ISE 789
SPRING 20201

PROJECT INITIAL STAGE PRESENTATION

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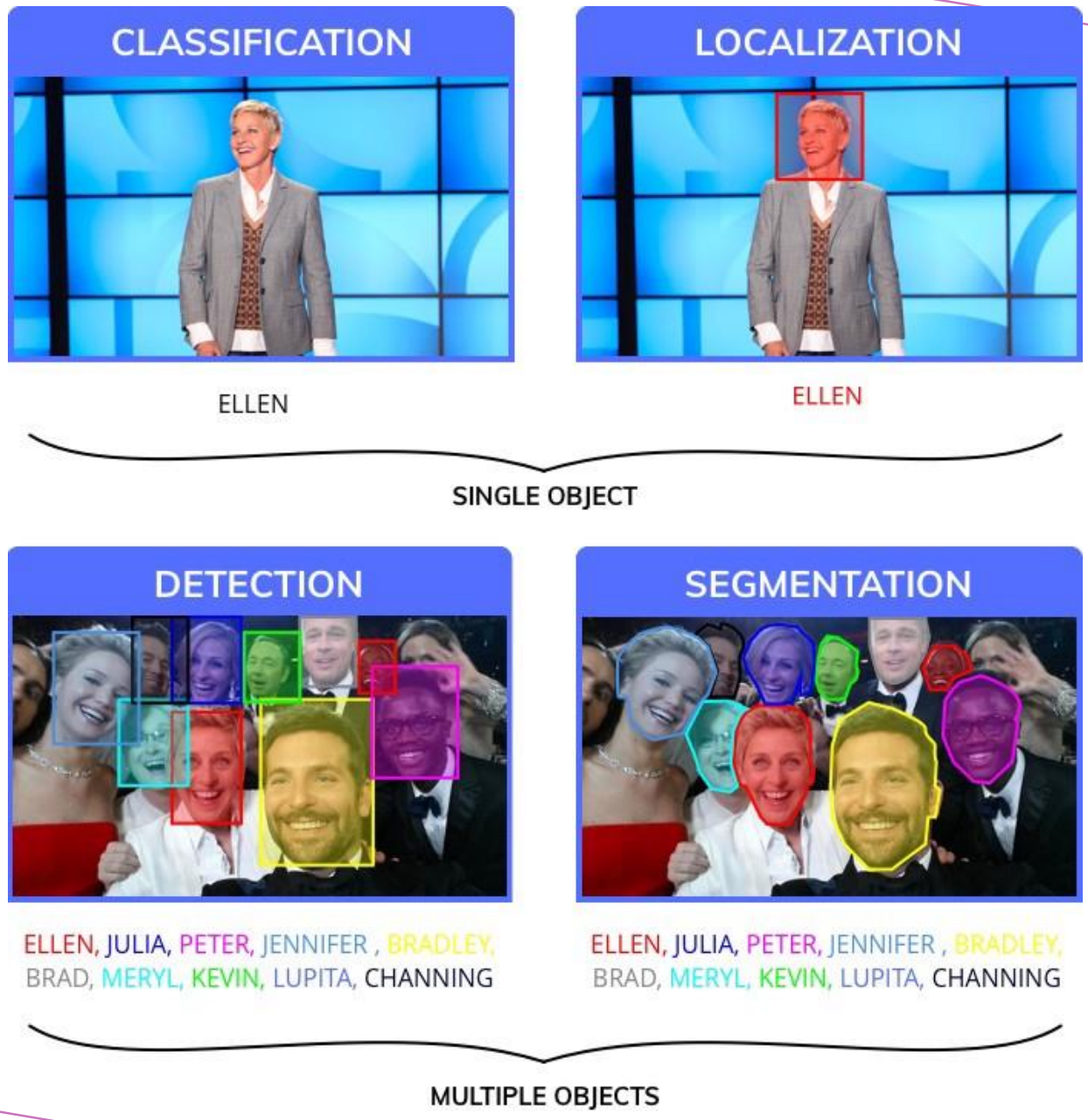
RECOGNITION AND DETECTION OF OBJECTS AND THEIR POSITION FOR ROBOTIC GRIP DECISION

OBJECT RECOGNITION VS DETECTION

What is object recognition ? And how it is different from object detection?



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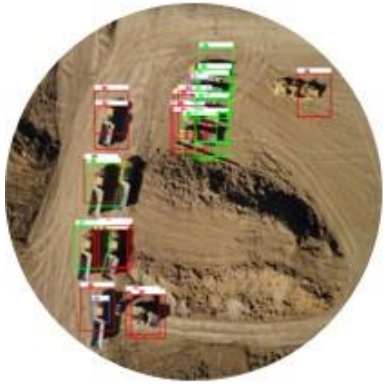
CURRENT STATE OF COMPUTER VISION

