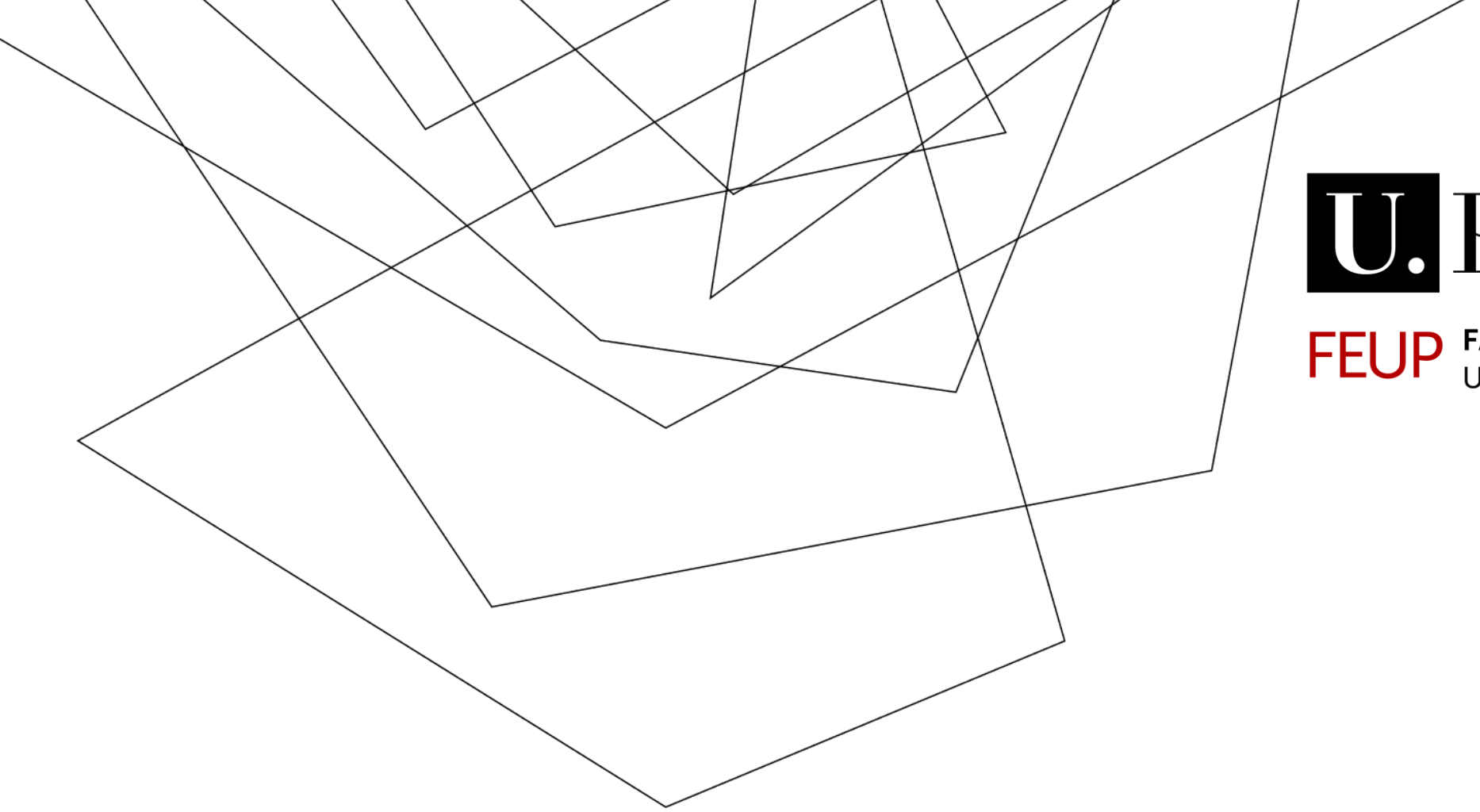


U.PORTO

FEUP FACULDADE DE ENGENHARIA
UNIVERSIDADE DO PORTO

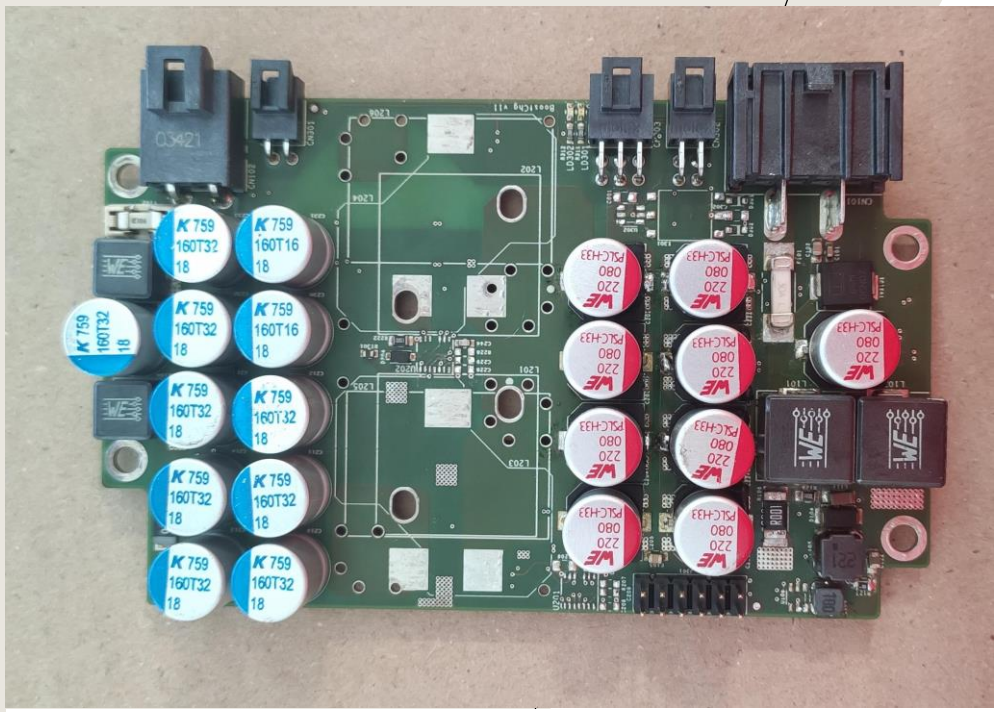
PCB INSPECTION

COMPUTER VISION - MDSE

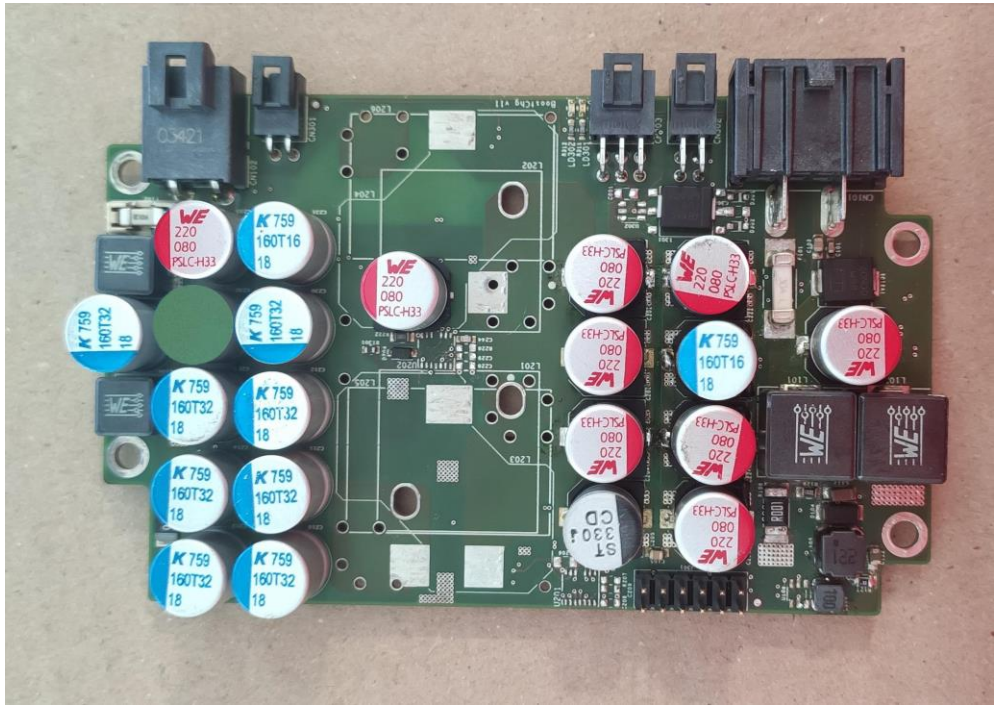
Fábio Silva
Joana Leite

17/12/2021

OVERVIEW



Ground truth image



Test image example

The goal is to detect if the target capacitors, which are the blue and red ones:

- are placed at the correct PCB location;
- have the correct polarity.

