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# **Development of a Traffic Incident Hotspot Data Acquisition System (TIHDAS) Based on GNSS Positioning and GIS**

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# **Contents**

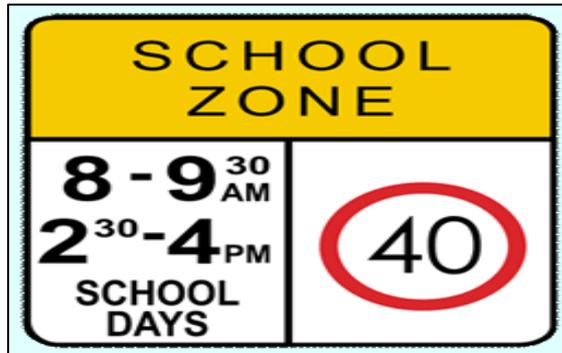
- **Problems**
- **Gaps and Solutions**
- **Our Efforts and Results**
- **Conclusions**

# Problems

Whether drivers realised potential dangers?

Any instant traffic information helping?

- **Dangerous Zones**  
(Time, Location)
- **Wrenched Weather**  
(Rain, Snow, Fog, Hail)
- **Accident Hotspots**  
(Intersection, Curvature)
- **Animal Protection**  
(Crossing Deer, etc)



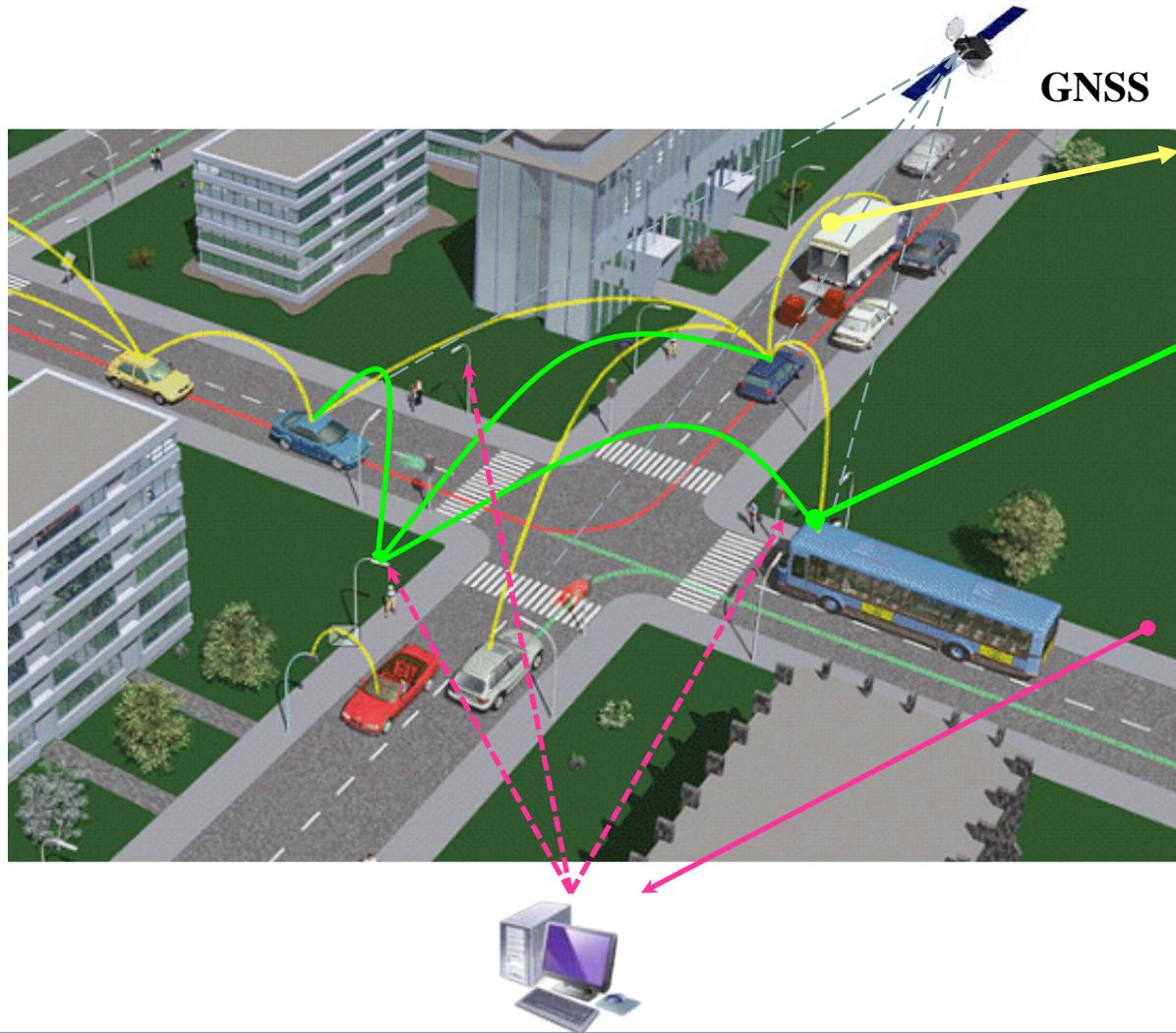
# Benefits of a Location-based Real-time System

