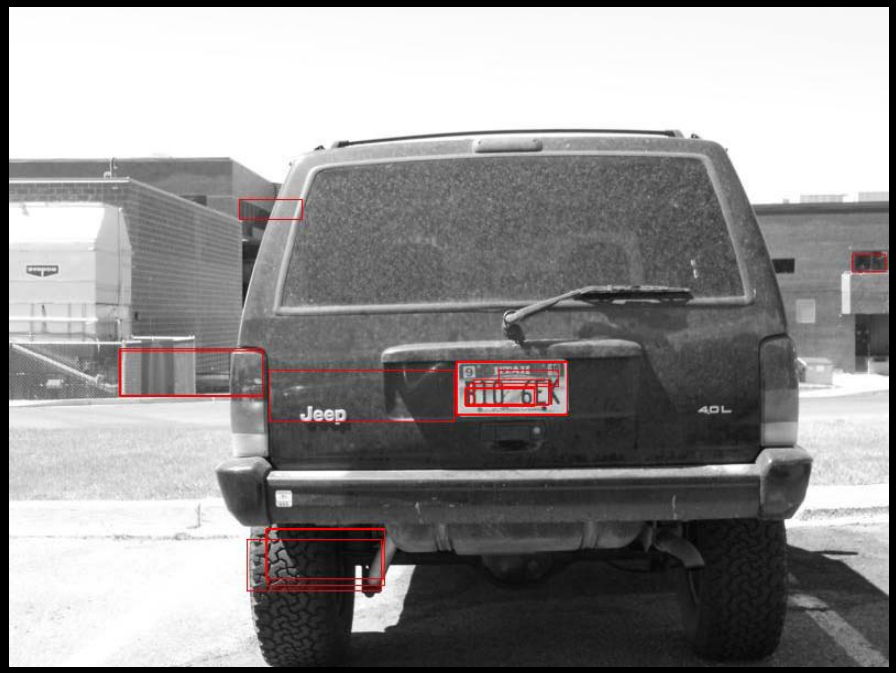


Nathan Woods
Carroll College Helena, Montana

LICENSE PLATE LOCALIZATION USING CONCURRENT COLUMNS

Related work

- Proposed system is based off of the work of Shen-Zheng Wang and Hsi-Jin Lee's
- Based on statistical plate recognition
  - Vertical Gradients Generation
  - Extraction of Compact Plate Regions
    - Place conditions on entire image
    - Extract dense pixel areas
  - AdaBoost Learners

Proposed Algorithm

- Pre-Processing
- Vertical Gradients Finding
- Concurrent Columns Localization
- Geometrically impossible plates Removal
- Adaboost Learning
- Overlapping plate regions merging

- 99.67% accuracy?

Pre-Processing

- Convert a color image to grayscale to reduce the size of the input image array by 2/3 and combine the color layers.
- Shrink the image to 600X800px allowing for minimal data accuracy loss and reduce processing time of the entire algorithm
- Apply histogram normalization to increase the contrast between the darks and lights of all elements.

Vertical Gradients Finding

- Say what?

- Scanning from left to right (vertical)

- Scanning from top to bottom (horizontal)

Concurrent Columns Localization (Part 1)

- Acc's and Reverse Acc's provide top and bottom of column information
- A resetting cumulative column summation
- Explanation of Concurrent Columns and acc's

