



Contactless Apprehension of Traffic Violators on 24-hours Basis All-Vehicle Detection System (CATCH-ALL)

FUNDED BY

Department of Science and Technology – Philippine Council for Industry, Energy, and Emerging Technologies for Research and Development (DOST-PCIEERD)

PROJECT PROPONENTS

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6Ps (CATCH-ALL)

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ITS Project Proposal

Objective Attainments

OBJECTIVES	DESIGN: SOFTWARE/ HARDWARE	IMPLEMENTATION
1. To implement a machine vision system that will capture vehicle images on the street intersection in real time.	100% Complete	75% Complete
2. To design and develop an Artificial Intelligence (AI) software that can do the following:	100% Complete	75% Complete
a) identify the vehicle plate using a camera vision,	100% Complete	75% Complete
b) identify number coding and reckless driving (swerving) traffic violations and provide immediate notification to the violators, and	100% Complete	75% Complete
c) provides unquestionable evidence on the traffic violations committed.	100% Complete	75% Complete
3. To integrate the results of objectives 1 to 2 and implement the Automated Traffic Violation Detection and No-contact Apprehension System (CATCH-ALL) on the traffic intersection of Taft-Estrada street, Malate, Manila in real time	80% Complete	50% Complete

Objective Attainments

OBJECTIVES	DESIGN: SOFTWARE/ HARDWARE	IMPLEMENTATION
4. To conduct actual study on the effects of CATCH-ALL in the street traffic.	-	20% Complete
5. To conduct actual study on the Filipino drivers' behavior towards the implementation of CATCH-ALL.	-	10% Complete

6Ps (CATCH-ALL)

- 1. PUBLICATIONS**
- 2. PRODUCTS OR PROCESS**
- 3. PATENTS**
- 4. PEOPLE SERVICES / CAPABILITY BUILDING**
- 5. PLACES AND PARTNERSHIPS**
- 6. POLICY**

6Ps (CATCH-ALL)

PUBLICATIONS

List of papers published in *IEEE HNICEM 2015* in Cebu, Philippines:

1. A genetic algorithm and artificial neural network-based approach for the machine vision of plate segmentation and character recognition
2. Machine vision for traffic violation detection system through genetic algorithm

List of papers published in *IEEE TENCON 2016* in Singapore:

1. Automated Traffic Violation Apprehension System Using Genetic Algorithm and Neural Network
2. Fuzzy Logic Based Vehicular Plate Character Recognition System Using Image Segmentation and Scale-Invariant Feature Transform
3. Intelligent System Architecture for a Vision-Based Contactless Apprehension of Traffic Violations
4. Machine Vision of Traffic State Estimation Using Fuzzy Logic
5. Passenger Demand Forecast Using Optical Flow Passenger Counting System for Bus Dispatch Scheduling
6. Philippine Vehicle Plate Localization using Image Thresholding and Genetic Algorithm

6Ps (CATCH-ALL)

PUBLICATIONS

List of papers to be published in Science and Information (SAI) Computing Conference 2017 in London, UK:

- Vehicle Detection and Tracking Using Corner Feature Points and Artificial Neural Networks for a Vision-based Contactless Apprehension System

List of papers to be published in *JACIII (Journal of Advanced Computational Intelligence and Intelligent Informatics)*:

- Traffic Estimation and Warning System using Fuzzy Logic and GSM

6Ps (CATCH-ALL)

PRODUCTS OR PROCESS

Software packages: Detecting traffic violations and contactless apprehension notice

- Vehicle detection and tracking
- Plate number localization and recognition
- Vehicle profiling (class and color)
- Number coding violation detection
- Beating the red light detection
- Swerving detection
- Over-speeding detection
- Traffic violation information system

6Ps (CATCH-ALL)

PATENTS

No pending patent application

Possible

1. Computer-implemented inventions
2. System architecture patents

6Ps (CATCH-ALL)

PEOPLE SERVICES / CAPABILITY BUILDING

List of graduate student/researchers:

NAMES	COURSE	EXPECTED YEAR OF GRADUATION
1. Robert Kerwin Billones	PHD-ECE	3 rd Term 2017-2018
2. Edison Roxas	PHD-ECE	3 rd Term 2018-2019
3. Rhen Anjerome Bedruz	MS-ECE	2 nd Term 2016-2017
4. Ana Riza Quiros	MS-ECE	2 nd Term 2016-2017
5. Aaron Christian Uy	MS-ECE	2 nd Term 2016-2017
6. Noel Alarcon	MS-ECE	2 nd Term 2016-2017
7. Jinmar Valentino	MS-CS	2 nd Term 2016-2017

6Ps (CATCH-ALL)

PLACES / PARTNERSHIPS

1. MANILA CITY GOVERNMENT AND AFFECTED BARANGAYS
2. MANILA TRAFFIC AND PARKING BUREAU (MTPB)
3. METRO MANILA DEVELOPMENT AUTHORITY (MMDA)
- Given access to CCTV database
4. DEPARTMENT OF TRANSPORTATION (DOTr) – possible candidate
5. LAND TRANSPORTATION OFFICE (LTO) – possible candidate

6Ps (CATCH-ALL)

POLICY

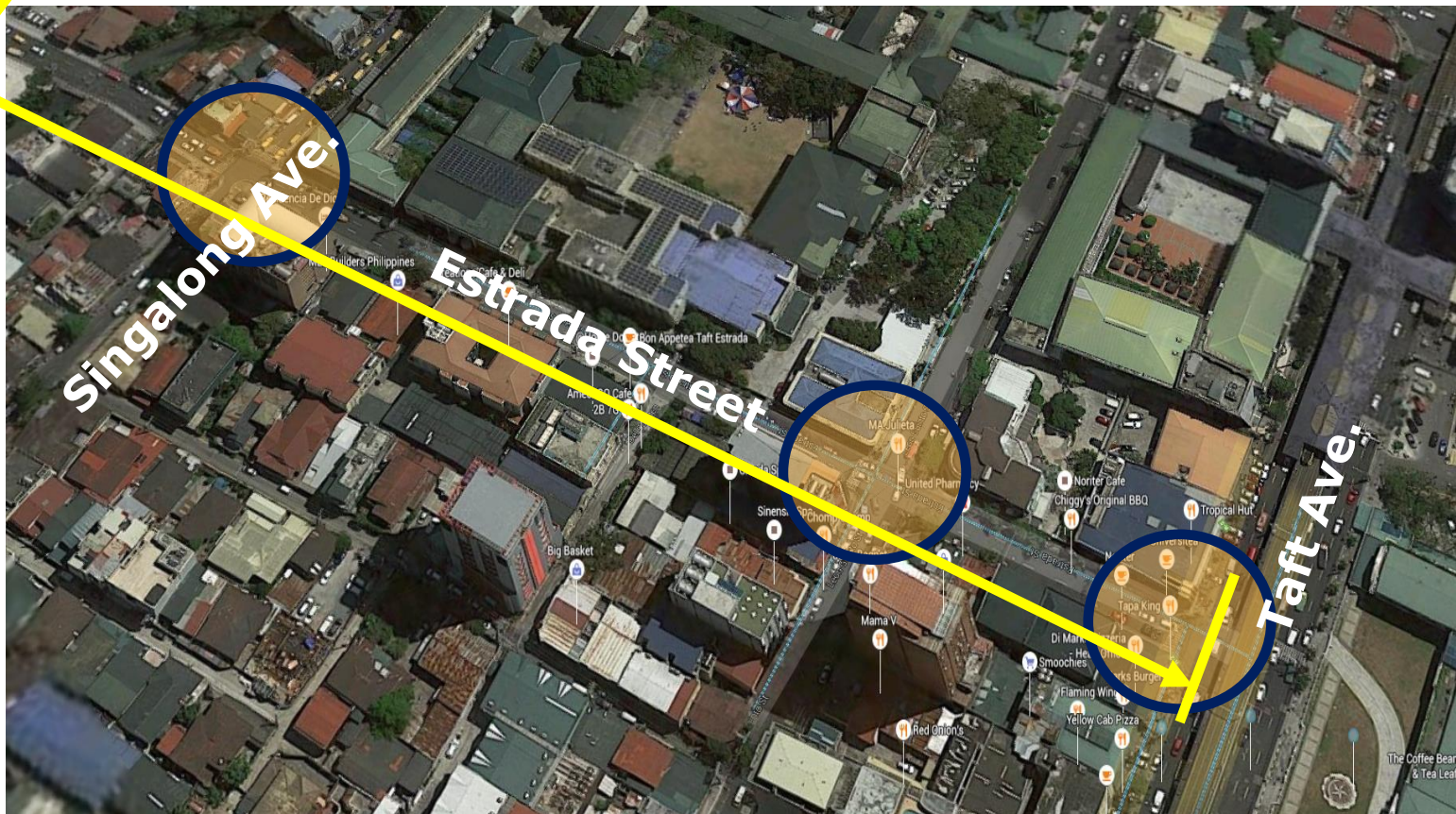
- Coordination with Manila Traffic and Parking Bureau for establishing Traffic Discipline Zone in Taft Ave. to Singalong Ave. along Estrada St.

