

# SMARTP3M: Smart Pavement Monitoring, Management, and Maintenance

**Project Number:**

22PUTSA47

**Start Date:**

04/01/2022

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**Funding Source(s):**

Tran-SET

University of Texas at San Antonio

**Total Project Cost:**

\$ 80,000

*Monitoring, management, and maintenance of pavements using SMARTP3M*

As an efficient pavement management practice, South-Central State DOTs, as well as many other state DOTs and local highway agencies across the nation, perform daily surveys to verify pavement roughness and the presence of potholes/distresses. The traditional testing methods for this purpose, however, are extremely expensive and beyond the technical and financial capabilities of different state DOTs. Conversely, smartphones and advanced on-board computers recording information related to the pavement condition, traffic data, and weather utilizing advanced sensors and stereo cameras are present in almost every vehicle traveling on the roads. This technology is reliable, affordable, and experiencing a fast and continuous development, and much more can be expected in the future, as they are generating a massive amount of data ("big data") that can and should be utilized to shift the pavement management process to a new and higher paradigm. Also, unlike the traditional surveys that are done at most once a year, fresh data can be collected and analyzed to verify the pavement condition and the required actions on a daily basis, or even real-time, at an extremely low cost approaching zero in the long run.

The proposed project will lead to the development of a smartphone application, when utilized, can be beneficial not only in the South-Central State DOT's, but essentially every state DOT and local transportation municipality. The successful completion of this project will result in achieving the Tran-SET goals of promoting sustainability and resiliency of the transportation infrastructure in renewing, upgrading and implementing the most cost-effective solutions.

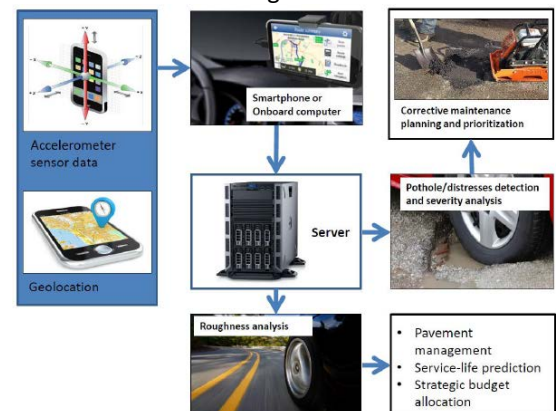
## Problem Statement

As an efficient pavement management practice, South-Central State DOTs, as well as many other state DOTs and local highway agencies across the nation, perform daily surveys to verify pavement roughness and the presence of potholes/distresses. The traditional testing methods for this purpose, however, are extremely expensive and beyond the technical and financial capabilities of different state DOTs. The project

presents a proposal to implement and proof-test a concept for data integration and a software system for pavement management, pavement condition monitoring, and early pothole/distresses detection. The data is automatically collected on a daily or real-time basis utilizing the accelerometer, gyroscope, and GPS sensors existing on drivers' smartphones and vehicles' on-board computers. The data will be collected, consolidated, analyzed, and translated into roughness for pavement monitoring (deterioration rates analysis) and management (strategic budget allocation and service-life prediction for local or state DOTs), as well as for distresses identification, geolocation, and severity analysis for fast pavement corrective maintenance prioritization and planning. This innovation, automatized and inexpensive, works for roads and streets and will be a great, top-notch tool used in every transportation agency within the States. Also, the running cost of this technology is almost zero.

## Objectives

This project is intended to implement and proof-test the concept, feasibility, performance, and practical results of the use of the accelerometer, gyroscope, and the GPS data collected by smartphones and on-board computers to perform a number of tasks related to pavement management, pavement condition monitoring, and maintenance management.



**Figure 1. Overall framework of the proposed project**



## Intended Implementation of Research

With the preparation of the final report and necessary conclusions, the App will be shared with South-Central State DOTs in order to implement the App at the network level. Feedback from the state DOT stakeholders will be solicited in order to improve the App at the completion of this task.

## Anticipated Impacts/Benefits of Implementation

The innovation has an immense payoff potential in many direct and indirect ways. Only to name a few of the most important, the proposed practice will:

- Allow small/middle sized transportation agencies that are unable to perform any pavement management due to its cost, to start in this practice in a simple and affordable way, improving the value for the spent budget and the road/street network condition;
- Complement, reduce the frequency needed, or even replace very expensive pavement surveys done nowadays utilizing specialized survey vehicles and dedicated hardware, will for sure save a huge amount of the transportation agencies' budget;
- Allow the continuous pavement performance monitoring by the freshly collected and analyzed data on a daily basis. Also, doing early detection of the changes in the pavement deterioration rate including those related to the seasonal factors will enhance the ability of the pavement management department in taking the action when the pavement rehabilitation is the cheapest;
- Perform early or even real-time detection, geolocation, and severity analysis of pavement potholes/distresses, allowing an accurate prioritization and planning for the maintenance works, will impact the riding safety, results in fuel saving and reduces the vehicles maintenance as well as the traveling/commuting times.

## Web links

- Tran-SET's website <https://transet.lsu.edu/research-in-progress/>

## Tran-SET

Tran-SET is Region 6's University Transportation Center. It is a collaborative partnership between 11 institutions (see below) across 5 states (AR, LA, NM, OK, and TX). Tran-SET is led by Louisiana State University. It was established in late November 2016 "to address the accelerated deterioration of transportation infrastructure through the development, evaluation, and implementation of cutting-edge technologies, novel materials, and innovative construction management processes".

## Learn More

For more information about Tran-SET, please visit [our website](#), LinkedIn, Twitter, Facebook, and YouTube pages. Also, please feel free to contact Dr. Momen Mousa (Tran-SET Program Manager) directly at [transet@lsu.edu](mailto:transet@lsu.edu).

