Automated Condition Analysis of Roads

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Introduction:

We are seeking to automate the collection of data regarding the condition of public roads as it pertains to surface cracking, potholes ect. The current system employed by the Georgia Department of Transportation (GDOT) consists of manual analysis of road surface condition being performed in accordance to a scheduled maintenance program which prioritizes high traffic areas, wherein, an employee characterizes the state of the road based on a section used for observation (Tanner 2015). This type of analysis assumes that surface damage is distributed somewhat uniformly, and is severely limited in scope due to the large time investment necessary to collect the data. Additionally, historical data shows a large amount of variation in analyses, making them difficult to use in predictive algorithms (Tsai 2008). In order to determine each road's priority in that schedule a series of traffic monitors are distributed throughout the road network (Wiegand 2019). These monitors assist in predicting the rate of wear on particular sections of highways, but are limited in that there is no direct measurement of road condition being collected.

Methods:

Our solution to the pitfalls of the current system is to utilize the accelerometer and gps module inside smartphones to detect anomalies in the road surface. Statistical analysis will be performed over intervals in the accelerometer data to obtain measurements such as Min/Max vertical acceleration, frequency of oscillation ect. These measurements will undergo unsupervised classification, and clusters will be manually cross-referenced with images from Google "Street View" at respective gps coordinates in order to understand the type of damage each category represents. For the purposes of this project a *bare-bones* mobile application which records the necessary sensors has already been made. The csv files generated by the app are transferred to a pc where analysis will be performed.

Results:

While GDOT certainly has access to sophisticated tools that assist and accelerate their analyses (described in Tanner 2015), they still must abide by a scheduled system and make a conscious effort to collect and record data. The proposed device is intended to be constantly collecting data whenever it is in transit. One of the benefits of this system is that it naturally includes lower priority roads, leading to fewer *blind spots* in GDOT's analysis. Additionally, it does not suffer from variation between operators, so it will serve as a more stable datapoint for GDOT's decision support system than manually performed analyses.

Discussion:

As stated above, the collection of data will be performed using a mobile phone. At this time, it is unclear what type of resolution we can obtain using a single sensor. As such we may need to incorporate other means of data collection such as audio, gyroscope ect. With that said, we fully intend to use only what is available in a smartphone in order to minimize the investment necessary to incorporate this into GDOT's decision support system, so there is no estimated cost. By week 4, 16/March, we expect to be working on our classification algorithm to detect differences in road surface anomalies (cracks vs potholes vs speed bumps ect.)

Related Works:

Tanner, Paul. Office of Transportation Data
(OTD). 2015. Available at: http://www.gampo.org/docs/20170925_gdot-pres_otd-overview.pdf. Accessed Feb 18, 2019.

Wiegand, Kiisa. "Georgia's Traffic Monitoring Guide". 2018. Available at:
http://www.dot.ga.gov/DriveSmart/Data/Documents/Guides/2018_Georgia_Traffic_Monitoring_Program.pdf. Accessed Feb 20, 2019.

Tsai, J. Wang, Z. "Improving GDOT’s Highway Pavement Preservation". 2008. Available at:
http://www.dot.ga.gov/BuildSmart/research/Documents/05-19b.pdf. Accessed Feb 21, 2019.