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- To notify construction zone, school zone or animal protection zone when entering a new environment
- To remind the approaching vehicles in a low-visibility environment
- To alert accident occurrences ahead and provide real-time safety re-routing information (3~5 minutes by current system)
- To assist clear-minded driving and keep reasonable speed
- To monitor and notify dangerous driving behaviours

# Gaps and Solutions – A Future Cooperative ITS Solution

**Solution** -- Promote information exchange between different entities



## Vehicle to Vehicle

- Relative location
- Speed and distance

## Vehicle to Infrastructure

- Dynamic data from the Internet

## Wireless Communications

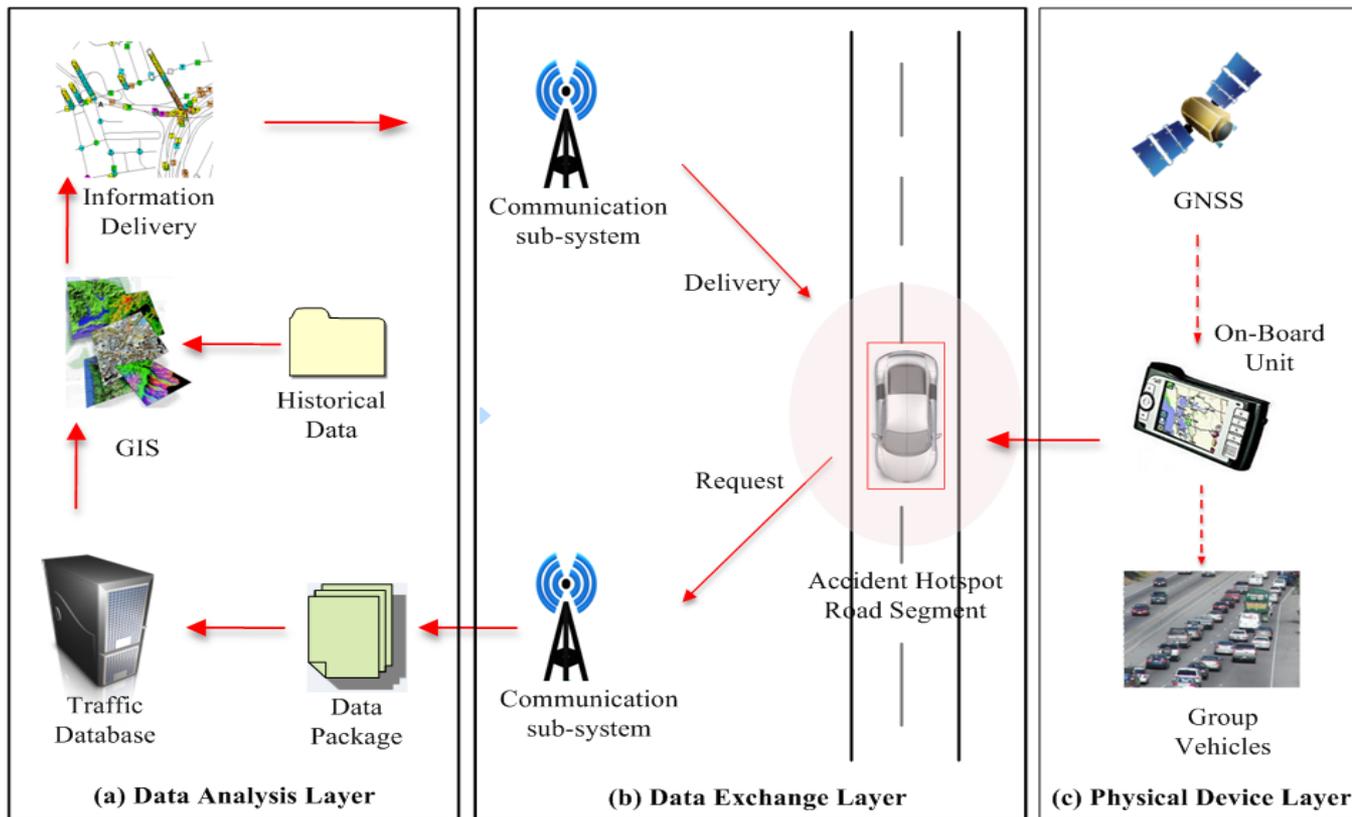
- 3G/DSRC

## Traffic Management Centre

- New role in Safety?

