Route Navigation and Pothole Monitoring using Crowd Sourced Pothole Mapping

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Motivation

- Potholes on roads act as hindrance to city life, which results in:
  - Accidents – Loss of life and property
  - Slow traffic
  - Accelerated Vehicular Wear-out and Damage
- Marked Increase in the number of smartphone users in India
  - 213 million smartphones connected to the internet, 2013 – IMAI
- E-Governance on the Rise
  - A transparent, accessible community enabled pothole management system – A possibility
  - Smart cities requires smart management of road conditions.

Source: Indian Express
Objective

- To develop a Location Based Service (LBS) using Smartphone based Crowd-Sourcing application for:
  - Mapping
  - Monitoring
  - Potholes free routing
- To develop a transparent, accessible pothole mapping interface for citizens and smart management utility interface for government authorities.
- To encourage and enable community participation through crowd sourcing concepts
### Existing Systems

<table>
<thead>
<tr>
<th>Features</th>
<th>Pune Region Transport Department</th>
<th>Mumbai Region Voice of Citizens</th>
<th>Our Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smartphone Based</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Manual Mapping</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Automated Mapping</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Severity Reporting</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Intelligent Routing</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Location Based Service</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Commercial Information</td>
<td>Yes, Developed by Persistent Systems</td>
<td>Yes, bought by BMC for 60 Lakh INR</td>
<td>Not Yet Commercialized</td>
</tr>
</tbody>
</table>
Solution Concept

- Monitoring
- Managing

ArcGIS Cloud Services

- Mapping – Manual and Automated
- Routing

Government Authorities (e.g. Municipal corporations)

Citizens

Indian Institute of Technology Bombay
Application Snapshots
Pothole Mapper
Report, Track and Route through Potholes the easy way...

Developed at Centre of Studies in Resources Engineering, Indian Institute of Technology Bombay

ESRI mAPP Your Way Challenge
Location 1 - Location 2
10.9 minutes (0.8 miles)

HOME

My Location

- Go west on Hostel Road
  1.8 minutes (0.1 miles)

- Turn left
  2.1 minutes (0.1 miles)

- Turn left on IIT Main Road
  7.6 minutes (0.9 miles)

- Turn right on JVLR
  (Jogeshwari Vikhroli Link Road;Powai Road)
  1.7 minutes (1.1 miles)

- At fork keep right toward
  Abhderi / Aarey Colony
  0.7 minutes (0.5 miles)

- At fork keep right toward
  JVLR (L&T Flyover;Jogeshwari
  Vikhroli Link Road;Powai Road)
  1.7 minutes (1.2 miles)

- At fork keep right on JVLR
  (Seosp Flyover;Jogeshwari)
Report a Pothole

Location
Latitude: 19.23647744
Longitude: 72.84792499

Severity
- Extreme
- Moderate
- Mild

REPORT
Application Demo
Citizen Impact

• Enable Community Participation:
  - Providing residents with a direct channel to report potholes in their locality to the authorities responsible.

• Improve Quality of Transit:
  - Guiding commuters by suggesting them a bump-free route. Specially useful for the elderly people, pregnant women, and patients.

• Ease of Monitoring and Management:
  - Helping authorities to keep track of potholes and take corrective measures and generate work orders to repair them.
Scalability

- **Multiple Concurrent User Support:**
  - ArcGIS cloud services have been used for storing potholes and route navigation, hence the application has the capacity to handle multiple concurrent users.

- **Scalable to diverse User Groups:**
  - Application can be easily scaled to different user groups by creating and hosting a new feature layer on ArcGIS cloud.

- **Use ESRI Spatial Framework for Hadoop for managing, clustering/classifying(analytics) large volume/streaming potholes data.**
Future Work

• Intelligent Severity Based Routing
  - Depending on the user preferences, routes with mild or intermediate severity can be computed.
  - Integration of Wavelets (feature extraction) and Machine learning approaches to improve classification of potholes via accelerometer data.

• Integration with Vehicular GPS Navigation System
  - The ArcGIS Feature Layer can be overlaid on the maps used by Vehicular GPS Navigation Systems.

• Integration with Emergency Services
  - Emergency Services such as Distress Call Ambulance, Fire Station Vehicles can use the Potholes data to anticipate Expected Time of Arrival and route accordingly.

• Pothole Report Notifications
  - Daily digests of reported Potholes can be sent through E-mails to government authorities.

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Questions?
Thank You!
To know more, visit us at:
www.esriindia.com

Or, write to us at:
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