# Object Detection within a Robotic Application

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## Introduction

Our idea was to teach a Braccio Robotic Arm to play the child's game pairs. It should detect the playing cards laying on the table, their position and the motif of a card and find the second one. The robot picks one playing card up, places it on the stack and searches for the second one within the remaining cards. For object detection YOLOv2-Real-Time-Object detection is used for transfer learning with datasets containing images of our playing cards. We trained our network with Google Cloud Service.

## Dataset

Datasets for the project could be devided into two parts. Darknet had pre-trained on the Pascal VOC 2007+2012, and we had trained 30 images for each of the 10 classes of the playing cards. **Add sample label from our dataset**

Fig. 1: Training data of the playing cards. Ten classes of the cards are:
Boat, Girl, Boy, Horse, EuropeanBird, PacificBird, Flower, BlueCard, Tree, Pineapple

## Related Work

For the object detection, we used Yolo9000 with transfer learning to detect the motifs of the playing cards in real time. *Add table? Add link?*
The communication between the Braccio Robotic Arm and the computer is enabled with ROS. *Also with the Arduino?* **How does Yolo train the bounding boxes and labels at same time What makes it fast and accurate?**

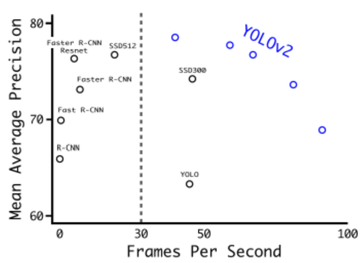



**Figure 4: Accuracy and speed on VOC 2007.**

Fig. 2: Network architecture.

## Methodology

### Network Architecture

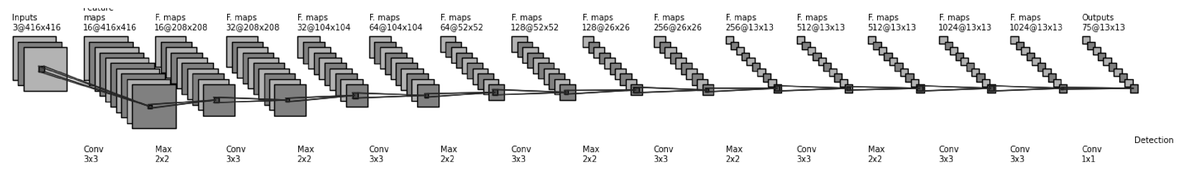



Fig. 3: Network architecture.

**Text about Transfer learning and network architecture, training - validation set**

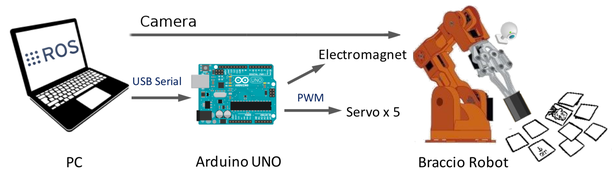


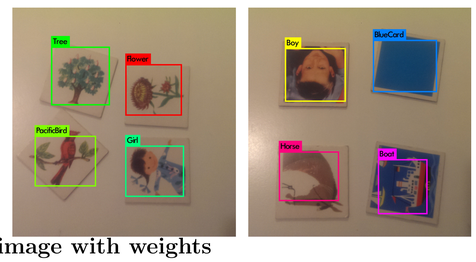

Fig. 4: Hardware setup

### Hardware Architecture (shorter)

- Input stream from camera
- Send stream to computer
- Pre-trained Yolo detects motifs of playing cards
- If card is detected, command is sent to robot to pick it up with help of a magnet and a metal strip attached on the back of the card
- Card is put on stack
- Robot searches for card with the same motif
- If detected, it picks it up and places it on the stack
- Robot starts looking for a new pair of playing cards

*Description of network architecture? How well did our model perform during training?*

## Outcome







**Add image with weights**

- network from tiny yolo
- 10 cards + classes
- architecture
- Filters from results
- Camera input with detection labels