Four tasks to accomplish:

1. Capacitor detection;
2. Capacitor location verification;
3. Capacitor type verification;
4. Capacitor polarity verification.

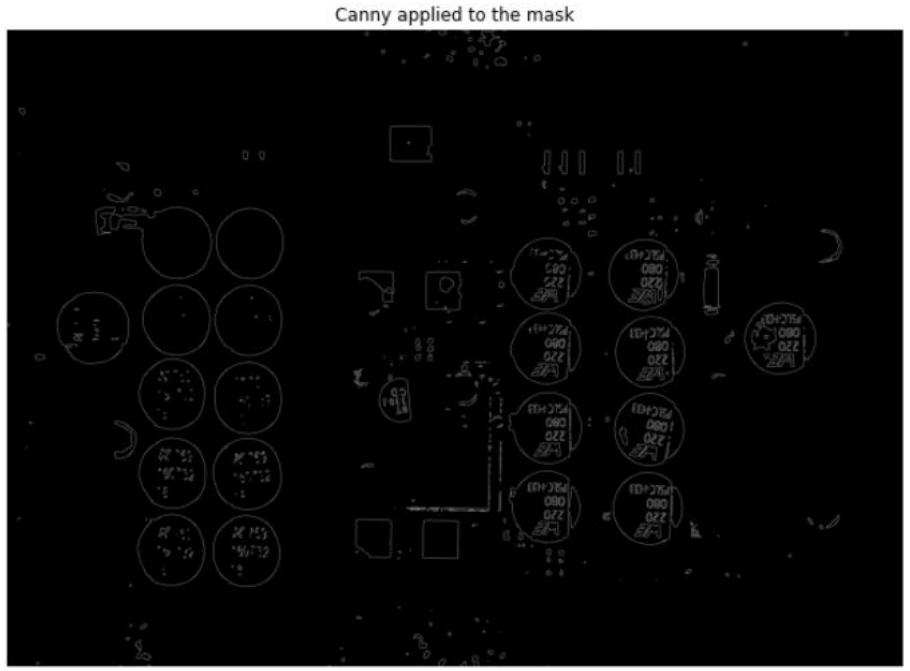
IMAGE TREATMENT

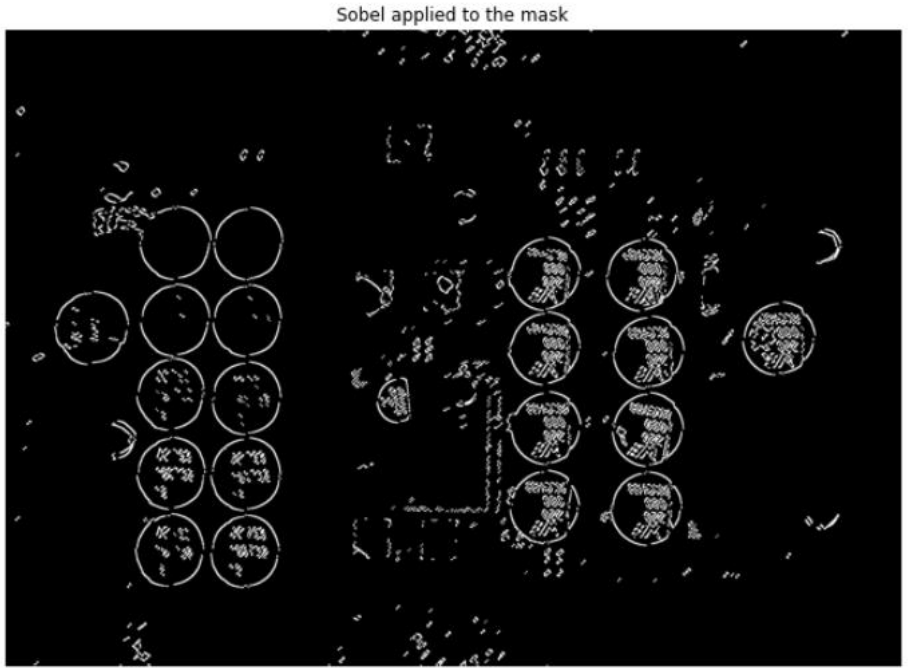
Filters tested:

