Towards smarter public transport

Sensing, Modeling and Visualizing Urban Mobility and Copresence Networks

Vassilis Kostakos

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Motivation

• People increasingly carry mobile communication technologies
• By taking advantage of technology that passengers carry
  – Better understanding of passenger behaviour
  – Increase bus seat occupation
    • Optimise network
    • Provide passengers with better information services
Outline

• Describe the enabling technology & algorithms
• Applications
  – End-to-end passenger counting
  – Contextual services
Exploiting people’s phones to collect mobility data
Main concepts

• Sessions
• Trails
• Encounters
Flow of people

![Graph showing the flow of people through City Gate and University Gate over the course of a day. The graph plots the number of devices passing through each gate against the hour of the day. City Gate has a peak around 13:00, while University Gate has a smaller peak around 14:00.]
Avenida - Recovery

Devices seen

Floods
End-to-end passenger detection on busses
Deployment

• Install the equipment onboard a bus
• Integrate with Automated Vehicle Location data
Results

• Identification of entry and exit points for individual devices
• Estimations suggest 10% of population have Bluetooth in discoverable mode
• System was deployed at a single bus for 4 weeks
• Bus covered 4 different routes at different times of day
Localisation

Bluetooth

GPS

Odometer

Door sensor

GPRS

Datastore

<DEVICE_ID>  BOARD_TIME  EXIT_TIME

BUS_ID  TIME  BUSSTOP_ID

<DEVICE_ID>  BOARD  BUSSTOP_ID

<DEVICE_ID>  EXIT  BUSSTOP_ID
Bluetooth passengers

Tickets validated

Avg. Bluetooth passengers

Avg. Tickets Validated

y = 10.261x - 1.3347

Avg. Tickets Validated

Avg. Bluetooth Passengers

Number of passengers with repeated visits

Number of repeated visits

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Contextual services for passengers
Proposed route

- Installation of 12 stations at/nearby public transit bus stops. Deployment at strategic locations
Proposed system

- Deploy equipment to collect data and provide services at bus stops
- Information is routed to the central server
- Provide both historical and (near) real-time perspective
Service triggering

- Services are triggered when a device is detected
- Parameters / filters of a service
  - What to send (URL? Local file?)
  - To whom to send? (Specific device, broadcast)
  - At which location(s)?
  - At what time/date?
  - ...
Content delivery for all locations

University

Festival

Info kiosk

Ticket kiosk

Successful Deliveries
Total Attempts
Results

• Many passengers did not successfully receive the test file
  – We did not advertise the service!
  – People don’t realise that their phone is trying to receive a file
  – Advertisement & increased awareness should resolve this

• New capabilities open up
  – Reward scheme based on how much time you wait
  – Personalised O/D matrix, predictions, better info
Summary

• By exploiting passengers’ mobile bluetooth-capable phones we can
  – Collect rich data about travel behaviour
  – Provide rich, context-aware services
• The collected data are much richer than what current techniques can capture
• The provided services can be fully personalised
The end

• Thank you!

• Questions?

• http:// www.m-iti . org