Intelligent Transport Systems (ITS) For Indian Cities

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Infrastructure growth is lagging behind growth in vehicle volumes. Better traffic management and more information to commuters can alleviate traffic woes, though cannot obliterate them. Technology to do this is called ITS.

**Intelligent Transport Systems (ITS)**

**Traffic Management**
- Intersection control
  - adaptive/static
  - isolated/co-ordinated
- Infrastructure planning
- Incident handling
  - detection
  - fine imposition
- Revenue collection
- Pollution control
- Infrastructure maintenance

**Commuter Information**
- Congestion map
  - historical/real-time
- Travel time
  - historical/real-time
- Transit tracking
  - bus/train/metro
  - arrival time prediction
- Cab services
  - locate nearest
  - trip fare/duration prediction
- Personal vehicle services
  - parking spaces
  - carbon footprint

And many more .......
Interdisciplinary Problem Space

Papers in diverse Venues!

Transportation Research Board Journals, Conferences on Image Processing, Artificial Intelligence, Machine Learning, Mobility, Sensing, Embedded Systems, ICT ......
Any ITS application would need information from the road. Hence the need for “road sensors”.

**Road Sensors**

**Static**
- Magnetic sensor
- Camera
- Infrared sensor [TIRTL]
- Radar
- Acoustic sensor [HornOkPlease]
- RF sensor [WirelessAcrossRoad]

**Mobile**
- GPS
  - [SurfaceStreet, EasyTracker, Balan]
- Phone sensors
  - [Nericell, PhoneAstra, Melos]
    - accelerometer, microphone
    - magnetometer, gyroscope
    - compass
- Phone radios
  - Wi-Fi [VTrack]
  - GSM [CTrack]

**Hybrid**
- Teledensity
- Bluetooth
- RFID

**Specialized hardware**
- [Autowitness, GreenGPS, Parknet]
Wait ....
do we need all sensor types?

Let's take a road map of Bengaluru and try to design a bunch of ITS applications for it
Wait ....

do we need all sensor types?

Adaptive control of traffic lights based on current queue length

- strictly periodic
- accurate
- from few important intersections
- queue length
Wait ....
do we need all sensor types?

Travel time from Jayanagar to Koramangla
- historical/delayed
- within error of few minutes
- from all over the city
- travel time
Wait ....

do we need all sensor types?

Red light violation detection

- immediate
- accurate
- intersections
- number plate of vehicle
Wait ....

do we need all sensor types?

Adaptive control of traffic lights based on current queue length
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1. Timeliness
2. Accuracy
3. Spatial coverage
4. Nature of Information
5. Cost
6. Deployment overhead

Should decide sensor type for the intended application
Open Problems

Static road sensors

- Magnetic sensor
- Camera
- Infrared sensor

Adapting existing techniques for non-laned traffic
Open Problems
Static road sensors

- Acoustic sensor [HornOkPlease]
- RF sensor [WirelessAcrossRoad]

*Designing new techniques for non-laned traffic*
Open Problems

Static road sensors

- Magnetic sensor
- Camera
- Infrared sensor [TIRTL]

Adapting existing techniques for non-laned traffic

- Acoustic sensor [HornOkPlease]
- RF sensor [WirelessAcrossRoad]

Designing new techniques for non-laned traffic

What to sense? How long to sense? How to train sensors for different road types?
Open Problems

Dense road network, ample urban canyons, how does GPS perform? What is Wi-Fi penetration to augment GPS? Or is cell-tower based localization the optimal choice?
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Dense road network, ample urban canyons, how does GPS perform? What is Wi-Fi penetration to augment GPS? Or is cell-tower based localization the optimal choice?

In non-laned traffic, how does surrounding traffic density affect driving behavior? Lane change – gyroscope Braking – accelerometer Honking – microphone Build realistic traffic simulators with the results.
Open Problems

Dense road network, ample urban canyons, how does GPS perform?
What is Wi-Fi penetration to augment GPS?
Or is cell-tower based localization the optimal choice?

How many vehicles of what type – defines Passenger Car Unit (PCU) for a road. PCU is used in planning infrastructure. Current method involves manual counting on road.

In non-laned traffic, how does surrounding traffic density affect driving behavior?
Lane change – gyroscope
Braking – accelerometer
Honking – microphone
Build realistic traffic simulators with the results.

 Shoot the trucks & score!
Will gaming or paid incentives help this application? How to handle label noise?
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Meaningful collaborations with the public sector are necessary, to implement and test our ITS systems at scale.

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For questions: please write to
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