Other possible policies:

1. Implementation in Taft-Estrada, Manila City for driver behavior monitoring (for traffic violations) which can be expanded to other MM roads.
2. Traffic Violations No-Contact Apprehension for LTO

6Ps (CATCH-ALL)

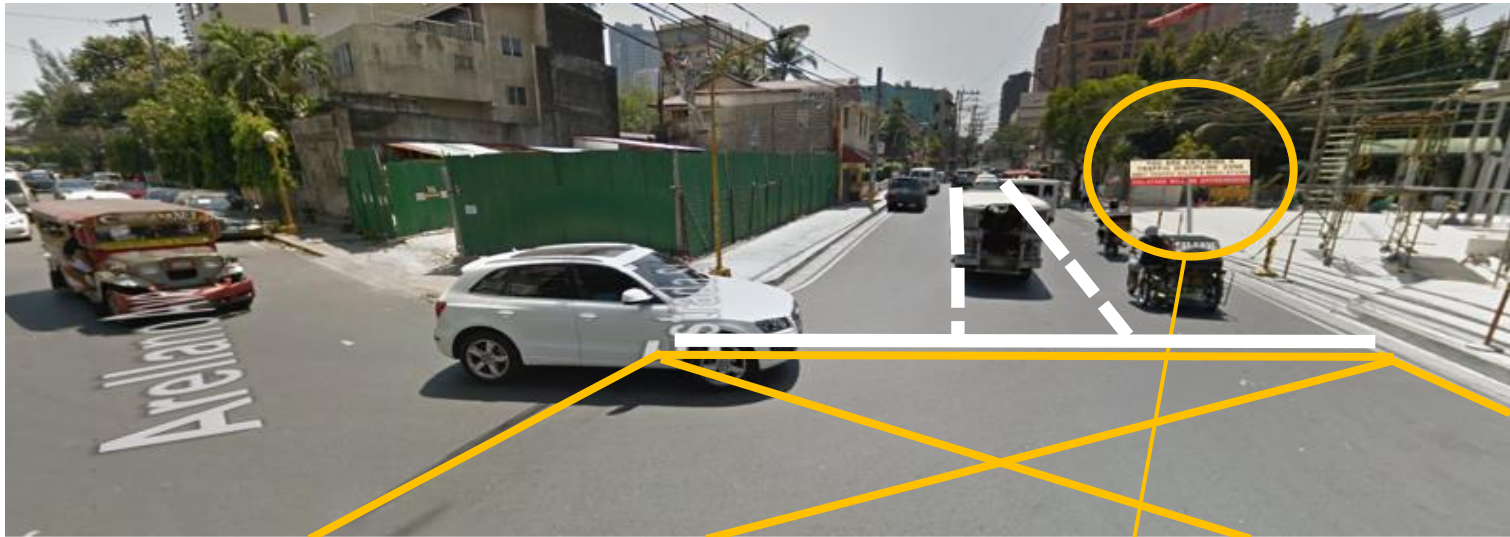
POLICY



Establishment of Traffic Discipline Zone

6Ps (CATCH-ALL)

POLICY

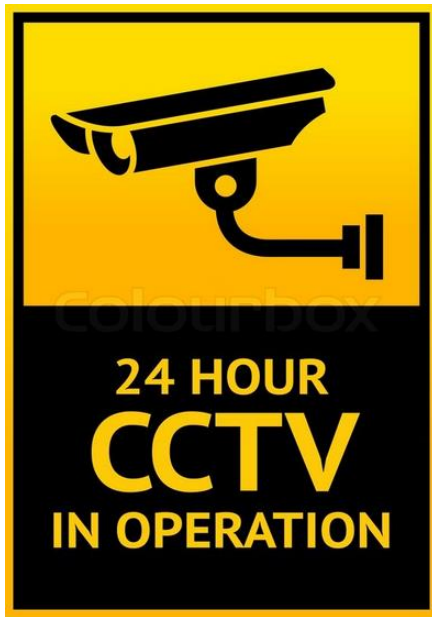


**Starting Point of
Traffic Discipline
Zone**

ESTRADA ST.(Singalong Ave. to Taft Ave.)
YOU ARE ENTERING A
TRAFFIC DISCIPLINE ZONE
OBEY TRAFFIC RULES & REGULATIONS
VIOLATORS WILL BE APPREHENDED

6Ps (CATCH-ALL)

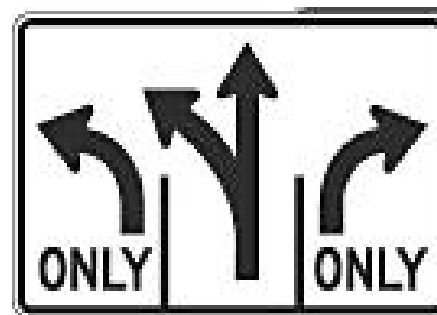
POLICY



Traffic Signage in the Traffic Discipline Zone

6Ps (CATCH-ALL)

POLICY



6Ps (CATCH-ALL)


POLICY



Meeting with MTPB

DYNAMIQ Simulation

- Plate survey was done to identify the O-D Matrix
- Centroids are designated as either entry, exit, or entry/exit
- DYNAMIQ does not take into account the actual cycle times of signalized intersections
- Jeepney stops are not modelled to be completely stopped
- Only took into account one lane at a time

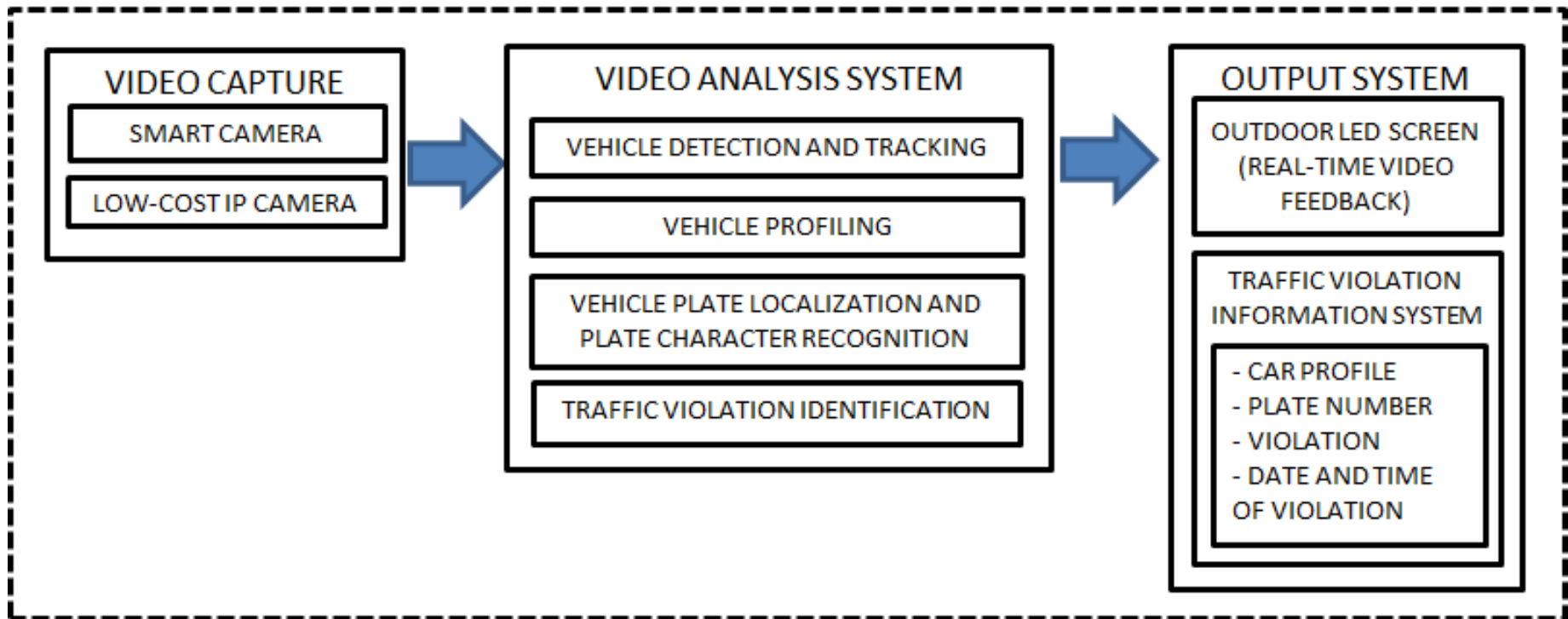


A map of a city area with a highlighted route. The route starts at centroid A, goes through B, C, D, E, F, and ends at G. The route is highlighted in blue. The map also shows other roads and landmarks. A legend at the bottom indicates that the blue line represents the route, the red dots represent centroids, and the green areas represent parks.

