License Plate Recognition

Patrick Greene
Goal/Assumptions

• Reasonably fixed height, distance, and camera type. (applications include DIA, Toll Booths, Security Checkpoints)

• Limited to Colorado license plates
General Algorithm p1

1. Input Fixed Distance Image
2. Obtain Vertically/Horizontally Limited Gradient images
3. Search for “Suspicious” Rectangles
4. Output License Plate
Obtain Vertically/Horizontally Limited Gradient images

- Matlabs “imgradient” command automatically includes the angle of the gradient, it is possible to limit the gradient image to include only strong, vertical/horizontal gradients as seen on the left. This image is then morphologically thinned.

- A white or silver car will result in a poor gradient surrounding the license plate as the white plate is roughly the same color.
- The mountains in the license plate add a strong noisy horizontal gradient easy to confuse with the top of the actual plate.
- Muddy cars add strong vertical and horizontal lines potentially presenting problems with proper detection.
Obtain Vertically/Horizontally Limited Gradient images (thinning)
Search for “Suspicious” Rectangles

• Ideally this algorithm results in nothing but rectangles. However, as can be seen in the left image, strong diagonals also find their way into the image. This makes searching for a correct sized 2x1 rectangle difficult.
Search for “Suspicious” Rectangles

- A license Plate is almost exactly a 2x1 rectangle, therefore a cross correlation with an approximately sized rectangle should find the plate. We can also add a weighting function to highlight correlations in the bottom center of the image.

- The letters within the license plate result in a lot of noise internal to the rectangle.
- Other abrupt lines can add noise to the correlation search
Output License Plate

- The edges detected earlier become the bounding box for pulling out the license plate of the image.
General Algorithm p2

1. Input Cropped License Plate
2. Crop Individual Letters based on Pre-Made Template
3. Run Correlation for each Letter. Record Best Match
4. Output Reading
Crop Individual Letters based on Pre-Made Template

- At this point all license plate images should be the same size and orientation, therefore, the assumption that only Colorado licenses are being read makes it possible to use a template at this point.

- The template idea breaks down even under these assumptions for 7 digit licenses, collector licenses, and non-recent licenses.

- To expand license plate recognition fully, PCA or some other more advanced method should be used.
Run Correlation for each Letter. Record Best Match
Output Reading

052 ZRE
More Advanced Methods

First, a wavelet transform is performed on a large dataset of images with known license positions. Position of the maxima in the square roots of the Hilbert Transformation of the Intrinsic mode functions of a 2D signal. These positions are then compared to the test images vertical and horizontal characteristics to locate a license.
More Advanced Methods

- To recognize Letters/Numbers despite occlusion or scale/rotation (SIFT)
Statistics/Results

Troublemakers
Conclusions

• To achieve high (90% or greater) accuracy, this algorithm must be modified or applied under more ideal circumstances.

Additional Constraints
• Reduced set of makes and models to improve contrast and quality of detected rectangles.
• Cleaner vehicles with dark colors to improve the rectangles formed around the license plate.

Potential Improvements
• Identifying the location of the license plate without relying on rectangles.
• Not relying on a template, or potentially template fitting to identify the correct state license plate first.
• Using video instead of a single image to identify the license more robustly.
References/Questions