# Gaps and Solution - Novel TIHDAS

- Based on a Client-to-Server model
- Provide trusted warning based on the historical data modelling
- Timely safety message delivery via back-up Transport Management Centre
- Real-time monitoring vehicles which are passing accident hotspot areas
- Collect vehicle performance data at accident hotspot (based on privacy protection)



# **Our Efforts –Objectives**

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- **Accident Hotspot Modelling**
- **Prototype System Design and Implementation**
- **Data Processing and Analysis**
- **System Evaluation and Performance**

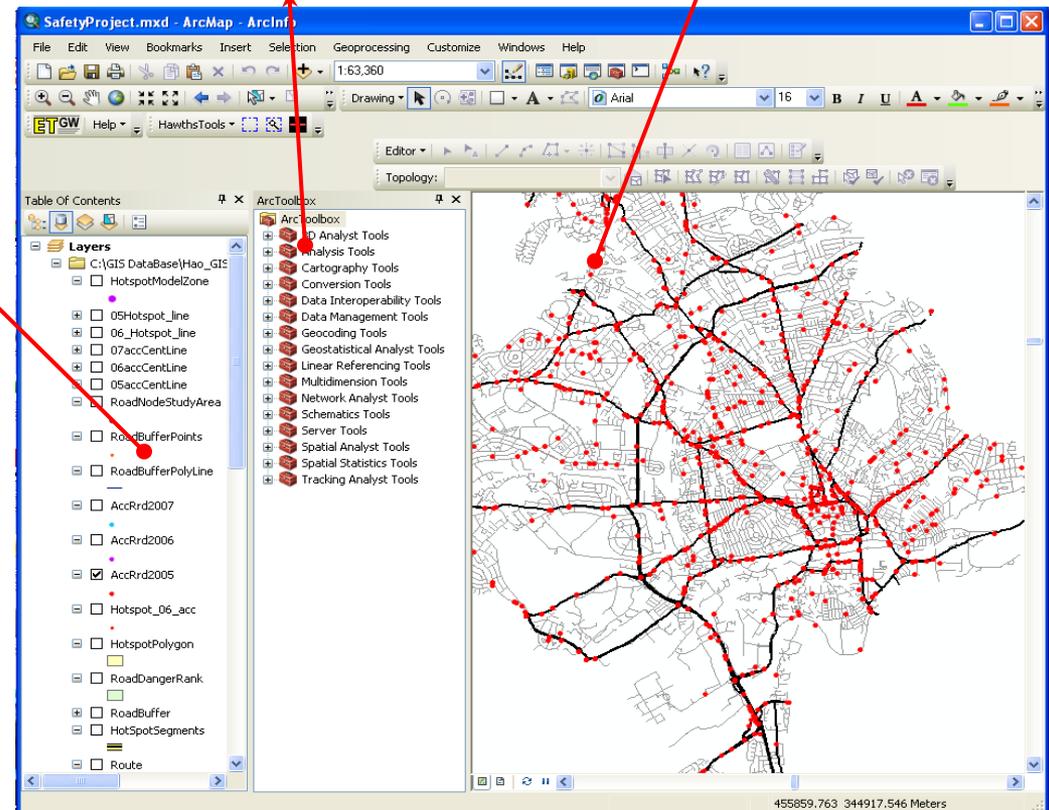
# Accident Hotspot Modelling Methodology

- ArcMap 10.0 and Geospatial Modelling Environment
- Integrated Transport Map from DigiCollection (Ordnance Survey, UK)
- 3,041 road casualties from 2005-2007 (**32 Fatalities**)
- Study area: Nottingham City Centre

