Machine Learning ready for Industrial Applications?

Demo: Real Time RGB-based Sorting System

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Introduction

Situation

Machine learning and optical systems are used more frequently to automate various industrial applications, such as performance prediction [1], instance reconstruction [2], predictive maintenance [3]

Challenge

Infrared, lidar, multispectral sensors for industrial applications are, compared to RGB-based camera systems expensive [4].

Goal: Maintain overall performance, although we use a low cost sensor

Application

Illustrative example: **Sorting Mechanism**

1. Detect objects
2. Classify objects
3. Sort objects based on class

Data Acquisition

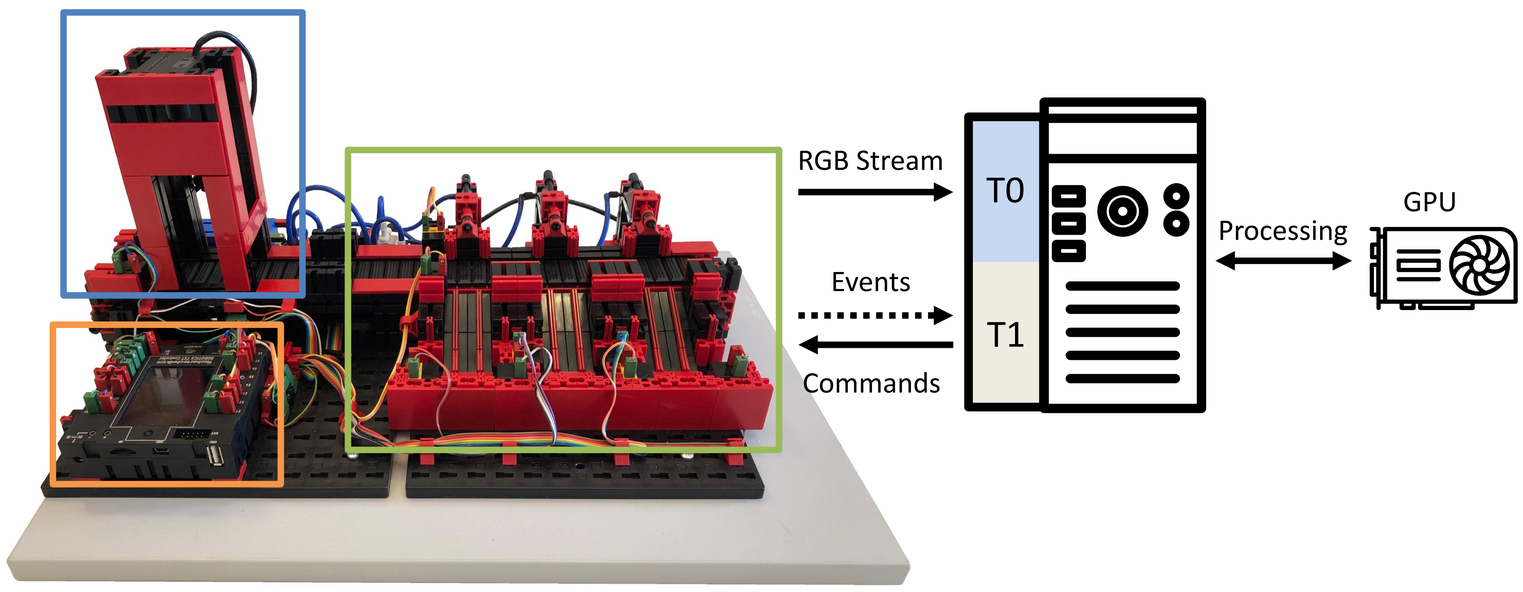
Multiple videos of 95 objects (four classes) in various displacements and lighting conditions. Objects vary in type, size, color.

→ 22,500 images (ca. 5000 per class)

→ Manually labeled (20h)

Figure 1: Set of objects: Legos (53), candies (6), heads (21), screws (15)

Demonstrator “Real Time RGB-based Sorter”



Workflow

1. **RGB-Camera (blue)** streams to **image processing** (T0)
2. **T0** updates shared Information in **controller** (T1)
3. **TXT controller (orange)** acquires information from T1
4. TXT controller processes class information to sort with **sorting device (green)**

Image Processing

- Object detection & classification using Yolo v2 [5]
- Pre-trained Yolo [5] on ImageNet [6] and fine-tuned using acquired dataset

Discussion

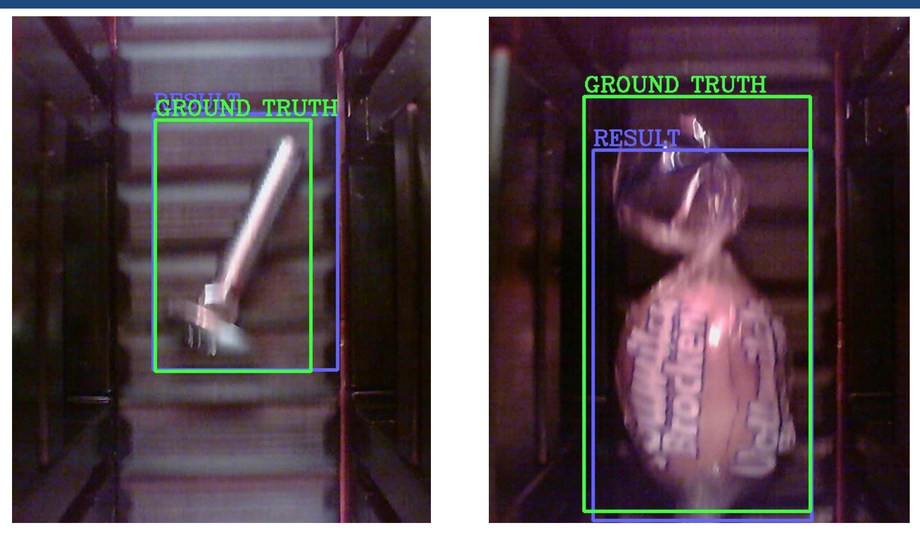


Figure 2: Result of Yolo[5] with screw (left) and candy (right)

Method

- Detections stored in sliding window and final classification based on “Method of Moments” i.e. median
- Final classification based on event from second light-barrier

Discussion

Trade-off:

- **Amount of data** vs. **restrictions**
- **Inter-** vs. **intra-class** Variance
- Labeling – **manual/semi-automatic**
- **Quality** vs. **quantity** (50 fps)

Sliding window leads to more robust classification (misclassification, spurious detection), compared to considering only the last detection

Conclusion

Summary

- Sorting mechanism based on object detection approach
- Collection and labeling of an in-the-wild dataset

Future Work

- Object tracking used for estimating time-of-arrival
- Analysis of sensor quality

Acknowledgements & References

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[8] Icon "gpu" by Misha Petrishchev from the Noun Project