- Average, Median, Gaussian and **Bilateral Filter** (better to preserve the edges)

Edge detection:

- **Canny filter** (less noise) and Sobel filter

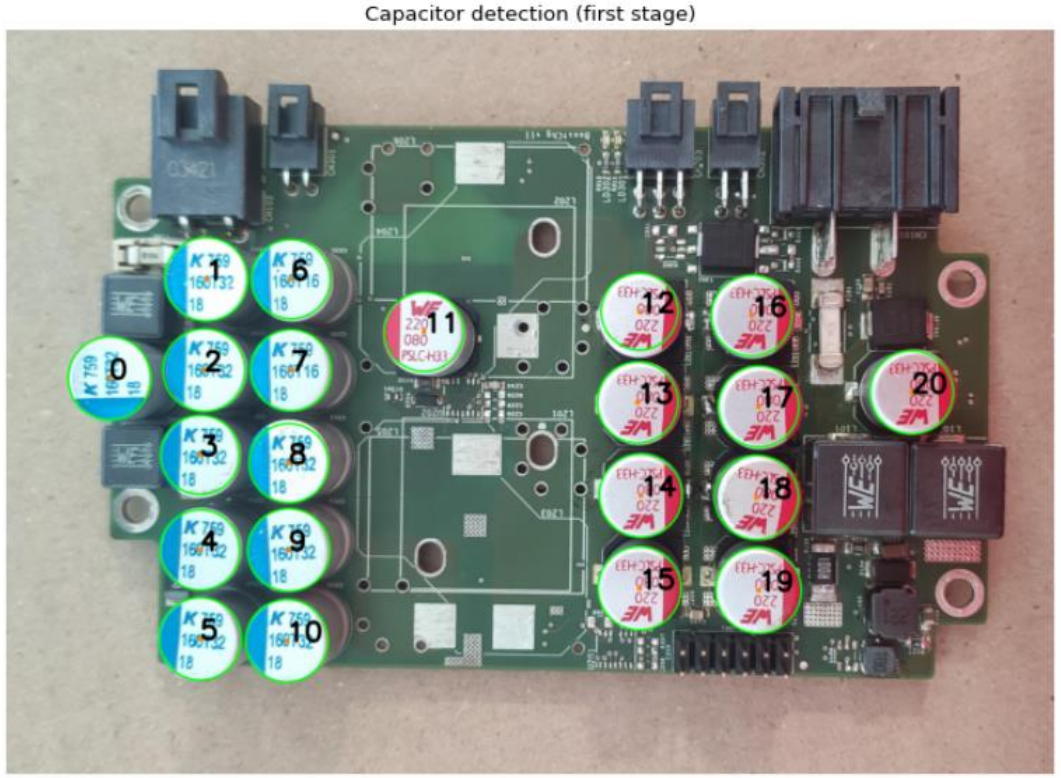




FEATURE DETECTION

Capacitor detection:

- cv2.HoughCircles to get circle info according do predefined radius (output not automatically sorted)



