Multimedia Sensor Dataset for the Analysis of Vehicle Movement

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Motivation

• GPS Trajectory has been widely used and analyzed.
• Analysis for driving pattern requires target data.
• Can be collected GPS and 4 sensors with videos using smartphones.
• Can correct accuracy of GPS and other sensor data and label movement patterns using videos.
Motivation (Cont...)

• Why Various Sensor Data?
  – GPS: collected by one second unit and include many errors
  – Other Sensors (e.g., accelerometer): errors can be accumulated over time, no absolute reference to the position
  – Video: no position by itself and it is difficult to qualify locations and movement. limitations for the machine to recognize the situation.

• Approach : solution for improvement accuracy
  – GPS: Generation speed correction with filtering
  – Other Sensor: calibrate location and collect detailed movements
  – Video : Label the exact situation by human
Dataset

• MediaQ Geo-Tagged Video and Sensor Data
  – Mobile multimedia management system to collect, organize, share, and search mobile multimedia contents using automatically geo-tagged metadata (mediaq.usc.edu)
  – Using MediaQ, one can collect GPS signal, Acceleration, Orientation, Gyroscope, Magnetic sensor data and matching movement video clips
Dataset (Cont...)

• Dataset Description
  – GPS Data:
    • Timestamp/ Timezone Offset (+hh:mm or -hh:mm (e.g., 07:00 when recording in Los Angeles))
    • Latitude/ Longitude/ Altitude/ Accuracy
  – Other Sensor Data:
    • Timestamp/ Timezone Offset
    • Acceleration (x, y, z), Orientation (Azimuth, pitch, roll)
    • MagneticField (x, y, z), Gyroscope (x, y, z)
  – Video Data Data:
    • Videos that match collected sensors in frame level
Type | Size
---|---
Driving Time | 22.4 hours
Driving Distance | 731.6 mile
Video Size | 50.4 G byte
Data Collection

• Device & Preparation
  – A cradle mounted on dashboard
  – Mounted horizontally to align the acceleration sensor z-axis.

• Covered Area
  – Downtown LA and Downey

• Collection Method (patterns)
  – Normal Driving, Aggressive Driving
  – Speed Bump Passing, Uneven Road Passing
Data Processing

Preprocess
- Merge
- Speed Generation
- Kalman Filtering

Graph Generation

Map & Photo Drawing

GPS Trajectory

Sensor Data
Preprocess

• Combine GPS and Sensor data (difference time scale)
  – Sample frequency - GPS: 1 second, Sensor data: 200 ms

• Device Independent Data Conversion
  – Calibration different scale between Android and iOS
  – (Acceleration x scale and include Gravity or not)

• Speed Generation using GPS coordinates
  – The speed is calculated by dividing the distance between current GPS coordinate and previous coordinate
    \[ v(t) = v(0) + \sum a \times dt \]

• Speed Generation using Acceleration
MediaQ Sensor Data Analysis

Filename: wonhee_2017_2_24_Videotake_1487957711650.csv
Time = 19.1 min, Distance = 12.734 km, 7.912 mile, Phone_os=android, User_name=wonhee

- kacc_x
- kacc_y
- kacc_z
- g speed
- k speed
- a speed
- azimuth
- pitch
- roll
- gyro_x
- gyro_y
- gyro_z
- mag_x
- mag_y
- mag_z

MAP
GRAPHS
IMAGE
User Interface
Abnormal pattern check using video
Program and Dataset File

Tool: Python, File: GenSensor.py

Source: http://mediaq.usc.edu/mmsys17
Conclusion and Future Direction

• Presented data collection from mobile camera and sensors using MediaQ app
• Provide dataset, program for processing
• Presented sample cases using collected data
• Will apply for all kinds of mobile devices
  – Blackbox camera in automobile, police bodycam,
  – Drone videos
Police and Soldier Movements

Bodycam w/o sensors

Simulating Bodycam w/ sensors
Ground Videos vs. Aerial Videos

Spatial Coverage of Aerial Video

Azimuth $\theta_a$

Roll $\theta_r$

Pitch $\theta_p$

the north
Thanks

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