VISIBLE LIGHT THERMAL IMAGING FUSION

Team 11
Senior Project CS 426
Spring 2012

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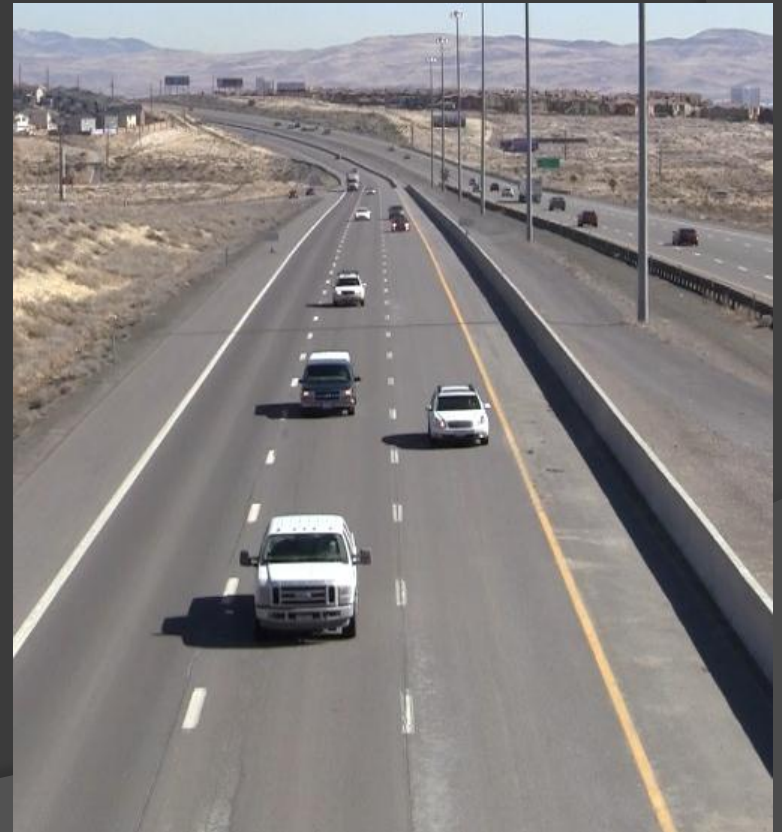
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VLTIF

VLTIF

PROJECT GOALS

Core:
- Detect any vehicles in image regardless of external conditions
- Accurately count vehicles passing through intersections regardless of external conditions

Potential:
- Generic classification based on type of vehicle (truck, sedan, sports utility vehicle)
- Discrimination between vehicles, pedestrians, cyclists
- Behavioral analysis (vehicles improperly parked in emergency zones, suspicious activity, etc.)
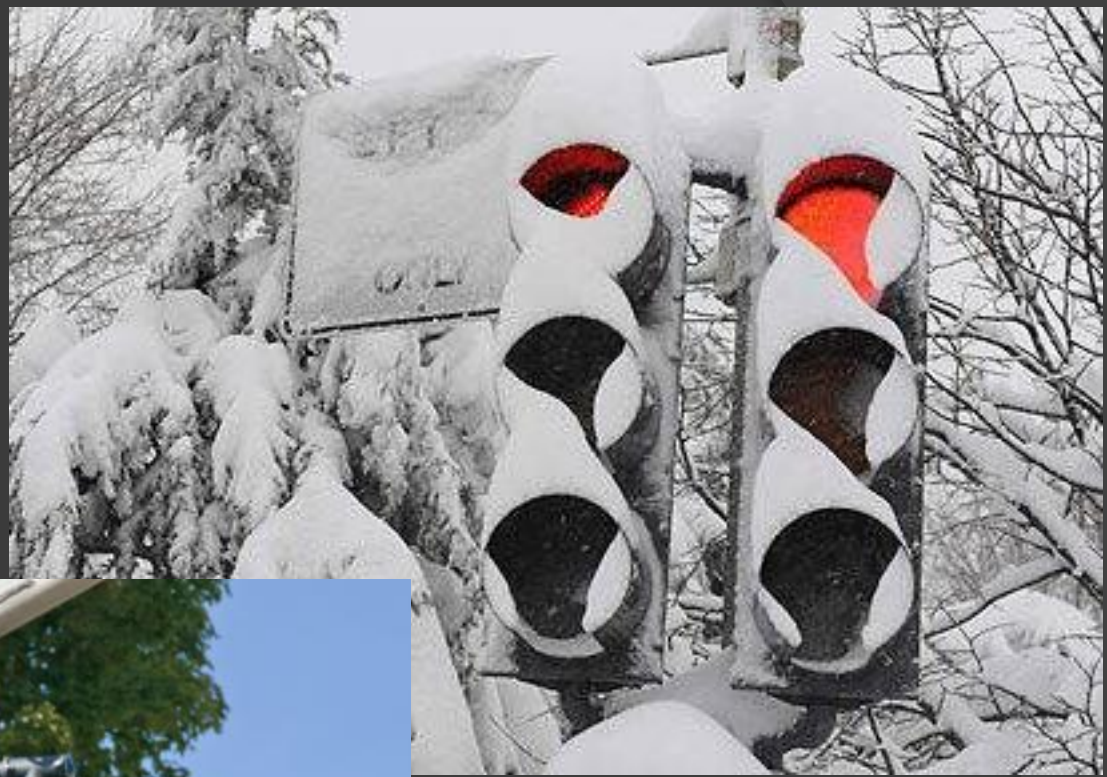
WHAT IS THE BEST WAY TO CONTROL TRAFFIC LIGHTS?

First came timers...

...followed by inductive loop sensors to detect if vehicle present

PROBLEM SOLVED?

Extremely invasive and expensive installation procedure

Loop operation sensitive to roadway conditions

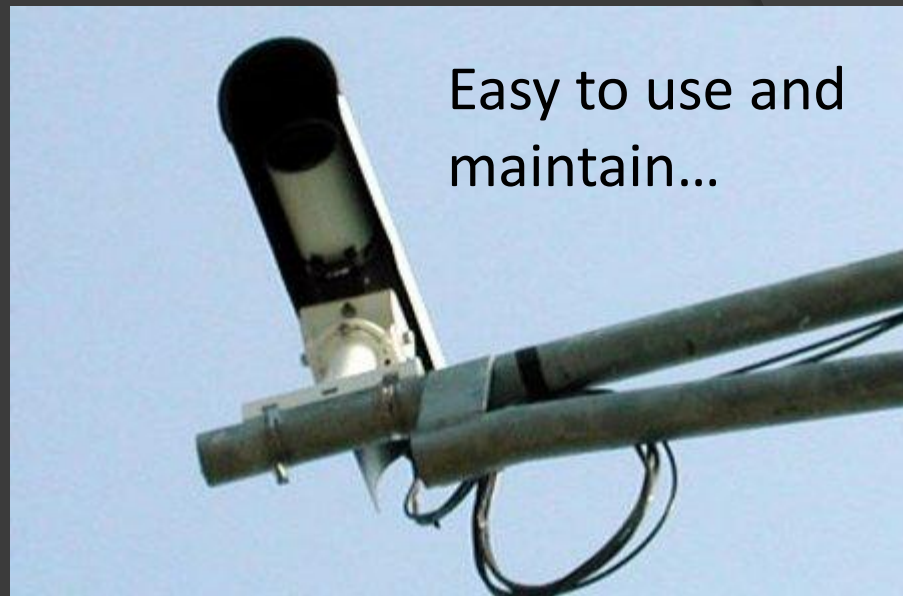And overall, the potential data collection from loop sensors is very limited.

WHAT IS A BETTER SOLUTION?

CAMERA BASED TRAFFIC MONITORING SYSTEMS

Easy to install…

Easy to use and maintain…

Existing products with over $100 million in annual sales…

PROBLEM SOLVED?

LIMITATIONS OF EXISTING SYSTEMS

- Rely on a single color camera as input sensor
- Good performance is limited to
  - Daylight
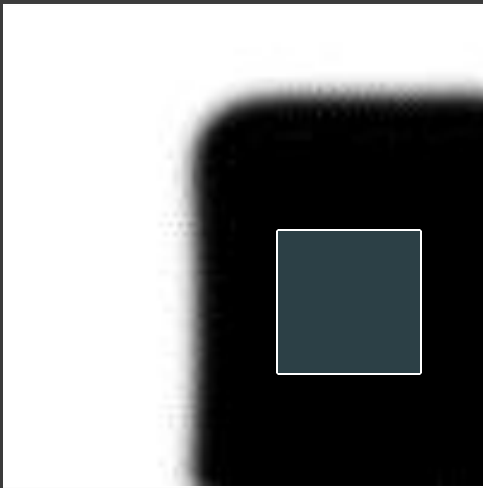 - Clear weather

WHY?

VLTIF

VLTIF

VLTIF

Traffic monitoring using thermal and visible light fusion.

