Context-Free
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CSC 7700-004
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1 Requirements

- **Primary goal**: to minimize the likelihood of pedestrian and driver casualties due to inaccuracies and inefficiencies in sign, crosswalk, and pedestrian detection algorithms.
- **Secondary goals, objectives, and tasks**:
  1. **Goal**: stop sign detection. Detect stop signs in real-time with sufficient efficiency to allow for stopping time. Test SURF against two alternate algorihtms, described below.
     (a) **Objective**: construct and R-channel integral-image-based detector.
        i. **Task**: compute integral image on the R-channel of the image.
        ii. **Task**: superimpose an mxm grid on the image and compute the sums of the R-channel intensity per 2x2 region.
        iii. **Task**: for the 2x2 region with the maximum sum, recursively apply (ii) until the region with the maximum R-channel intensity density is obtained.
        iv. **Task**: in the neighboorhoods of the vertices inside the maximum-density region, find the four box such that the diagonal along those boxes separates a maximum-density R-channel triangle from a minimum-density R-channel triangle.
        v. **Task**: obtain the 8 vertices of the sign from the above.
     (b) **Objective**: construct octagon detector.
        – **Task**: apply a shape detector to yield sets of vertices.
        – **Task**: discard all sets where $n \neq 8$.
        – **Task**: check to see if the opposing edges of the 8-vertex shape are parallel (within a certain threshold).
  2. **Goal**: pedestrian crosswalk sign detection.
     (a) **Objective**: construct and RG-channel integral-image-based detector.
        i. **Task**: compute integral image on the R-channel of the image.
        ii. **Task**: superimpose an mxm grid on the image and compute the sums of the R-channel intensity per 2x2 region.
        iii. **Task**: for the 2x2 region with the maximum sum, recursively apply (ii) until the region with the maximum R-channel intensity density is obtained.
        iv. **Task**: in the neighboorhoods of the vertices inside the maximum-density region, find the two boxes such that the diagonal along those boxes seperates a maximum-density RG-channel triangle from a minimum-density RG-channel triangle.
        v. **Task**: obtain the 3 vertices of the sign from the above.

2 Design

- **Modules**
  1. **SignDetector1**:
     – **Functionalities**: computes and uses integral image on the R-channel to find maxmium-density areas used to approximate the region occupied by the stop sign.
     – **Data structures**:
        ∗ **Namespaces**: `EmguCV.CV`.

    * **Classes** (`Image`) and **class members**: `Resize()`, `Convert()`,

2. **SignDetector2**:
   - **Functionalities**: uses edge detection, then isolates eight vertices with maximum octagonality.
   - **Data structures**: `Image, LineSegment2D, boxList, triangleList, Contour`
     * **Namespaces**: `EmguCV.CV`.
     * **Classes** (`Image`, `Contour`) and **class members**: `Canny()`, `HoughLinesBinary()`, `Resize()`, `Convert()`, `PyrUp()`, `PyrDown()`, `FindContours()`.

3. **PedDetector**:
   - **Functionalities**: detects pedestrians using built-in EmguCV classes.
   - **Data structures**: `Rectangle[]`.
     * **Namespaces**: `EmguCV.CV`.
     * **Classes** (`Image`, `HOGDescriptor`) and **class members**: `Draw()`, `SetSVMDetector()`, `DetectMultiScale()`, `GetDefaultPeopleDetector()`.

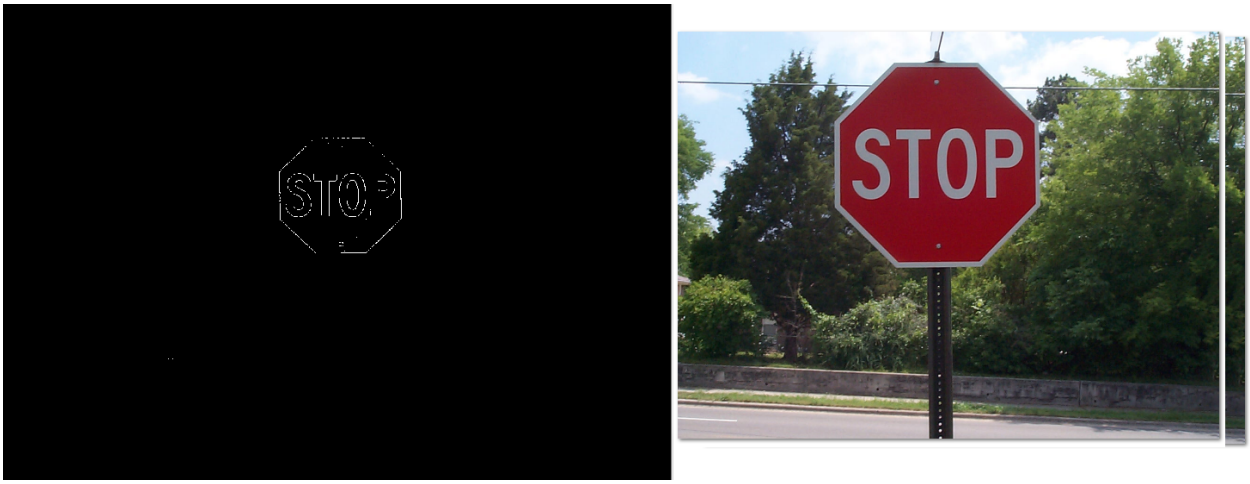

Figure 1: Edge detector by computing R-(G+B), clamped from 0 to 255

Figure 2: Edge detector by computing R-(G+B), clamped from 0 to 255