VLAIO TETRA

Machine Vision for Quality Control

(MV4QC)

Case 4 - Determination of the proper functioning of a LED display

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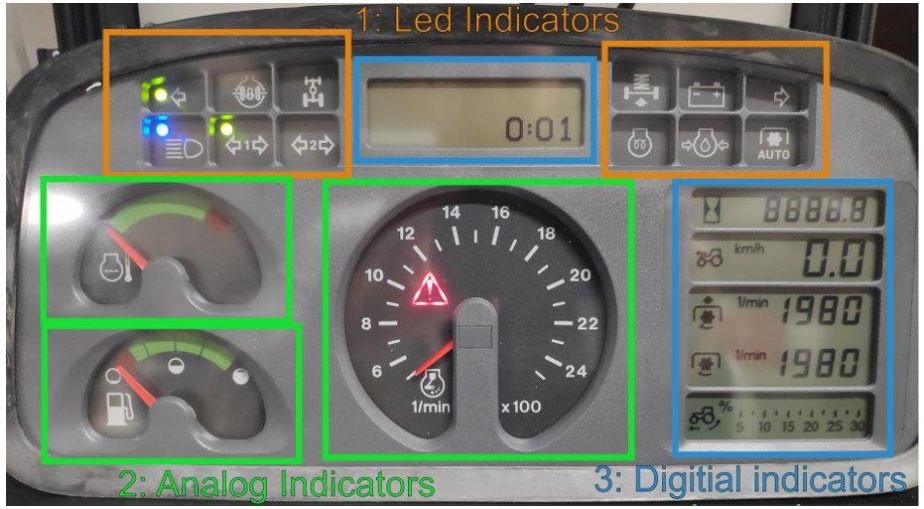
Case 4



Can we utilize machine vision to evaluate the proper functioning of the various components of a forklift display?

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Methodology: Data

No machine learning model → Dataset different

Images with different states of the display → Problems?

- Lighting
- Reflection
- position

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Methodology: Setup

Traditional Computer Vision → No machine learning model

→ Using only computer vision techniques

- Image thresholding
- Edge detection
- Finding contours
- …..

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Methodology: Detection of Light

1: Take the component

2: Filter out non relevant data

Only want the active light
- HSV filtering
- Image thresholding

3: Find the source

Find the source of the Led by using contour detection
- Led circular
- Other shapes

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Methodology: Evaluation of Gauge

1: Take the component → Pointer indicates value

2: Filter out relevant data → Only want the pointer

3:Plot needed lines/ploints → Using the filtered lines and extra validation lines/points

4:Extract value → Convert it to a value
- Convert in between bounds
- Margin of error

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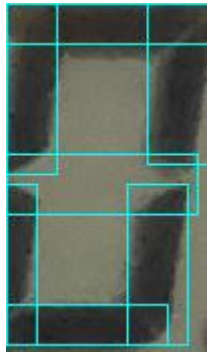
Methodology: seven-segment display.

7 segement → Number indicated by active segments

Detect the value
- Extract number
- Inspect segments
- Map states to numbers



```
DIGITS_LOOKUP = {
    (1, 1, 1, 1, 1, 1, 0): 0,
    (0, 1, 1, 0, 0, 0, 0): 1,
    (1, 0, 0, 0, 1, 1, 1): 1,
    (1, 1, 0, 1, 1, 0, 1): 2,
    (1, 1, 1, 1, 0, 0, 1): 3,
    (0, 1, 1, 0, 0, 1, 1): 4,
    (1, 0, 1, 1, 0, 1, 1): 5,
    (1, 0, 1, 1, 1, 1, 1): 6,
    (1, 1, 1, 0, 0, 0, 0): 7,
    (1, 1, 1, 1, 1, 1, 1): 8,
    (1, 1, 1, 1, 0, 1, 1): 9
}
```

```
(1, 1, 1, 1, 1, 1, 0): 0,
```

