Computer Senior Seminar Research Paper Outline

By Matthew Clark

Basic Questions that need to be answered:

identifying the problems, defining the reliability and robustness, measuring the performance, and evaluating the cost

1. Why is a review and analysis of HOG for PD (Pedestrian Detection) an effective tool to understand the field of AV (Autonomous Vehicles)?
   1. HOG is a basis for most of the PD systems today, including AV
      1. Improved versions of HOG result in some of the most reliable, accurate, and performant PD systems
   2. It is a good platform to learn more advanced techniques
2. What is the Histogram of Oriented Gradients Technique?
   1. History of the Technique
      1. Before HOG
      2. 2006 introduction
      3. Current development and improvement using ML (Machine Learning)
   2. How does it work (2006-ish version and use Letters for an example)?
      1. HOG
      2. SVM
   3. How is the Histogram of Oriented Gradients used for Pedestrian Detection?
      1. Why does HOG work well for PD?
      2. Compared to other Object Detection Techzniques
3. How is this technique used in Autonomous Vehicle systems?
   1. **RESEARCH**

Introduction

* 1. Describe the problem and its background
     1. Why I chose this topic:
        1. Autonomous vehicles’ socioeconomic impact:
           + Safer traffic system
           + Cheaper automotive economy
           + Mobility for the disabled or elderly
        2. Personal interest:
           + Strong long-term career opportunities
           + Satisfying and impactful work
     2. Identify three key developments in recent years
        1. Darpa’s ALV, Lidar/Camera based autonomous vehicle and investments
        2. Self-Parking Systems
        3. Google’s Demo car
     3. Current state of Autonomous Vehicles
        1. The Autonomous Level System
        2. Example of Current AV
        3. Examples Failures/Issues of the current AV systems
  2. Present the problem that is studied in the paper
     1. What object detection techniques and systems show the most promise?
        1. People
           + Identify the problems
           + define the reliability and robustness
           + measure the performance
           + evaluate the cost
        2. Vehicles
           + “ … ”
        3. Road signs, lanes, signals, etc.
           + “ … ”
        4. Environment
           + “ … ”
  3. Define some Terms
     1. Assumptions:
        1. What Companies and Consumers desire
  4. Outline limitations
     1. Inability to test systems and techniques
        1. No access to self-driving cars
        2. Little replication or implementation of techniques into working code
     2. No visibility into private companies’ R&D

Review of Literature

* 1. Restate the categories of object detection
     1. People
     2. Vehicles
     3. Road signs, lanes, signals, etc.
     4. Environment
  2. Background of what makes this technology possible
     1. Hardware
        1. Advancements of Processors
        2. Development of the Digital Camera Sensor
        3. Other sensors
     2. Significant Algorithms
  3. For each category, describe different solutions
     1. This is not the analysis, but simply a description of what the solutions are

Analysis

* 1. Restate the purpose
  2. Description of metrics and procedure
     1. How to…
        1. Identify the problems
        2. define the reliability and robustness
        3. measure the performance
        4. evaluate the cost
     2. describe the general procedure
  3. Discuss the strength and weaknesses of my methodology
     1. Pros
     2. Cons
  4. Research Methodology
     1. Metric for sources
        1. This how and why I chose x & y sources
     2. Alternate sources and experiences that influenced the paper
        1. Why they were included
  5. Go through each type and technique/implement the procedure described above
     1. People
     2. Vehicles
     3. Road signs, lanes, signals, etc.
     4. Environment

Discussion of Results

* 1. Restate the research questions
  2. Outline and organize the results
     1. Employ statistics, figures, and graphs
  3. Discussion
     1. Describe the implications
     2. Evaluate whether the results answered the research question

Summary

* 1. Briefly sum the study
  2. Conclude the results
  3. Recommend future research
  4. References/Bibliography

Notes:

* Thus, while increasing the redundancy of the representation offers improved detection and false-alarm rates, it is paid for by increased computational costs
* Terms to define:
  + Quantization –

EX: Taking a linear equation and sampling points (i.e. quantize or quantify the equation) -

* + Interpolation–

EX:

* + Binning–

EX:

* + Image Gradients–

EX:

* + Support Vector Machines –

EX:

* + Normalization –

EX: RGB color vector , length of this vector is then divide each element by 146.64 to result in the normalized vector: and even if it will still result in the same normalized vector. Normalizing a vector removes the scale.

* + Multi-resolution decompositions–

EX:

* + Coarse vs Fine binning/gradients–

EX:

* + Wavelets–

EX:

* + Hermitian matrix–

EX: