Ensuring Road And Pedestrian Safety Through the Use Of Computer Vision and Data Fusion

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MOTIVATION

- 137,000 pedestrians injured in traffic accidents in the USA in 2017 [1]
- Increased threat for pedestrian safety on the Georgia Tech campus:
  - Population growth on campus with a constant infrastructure size: population increased by 48% between 2012 and 2018: Additional traffic and pedestrian flow on campus
  - Emerging modes of transportation (scooters) and potential distractions for walkers

PROBLEM FORMULATION

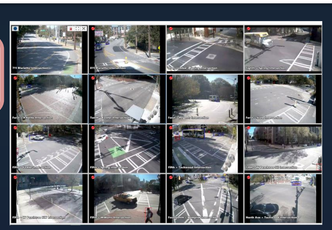
Problem: Currently certain incidents are not reported. Incident reports are manually produced, which is tied to a labor-intensive process to analyze data and understand the needs for potential measures to improve safety

Objective: Describe, detect and quantify the frequency of high-risk behaviors and near-accidents involving pedestrians, in order to explore countermeasures to improve pedestrian safety

Constraint: Ensure privacy protocols are respected (anonymized data only)

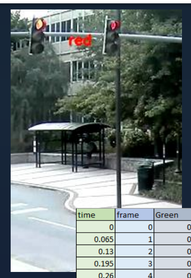
AUTOMATED PEDESTRIAN AND TRAFFIC DATA COLLECTION THROUGH COMPUTER VISION

Video footage available via Avigilon software



Traffic and pedestrian light color detection

Traffic and pedestrian light state at a given time stored in the database



time	frame	Green	Orange	Red
0	0	0	0	1
0.065	1	0	0	1
0.13	2	0	0	1
0.195	3	0	0	1
0.26	4	0	0	1
0.325	5	0	0	1
0.39	6	0	0	1
0.455	7	0	0	1
0.52	8	0	0	1
0.585	9	0	0	1

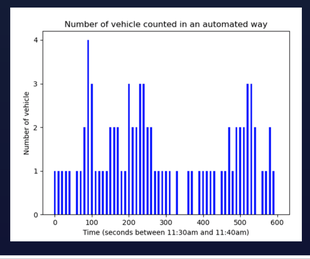
People and vehicle detection

People and vehicle tracking

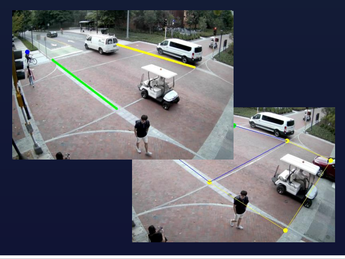
Points and detection of interest area

Line and equations of interest area

Location and time stored in a database



People and vehicle counts Entering and exiting flows



1. Centers for Disease Control and Prevention

TRAFFIC AND PEDESTRIAN DATA ANALYSIS THROUGH DATA FUSION

Overview

Traffic light color
Pedestrian location
Vehicle location
Pedestrian signal
Pedestrian count
Area of interest detection and location
Vehicle count

Data fusion
Set of rules and conditions
Threshold values

Incident detections, classification and recording in a database
- **Safety distance on vehicle-vehicle not respected**
- **Pedestrians stepping into traffic**
- **Pedestrians or drivers crossing against the light signal (e.g. running a red light)**
- **High speed of a vehicle**

Example 1: Distance vehicle-vehicle below safety distance

Vehicle location

Keep only moving vehicles

1. From location table, determine the direction for each car
2. Determine the vector distance between cars going in the same direction
3. Determine the distance as the norm of the vector
4. Convert into meter (no calibration so approximate conversion) and compare to a threshold of 3 meters

Store output into tables to include in a database
Output table: Indices and number of cars that are too close

Time (seconds)	Indices of car that do not respect the limit	Number of car(s) too close
0	(3, 4)	2
30	(2, 3)	2
60	(6, 5)	2
90	(6, 5)	2
120	(6, 5)	2
150	(6, 5)	2

Example 2: Red-light running detection

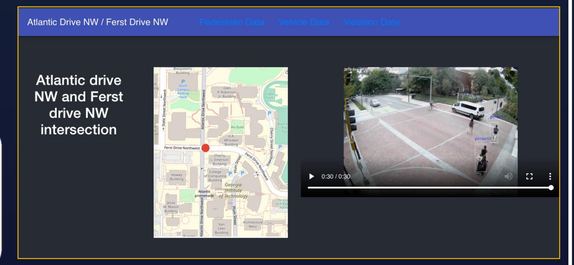
Vehicle past and current locations
Traffic light color
Stop line location

Check if the vehicle crosses the stop line after the light turn red

Red-light running detection

OUTPUT DATABASE AND USER INTERFACE

Database with high-risk situations detected
- **Safety distance on vehicle-vehicle not respected**
- **Pedestrians stepping into traffic**
- **Pedestrians or drivers crossing against the light signal**
- **High speed of a vehicle**

User interface
- **Interactive map for selecting a campus location**
- **Visualization of security video footage and obtain people count at selected location**
- **Selection of historical data for vehicle count and incidents**
- **Download the table with the selected data**

Explore countermeasures to improve pedestrian safety