Smartphone-based Road Monitoring (SRoM) System

A Dynamic application for crowd sensing in Intelligent Transportation Systems

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Abstract— The growing abundance of smart devices (smartphones, tablets, etc) are enabling an unprecedented level of accuracy and spread for sensing applications. In this demo we will present a framework developed for both Android and iOS platforms, to enable fine grained sensing and monitoring of road conditions in a ubiquitous fashion. We employ crowd sensing approaches that are fine-tuned with back-end data analytics, to empower both active and passive sensing schemes. The application, named Smartphone-based Road Monitoring (SRoM), has been tested in real-life scenarios and its accuracy and fidelity have been validated in physical implementations. Current implementations are being communicated with the Ministry of Transportation in Canada for testing on their fleets.

Index Terms— Intelligent Transportation Systems; crowd sensing; passive sensing; mobile application

I. INTRODUCTION

The advent of Intelligent Transportation Systems (ITS) and their projected impact on safety and efficiency, necessitate the adoption of resilient and scalable architectures. A core component of ITS is monitoring road conditions and ensuing traffic disruptions/patterns. In this demo we will present a novel monitoring system developed at the Telecommunications Research Lab in Queen's University, named the Smartphone-based Road Monitoring (SRoM).

The pool of resources in smartphones is ever-growing. Inevitably, an already competitive market of smartphone producers is facilitating more complex sensing, communication and processing tasks. SRoM is designed to empower smartphone users in passively collecting and reporting road conditions to dedicated servers. More involved users have the option to actively partake in collecting media on road conditions (pictures, video and audio).

We designed a low-footprint application for both iOS and Andriod based smartphones to enable seamless user interaction with SRoM servers. Utilizing an innovative and user-friendly interface, we facilitate wide-spread usage of SRoM for real-time sensing and reporting. In Figure 1 we present an overview of the operational phases of SRoM.

The main goal of SRoM is empowering smartphone users on the road to effectively communicate road conditions with varying granularities of participation; emphasizing usability and seamless operation as core design goals.
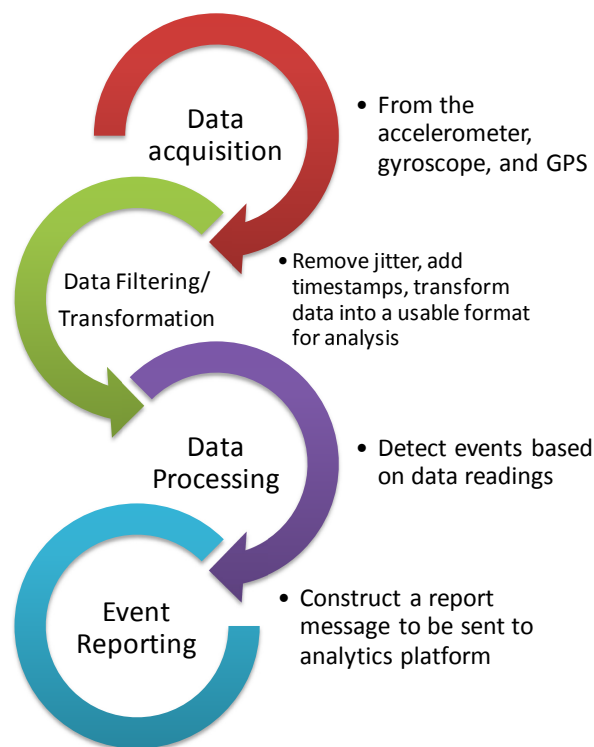

Figure 1 - Overview of SRoM operational phases

We note the objectives of SRoM as follows:

- Designing a user-friendly application interface; spanning both active and passive participation options (crowd and participatory sensing).
- Enabling seamless background operation of SRoM to boost market-uptake and usage traction, to improve fidelity and accuracy.
- Pairing granular data acquisition with corrected locations (catering for lossy GPS signals).
- Proactive data analytics and filtering on dedicated servers to facilitate real-time monitoring of road conditions; with noise and false-positives management.
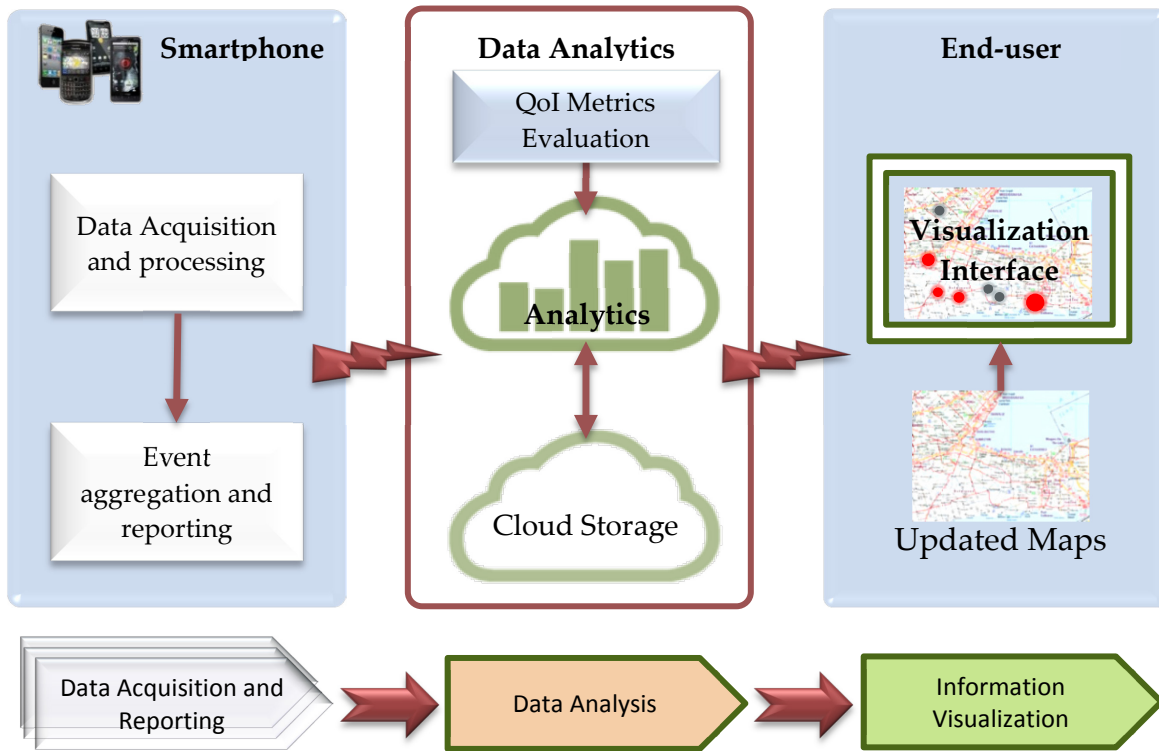
Figure 2 - Overview of SRoM architecture

- Presenting tunable degrees of data visualization via dynamic heat-maps of various road conditions to end users (e.g. municipalities).

In the remainder of this demo proposal we present the overall architecture of SRoM, and the requested facilities to setup our demo.

II. OVERALL ARCHITECTURE

SRoM operates on three communicating systems, namely: Smartphone applications, servers for data analytics and storage and an end-user interface on a web-portal. The communicating systems are presented in Figure 2.

As for the user interface and operation modes, SRoM Empowers different users via voice activated commands (for drivers) or active reporting of events via on-screen buttons (e.g. for passenger). In both cases, the interface capitalizes on simplicity and intuitive navigation. The operational modes are detailed in the remainder of this section.

A. Passive reporting mode

In SRoM's passive mode, the app automatically detects events and identifies them by type without you having to provide information. The user has the option of deactivating the app and sending event reports or just sending the reports and continuing with detection. This is also beneficial as we log reports and enable offline transfer of logs when a stable (e.g. WiFi connection is available).

B. Active Reporting mode

If the user opts to actively report events in a fully involved mode, he/she will get a number of methods to submit an event. Reports could also be shared on social networks. Figure 3 demonstrates a sample of the reporting screen, and the following option of including media with the final report.

Figure 3 – Active reporting mode for SRoM

III. Demo Requirements

To setup this demo, we kindly request the availability of a power outlet, space for a 40 inch LCD screen (for visualization of heat maps and active reporting), and High-speed Internet access (wireless). We would also request a long table to place our demo material and laptop on.