0	1	1	1
1	1	1	0
1	1	0	1
1	1	1	1

Binary Image

0	1	1	1
1	2	2	0
2	3	0	1
3	4	1	2

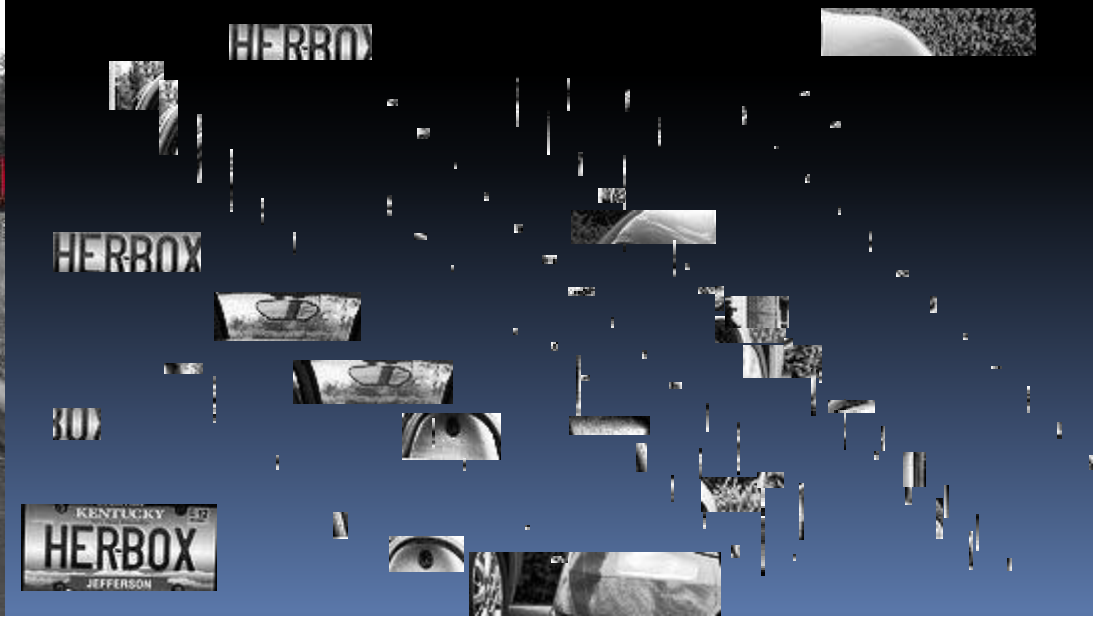
Acc's

0	4	2	1
3	3	1	0
2	2	0	2
1	1	1	1

Reverse Acc's

Concurrent Columns Localization (Part 2)

- Using Acc and Reverse Acc data, search for columns that are of similar height and horizontal location.
- 99 possible plates returned for this image



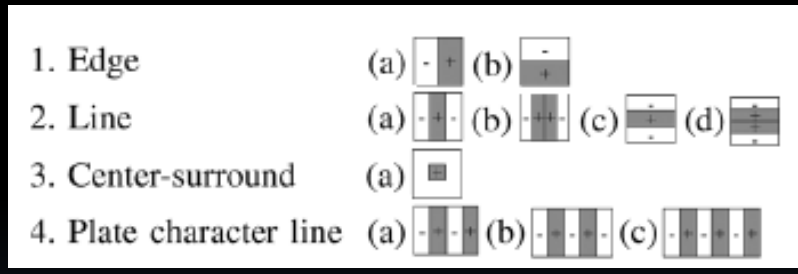
Geometrically impossible plates

- License plates have a height to width ratio between 1:2 and 1:4
- Plates cannot be too big or too small

12 possible plate regions remaining

AdaBoost Learners

- AdaBoost is a machine learning algorithm
- Using Haar-like features to generate data to train AdaBoost Learners



3 possible plate regions remaining

Overlapping plate regions merging

- Since the plate candidates may overlap to each other, a plate merging function merges plate regions that overlap.

Results

True +	False +
150	294
False -	**True -**
182	145,146

	True +	False +	False -	True -
Input				
Output			Empty	Empty

- Accuracy vs. Precision

$$\frac{True_{(+)} + True_{(-)}}{True_{(+)} + False_{(+)} + False_{(-)} + True_{(-)}}$$

$$\frac{True_{(+)}}{True_{(+)} + False_{(+)}}$$

Total Plates	Total Non-Plates	TPR	FPR	Accuracy	Precision
332	145,440	45.181%	0.202%	99.673%	33.784%

Future work

- Modify Acc counting
- Convert static variables to percentages
- More data = better learners
- Recursive non-plate suppression

- All of these should be able to increase the precision of the algorithm

Conclusion

- A completely new way to generate possible plate runs from an image
- This algorithm adds the following methods to previous work
  - Geometrically reject plates
  - Plate Merging

The End