Number of capacitors detected: 21

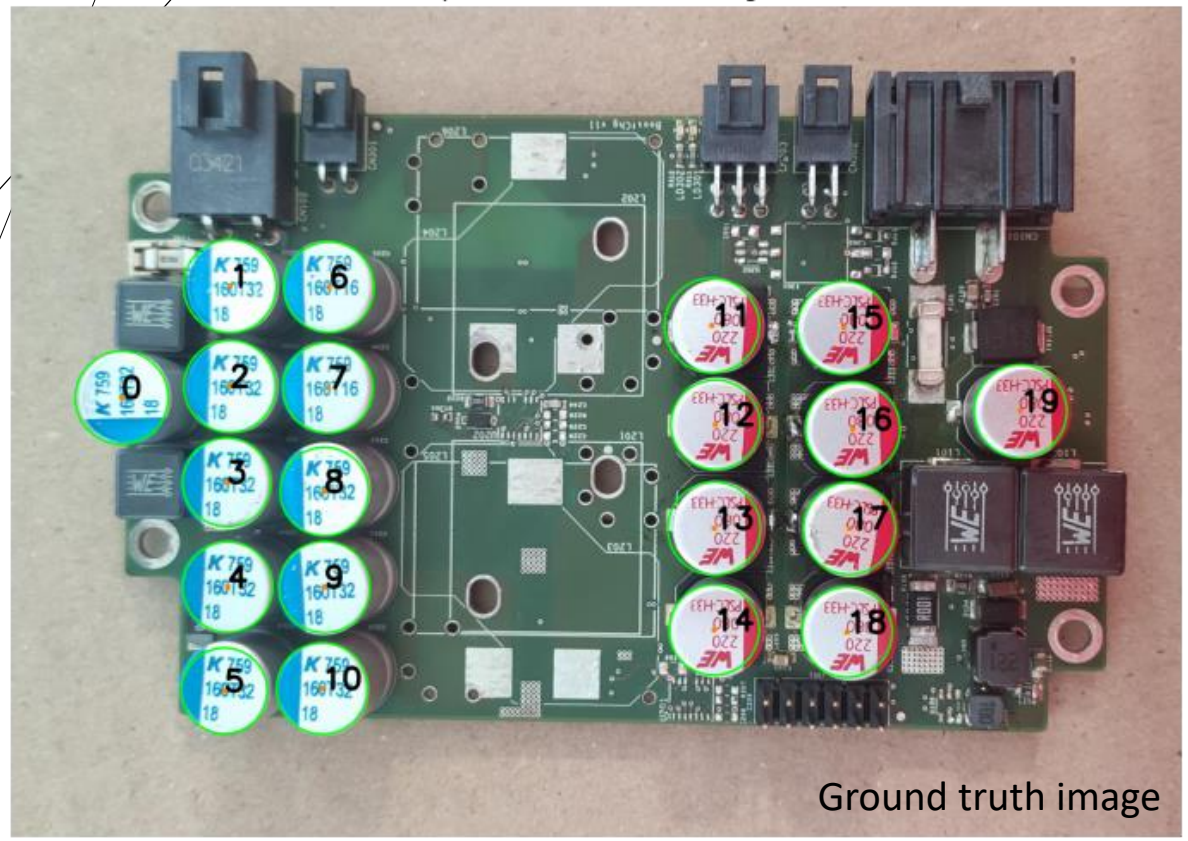
Polarity verification based on key points from the SIFT algorithm:

- Invariant to scale and rotation;
- Homography to get rotation.

