data labeling
- Resource requirements
- Training time
- Overkill for a known product list

SYSTEM COMPONENTS
Software
- Depth Capture: Intel RealSense SDK
- 3D Calculations: Point Cloud Library (PCL)
- 2D Feature Extraction: OpenCV, SIFT (SIFT)
- Image Matching: OpenCV, FLANN (FLANN)
- Product Database: MySQL
- GUI: NodeJS, Socket.IO, Bootstrap

Hardware
Intel RealSense D415 Depth Camera, Windows 10 Laptop

CHALLENGES
- Image Match: FLANN in lieu of unusable VDMS db
- Square items: Oriented Bounding Box may rotate 45°
- Object tilt in z-plane: less accurate image extraction
- Object shapes: designed for packaging with straight lines and flat surfaces (i.e., squares and rectangles)
- 2D Image Quality: low image quality from Intel camera complicates identification

RESULTS
Match in 7.61 total seconds!

4900+ images in index • <3ms for ANN search
100% match rate given our constraints

NEXT STEPS
- Robotic arms to sort products
- High-resolution camera for 2D image capture
- Additional packaging shapes (e.g., curved, irregular, etc.)
- Alternate features (e.g., weight, color, barcode, etc.)
- Automatically add new products (2D & 3D features)