Study area and accidents

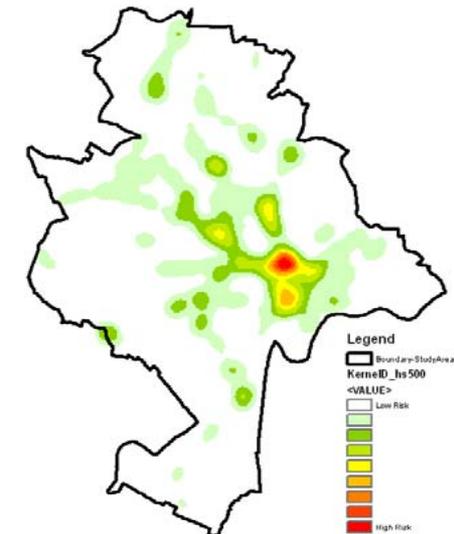
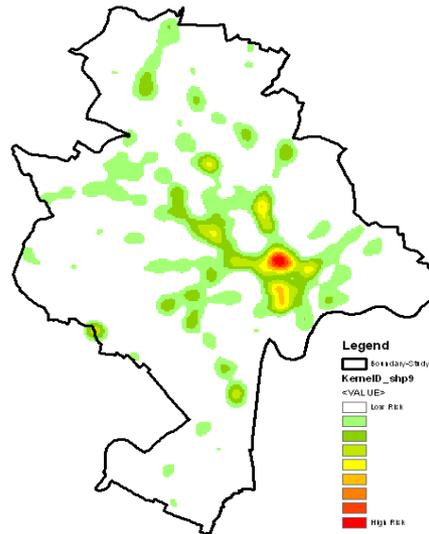
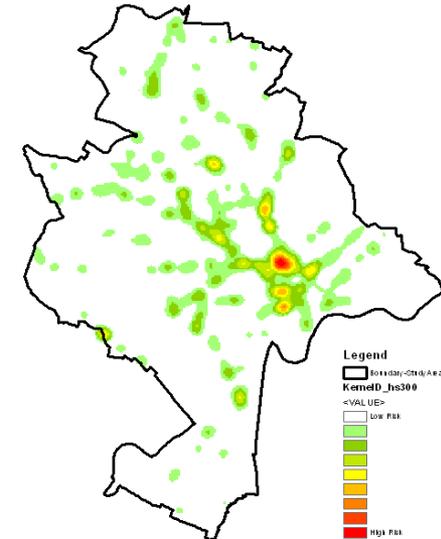
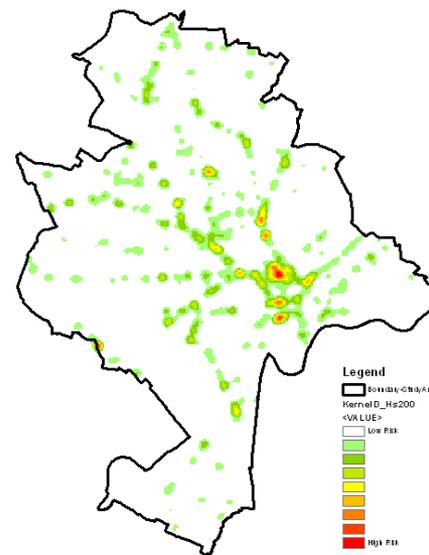
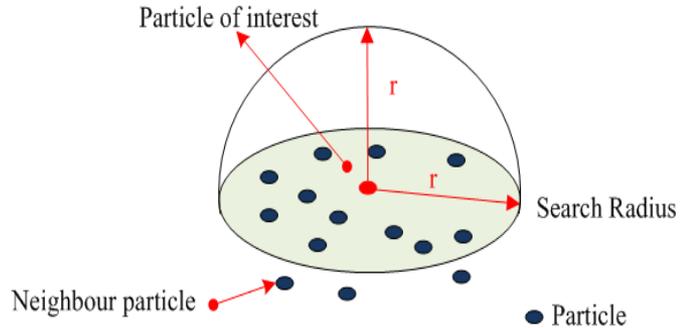
Geospatial Box

