LNPR user guide

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1. Capture Image

After application is launched focus phone camera on required plate to be deducted. Tap anywhere on the screen image will be taken

Fig1.0

2. Resize image

Image taken from camera is too large therefore we have to resize so that OpenCV can process otherwise image will be discarded and no plate will be detected. Resizing (reduce size) also helps in processing as small data will be processed. We are resizing image to half of its size. After resizing Fig1.0 it looks like

Fig 2.0

3. Pre processing

Image captured from camera has many noise and dust that needs to be filtered before passing to plate detection module.
Following steps are done in pre processing.

3.1 Gray scale conversion

First of we convert color image to gray scale image.

Fig 3.1

3.2 Gaussian filter

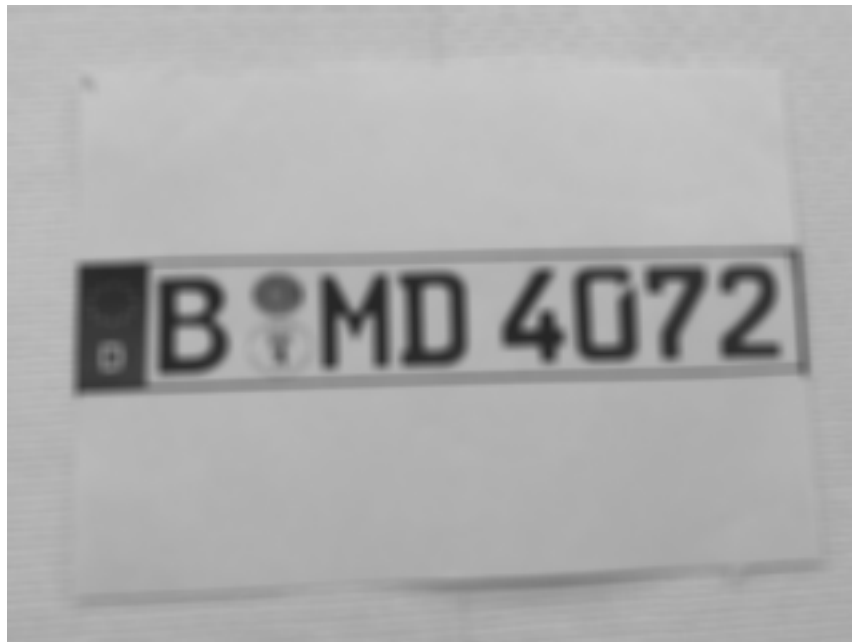After converting to gray scale we apply Gaussian filter of 5x5 remove noise.

Fig 3.2

3.3 Sobel filtration

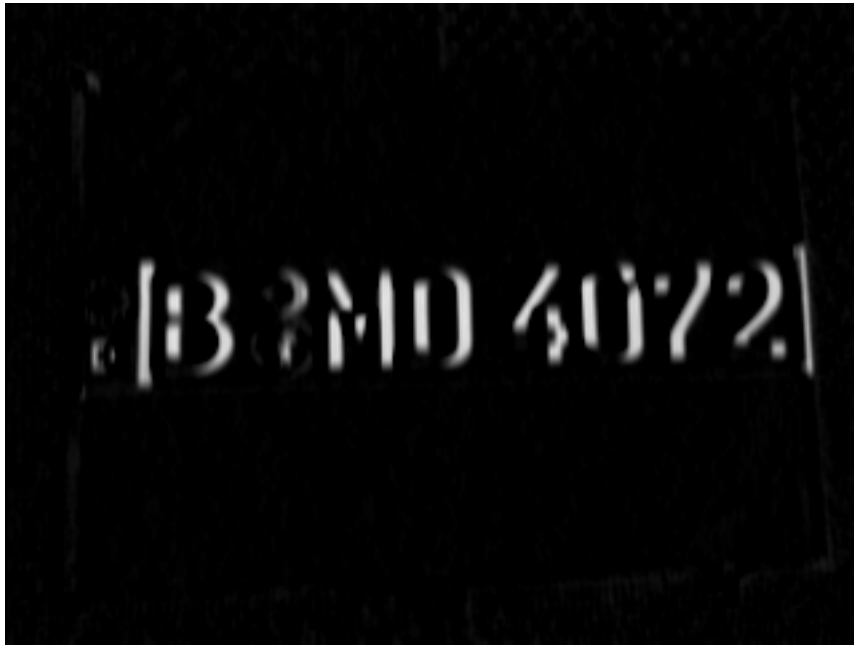To find edges in image, we use Sobel filter.

Fig 3.3

3.4 Threshold filter

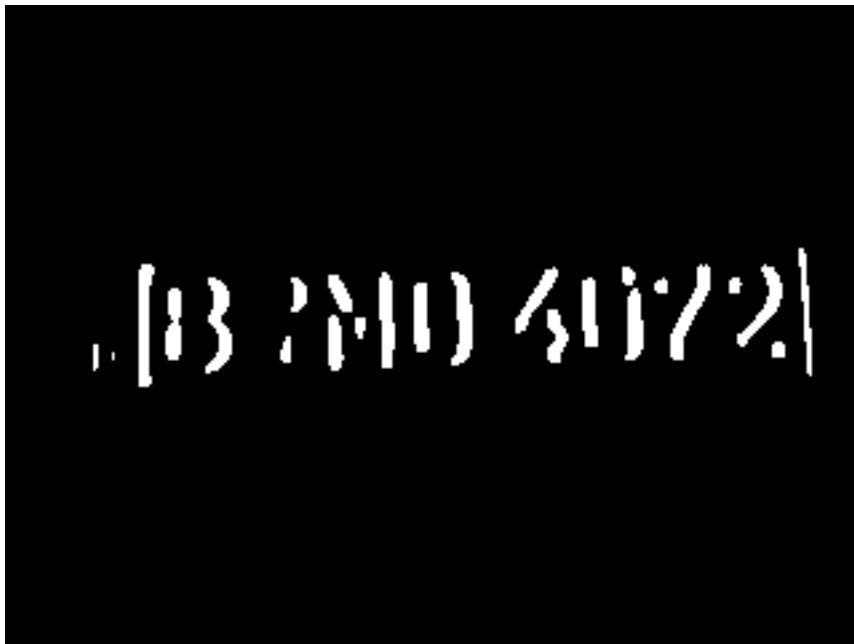We threshold image to remove enhance white color in image.

Fig 3.4

3.5 Morphology filter

We apply morphology operation so that we get edges of characters connected. Morphology is performed erosion followed by dilation.
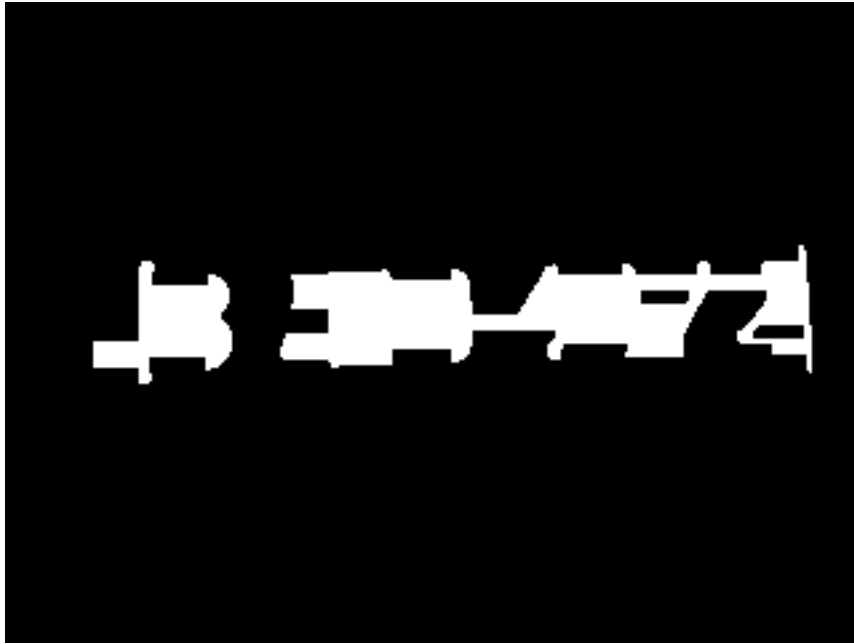
Fig 3.5

3.6 Edge detection

In this module we detected all possible edges in image. Here we remove any detected edge/patch that is not inside aspect ratio limit (520/112 = 4.6429). We also discard any patch that is not a perfect square.

4. Plate detection

In this module we extract plate from given image. This involves following steps.

4.1 Image mask

License plates have white background. We use this property of license plate to extract white region from image. We have frame of possible plate in image from preprocessing. We use flood fill with possible plate's frame to make mask image.

Fig 4.1

4.2 Verify plate size

German plate has 520x112 dimensions. We use aspect ratio (520/112) to verify size of detected plate's frame with error margin $\pm$**40**%**.**

4.3 Crop plate

In this step we crop plate from original image. Before cropping plate image we transform original image to remove any rotation. After this we crop image from calculated frame of number plate.

Fig 4.3

4.4 Resize plate

Returned plate image is small in size. Therefore we resize it so that OCR can detect text on image.
We make image 300x80.

Fig 4.4

5. Sticker removal

If we pass plate image to **OCR** module, it will detect extra and wrong characters due sticker present in plate.

Fig 5.0

In Fig 5.0, OCR consider stickers to be "**8**" which is wrong and gives wrong results. Therefore we remove stickers before sending to OCR module.
Sticker removal involves following steps.

5.1 Remove Sticker

We can have maximum of two circles in plate. One is larger and one small. We check 35% of plate for possible circles in image and paint them background color.

Fig 5.1

5.2 Background color removal

As we know that our characters are black in color therefore we can make background white so that possible sticker circle are completely removed.

Fig 5.2

5.3 Add white border

Now we add extra 20px white border around plate image so that any other extra border around plate image is removed.

Fig 5.3

6. OCR

Now we pass detected image to OCR so that we get text. We get "**M BD 4072**".

7. Character filtration

Some time we get extra punctuation marks in returned OCR text. Also some there are characters in digit part of text or digits in characters part of plate number or extra spaces in. We apply text filtration to remove any punctuation, illegal characters (e.g. I&Ω© etc.) and extra spaces.

8. Show Picker

If still number is not correctly detected we show picker views with pre filled plate number using German plate number database. User can adjust plate number before sending it for print.

9. Print

In the end detected plate number is printed. User just has to tap on screen for printing. Printer, which is on same network as your phone, is already used for printing. Now printer selection dialogue is displayed.