AUTONOMOUS VEHICLES

WORKPLACE AUTOMATION

MANUFACTURING



DRONE IMAGERY

AGRICULTURE

AUGMENTED REALITY

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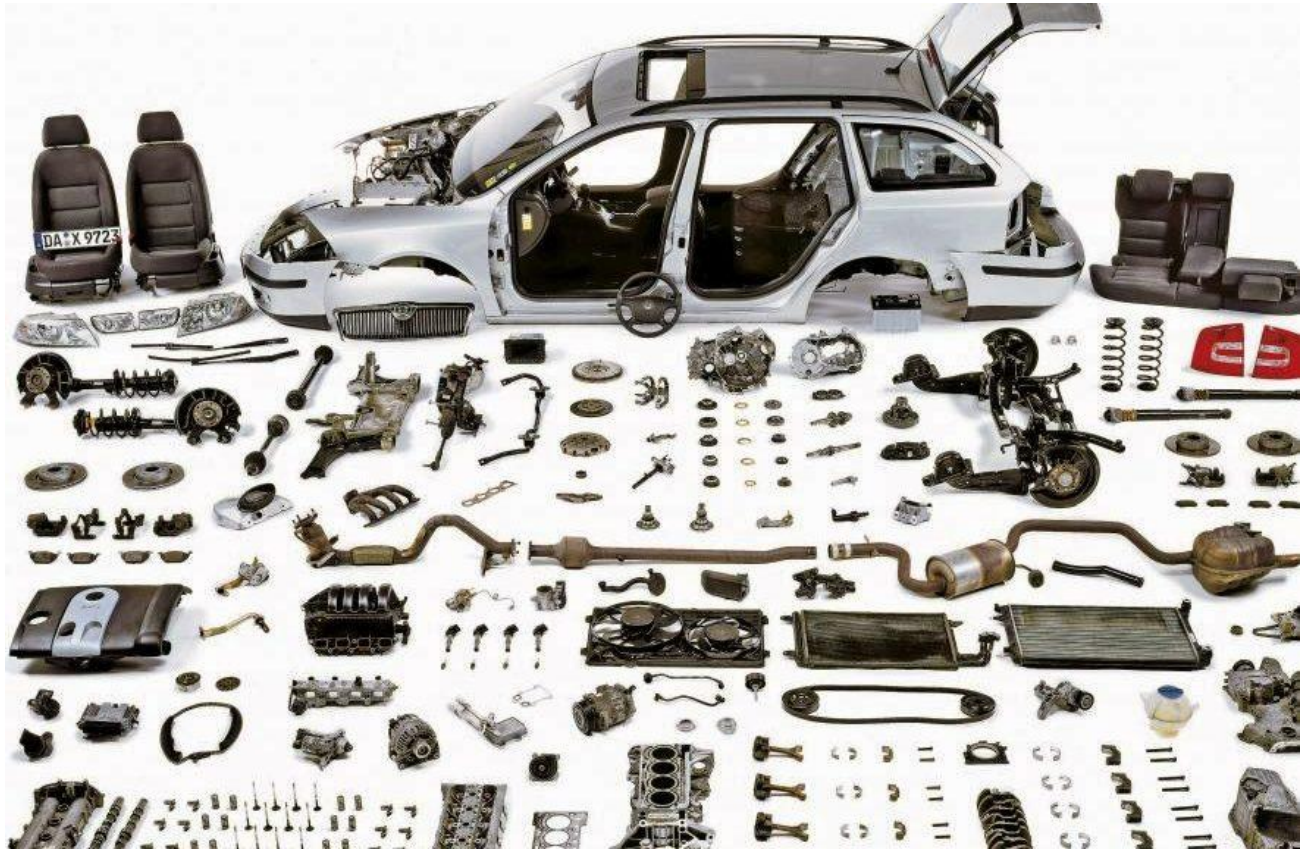
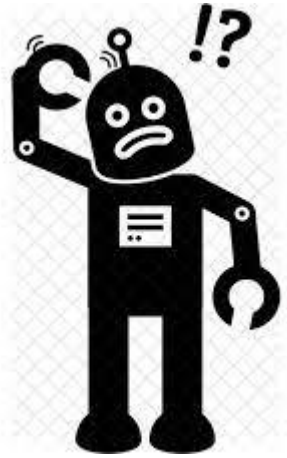
WHY THE OBJECT POSITION IS IMPORTANT ?

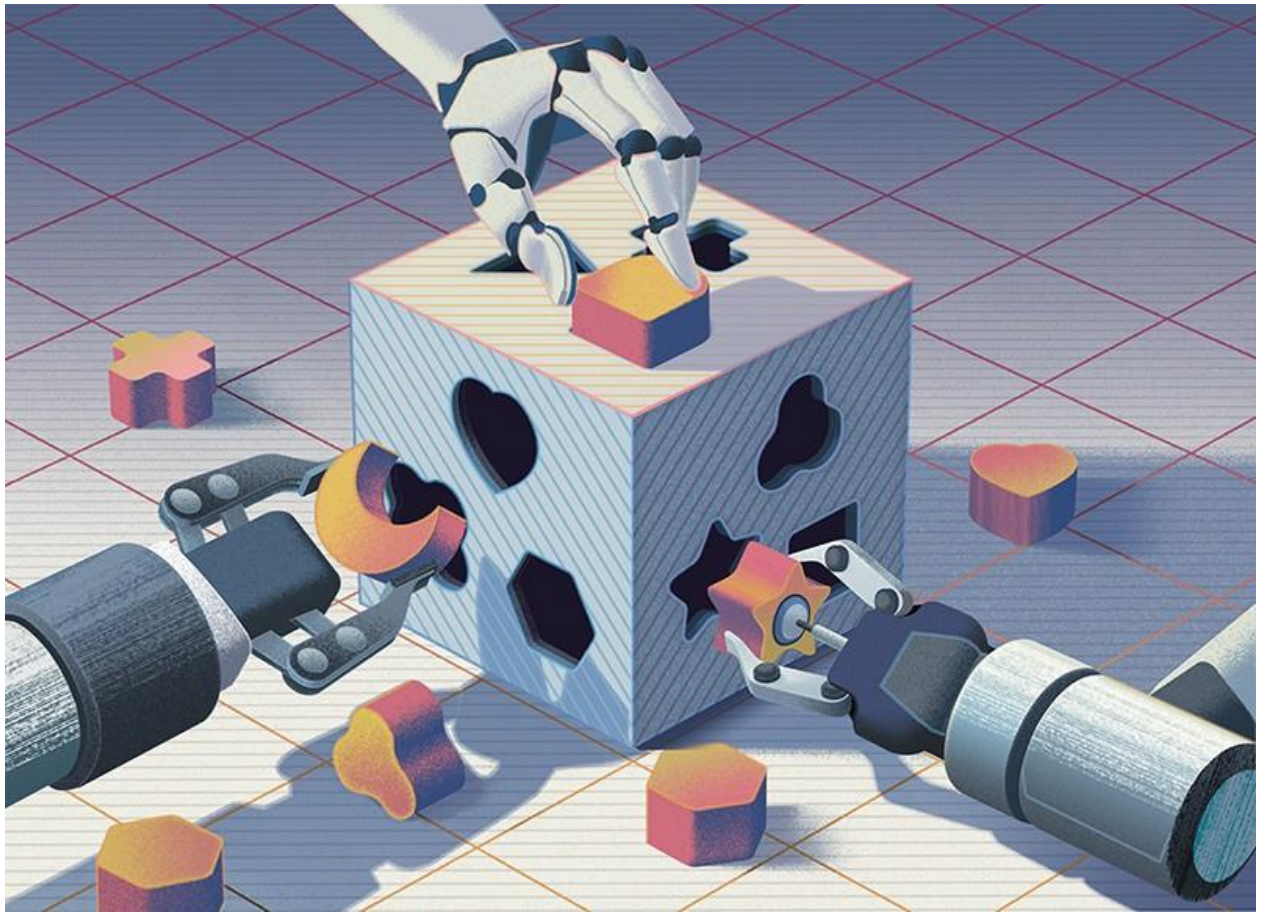
Will the human assemble the car??