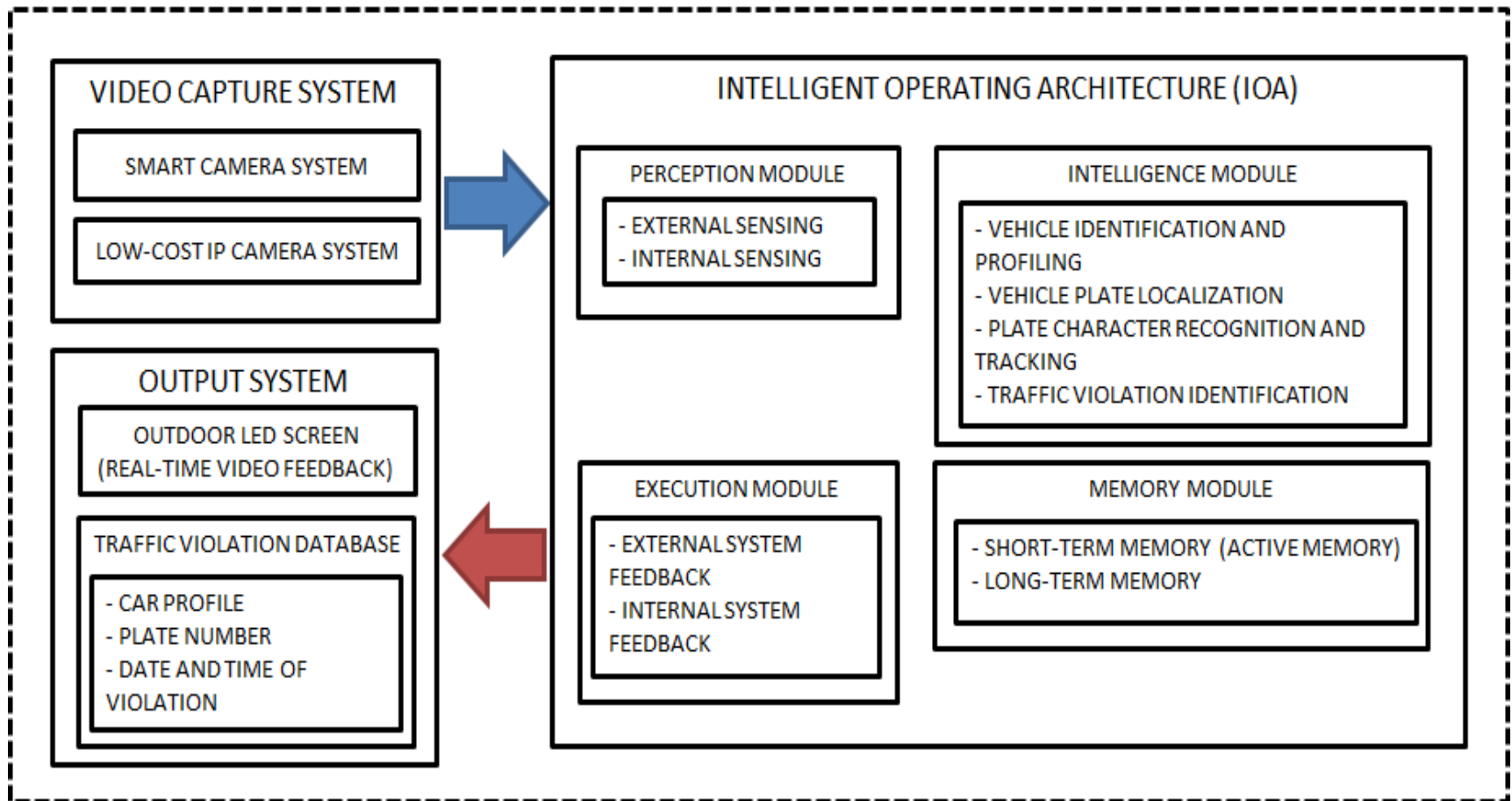


OVERVIEW OF THE PROJECT

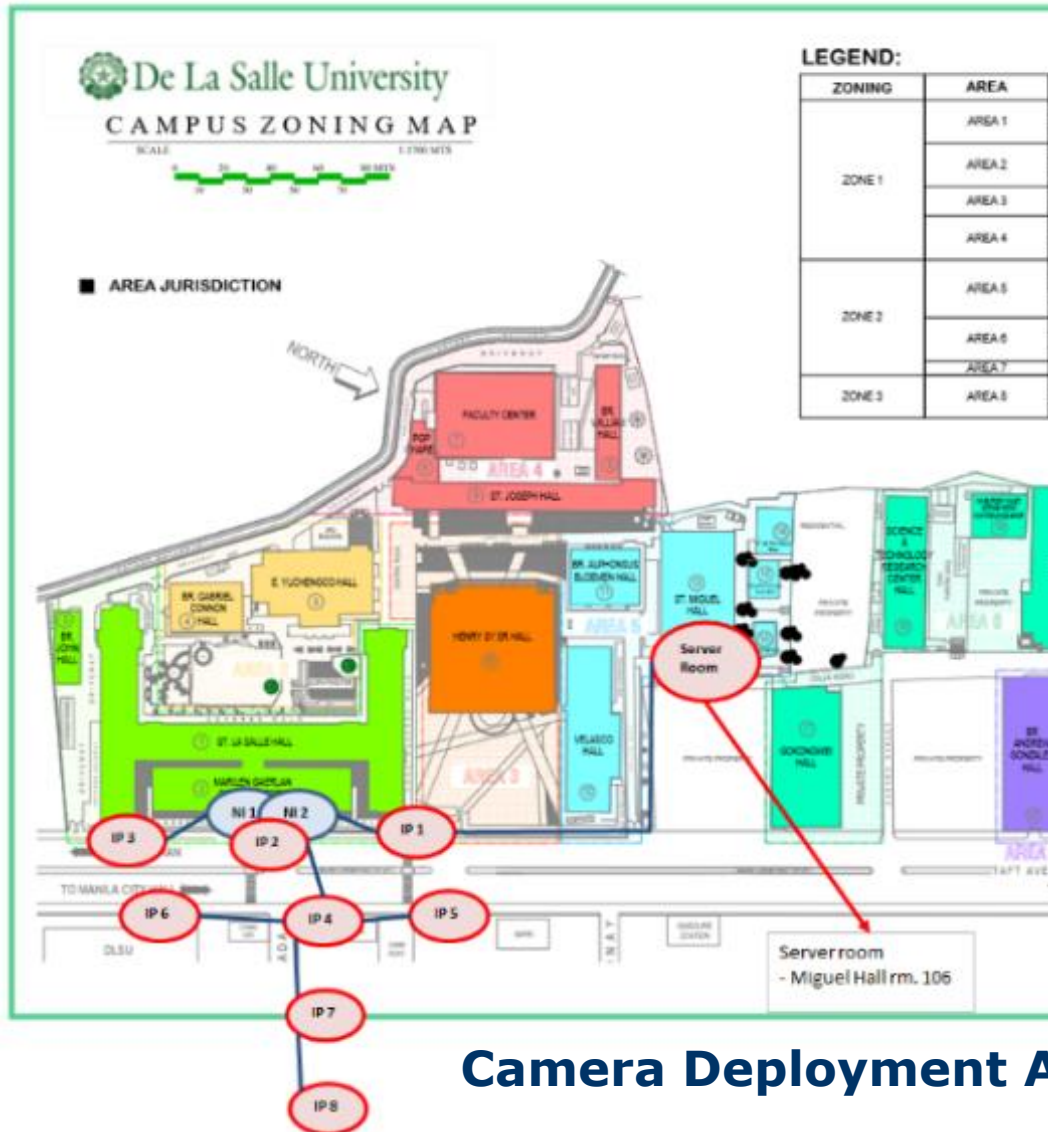
CATCH-ALL SYSTEM ARCHITECTURE



Vision-Based Contactless Apprehension System



Video Capture Sub-System



NI 1778 Smart Camera (1.6GHz Atom Processor, 5MP, Monochrome)
781859-01



NI 1776C Smart Camera (1.6GHz Atom Processor, 2MP, Color)
781858-01



Reolink RLC-423 IP Camera



Camera Deployment Area

Video Capture Sub-System



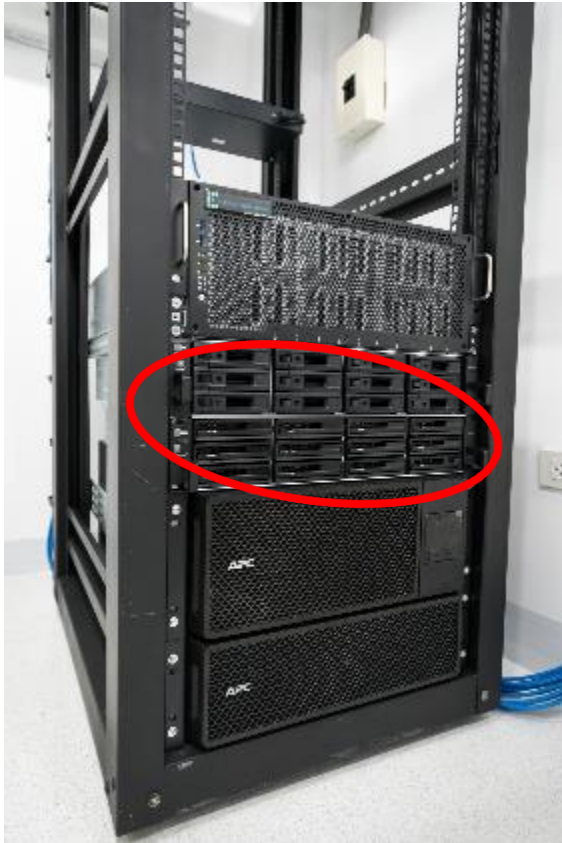
Camera Locations and Views

Computing Server



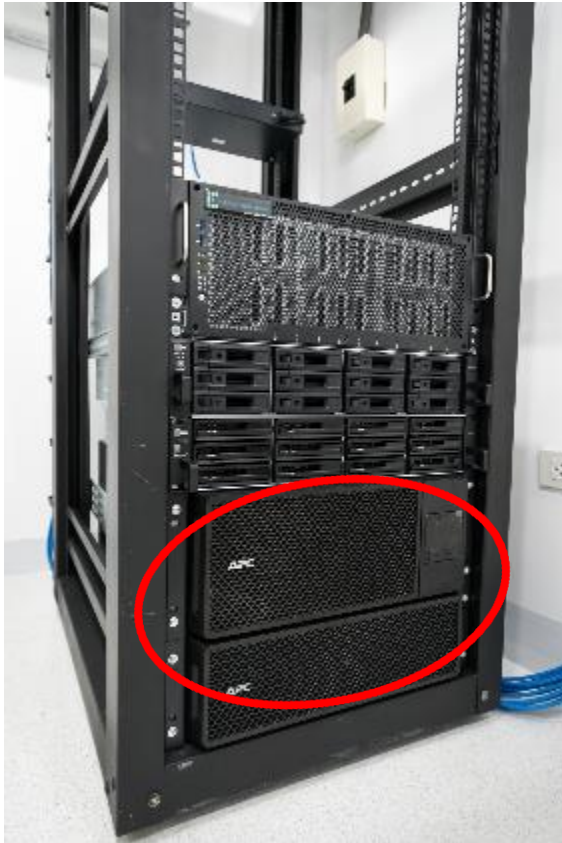
- ❖ Tesla computing processor, 256 Cores
- ❖ 40 Terabytes of storage data
- ❖ Running on Linux (CentOS 7)
- ❖ Programming environment ready for use
 - Additional libraries can be installed as needed
 - Automatic connection to the NAS (drives)

Computing Server



- ❖ Configured as shared storage (hard drives) for the server and all network-connected computers
- ❖ Also configured as credential server for Windows and Linux
- ❖ Information and any recorded videos from the IP cameras will be stored here

Computing Server



- ❖ Two units:
 - Main UPS
 - Extra battery
- ❖ To be used in case of power failure

Terminal Systems (Desktops)



- ❖ Computers fully assembled and operational
 - One motherboard is defective and awaiting replacement
- ❖ Basic software configuration complete
 - 3 Linux computers
 - 4 Windows computers
- ❖ Work-in-progress:
 - Licensing (c/o ITS)
 - LabVIEW (c/o ITS)
 - Microsoft Office (c/o ITS)
 - Create accounts for all users (via NAS)

VIDEO ANALYSIS SYSTEM



Vehicle Detection and Tracking Experiment 1
(Using Optical Flow in Labview)

VIDEO ANALYSIS SYSTEM



Vehicle Detection and Tracking Experiment 2
(Using Blob Analysis and Kalman Filter in MATLAB)

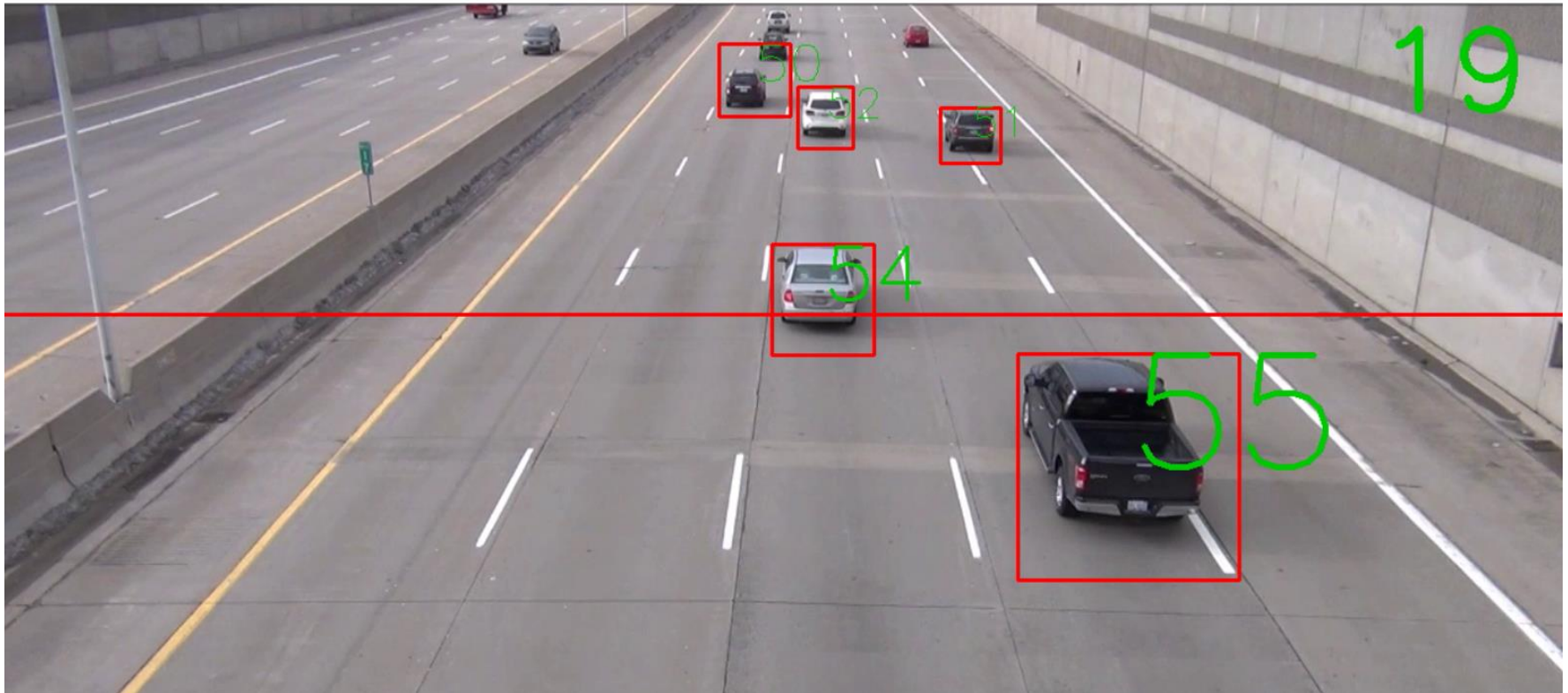
VIDEO ANALYSIS SYSTEM



Vehicle Detection and Tracking Experiment 3
(Taft-Estrada Intersection)

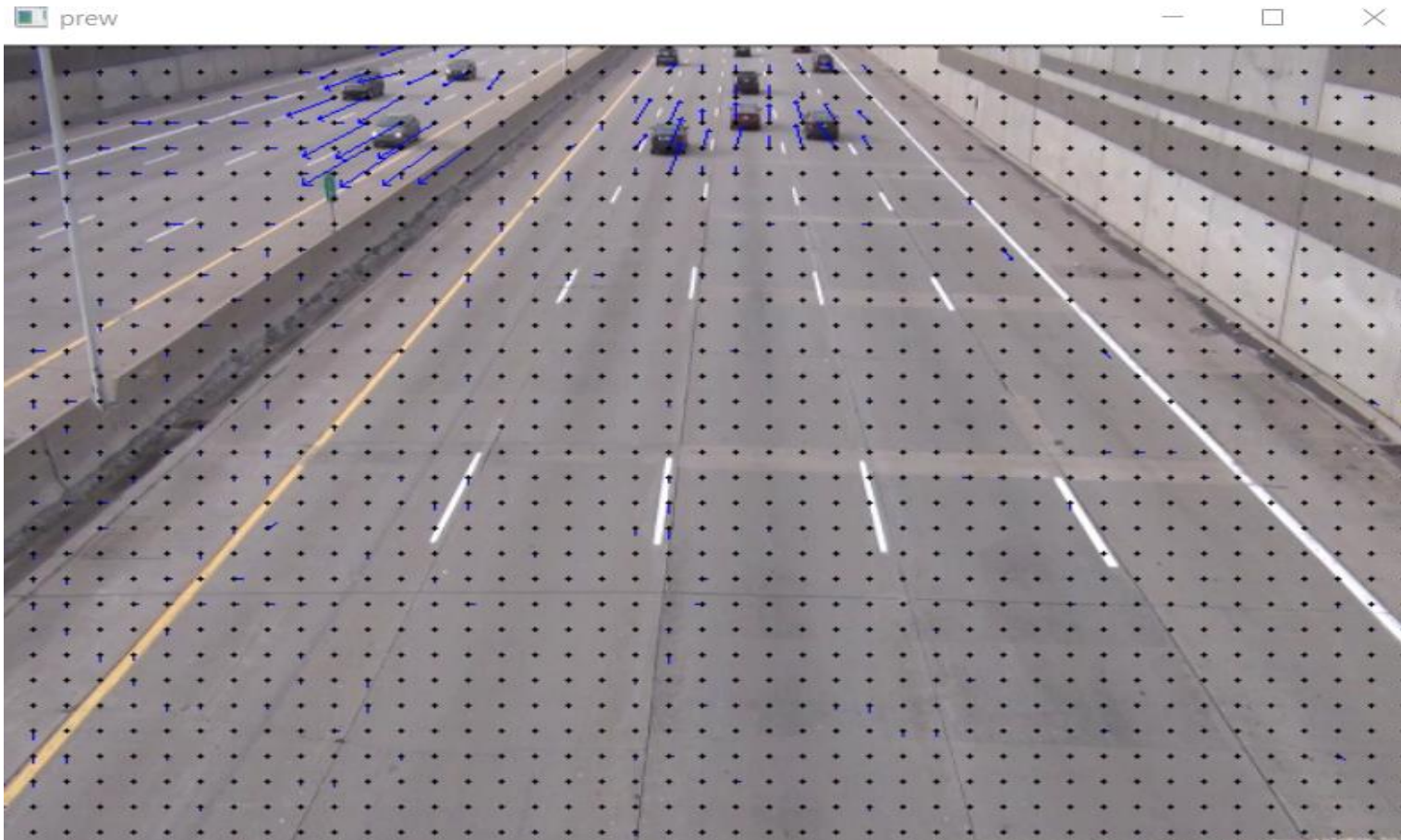
VIDEO ANALYSIS SYSTEM

imgFrame2Copy



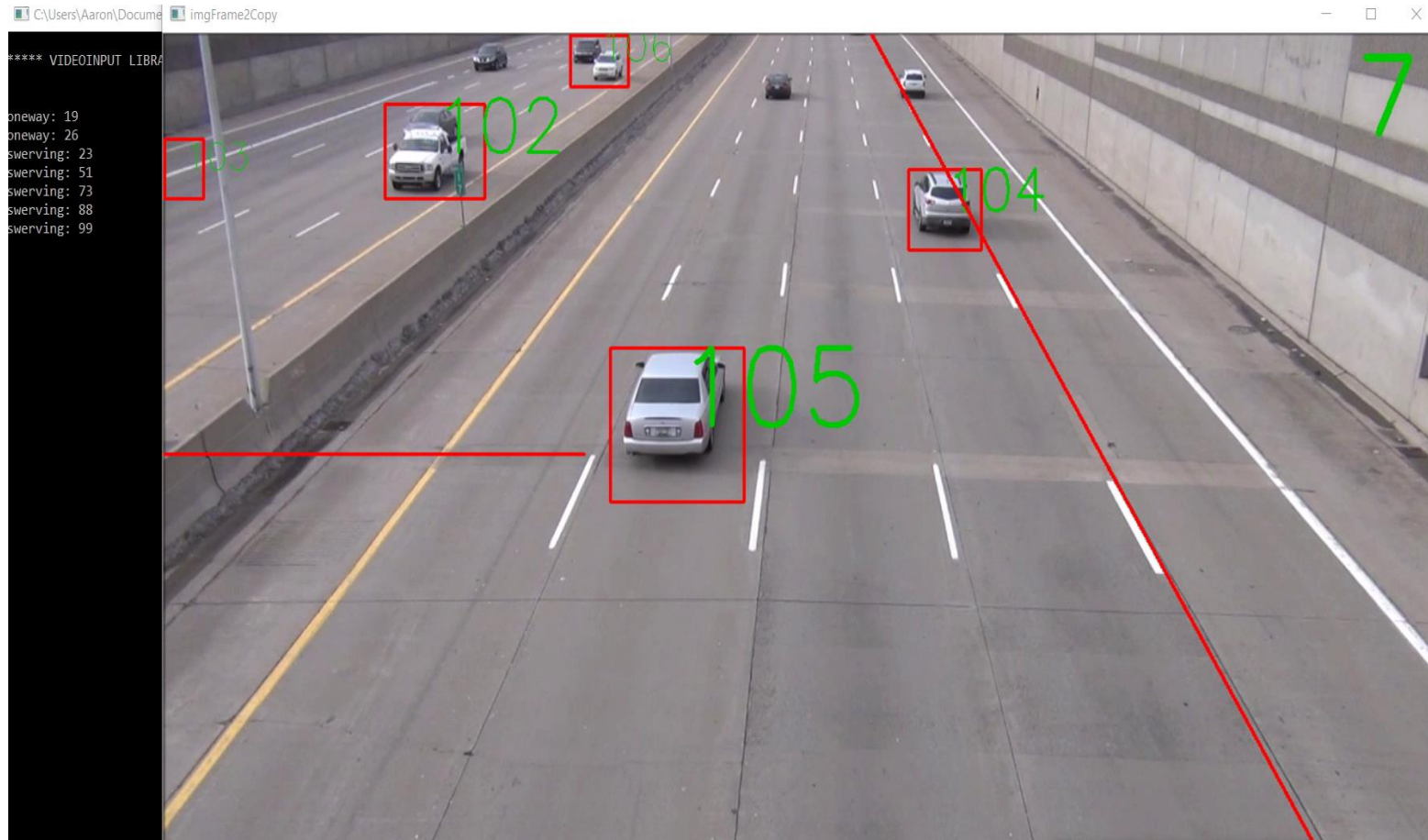
Vehicle Detection and Tracking Experiment 4
(Using OpenCV)

VIDEO ANALYSIS SYSTEM



Vehicle Detection and Tracking Experiment 5
(Using Optical Flow in OpenCV)

VIDEO ANALYSIS SYSTEM



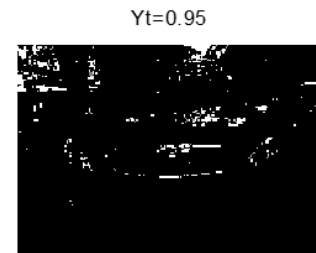
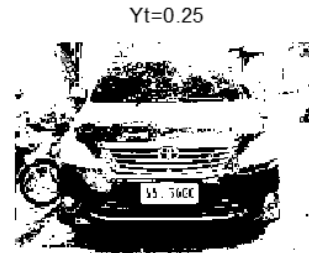
Vehicle Detection and Tracking Experiment 6
(Violation Detection in OpenCV)

VIDEO ANALYSIS SYSTEM

Plate Localization System



ORIGINAL IMAGE



DIGITAL IMAGE AT DIFFERENT THRESHOLDING VALUES



FINAL OBTAINED PLATE LOCATION



OBTAINED PLATE AREA

VIDEO ANALYSIS SYSTEM



(a)



(b)

Sample Optical Character
Recognition



Text Read
AAJ3800

VIDEO ANALYSIS SYSTEM



Text Read

TL0453



Text Read

AAP807?



Text Read

DQ3968



Text Read

AAS7843

OUTPUT SYSTEM

OUTPUT SYSTEM

OUTDOOR LED SCREEN
(REAL-TIME VIDEO FEEDBACK)

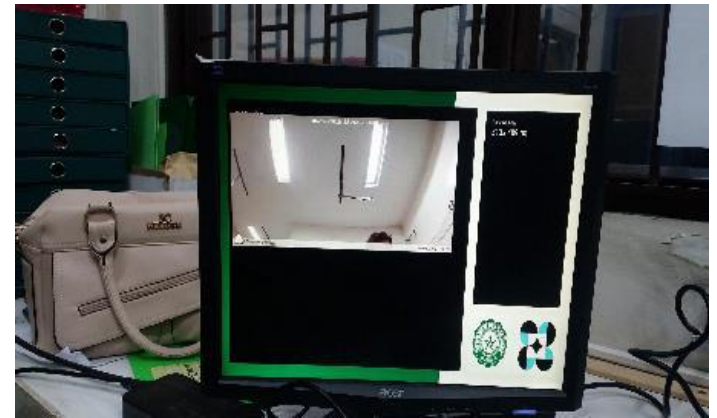
TRAFFIC VIOLATION DATABASE

- CAR PROFILE
- PLATE NUMBER
- DATE AND TIME OF VIOLATION

- TRAFFIC VIOLATIONS
 - NUMBER CODING
 - BEATING THE RED LIGHT
 - SWERVING
 - OVERSPEEDING



OUTPUT SYSTEM



Outdoor LED Screen: Hardware and Software Testing

ACTION PLANS

[illegible]

ACTION PLANS



- Ongoing Construction of Fiber Optics Cable
- Placement of LED Screen
- Pavement Markings