Changes in lighting, occlusion, texture, and orientation greatly affect object recognition algorithms in computer vision.
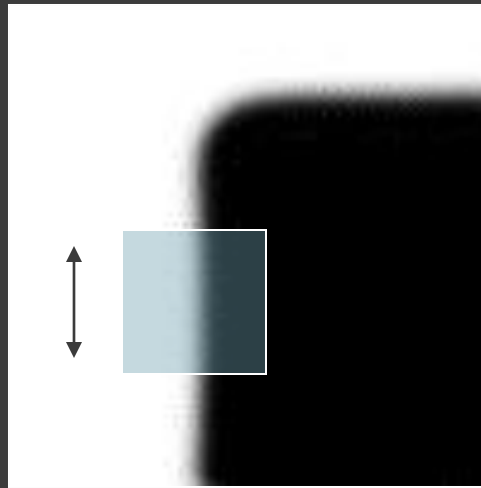

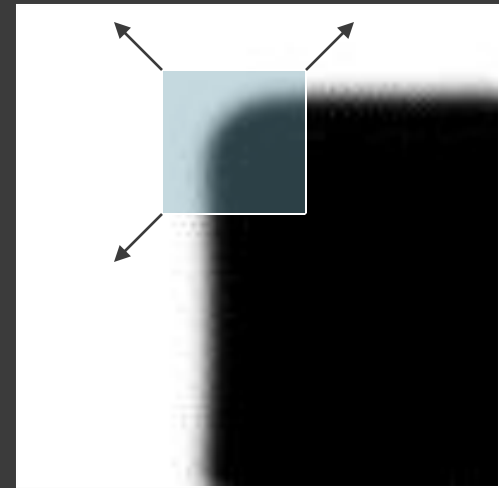Humans are much better at pattern recognition with partial data.

INTEREST POINT CONCEPTS

"flat" region:
no change in all
directions

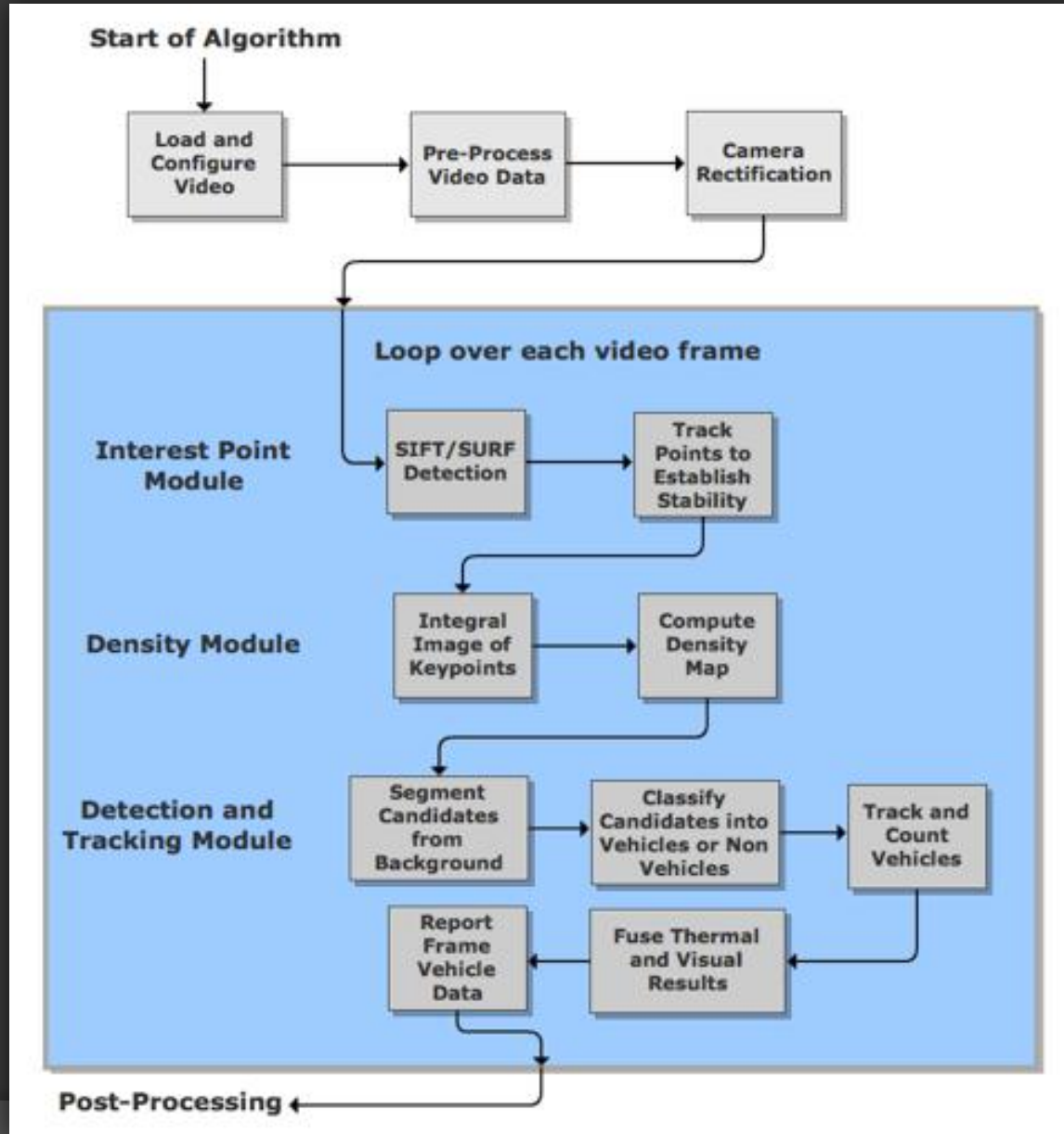"edge": no change
along the edge
direction
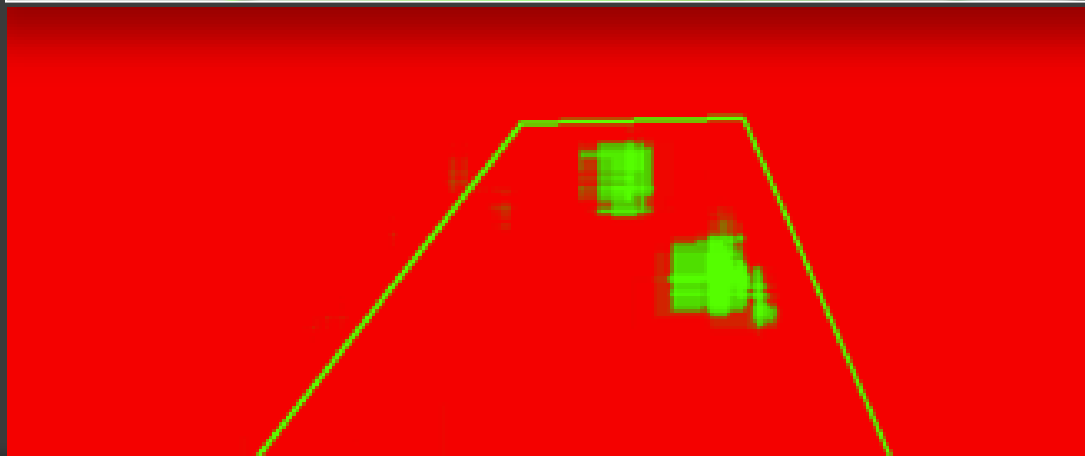
"corner": significant
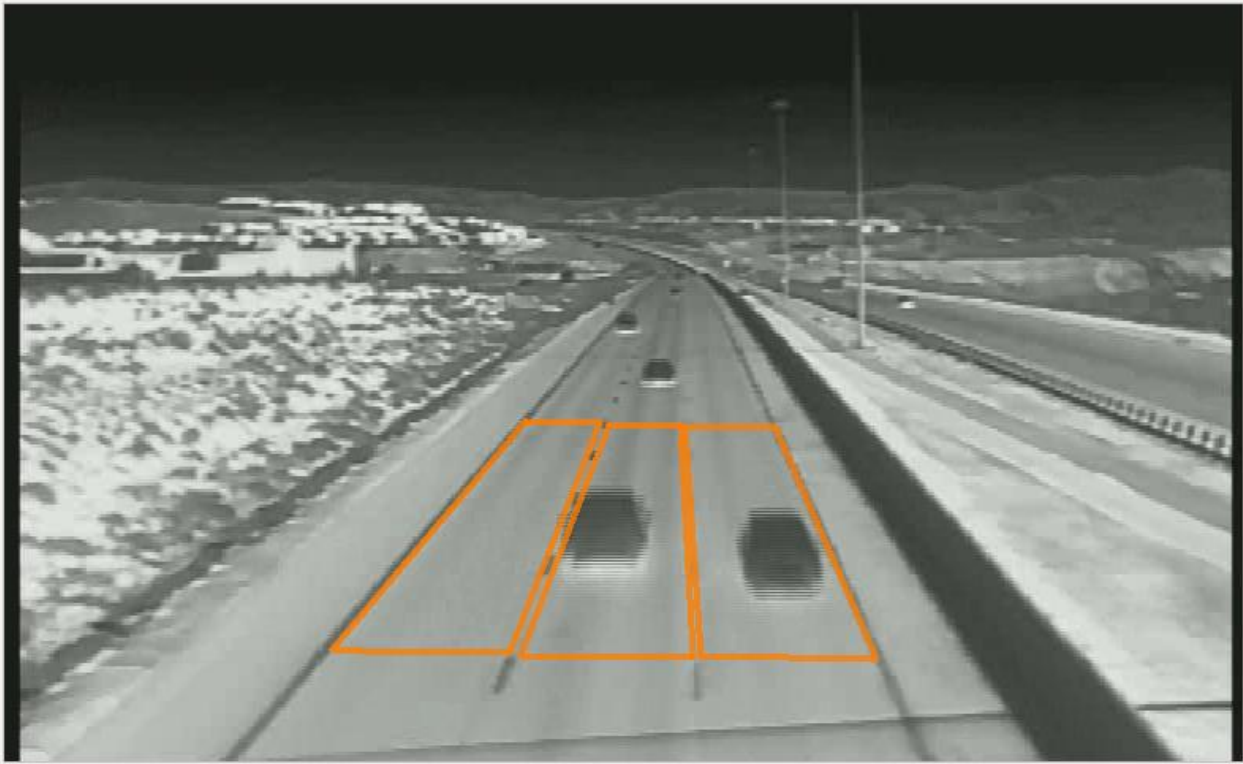change in all
directions