THE POSITION OF THE OBJECT DEFINES THE GRIP

The information from the image gives the clue of how to position the robotic grips and how to grab the object



“Hodson - 2018 - How robots are grasping the art of gripping.pdf.” Accessed: Mar. 11, 2021. [Online]. Available: https://www.nature.com/magazine-assets/d41586-018-05093-1/d41586-018-05093-1.pdf.

INITIAL LITERATURE REVIEW

F. H. Zunjani, S. Sen, H. Shekhar, A. Powale, D. Godnaik, and G. C. Nandi, "Intent-based Object Grasping By A Robot Using Deep Learning," in 2018 IEEE 8th International Advance Computing Conference (IACC), Dec. 2018, pp. 246–251, DOI: 10.1109/iadcc.2018.8692134

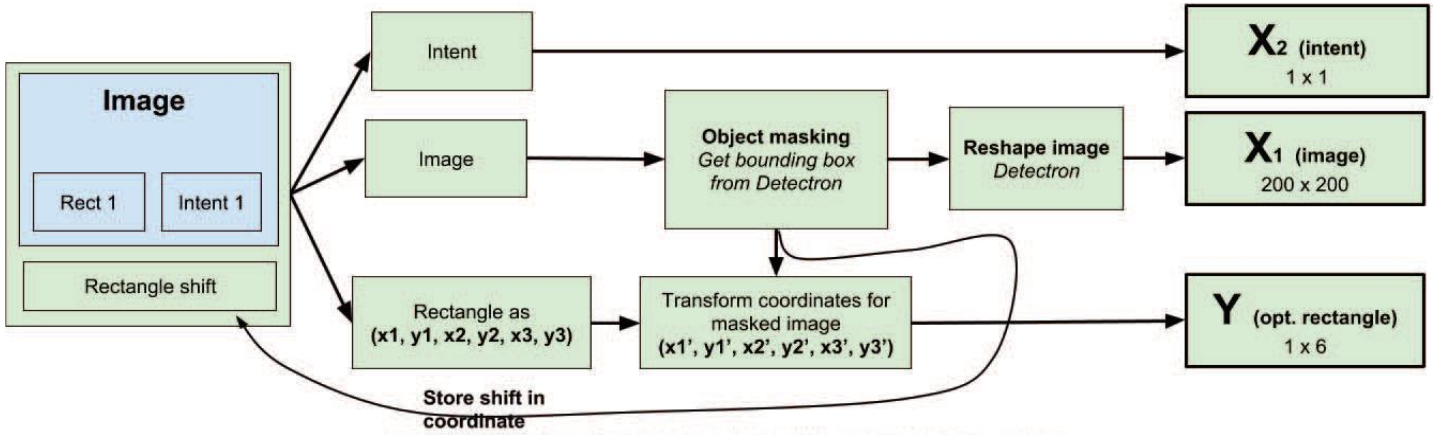


Fig 6: Data Pipeline : Preprocessing datapoint to generate training variables

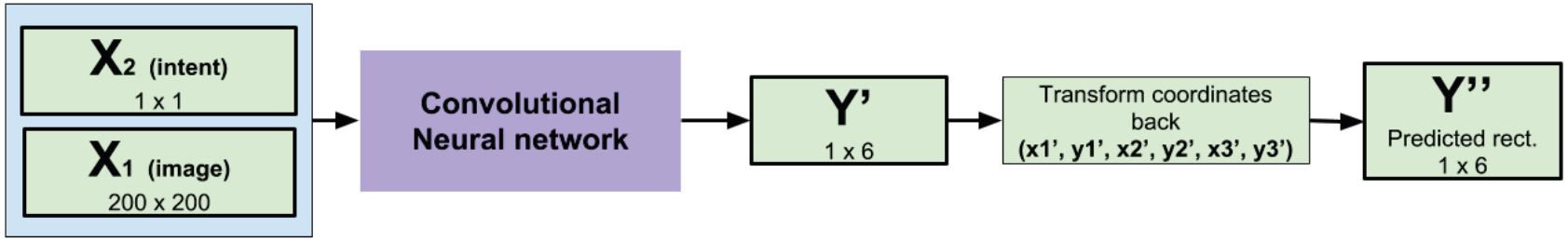


Fig 7: Data Pipeline - Passing training variables from CNN and finding predicted rectangle