PUBFIX AND CATCH-ALL INTEGRATION PROPOSAL PROJECT

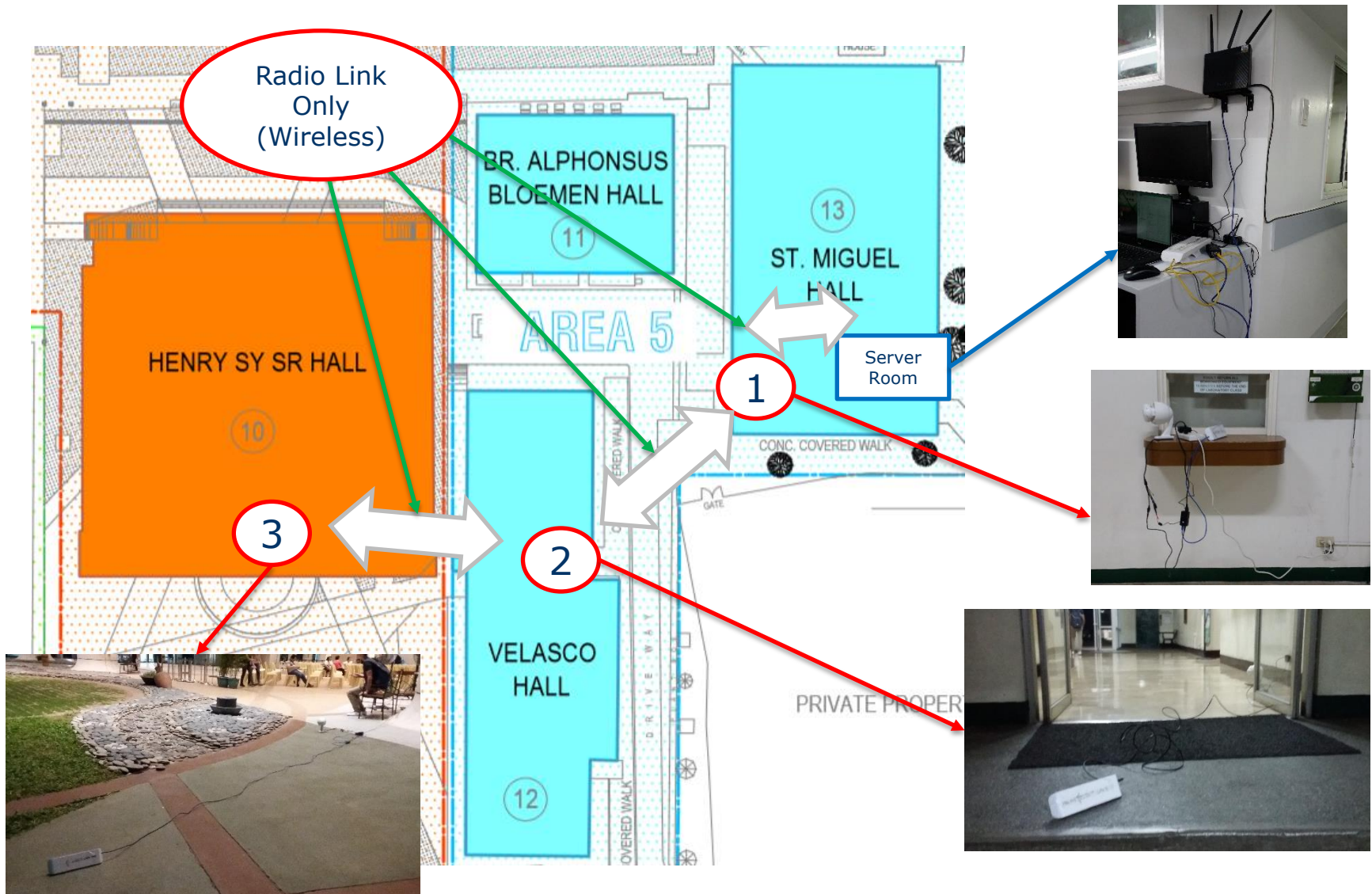
PUBFIX AND CATCH-ALL INTEGRATION PROPOSAL PROJECT

1. WIRELESS MESH COMMUNICATIONS NETWORK FOR VIDEO STREAMING

NOTE:

Video-based networks can be efficiently scaled using a wireless communications network setup. Traditional wired networks are more difficult to scale because of cost and time-delays in construction.

Wireless Video Streaming Experiment Setup



Video Streams from Remote Locations

The screenshot displays the Reolink Network Surveillance software interface. The top bar shows the version V7.1.2.25, the user 'admin', and the time 19:14:41. The interface is divided into three main sections: a top-left live feed, a top-right live feed, and a bottom-left live feed. The top-left feed shows a glass entrance with a timestamp of 10/02/2017 03:12:47 FRI. The top-right feed shows an outdoor area with a timestamp of 10/02/2035 03:14:0 SAT. The bottom-left feed shows an indoor hallway with a timestamp of 10/02/2017 03:14:15 FRI. The right sidebar contains a list of cameras (Camera1 through Camera1(7)), a PTZ control panel with various movement buttons, a speed slider, and a table for preset points. The bottom of the interface features playback controls and a volume slider.

Video data are sent wirelessly from remote locations (Henry Sy Sr. Hall, Velasco Hall, St. Miguel) to a computer in M106 Lab.

No.	Preset Point Name	Enable
1	Preset 1	Unset
2	Preset 2	Unset
3	Preset 3	Unset
4	Preset 4	Unset

PUBFIX AND CATCH-ALL INTEGRATION PROPOSAL PROJECT

2. IN-VEHICLE TRAFFIC VIOLATIONS DETECTION FOR PUBLIC UTILITY VEHICLES (BUSES OR TAXIS OR JEEPNEYS)

Computer Vision-Based In-Vehicle Traffic Violations Detection

- Not wearing seatbelt
- Texting while driving

Sensor-Based In-Vehicle Traffic Violations Detection

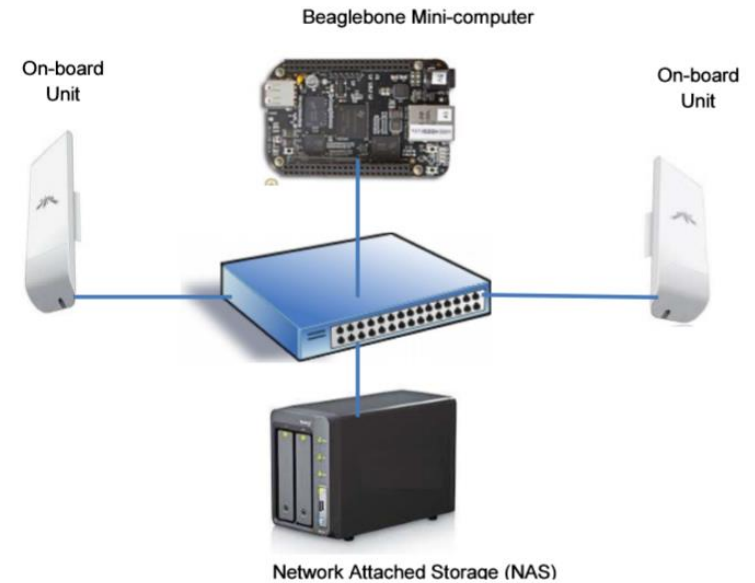
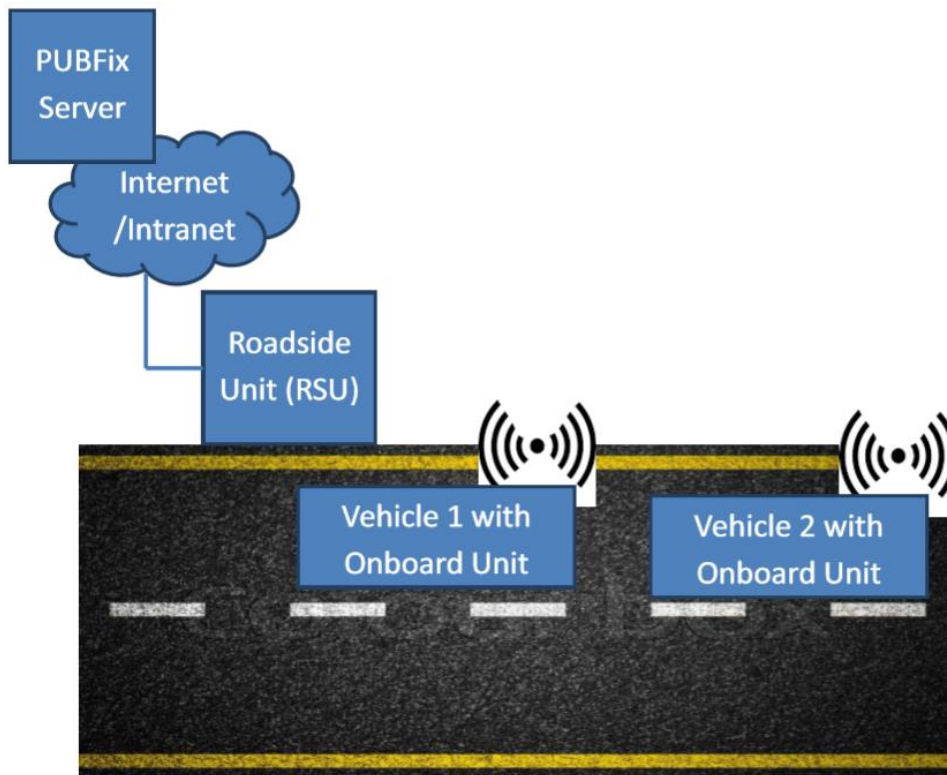
- Drunk Driving