SIFT KEYPOINTS

PROCESSING MODULE

Start of Algorithm

Load and Configure Video → Pre-Process Video Data → Camera Rectification

Loop over each video frame

Interest Point Module
SIFT/SURF Detection → Track Points to Establish Stability

Density Module
Integral Image of Keypoints → Compute Density Map

Detection and Tracking Module
Segment Candidates from Background → Classify Candidates into Vehicles or Non Vehicles → Track and Count Vehicles

Report Frame Vehicle Data ← Fuse Thermal and Visual Results

Post-Processing ←

KEY POINTS

GUI

DATA COLLECTION

Get thermal and visible cameras working in field
Find locations that mimic position of traffic camera (overpasses)

Film each site in different external conditions (time of day, weather)

IDEAL DEVICE SETUP

Each device works automatically and is powered by hard work and determination

REAL DEVICE SETUP

Need monitor to observe output and a source to power it all

TEAM EFFORT

The roof of the van is sufficiently elevated to see over the fence

Not getting arrested while recording data

GROUND TRUTH

ANALYSIS

In order to evaluate our results, we use an analysis tool which will compute the Precision Recall Curve.

$$\text{Precision} = \frac{\text{true positives}}{\text{true positives} + \text{false positives}}$$

$$\text{Recall} = \frac{\text{true positives}}{\text{true positives} + \text{false negatives}}$$

Recall: The likelihood that an object is found.

Precision: The likelihood that an object found is accurate.

DEVELOPMENT NOTES

- [Team Website](#)

- [Git Distributed Version Control](#)

- Github Issue and Bug Tracking

- Doxygen Code Management

OBJECTIVES FOR SECOND PRESENTATION

1. Develop labeled ground truth using Vatic.

2. Finish building segmentation module.

3. Integrate Qt GUI with Vision Module.

4. Achieve an accuracy of 80% with a PR Curve Area of over 0.6.

- http://sherifftechnologies.com/civil-engineering/groundworks-installation-civils/loop-cutting-contracts

- http://www.fhwa.dot.gov/publications/publicroads/07nov/04.cfm

- http://auto.howstuffworks.com/car-driving-safety/safety-regulatory-devices/red-light-camera1.htm

- http://ops.fhwa.dot.gov/freewaymgmt/publications/frwy_mgmt_handbook/chapter15_01.htm
- http://www.fhwa.dot.gov/publications/research/operations/its/06139/chapt6.cfm
- http://www.nctimes.com/news/local/swcounty/article_3ac18877-b62c-5a59-a8ce-e8ab648baffa.html

- http://www.telegraph.co.uk/news/worldnews/northamerica/usa/7177471/US-east-coast-shut-down-as-snowpocalypse-hits.html
- http://www.instructables.com/id/Trigger-GREEN-Traffic-Lights/
- http://www.richmond.ca/services/ttp/signals/faq.htm
- http://attackoftheblargg.blogspot.com/2011/01/rain-traffic.html
- http://www.nationalgeographicstock.com