Map Layers



# Accident Hotspot Modelling Methodology

## Kernel Density Estimation



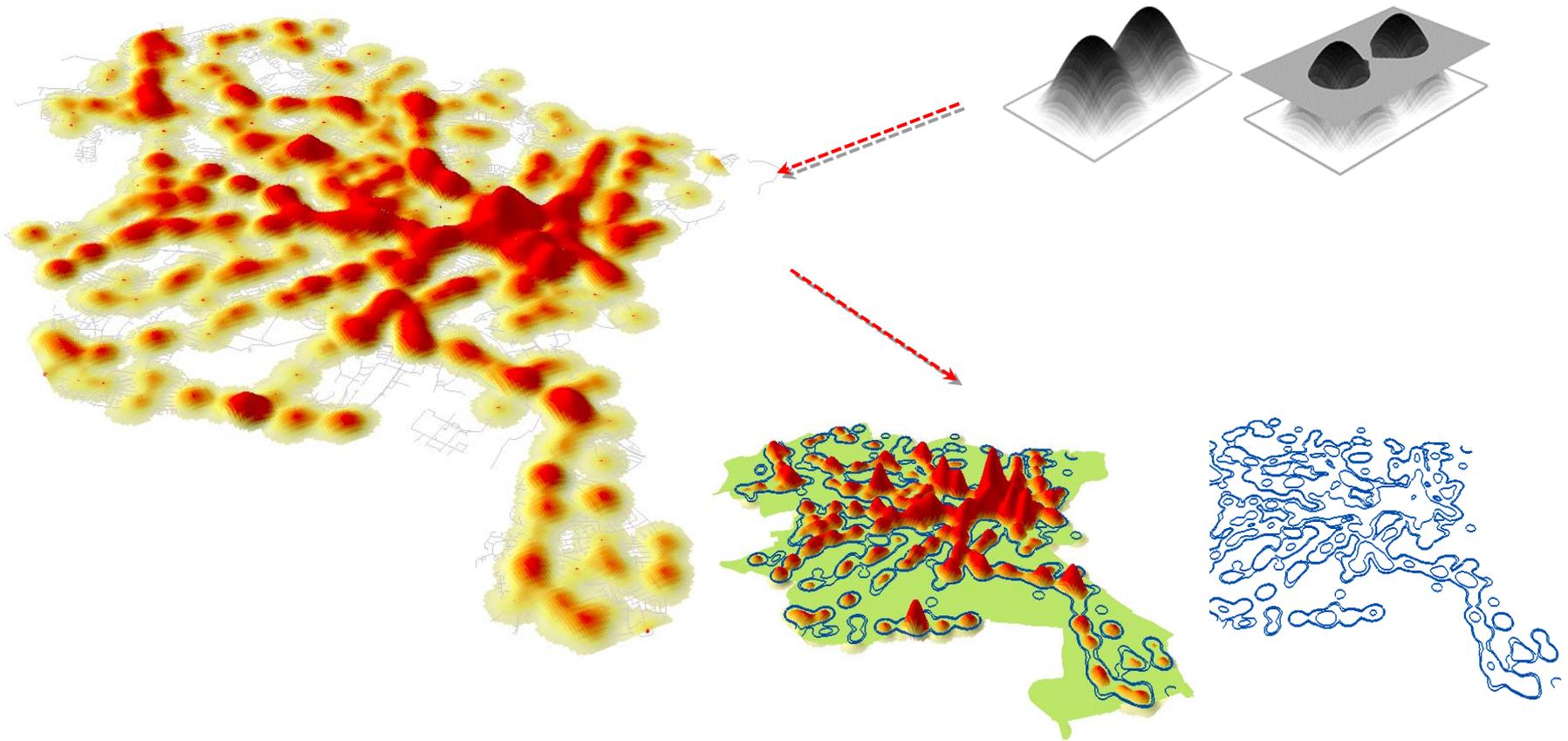
## Notes:

- Bandwidth Selection
- Kernel function Selection
- Quadrat Selection

Bandwidth influence for accident modelling results

# Accident Hotspot Modelling Methodology

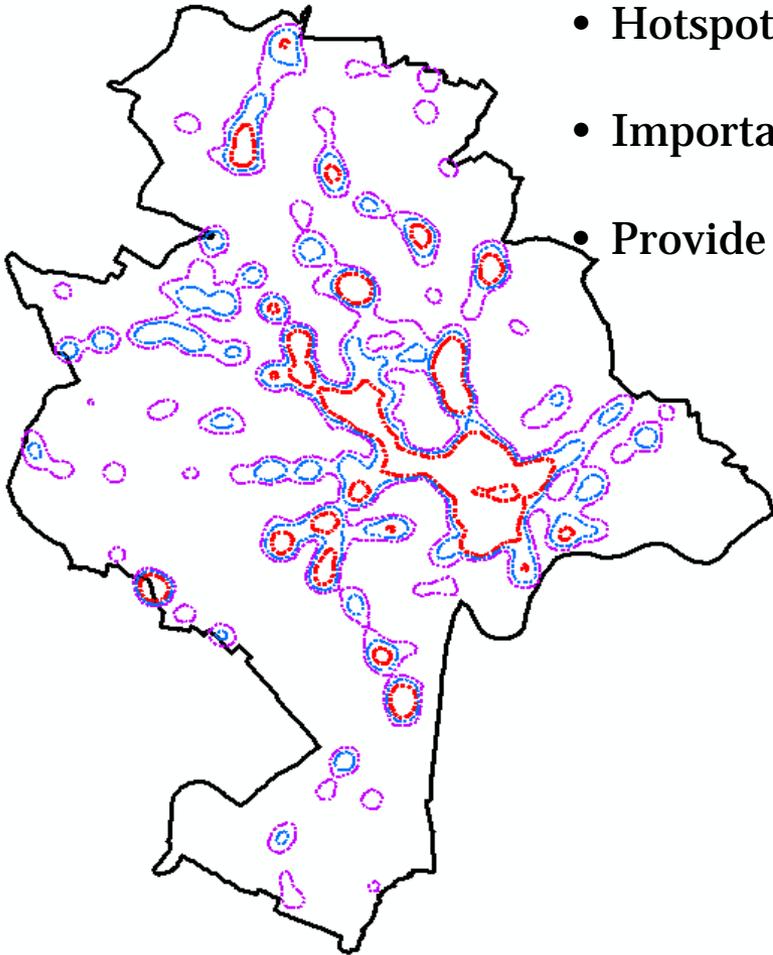
- To select accidents boundaries based on their probability volumes



**3D Accident Risk Contour Map calculated with the data in 2005**

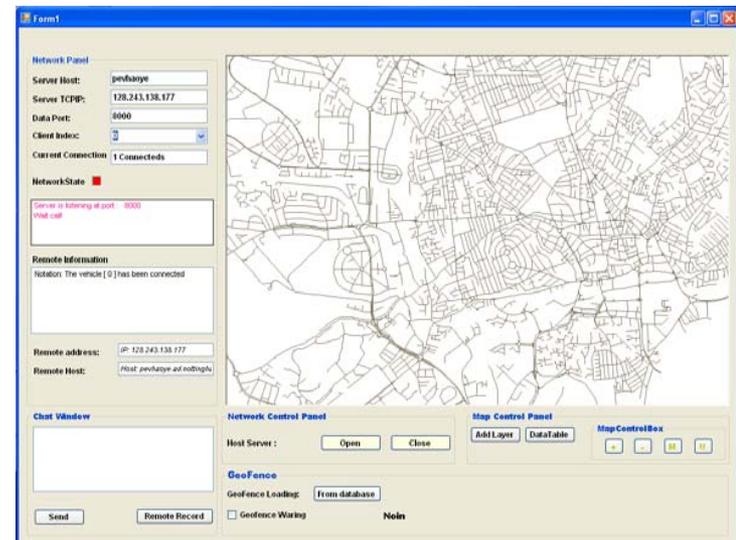
# Hotspot-based Electronic Map

- Enhance road safety using location-based notification
- Hotspot filter to identify different safety requirements
- Important component for location-based safety application
- Provide hotspot management function to assist traffic control



# System Design and Implementation

- Built on C# programming and .NET Framework
- Partial Functions based on GPS.NET and Dotspatial (Open Source Library)
- TCP/IP Communication using Socket programming
- Real-time GPS Tracking on British ITN map
- Real-time automatic hotspot entrance identification and data logging

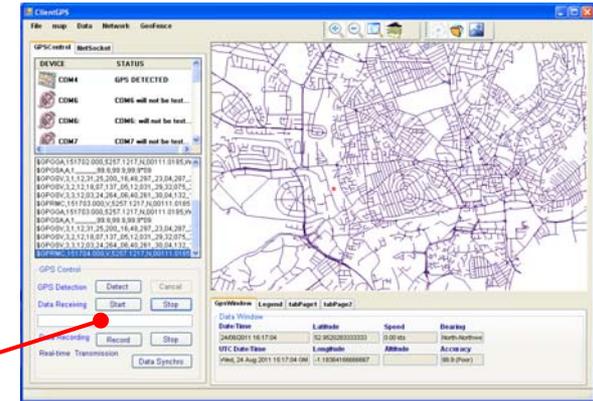
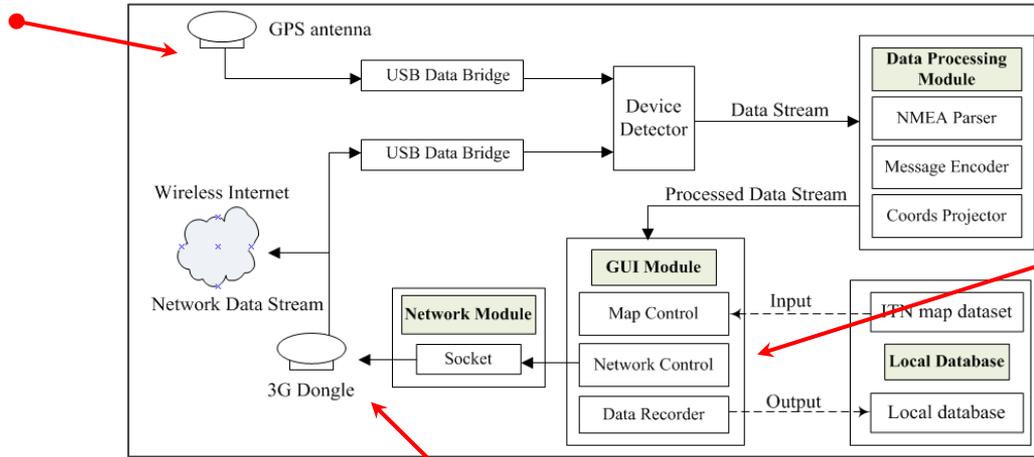


Client and Server Prototype GUI

# System Design and Implementation

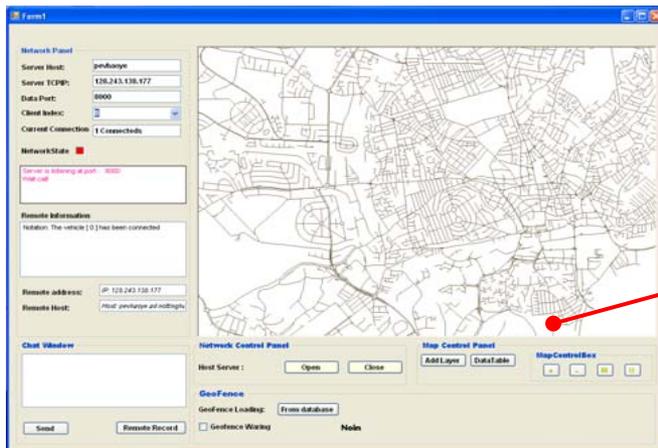
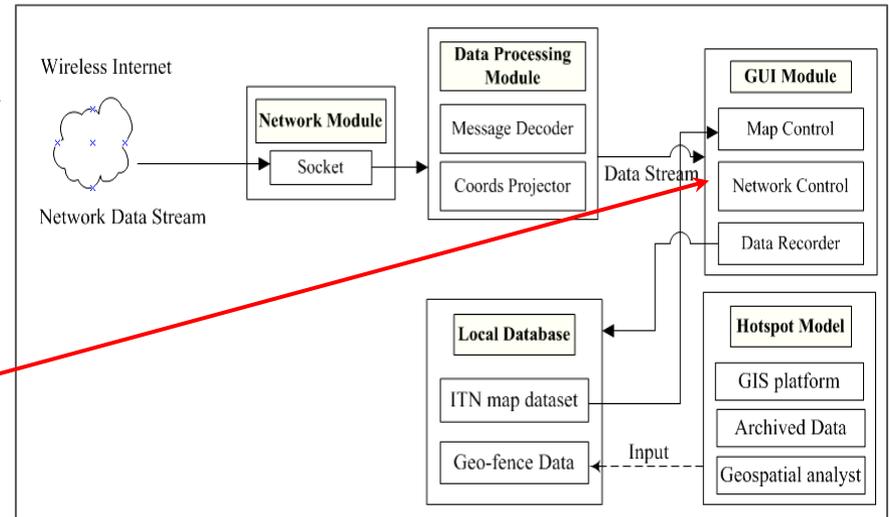