NOTE:

Traffic violations will be transmitted to the server whenever the vehicle passes through the road-side unit (RSU)

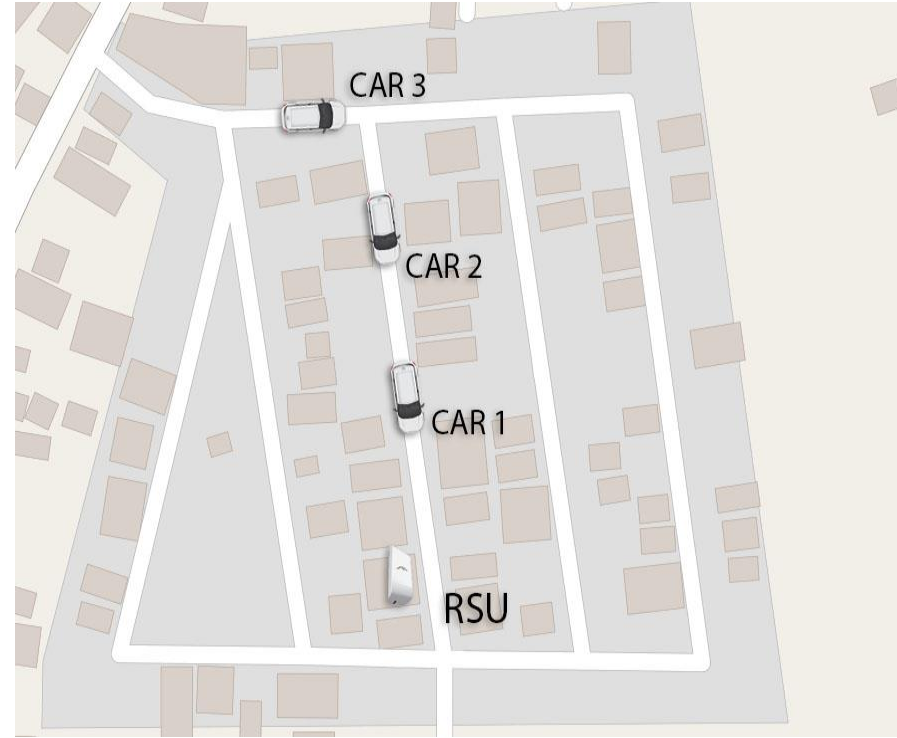
This is an automatic traffic violations detection system and also an accident prevention system.

PUBFIX AND CATCH-ALL INTEGRATION PROPOSAL PROJECT



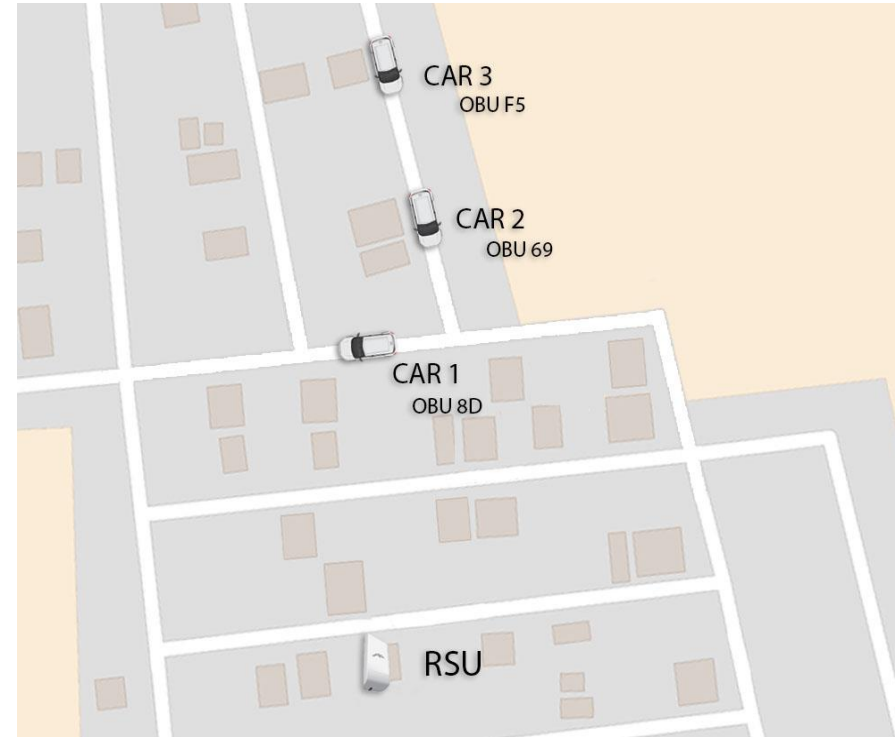
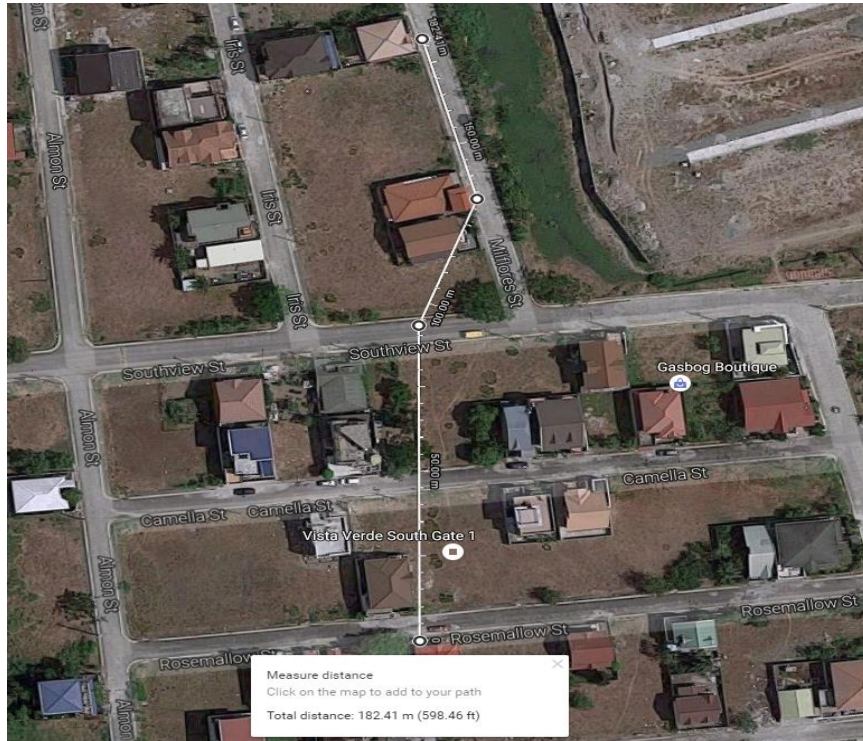
Vehicle Equipment Setup

PUBFIX AND CATCH-ALL INTEGRATION PROPOSAL PROJECT



Gabriela Hills: short distances, narrow roads, more obstructions

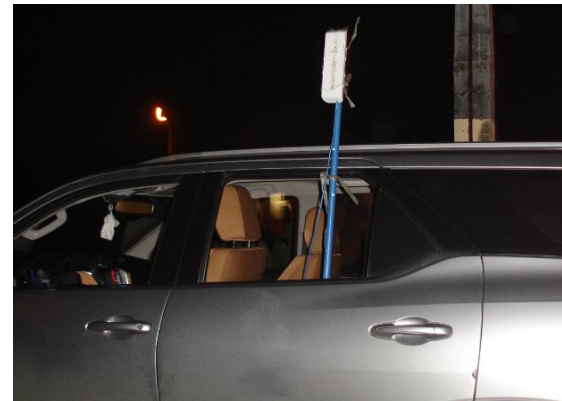
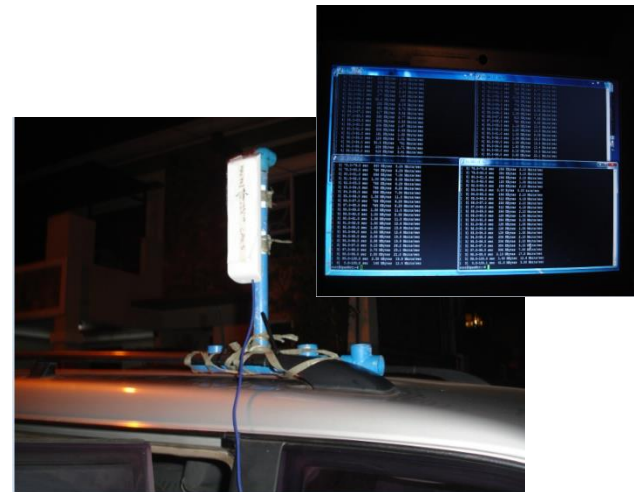
PUBFIX AND CATCH-ALL INTEGRATION PROPOSAL PROJECT



Vista Verde: long distances, narrow roads, less obstructions

PUBFIX AND CATCH-ALL INTEGRATION PROPOSAL PROJECT

Test Setup (Typical, 3-Hop Connection)



PUBFIX AND CATCH-ALL INTEGRATION PROPOSAL PROJECT

3. DEVELOPMENT OF TRAFFIC VIOLATIONS INFORMATION SYSTEM AND TRAFFIC VIOLATIONS DATA ANALYTICS USING CATCH-ALL SYSTEM

- Traffic violations information system that runs on web platform will be available to online users. Traffic violations data from no-contact apprehension systems (CATCH-ALL) will be used.
- Traffic violations data analytics from no-contact apprehension systems (CATCH-ALL) are used to analyze traffic patterns in specific routes. These data analytics can be used as guide in decision making by policy makers, traffic law enforcement agencies, and other stakeholders.