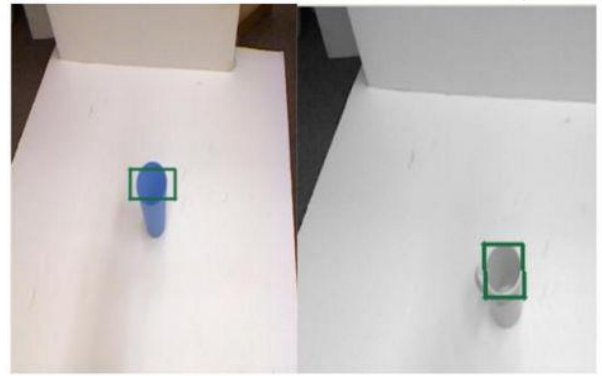


Fig 2: Primary intent rectangles on sample image of plastic cup and mug

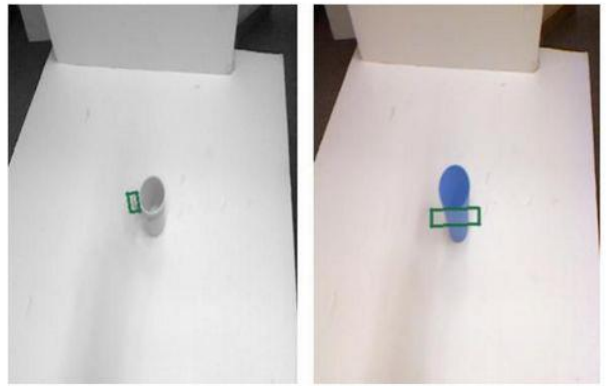


Fig 3: Secondary intent rectangles on sample image of plastic cup and mug

Tsarouchi et al. offer to use hybrid system to recognize the object through the 2D Vision system and calculate the distance to the object from the 3D CAD file, using different poses of the object.

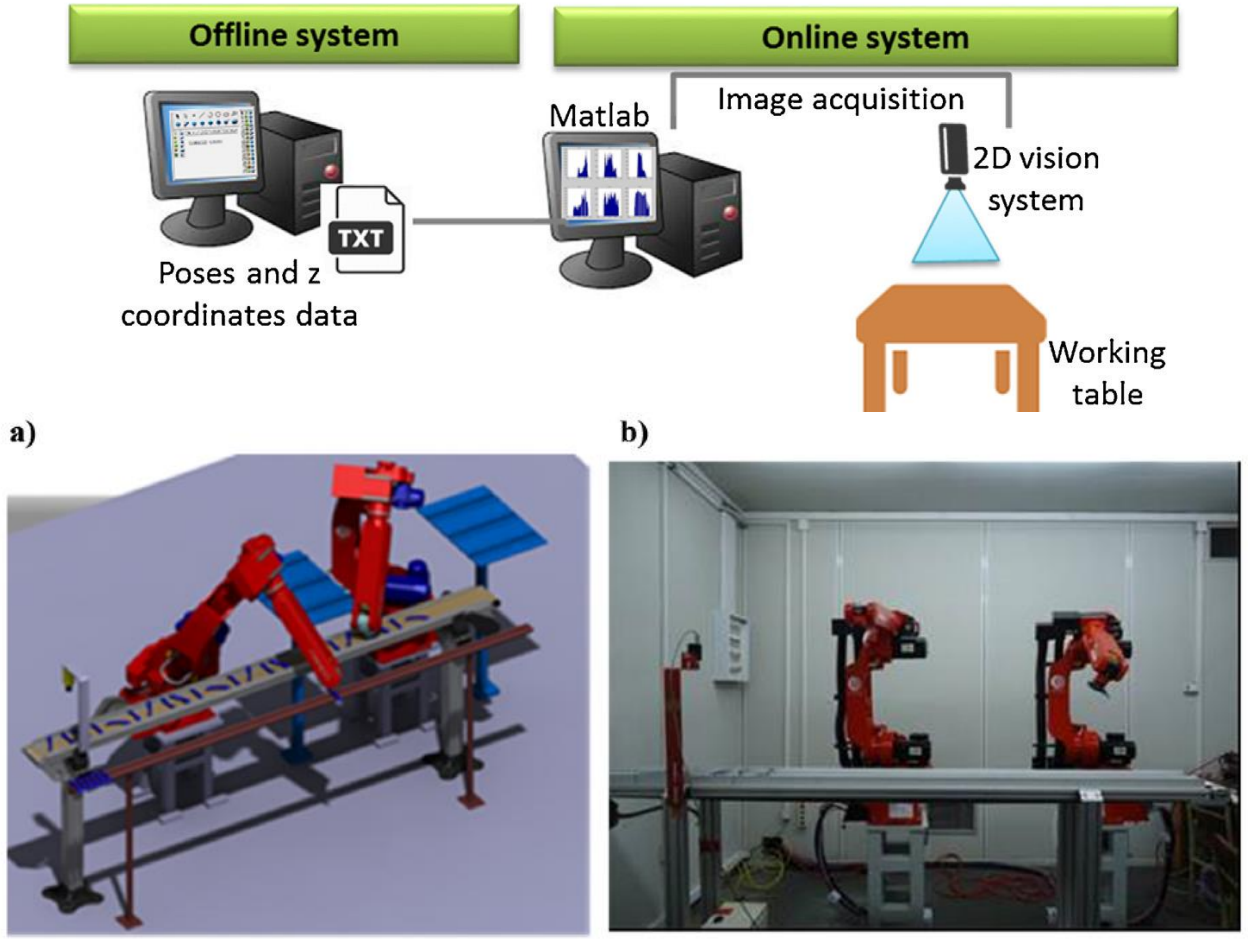
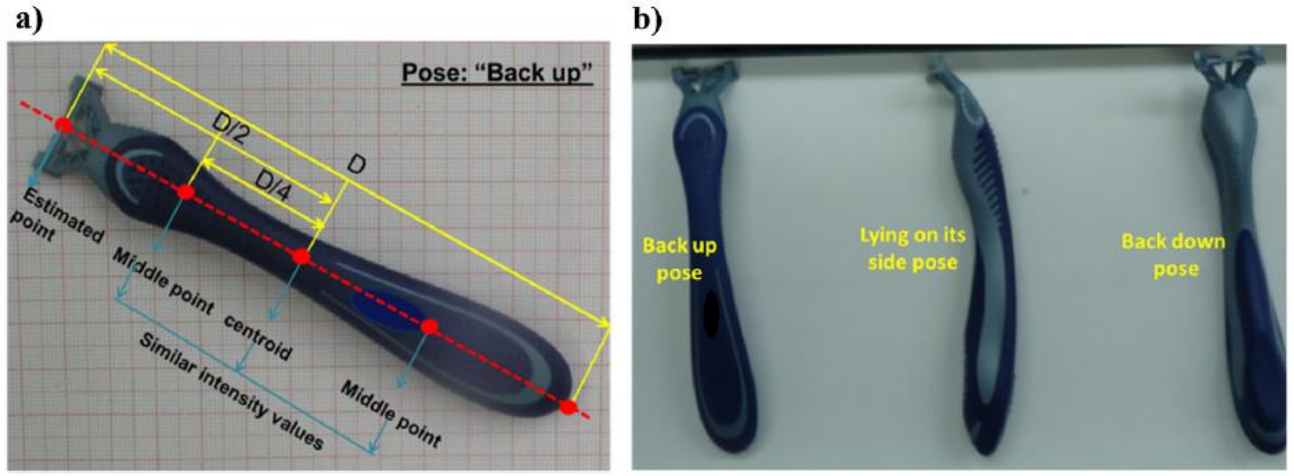