→ Alternative one could use an OCR system

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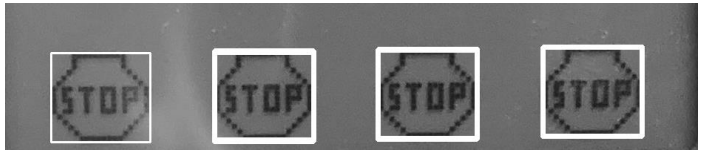
Methodology: board computer

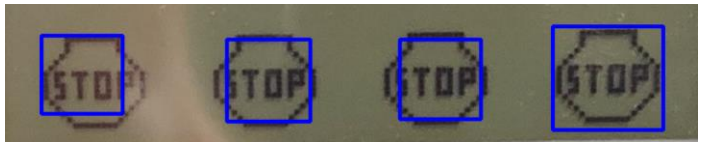
See if 4 symbols are present

Template matching
- Computationally expensive
- Searches for areas not symbols
- Sensitive to noise



Contour detection
- Faster and cheaper
- Searches for contours of exact size
- Less sensitive to noise

Preferred option



Methodology: Traction

What does the traction indicate?

- Value indicated by a collection of black squares
- We need to see if all squares work meaning we test the maximum value
- Look if we can detect the fully active bar

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Methodology: Backlight

Backlight not visible

Influences other components

We check if the color of a representative component is different

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Results: Light detection

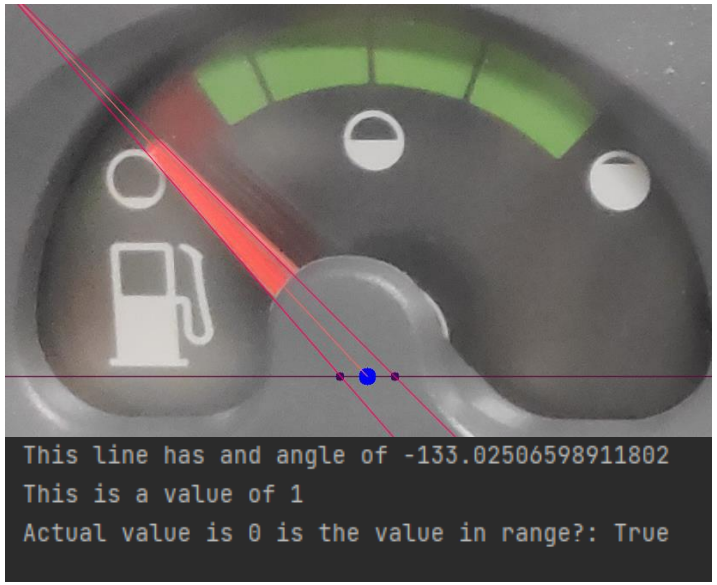
Multiple tests:

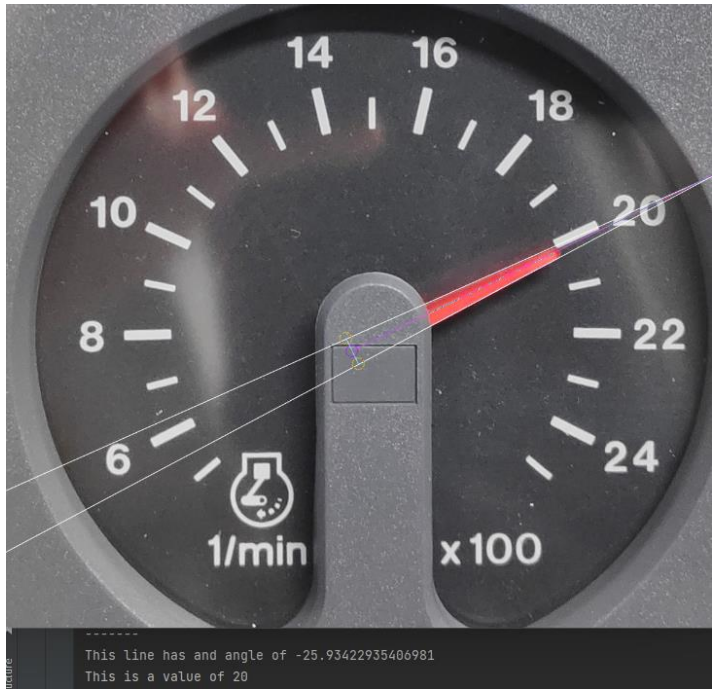
Detecting if all LEDs are on

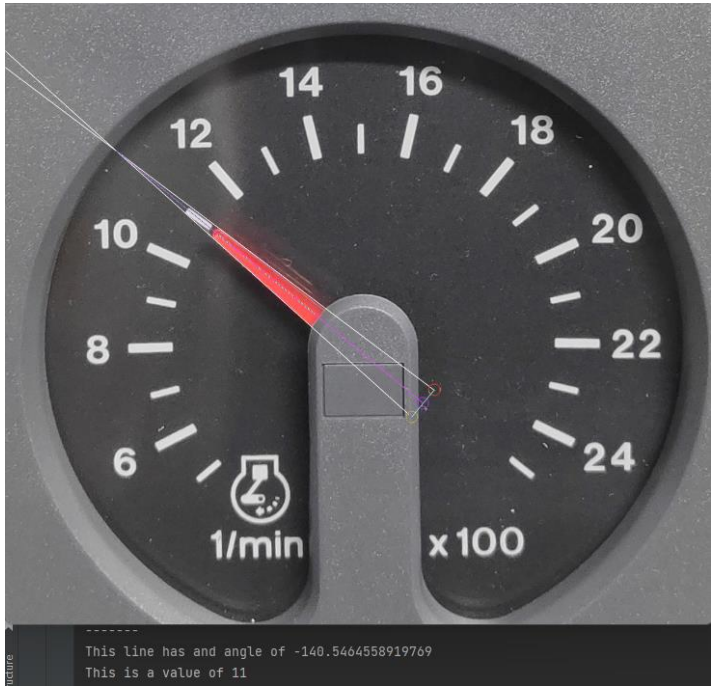
Detecting state of different LEDs

Using similar techniques, we can also detect an active warning symbol

Results: Analog instruments







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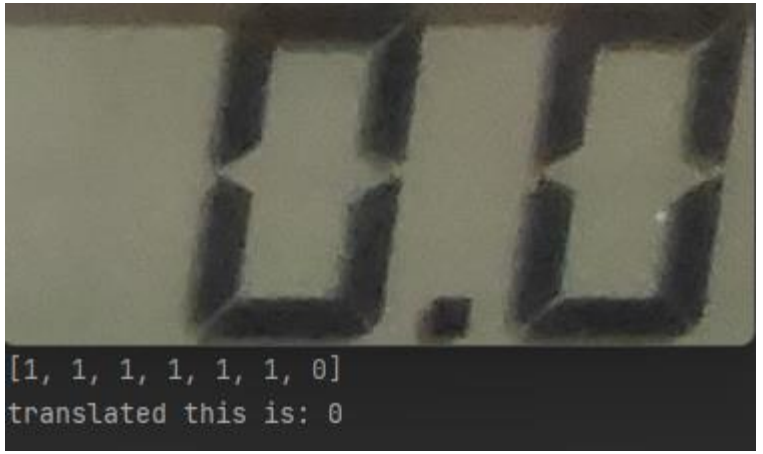
Results: seven-segment

Evaluation works most of the time

→ Problems can occur

→ Due to inconsistent lighting and reflection



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Results: Traction meter

Using contour detection, we can detect the full bar

Inactive and faulty values do not pass

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Results: Backlight detection

Board computer represents the status of backlight

- Filter out unwanted colors

- Calculate the percentage of active pixels
- Calculate the percentage of active pixels → If more than 80% of the pixels are active the display is on

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Results: Problems

Previous tests sometimes fail

- Inconsistent lighting
- Inconsistent distance
- Internal/external reflection

→ Lighting and reflection can be solved with better hardware

→ Positioning can be solved using a fixed setup

→ Future research on the implementation in industrial setting?

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Results: Hardware testing

Best lighting? How to avoid reflection?

→ Earlier tests using IDS camera and polarised lights

Polarised Lens

Lights on long edge

Light perpendicular on display