

2024 GRA (Graduate Research Assistant) Assessment:

Size estimations of Traffic Sign Plaques

Context

Traffic sign inspection plays a critical role in autonomous driving systems and for transportation agencies for ensuring road safety by providing crucial information for navigation, safety, and regulatory compliance. It plays a vital role in ensuring road safety by accurately recognizing and interpreting traffic signs, enabling vehicles to comply with regulations and navigate effectively. The **MUTCD** regulates and provides guidelines for traffic sign placement and design.

Deep learning has emerged as a powerful tool in computer vision, enabling significant advancements in various applications, including traffic sign recognition. By leveraging deep learning techniques, traffic sign detection systems can enhance safety, efficiency, and reliability on the roads.



Fig 1: Automatic Sign Detection, Classification, and clustering on video camera recording.

Challenges and Objectives

While detection and recognition of traffic signs using video recording is a common task, some challenges are still encountered to extract specific attributes such as sign plaque dimension estimation, sign support type, sign plaque height from the ground.

This research project aims to investigate the limitations of current methods. and develop innovative approaches to **estimate the sign plaque dimensions (width, height) of traffic signs on video recordings**. The MUTCD rules specify the requirements (minimum, maximum) for such sign plaques dimensions based on the road type (highway, interstate ...). See below one example for the stop signs:

Table 2B-1. Regulatory Sign Sizes

Sign	MUTCD Code	Section	Conventional Road	Expressway	Freeway	Minimum	Oversized
Stop	R1-1	2B.04	750 x 750 (30 x 30)	900 x 900 (36 x 36)	—	600 x 600 (24 x 24)	1200 x 1200 (48 x 48)

Fig 2: MUTCD regulation regarding STOP sign dimensions. Reference:

<https://mutcd.fhwa.dot.gov/hm/2003r1/part2/part2b1.htm>

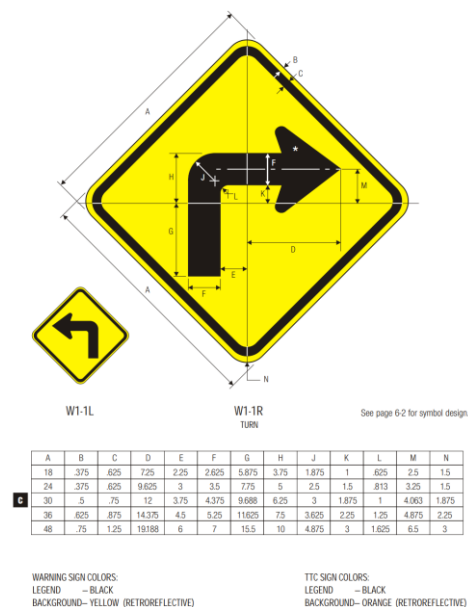


Fig 3: Standard design guideline of W1-1 warning sign plaque

Reference:

<http://www.trafficus.com/w1.html>

Part 1: Literature Review & Proposed solution

1. Perform a comprehensive literature review and address the following points:
 - a. Explain the importance of estimating the dimensions of traffic sign plaques, emphasizing the need to address this problem
 - b. Provide an analysis of the pros and cons of each algorithm in the context of estimating traffic signs plaques dimensions on images.
 - c. Identify the inputs, outputs and factors that significantly impact performance.
 - d. Outline the evaluation methods used to assess the effectiveness of these algorithms.
2. Investigate and select **Only One solution** to use for this task, you should explain your choice as well as provide the data needed to implement this solution.
3. Write a report about your review including the previous points.

You will be asked to present your work at the end of the part 1 assessment to the research group. Your presentation should at a minimum include:

- Summary of your understanding of the research problem background and research need.
- Summary of literature review that includes the discussion mentioned above.
- Your reasoning for selecting the model, the dataset, and the methods to implement and your technical approach
- Any Additional information as you see fit
- References

Deliverable: PDF report and slides

Part 2: Implementation & Testing

1. Data preparation, this part involves

- a. Preparing an experimental setup meeting your chose algorithm inputs:

This setup may include different sign dimensions, sign types and distance from the camera as well as camera's parameters.

- b. Preprocessing the raw data, define ground truths and appropriate metrics to assess your future estimations
- c. Highlight any weakness in your data and assumptions taken during the process.

2. Solution implementation, testing and validation

- a. Implement your proposed method for estimating traffic sign plaque dimensions
- b. Test your implementation on the data you prepare
- c. Validate your method

3. Future investigations

- a. Based on the challenges you encountered, highlight what you would suggest doing next, and potential improvements.

You will be asked to present your work at the end of the part 2 assessment to the research group.

Your presentation should go through each step of part 2, remind the part 1 decisions and highlight the challenges you encountered and how you overcame them.