Fig. 4. (a) Consumer goods industry scenario and (b) system setup.

P. Tsarouchi, S.-A. Matthaiakis, G. Michalos, S. Makris, and G. Chryssolouris, “A method for detection of randomly placed objects for robotic handling,” *CIRP Journal of Manufacturing Science and Technology*, vol. 14, pp. 20–27, Aug. 2016, doi: 10.1016/j.cirpj.2016.04.005.



$$\begin{bmatrix} x_{WRF} \\ y_{WRF} \\ z_{WRF} \end{bmatrix} = \begin{bmatrix} Zc/f & 0 & 0 \\ 0 & Zc/f & 0 \\ 0 & 0 & Zc \end{bmatrix} \begin{bmatrix} x \\ y \\ 1 \end{bmatrix} \tag{3.4}$$

where:

- Zc is the distance from the horizontal measurement surface to the camera's sensor surface;
- f is the camera's focal length.

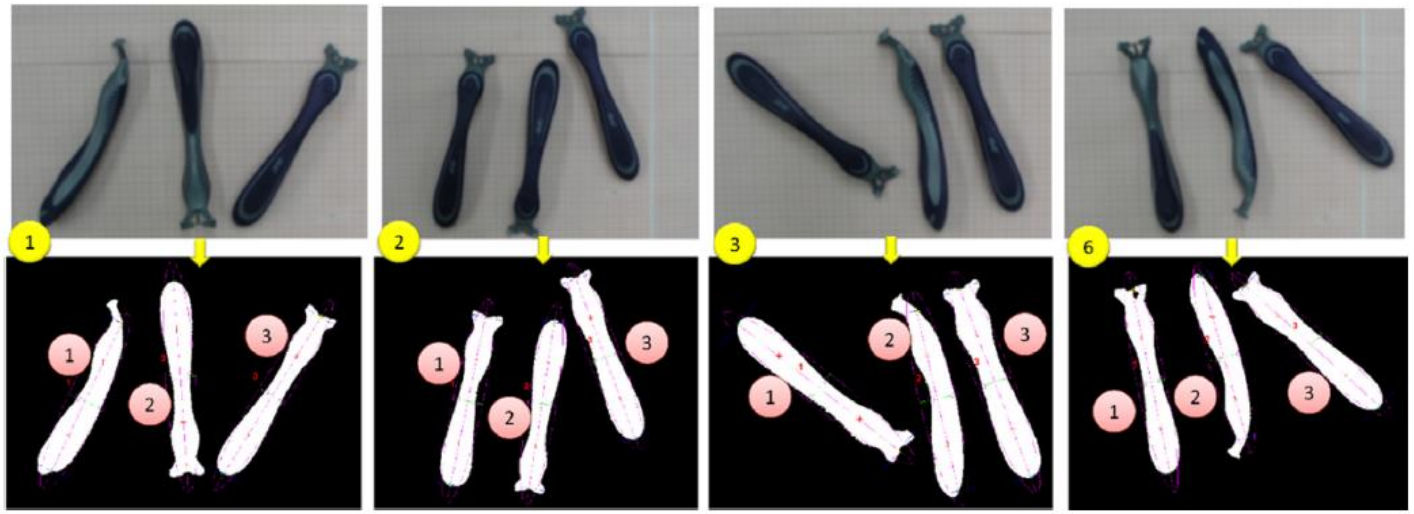
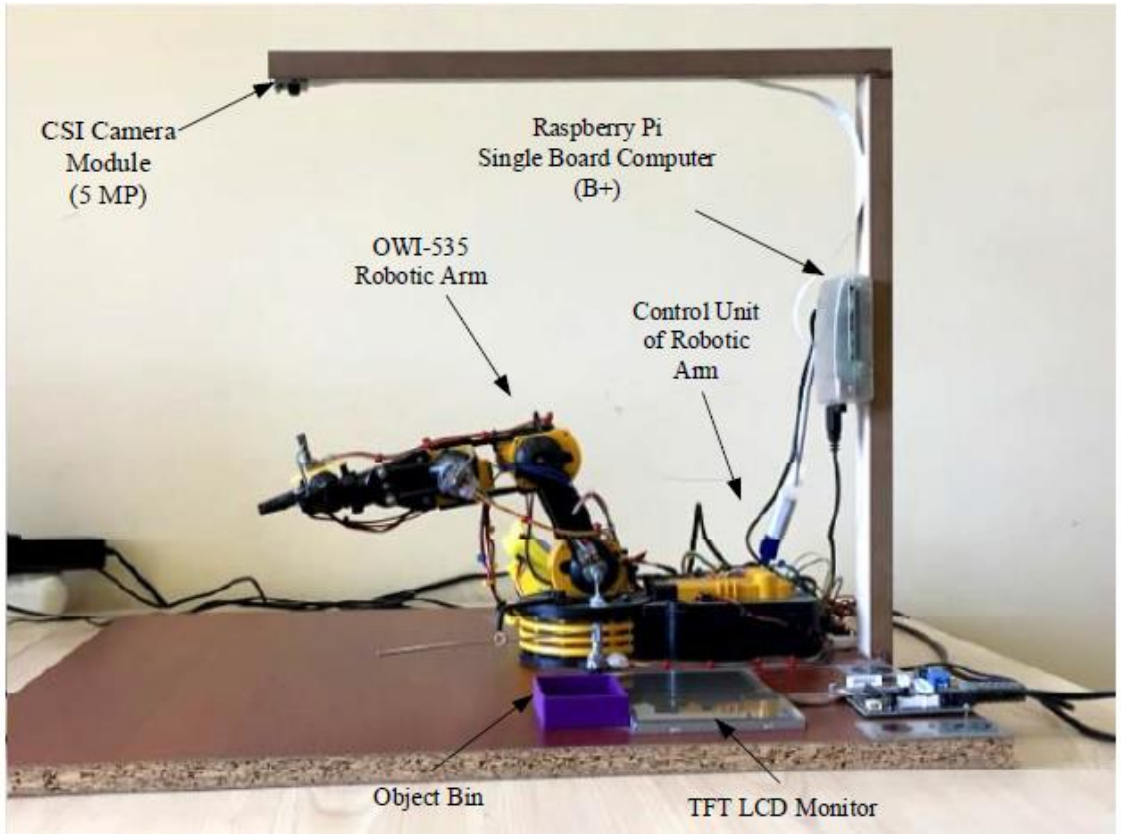
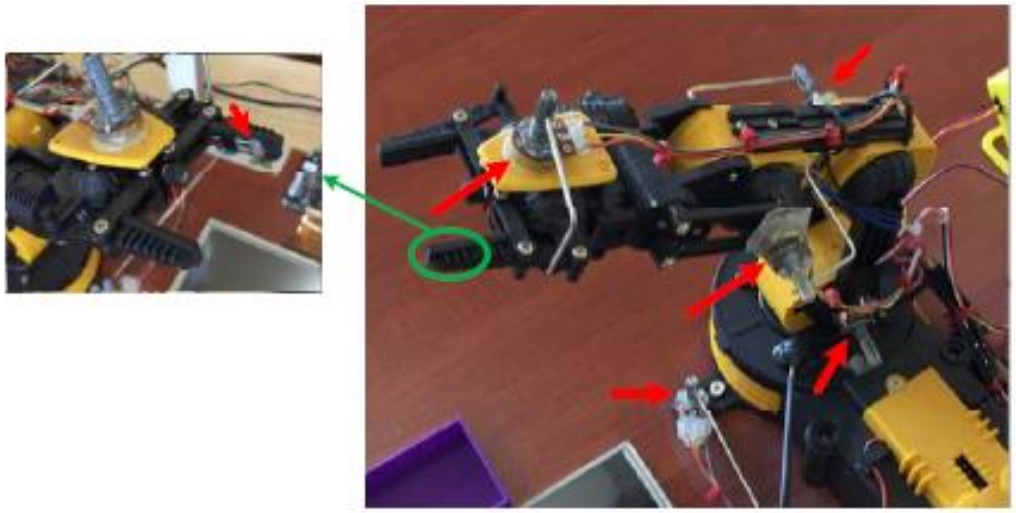


Fig. 8. RGB images and recognition results in binary images.

Kaymak et al. implemented the robotic arm with the use of Raspberry PI to actually test their approach. Distance on Z coordinate was fixed.





C. KAYMAK and A. UCAR, “Implementation of Object Detection and Recognition Algorithms on a Robotic Arm Platform Using Raspberry Pi,” in 2018 International Conference on Artificial Intelligence and Data Processing (IDAP), Sep. 2018, pp. 1–8, doi: 10.1109/IDAP.2018.8620916.

The YOLO version by Chatterjee et al. gives promising performance for low computing devices.

Fig. 3. (a), (b) Testing the inference model on the NAO robot to identify the primary object among distracting objects in view and take actions accordingly.

S. Chatterjee, F. H. Zunjani, S. Sen, and G. C. Nandi, “Real-Time Object Detection and Recognition on Low-Compute Humanoid Robots using Deep Learning,” *arXiv:2002.03735 [cs, stat]*, Jan. 2020, Accessed: Mar. 05, 2021. [Online]. Available: http://arxiv.org/abs/2002.03735.

