Localization for Traffic Sign Detection Proposal

Chloe Lee
Department of Computer Science
Amherst College
Amherst, MA
chhlee28@amherst.edu

Isabella Niemi
Department of Computer Science
Amherst College
Amherst, MA
iniemi27@amherst.edu

Marah Sami
Department of Computer Science
Amherst College
Amherst, MA
msami26@amherst.edu

Gloria Wu
Department of Computer Science
Amherst College
Amherst, MA
gwu28@amherst.edu

I. Introduction

We plan on implementing and evaluating a traffic sign detection model, loosely based on an older model [1]. We will focus solely on the localization task. We also hope to improve the model by implementing newer techniques.

II. Literature Review

The current detection strategy increases the contrast of the video frame and utilizes Laplacian of Gaussian (LoG). LoG smooths the image, reduces noise, and highlights regions of intensity change to find edges [2]. When it comes to object detection, LoG can produce false edges or gaps, malfunction in corners or curves, and is sensitive to noise [3], [4]. More widely accepted approaches to localization involves deep neural networks, including YOLO and Single Shot Detectors (SSD). YOLO frames object detection as a single regression problem and uses a single convolutional network to predict multiple bounding boxes [5]. There are many versions of YOLO to account for weather conditions, low-light, and overexposure [6]. SSD uses a single deep neural network to detect object in images, which makes it faster, simpler, and less computationally expensive [7].

III. Implementation

We will use a similar strategy to the original model by first increasing contrast and removing unnecessary colors. We will train purely on images and take an image as input, rather than a video. Our model will be trained using PyTorch, which provides built-in neural network layers and optimizers. [1] We will train using the LISA dataset, which contains images of 47 different types of U.S. traffic signs taken from driving vehicles. [2]

IV. Evaluation of safety specifications

We define a model as adversarially robust if the output stays the same if the input is perturbed by a small, pre-defined ϵ. We will focus on 2 main safety specifications.

A. Weather Conditions

Bad weather conditions, such as snow or heavy rain, can heavily distort an image and change the model's predicted output. We will evaluate the model's performance on different weather conditions using the imagecorruptions package, which includes 16 corruption presets. [3]

B. Lighting Conditions

Similarly, bad lighting conditions can negatively impact the model's decision-making. To generate different lighting conditions, we will use the ColorJitter module from TorchVision [8].

C. Additional Evaluations and Implementations

Given adequate time, we would like to evaluate the model's performance when faced with more than one traffic sign in one image, as well as different distances to the traffic sign. We would also like to implement a newer strategy for traffic sign detection, such as YOLO or SSD.

V. Timeline

Deadline	Task/Benchmark
10/22, 11:59 PM	**Group formation**
	Literature review: Establish motivation and background
10/31, 5:00 PM	**1 page project proposal**
	Existing code review: Flag sections that can be improved
	Find more recent and diverse dataset Train base model using PyTorch on data
11/17, in class	**5 minute mini-update presentation**
	Implement benchmarks to evaluate robustness
	Data analysis and generate graphs
12/3, in class	**10 minute project presentation**
	Draft of project report
12/12, 11:59 PM	**4-5 page project report** **Link to code** **1 page individual contribution summarization**

[1] Code: https://github.com/gloriawu2014/traffic-sign-localization
[2] Dataset: https://github.com/AminJun/lisa
[3] Code available at: https://github.com/bethgelab/imagecorruptions

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