Examining the Applicability of Small Quadcopter Drone for Traffic Surveillance and Roadway Incident Monitoring (Paper No: 15-4184)

Joyoung Lee, PhD., Zijia Zhong, Kitae Kim PhD., Branislav Dimitrijevic, Bo Du, and Slobodan Gutesa

John A. Reif, Jr. Department of Civil & Environmental Engineering
New Jersey Institute of Technology

NJIT New Jersey's Science & Technology University

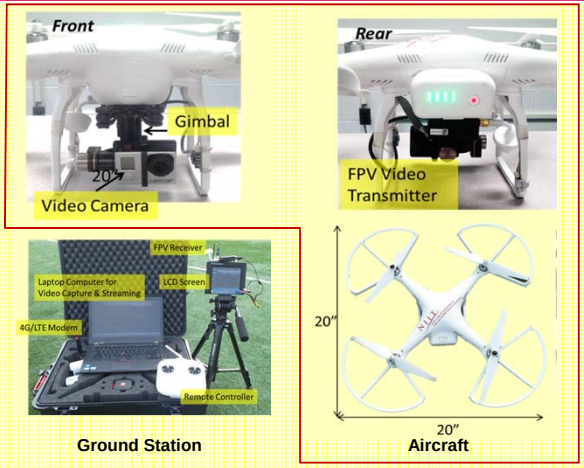
Introduction

Small quadcopter drone has been popular with the advancement of cutting-edge flight control technologies: 1) GPS-based position hold, 2) long-range wireless communications for video transmission, 3) automatic flight assistance, and 4) fail safe. In conjunction with traffic surveillance, small drone would offer a promising potential to tackle the challenges by immobile surveillance device with its capability. In this research. with two quadcopter drones powered by video capturing and transmission devices and a ground station unit, several pilot tests have been conducted to examine the effectiveness of quadcopters for traffic surveillance and incident monitoring.

FAA Regulation

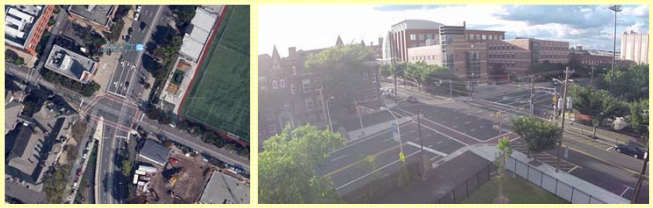
- Aircraft must be no more than 55 pounds to be considered as model aircraft (unless certified by an aero-modeling community-based organization).
- Prior notice of the flying operation should be provided to the airport traffic control tower when flying within 5 miles of an airport (The FAA Modernization and Reform Act of 2012)
- 400 feet allowable group altitude within 3 miles of an airport (Academy of Model Aeronautics National Model Aircraft Safety Code, 2014)

Major System Components



Ground Station | Aircraft

Traffic Surveillance



NJIT Campus, 45 ft ground altitude

Piscataway Twp., 90 ft ground altitude

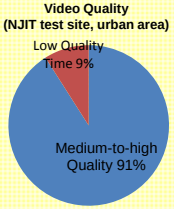
	Site #1 Northbound	Site #2 Eastbound
Volume Count	98	87
Average Queue Length	64ft (sight restriction)	104ft
Total Delay	879 seconds (7 cycles)	247 seconds (2 cycles)
Average Headway	2.18 seconds	2.0 seconds
Saturation Flow Rate	1,651veh/h/ln	1,800veh/h/ln

Intersection Congestion Measure

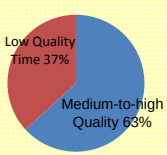
Roadway Incident Monitoring

High-level Framework for Quadcopter-based Incident Monitoring

Test Site #1: Lock St., Newark, NJ



Roadway Incident Monitoring



Test Site #2: I-80, Parsippany-Troy Hills, NJ

High quality video stream (Strong Signal Strength)

Medium quality video stream

Low quality video stream (Weak Signal Strength)

Conclusions

The small quadcopter drone adopted

- has low operation and maintenance costs
- does not require advanced skills for aircraft control
- is capable of capturing video footage for video analytics
- has promising capability for short-term traffic monitoring in real time (e.g. traffic incidents).

Future Research

- Improve video streaming quality
  - Image compression
  - Image reproduction (e.g., decoding, resizing)
- Enhance video image stability for more reliable video analytics
- Test for potential applications
  - Traffic simulation model validation
  - Traffic studies (traffic counts, speed estimation, congestion assessment, queue detection and measurement, etc.)
  - Transportation infrastructure inspection