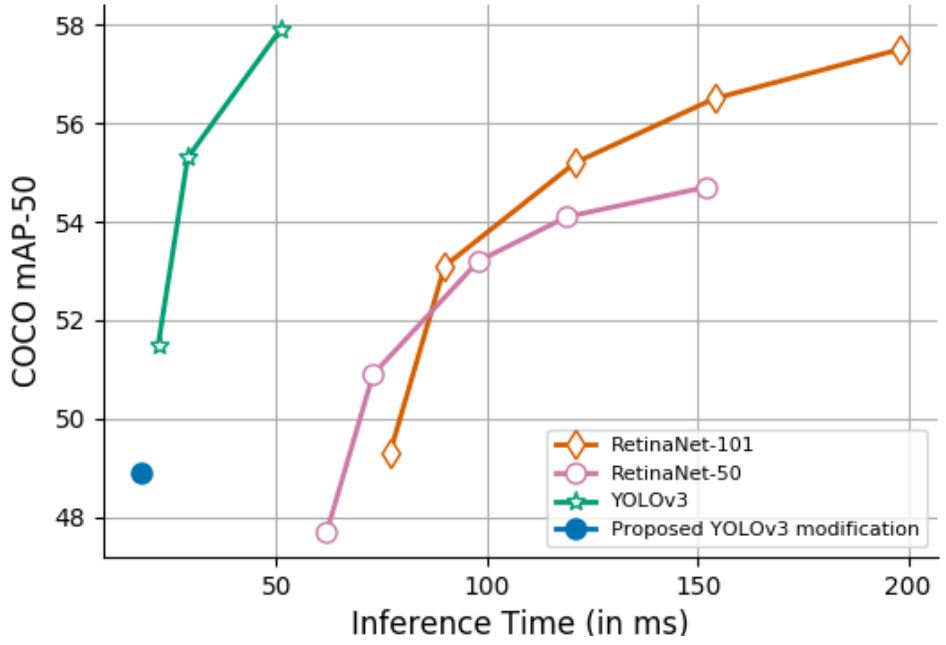


Fig. 5. Results of YOLOv3 modification compared against state-of-the-art RetinaNet models and other YOLOv3 variants as a demonstration of the low inference time and at relatively at par accuracy of the proposed model

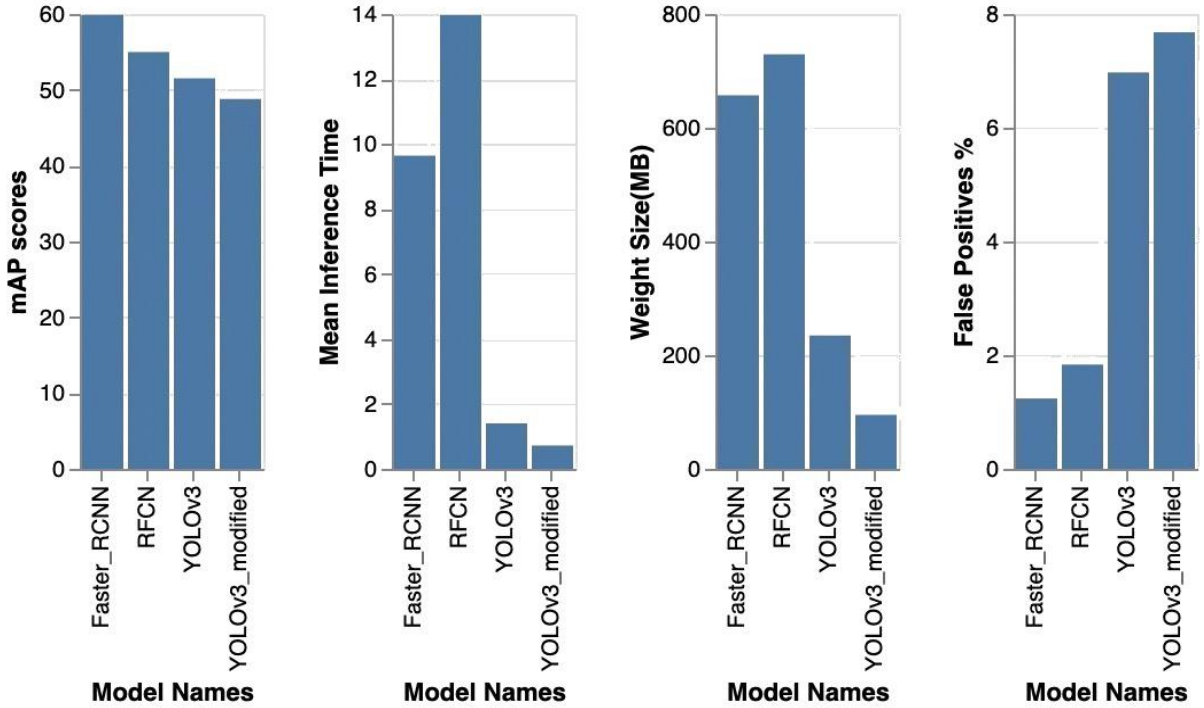
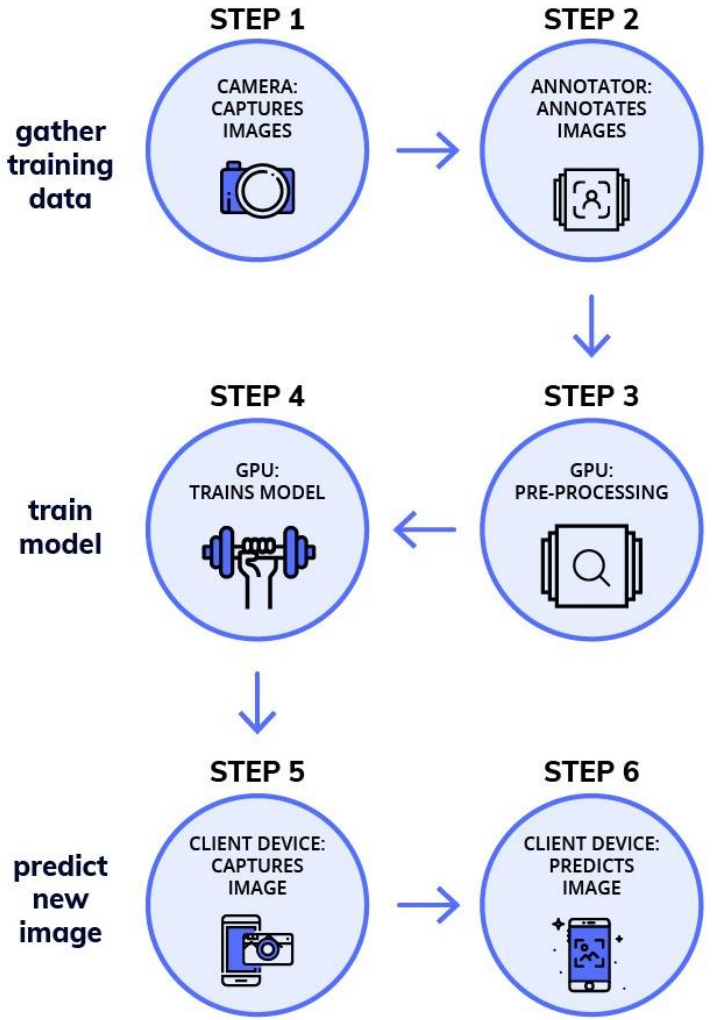


