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# The Roasted Tomato Challenge for a Humanoid Robot.

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A variety of @Home robots at the RoboCup 2009

## Context

- The RoboCup@Home is a socially relevant competition, but a lot of effort is going into the design of the robots.
- Although most modules are ROS-build, sharing is difficult due to the variety in hardware.



A Nao robot in the standard IKEA kitchen

## Challenge

- The Humabot challenge uses standard humanoid robots, which has to fulfil three kitchen tasks. One of the tasks is to roast the tomato.

## Approach

Tomato detection algorithms:

- Color based and finding contours.
- Circle based and average color
- Blob = Color Invariant Classification (Geon inspired)
  - Segments with  $\pm$  same color are found
  - Segments with distinctive colors on the same location are grouped (green/red tomato)
  - Grouped segments are filtered on characteristics as area, circularity and convexity.

## Discussion

This is the first publication of a solution for the Humabot challenge. To avoid confusion between vegetables, currently an algorithm is build which could classify all standard IKEA vegetables and fruits:



The IKEA Duktig object dataset

## Results

All three tomato detection algorithms found the tomato, but the number of false positives from the circle based and blobs were too high:

	color based	Circle based	Blobs
tomato	1	1	1
carrot	0	0	0
cucumber	0	0	0
garlic	0	background	0
lettuce	0	0	lettuce
all1	1	1	1
all2	1	0	garlic
all3	1	1	1 & background
without1	0	0	garlic
without2	0	0	carrot

## Conclusion

The colour based object detection outperforms the color invariant method, but this is only tested in controlled lighting conditions. Other characteristics (area, shape, Haar features) could become important when the object dataset grows. .

## References

- [1] P. J. S. Enric Cervera, Juan Carlos Garcia, "Toward the robot butler: The humabot challenge", IEEE Robotics & Automation Magazine (Volume:22, Issue: 2), 2015.