Low-cost GRays2 Receiver



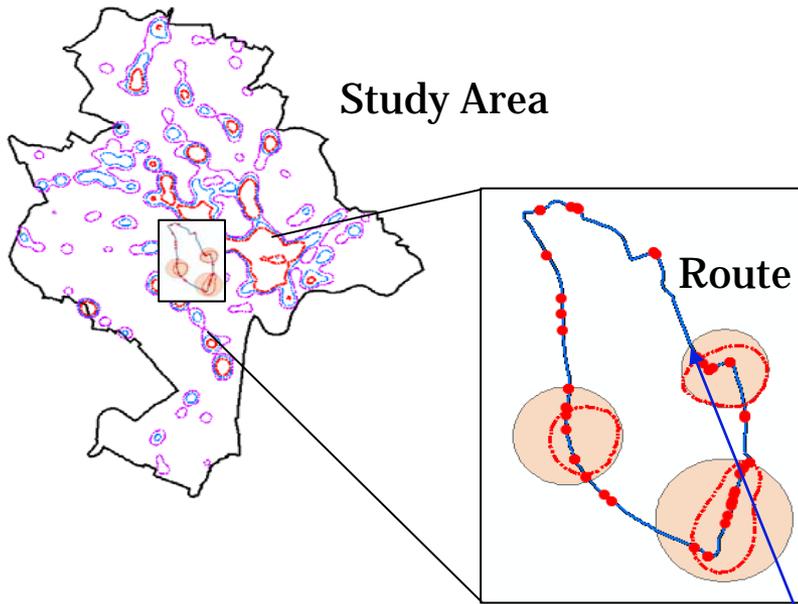
Client Prototype GUI

HuaWei 3G Dongle

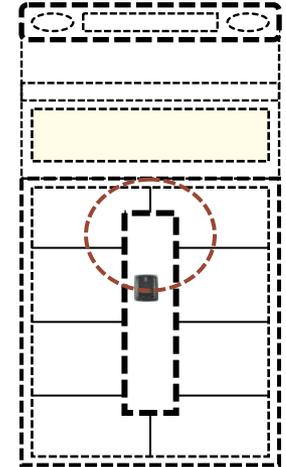


Server Prototype GUI

# System Performance and Evaluation – Instant Alert



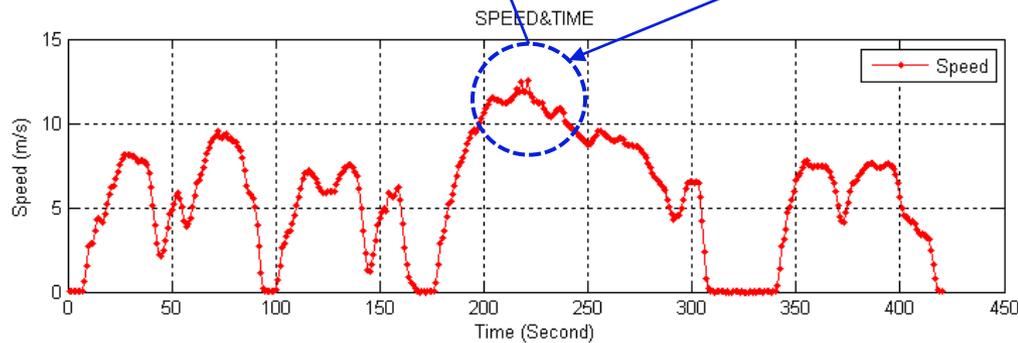
Installation on roof of vehicle



Message Sign



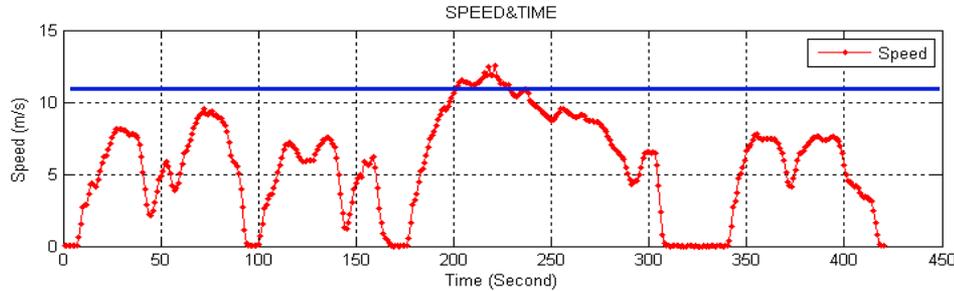
Speed



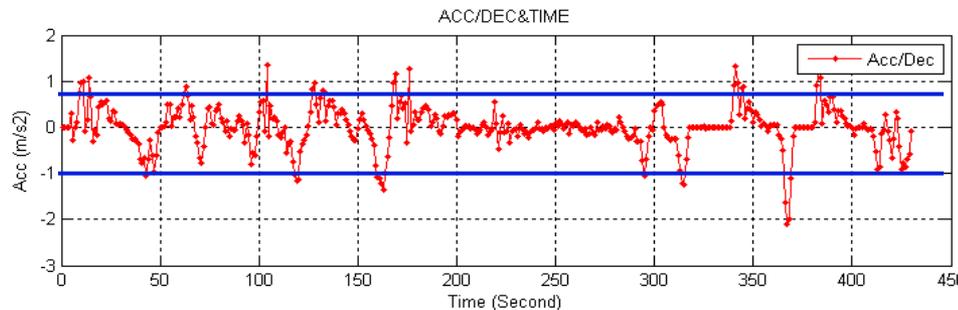
Time

# System Performance and Evaluation – Data Collection

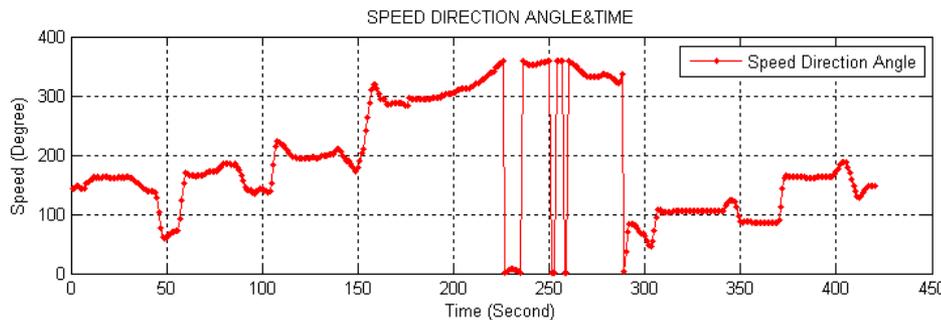
What we can obtain from GPS data to accident analysis?



**Speed Variance**



**Acc/Dec Variance**



**Speed Direction**

- Speed
  - Over speeding
- Acc/Dec
  - Driving behaviour
  - G-Force
- Speed Direction
  - Sharp Turn?
  - Road Design?
- Other
  - GPS Trajectory?
  - Satellite number?
  - Out of Boundary?
  - Collision Distance?
- More explorations needed



# Conclusions

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- A real-time location-based hotspot notification system is introduced
- Detailed description on the accident hotspot modelling, the system architecture and also on the prototype design with initial experiment results
- More experiments will be carried out for data collection and analysis
- Standardised traffic message encoding to traffic message will be implemented in the next stage.

# Many Thanks!

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