Fig. 6. Comparative results of bounding box algorithms on COCO dataset alongside the modified model used in the NAO robot

SLAM approach for object recognition for robots by MIT

USEFUL RESOURCES THAT I FOUND ON INTERNET

Nanonets



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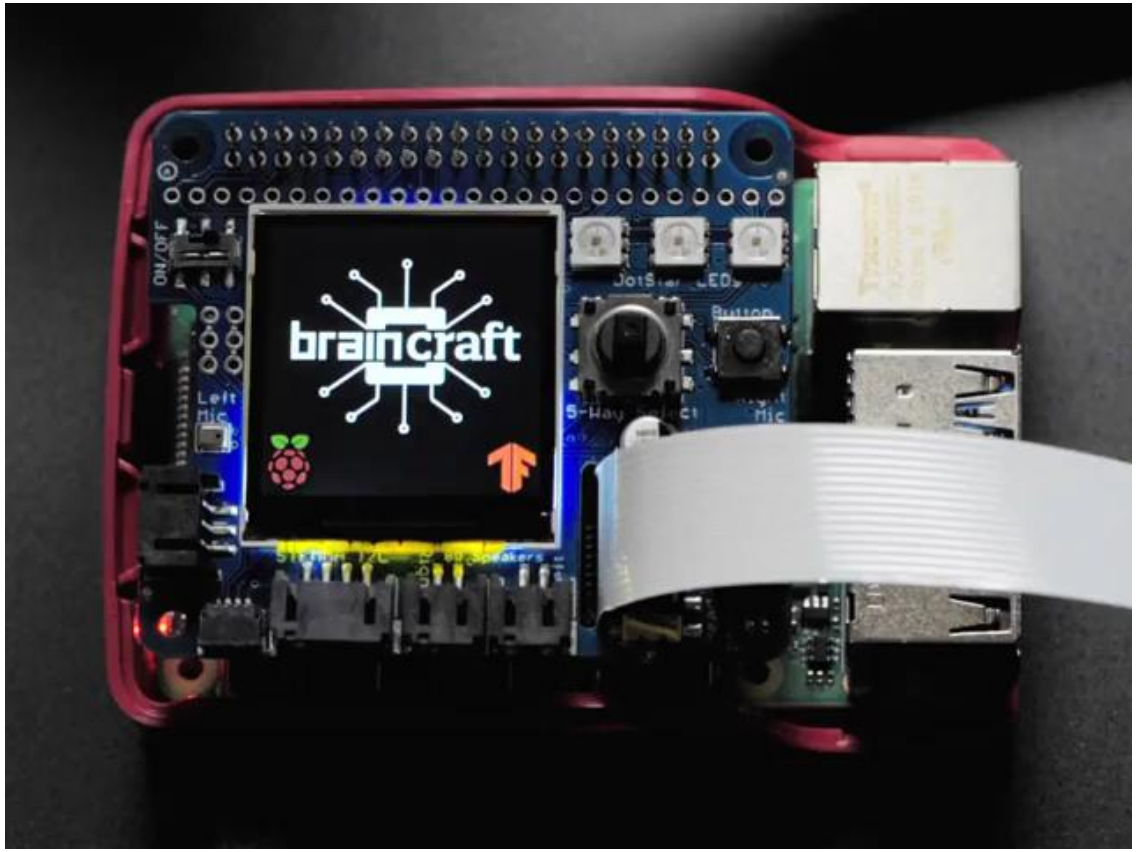
adafruit



Retrieved from : https://learn.adafruit.com/running-tensorflow-lite-on-the-raspberry-pi-4/overview on 3/10/2021

NEXT STEPS

- Create a dataset of the objects for the experiment (Probably LEGO blocks)
- Create and train the model for the object position recognition
- Build the Raspberry PI-based computer-vision system
- …
- Make robot to pick parts in a correct manner and place them correctly to designated space

PROBLEMS IN A FORESEEN FUTURE

- Distance calculation for robot trajectory built
- Grip force selection
- Speed performance
- Error rate

QUESTIONS?

…

COMMENTS?