Introduction

Motivation

Speed limit signs (SLS) are used to encourage drivers to drive under the maximum speed. This helps reduce traffic accidents caused by excessive speed. However, a driver may not notice a particular speed limit sign due to tiredness, distraction or lack of concentration. In this case, an automatic speed limit sign recognition system may be helpful in making drivers aware of speed limit information they may have missed.

Ongoing commercial research shows that there is room for improvement in existing technologies, and the field is eager for new ideas and approaches to increasing recognition accuracy, system reliability and processing speed etc.

Research Goal

- Design and implement a real-time automatic speed limit sign detection and recognition system.
- Exploring new ideas, approaches and/or algorithms and using them to enhance the system performance.

System Design

The system consists of three major steps, which are colour segmentation, sign detection and sign recognition.

- Colour segmentation discards all uninteresting regions in YCrCb colour space to smooth the speed limit sign detection.
- Possible speed limit signs are detected and extracted in the detection stage.
- Candidate Speed limit signs are classified in the Recognition stage. Driver is notified with checked result reading.

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Colour Segmentation

1) Original Image
2) YCrCb Image
3) Non-red region binary image
4) Labelled image

SLS Detection

1) Detect non-red circular region with Linear Support Vector Machine (LSVM).
2) Extract ellipses from the original image.
3) Fill four corners with background colour.
4) Apply Optimal Thresholding.
5) Label blobs with unique colour.
6) Check the modality of ellipse:
   - Whether contain a "Km/h" pattern in the lower section.
   - Number of blobs in the upper section.
   - All blobs in upper section MUST have roughly same height.
7) Discard any fake ellipse.

Digit Recognition

A new improved Scan-line based digit recognition algorithm has been designed and implemented.

- Scan every blob with multiple scan-lines
- Extract the 10 features of every blob
- Compare every feature with the field in The Standard Digit Feature Table
- Increase probability of matched digits
- Decrease probability of unmatched digits
- The digit with highest final probability is considered as the reading of the blob

Result & Conclusion

Result

- Overall Accuracy: 92.20%
- Average processing speed: 13fps (0.077 sec. per frame)

Conclusion

- A robust real-time speed limit sign recognition system is attained.
- A new Scan-line based digit recognition algorithm is successfully introduced.