PUBFIX AND CATCH-ALL INTEGRATION PROPOSAL PROJECT

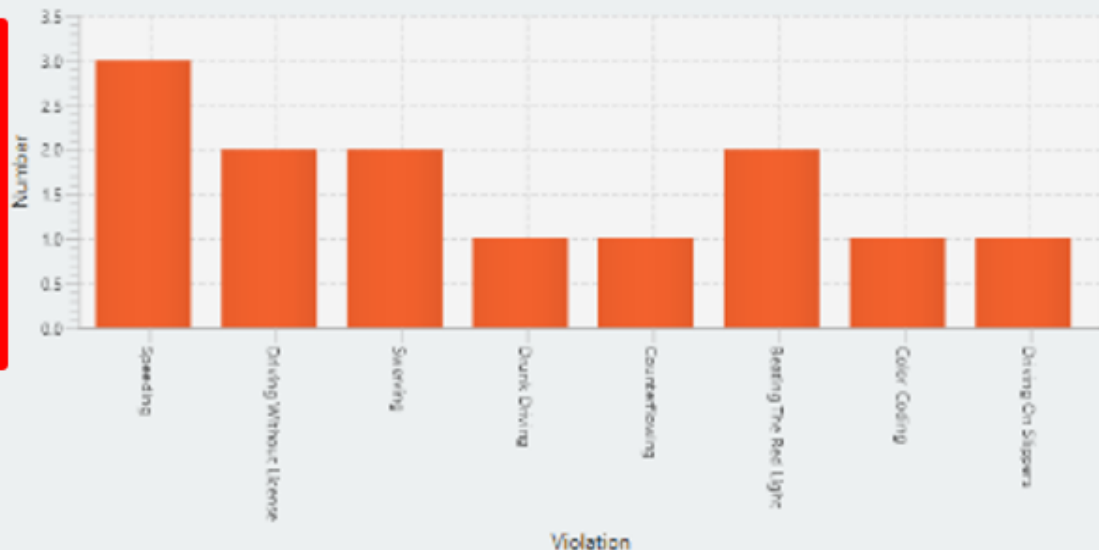
List of violators on the specified traffic violation

Traffic Violation Information System

VIOLATION	PLATE NUMBER	VEHICLE CLASS	VEHICLE COLOR	DATE VIOLATED	TIME VIOLATED
SPEEDING	abc123	van	blue	January 1, 2016	415
SPEEDING	def456	sedan	red	January 2, 2016	530
SPEEDING	xyz	truck	black	July 3, 2016	300
DRIVING WITHOUT LICE...	xyz	truck	black	November 3, 2016	700
DRIVING WITHOUT LICE...	def456	sedan	red	July 2, 2016	200
SWERVING	xyz	truck	black	November 3, 2016	500
SWERVING	def456	sedan	red	July 2, 2016	400
DRUNK DRIVING	def456	sedan	red	January 10, 2016	1100
COUNTERFLOWING	xyz	truck	black	September 3, 2016	300

Shows the distribution of violations in daily, weekly, and monthly basis.

Traffic Violation Summary



PUBFIX AND CATCH-ALL INTEGRATION PROPOSAL PROJECT

ABOUT SCENE

travis

Traffic Violation Information System

Number of people having cars are increasing nowadays, making the roads more busy. Busy road can cause drivers to commit traffic violation whether it is intentional or not. To help people review the violations that have been committed, the traffic violation information system or TraVIS, can be used. TraVIS is a system that interacts with a user using a graphical user interface (GUI) to help them monitor the violations that have been committed in a particular day. TraVIS can show the user what type of vehicle committed the violation, plate number, color of the vehicle, and the date and time of when it was committed.

This program was made by a Computer Engineering students of De La Salle University, Science and Technology Complex that serves as a partial completion of the course, System Analysis and Design.

Speak

home

facts

graph

close



TRAVIS Version 1.0 Development (Traffic Violation Information System)

PUBFIX AND CATCH-ALL INTEGRATION PROPOSAL PROJECT

FACTS SCENE

travis

Traffic Violation Information System

List of traffic violations and corresponding penalties

VIOLATIONS	PENALTIES		
	First Offense	Second Offense	Third Offense
WINDSHIELD / WIND GLASS			
COLORUM OPERATION (CARGO VEHICLE)	(C) 1,000.00 (C) 3 Mos Conf Plt	(C) 2,000.00 (C) 6 Mos Imp Mvr	(C) 3,000.00 (C) Cncl of Fran
COLORUM OPERATION (CARGO VEHICLE)	(D) 500.00 (D) 3 Mos Sus DL	(D) 750.00 (D) 6 Mos Sus DL	(D) 1,000.00 (D) Rev of DL
COLORUM OPERATION (PASSENGER) - MMDA Reg. No. 97 - 004	(C) 5,000.00 (C) 3 Mos Conf of Plt	(C) 5,000.00 (C) 6 Mos Imp of Mv	(C) 5,000.00 (C) Cncl of Fran
COLORUM OPERATION (PASSENGER) - MMDA Reg. No. 97 - 004	(D) 1,000.00 (D) 3 Mos Sus of DL	(D) 1,000.00 (D) 6 Mos Sus of DL	(D) 1,000.00 (D) Rev of DL
CR / OR NOT CARRIED	(D) 150.00	(D) 150.00	(D) 150.00

Source: <http://www.mmda.gov.ph/index.php?c=104> (http://258 traffic violations and penalties) As of July 2016

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about

graph

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PUBFIX AND CATCH-ALL INTEGRATION PROPOSAL PROJECT

HOME SCENE

travis

Traffic Violation Information System

Enter a plate number

Select a violation

- Speeding
- Driving Without License
- Swerving
- Drunk Driving**
- Counterflowing
- Beating The Red Light
- Color Coding
- Driving On Slippers
- All Violations

Selecting a violation

About facts graph close



PUBFIX AND CATCH-ALL INTEGRATION PROPOSAL PROJECT

HOME SCENE

travis

Traffic Violation Information System

List of violators on
the specified traffic
violation

VIOLATION	PLATE NUMBER	VEHICLE CLASS	VEHICLE COLOR	DATE VIOLATED	TIME VIOLATED
SPEEDING	abc123	van	blue	January 1, 2015	415
SPEEDING	def456	sedan	red	January 2, 2016	530
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DRUNK DRIVING	def456	sedan	red	January 10, 2016	1100
COUNTERFLOWING	xyz	truck	black	September 3, 2016	300

home

facts

about

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PUBFIX AND CATCH-ALL INTEGRATION PROPOSAL PROJECT

4. IN-VEHICLE DRIVER BEHAVIOR ANALYSIS AND DRIVER ASSISTIVE TECHNOLOGIES

Computer Vision-Based Driver Assistive Technologies

- Drowsiness detection and speech-based feedback system (driver will be notified/alerted by the computer if he is sleepy)
- Road signs notification and speech-based feedback system (the system will detect road signs and advise the driver to follow traffic rules), ie.
 - Red light notification
 - No loading/unloading notification
 - One-way notification
 - No U-turn notification, etc.

NOTE:

The system can help the drivers in avoiding traffic violations and accidents.

Traffic violations can be recorded if the driver violated the road signs notification. Traffic violations will be transmitted to the server whenever the vehicle passes through the road-side unit (RSU)

PUBFIX AND CATCH-ALL INTEGRATION PROPOSAL PROJECT

5. PUBLIC UTILITY VEHICLES (BUS, TRAINS, ETC.) ON-BOARD SECURITY SYSTEM USING AUDIO-VISUAL MULTIMEDIA SYSTEM

Computer Vision- and Audio-Based Security System for Detecting People's Behavior and Activity in Public Utility Buses

- Detection of deadly weapons (guns, knives, etc.)
- Audio-visual commotion detection during robbery/hold-up, hostage taking, and bomb threats
- Monitoring road conditions (illegal parking, accidents, etc.)

NOTE:

Activity will be transmitted to the server whenever the vehicle passes through the road-side unit (RSU)

PUBFIX AND CATCH-ALL INTEGRATION PROPOSAL PROJECT

6. AUTOMATED PARKING SPACE DETECTION SYSTEM USING COMPUTER VISION AND SMARTPHONE APPS

- Computer vision are used to detect vehicles entering and leaving a parking area. Smartphone app users are notified in real-time of possible parking space in nearby locations.

NOTE:

The system aims to minimize traffic congestions due to vehicle owners unable to find a parking space. It can also minimize illegal parking violations.



Thank You !