Vehicle Location by Thermal Images Features

CS 426 Senior Project - Spring 2012

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Abstract

Video-based traffic monitoring systems are attractive replacements for induction loop sensors. However, visible light systems currently suffer limitations such as daylight-only tracking, severe performance degradation during inclement weather, and false readings due to shadow interference. The Vehicle Location by Thermal Image Features (VLTIF) system addresses these problems by using thermal imaging for the detection process. VLTIF records data gathered from infrared light, uses effective image processing techniques all of which is integrated into a simple user interface. The resulting product is a useful tool for traffic management.

Description

Figure 1: Visual Light versus Thermal Video

The VLTIF system is a stand-alone application designed to accurately detect and count vehicles in varying external conditions: day or night (Fig. 1), whether clear skies, rain, snow or fog. It processes video from thermal imaging cameras. VLTIF features an intuitive interface that allows quick loading and display of results and a processing and analysis engine that translates this footage into re-useable data. Users need only outline a traffic lane to enable counting cars in that lane. Besides standard image processing techniques, the analysis engine implements Mixture of Gaussians and Bag of Features with the SIFT feature descriptor.

Devices & Data Collection

Devices in prototype system (Fig. 2):

- Canon Vixia HF S10 Camcorder(On loan from UNR)
- FLIR SR-19 Thermal Camera (Donated by FLIR)
- GE Digia II Digital Video Recording Device
- PELCO WCS1-4 Environmental Power Supply

Figure 2: Prototype Input Devices

Figure 3: Initial Field Setup

Realistic data collection (Fig. 3) required an additional physical display, a power source and a means of elevating the cameras to prevent occlusion by environmental barriers such as safety fences and guardrails.

Video Processing and Analysis

VLTIF video data was processed using the following method:

- Load/Configure Video
- Pre-Process Video Data
- Camera Rectification
- Interest Point Module (Fig. 4)
  - ➢SIFT Detection
- Density Module (Fig. 5)
  - ➢Integral Image of Key points
  - ➢Compute Density Map
- Detection and Tracking Module
  - ➢Segment Candidates
  - ➢Classify Candidates
  - ➢Track and Count Vehicles
- Post Processing

Figure 4: SIFT Detection

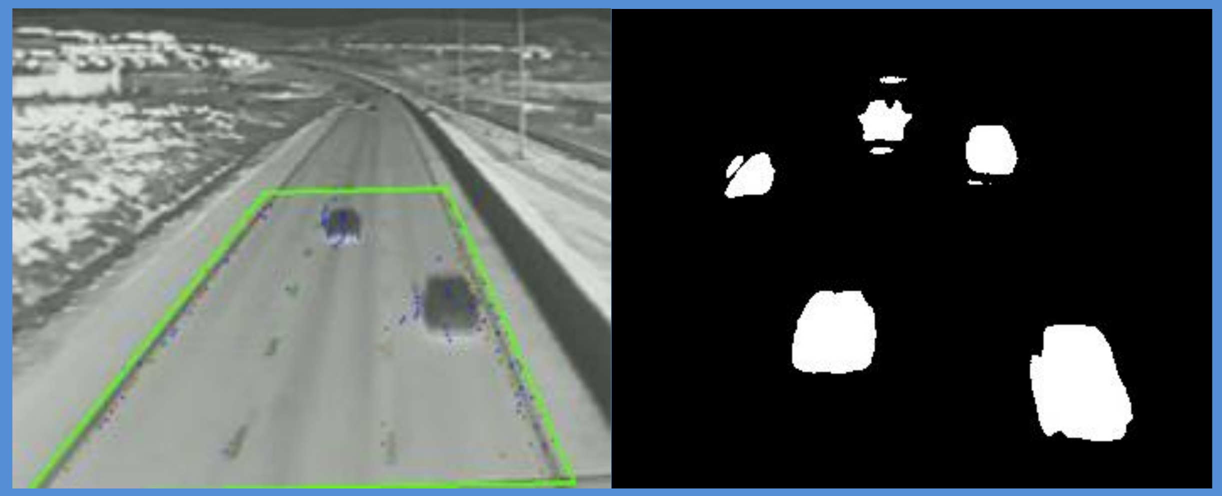

Figure 5: Integral Image and Mixture of Gaussians Image

User Interface

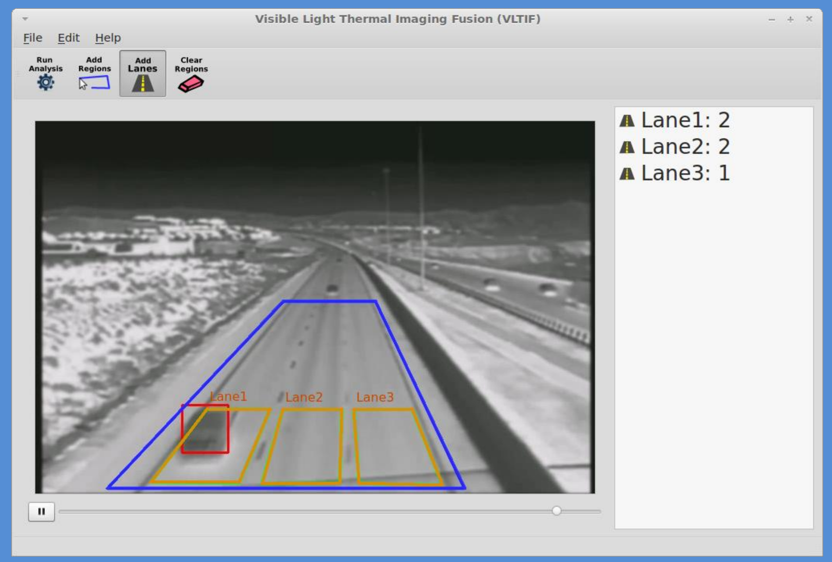

Figure 6: Prototype User Interface

User Interface (Fig. 6) optimized for efficiency, clarity and functionality. Features include:

- New/Save/Open
- Import/Export Video
- Define/Clear region
- Play/Pause Video
- Video Slider bar
- Detailed Help Tutorial

Future Work

Future VLTIF development will improve the system with increased functionality allowing it to:

- Include the ability to classify vehicle make
- Discriminate between pedestrian/ cyclist/vehicle candidates
- Traffic behavioral analysis

Conclusions

The VLTIF system offers a novel way to observe and analyze traffic. It provides users sufficient traffic statistics and detection capability to make it essential to any modern traffic system. By using an additional data input as a extra source of data validity, VLTIF guarantees a higher level of accuracy that anything previously seen. VLTIF was realized by a diverse team of computer scientists and engineers following advanced product development strategies. These strategies guaranteed the timeline and quality of the final product.

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