Shows only the 4 best keypoints

RESULTS

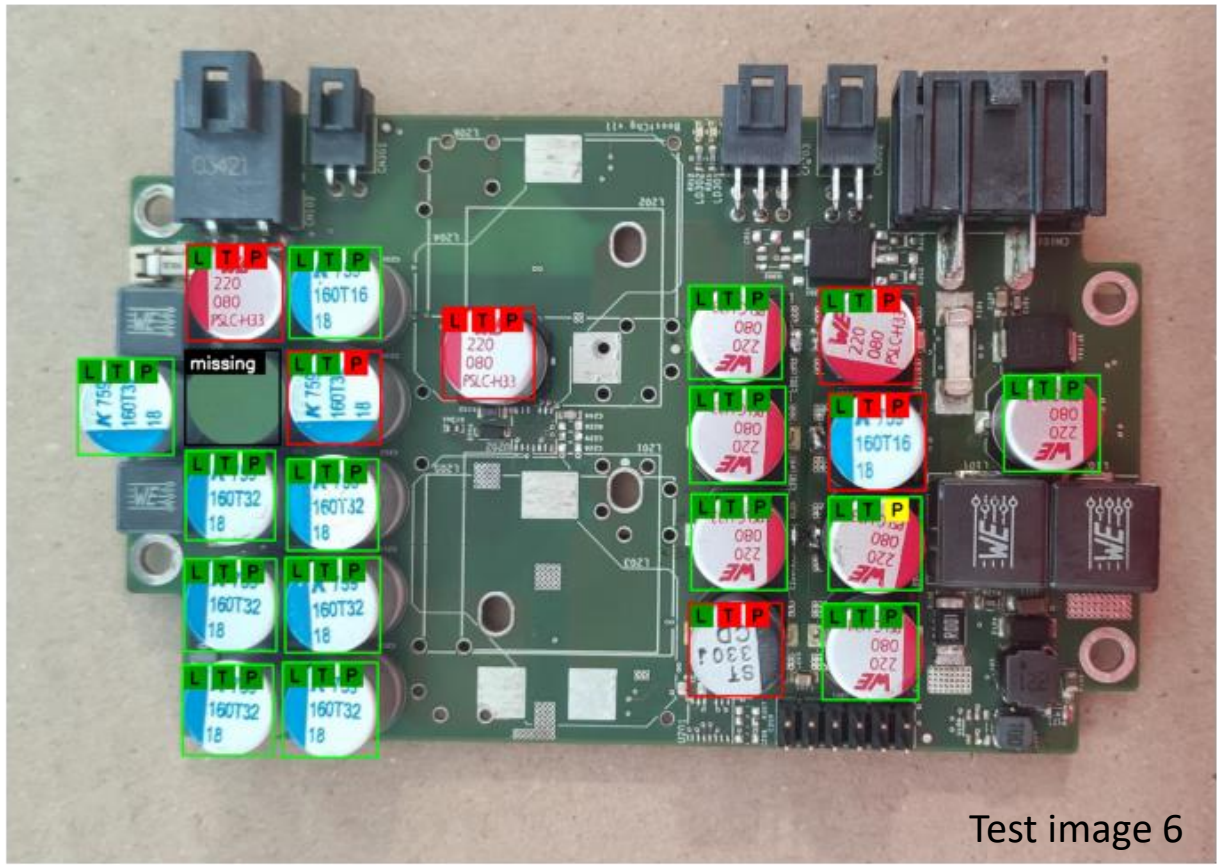
Capacitor detection (first stage)



Ground truth image

- Black bounding - Component missing
- Green box - In compliance ☺
- Red boxes - Noncompliance

Blue and Red capacitor verification



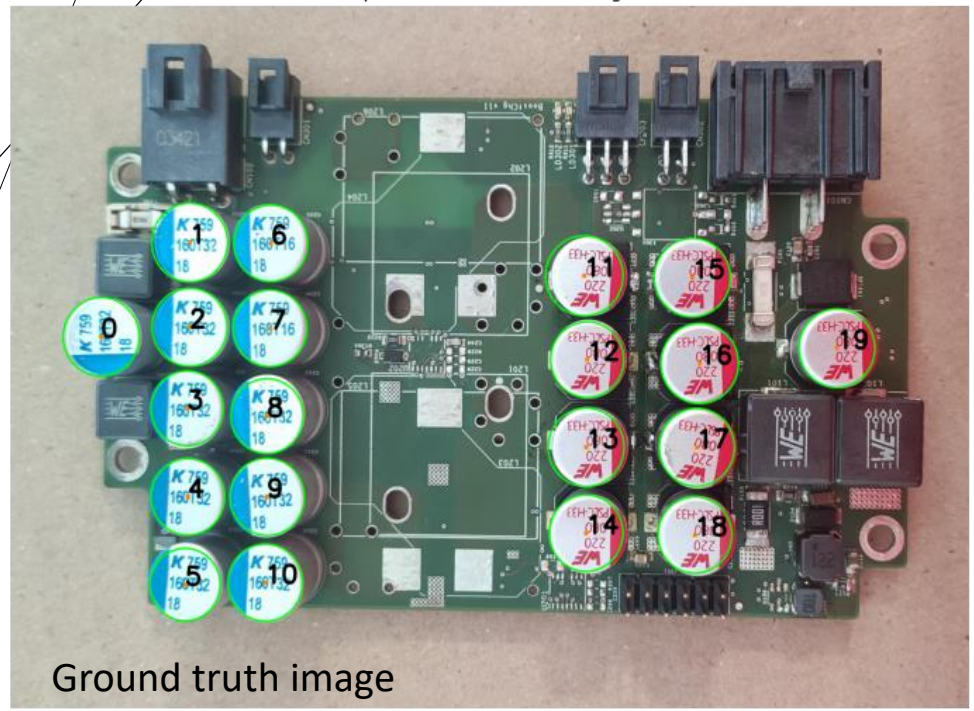
Test image 6

- L – Location
- T – Type
- P – Polarity

If the polarity has a significant deviation from the ideal position, about 10 degrees (allows adjustment), “P” will be highlighted in yellow color.

