A Public Transport System Based Sensor Network for Road Surface Condition Monitoring

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Outline

- WASN Lab at UCSC
- BusNet
- Road Condition Monitoring
- Road blocks
- Future work
- Related work
WASN Lab at UCSC

- We are very young!
  - Started in February last year
- Funded by SPIDER
- Collaboration
  - Ericsson
  - Volvo
- Brainstorming
  - What can we do with the sensors we got?

Monitoring Environmental Pollution

- Common problem in third world countries
- Lack of proper monitoring system
  - Cost
  - Deployment
  - Maintenance
- Sensor networks to the rescue
Challenges

- Needs a large number of sensors
  - We only have a few !!
- May be a sensor fairy would give us a big bag of sensors
  - How do we protect them?
  - How do we change the batteries?
  - How do we repair them?
    - Locating sensors
- Management nightmare

BusNet

- Mount the sensors on public transport buses
  - They will carry them around
  - Sensors come home after work
    - Security
    - Maintenance
    - Easy to manage
Overlay Network On the Transport Network

- Buses collect data en route
- Sub stations get data from the buses
- Sub stations route data to the main station over buses
- Main station transfers data to the processing center
Ad Hoc Network?

- Not really!
  - Nodes are fixed
  - Routes are relatively stable
- These words may be still ringing in your ears (Thanks to Michael)
  - Stable DTNs
  - 100% uptime with buses

A Free Ride

- Acceleration sensors on the sensor boards
  - They are not fully utilized
- Vertical and horizontal acceleration to detect the road surface condition?
A Bumpy Ride

- Sri Lankan roads are not known for their quality!

The Culprits

- Lack of funds
- Lack of a proper monitoring or reporting system
  - Identify problems early
    - Take preventive actions
    - Help to plan and build roads better in future
- ?
Telltale Signs

- You see a bad patch of road
  - Break suddenly
  - Steer clear off the patch
    - Sudden change in the horizontal component of the acceleration
- You did not see the pot hole
  - The vehicle goes over the pot hole
    - Change in the vertical component
    - Change in the horizontal component

- You see the pot hole, but you cannot avoid it
  - A change in the vertical and horizontal components
Some Data

Collecting Data
The Road Map
Y-Acceleration

Y-Acceleration (Another View)
X and Y and Pot Holes

Research in the Other Side of the Digital Divide

For and In
### Road Blocks

- We could not acquire GPS sensor boards
  - Xbow does not want to sell them to us
  - The same set of sensors are used for teaching and research
  - Undergraduate projects

### Quite a Lot to Do

- Get hold of some GPS sensor boards !!
- Improve the data gathering process
  - Roughness as perceived by the operator
    - How do we remove this subjectivity?
  - What is the depth/width of the pot hole?
  - Other type of bad surface conditions
- Analyze the data
  - Build a model
- Deploy in the real world
Related Work

- CarTel
- DakNet
- Zebranet

Going off on a Tangent

- Protecting people from jumbos and jumbos from people
- Jumbo size train accidents!

Photo Source: BBC
Thank You!