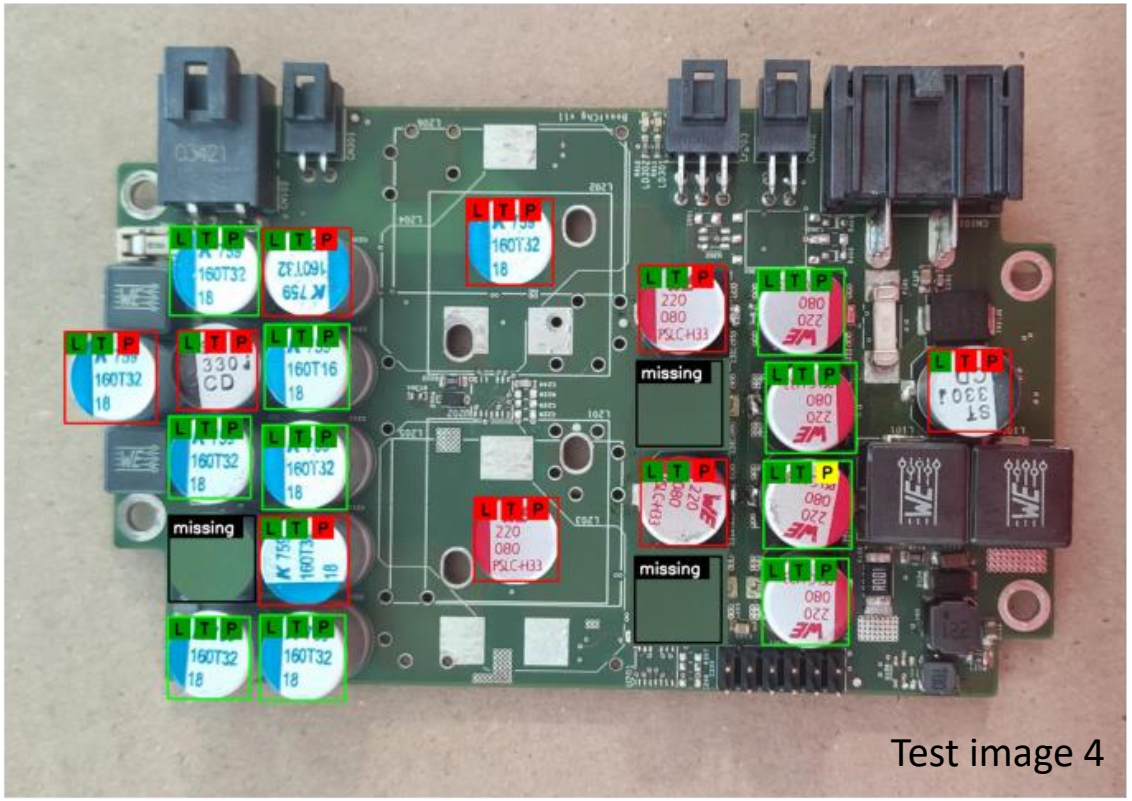
RESULTS

Capacitor detection (first stage)



Ground truth image

Blue and Red capacitor verification



Test image 4

Changes to the ground truth image	Image 1	Image 2	Image 3	Image 4	Image 5	Image 6
Missing capacitor	0	0	1	3	2	1
Additional big capacitor	0	1	0	2	1	1
Correct location Wrong type	0	0	2	2	3	3
Correct location Correct type Wrong polarity	0	0	1	5	2	2

100% accuracy in the test images

DISCUSSION OF THE RESULTS (BENCHMARKING)

Comparison with *Capacitor detection in PCB using YOLO algorithm* [1]

- The paper presents a method **to detect** specific capacitors in PCB;
- Uses CNN for a simple task;
- **Needs annotated images** to train algorithm;
- Incomplete inspection:
  - It does **not include** the notion of **polarity**;
  - It does **not identify** if capacitor types were **at the wrong place** (it only detects);
- Missing component, wrong component, or wrong polarity affects inspection.

[1] doi: 10.1109/ICSSE.2018.8520170