RITA Office of Research, Development, and Technology

UTC Spotlight

University Transportation Centers Program

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Smartphone Applications Aid Transportation Research at UNLV

Use of smartphone applications to collect traffic data is being investigated at the Nevada University Transportation Center (NUTC) of the University of Nevada, Las Vegas (UNLV). Recently developed applications, which run in the background and do not interact with nor distract drivers, include a Car Travel Run Recorder and a Seatbelt Data Recorder for a high-speed traffic survey.

Smartphones—mobile phones that are also personal digital assistants (PDAs)—have more sophisticated operating systems than basic cell phones. In particular, applications can be developed for these devices, which have sensors that are useful for transportation research. Perhaps the most important sensor is the Global Positioning System (GPS), which has a built-in chip that quickly finds a location's latitude and longitude as well as variables such as speed and saves this data in local memory. These devices, which do not interface with the driver, also have at least one camera, sometimes two, valuable for taking pictures or video of the road ahead as a vehicle is moving. Two other important smartphone sensors are the accelerometer and gyroscope. The accelerometer measures g-force in three axes, while the gyroscope measures rotation in three axes. In combination, data from both sensors detect how the smartphone moves in six dimensions.

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Longitude	Lattitude	Heading	Speed	Timestamp
-115.1755	36.08615	-1	0	2011-03-17 18:37:06
-115.1755	36.08615	-1	0	2011-03-17 18:37:11
-115.1755	36.08615	-1	0	2011-03-17 18:37:17
-115.1755	36.08615	-1	0	2011-03-17 18:37:22
-115.1758	36.08613	262.8549	8.653521	2011-03-17 18:37:27
-115.1765	36.08608	264.8859	14.25689	2011-03-17 18:37:33
-115.1775	36.08602	268.0153	15.3159	2011-03-17 18:37:39
-115.1784	36.08603	271.7021	13.21523	2011-03-17 18:37:44
-115.1787	36.08604	270.6191	8.93679	2011-03-17 18:37:49
-115.179	36.08605	270.5254	0	2011-03-17 18:37:55
-115.179	36.08605	270.5254	0	2011-03-17 18:38:00

Video and data collected using an IPhone 4 application developed by UNLV's Transportation Research Center.

The first application developed was a Car Travel Run recorder using an IPhone 4. NUTC wanted to collect information about vehicle driving behavior on the I-15 highway that runs through the center of Las Vegas, NV. Originally, a non-smartphone device was purchased that recorded the road ahead of the vehicle, the inside of the vehicle, GPS location, and accelerometer readings. However, all of this data was embedded in the video and could not be exported for analysis. As a substitute for this device, an IPhone 4 application was developed that recorded video of the road with the rear camera and collected data such as GPS location, accelerometer and gyroscope readings, and timestamps. This data was transferred to a remote server using the phone's constant connection and was also saved in the smartphone's memory.

Another application was developed on a Windows Mobile PDA to survey seatbelt use by vehicle occupants, along with other variables such as gender and age. This software was designed to get input from the observer of vehicles passing by the device at high speeds. The software was successfully transferred to the IPhone 4, which had a constant internet connection providing data backup to a remote server.

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An application developed to survey the use of seat belts in moving traffic.

Another smartphone application was developed for a vehicle-miles traveled study that used GPS data to calculate and output distance traveled. Alternatively, when there is concern for privacy, the app can take constant pictures of the odometer and use image processing to determine distance traveled. Currently, NUTC is developing a smartphone app for lane detection. By constantly taking pictures of the road ahead and using image processing, the lateral location of the vehicle with respect to the lanes can be detected. The smartphone has a screen and speakers to give a warning to the driver when he or she is drifting from their travel lane.

Finally, in an arterial performance measure study (APMS), information is extracted from vehicle-based smartphones to gauge traffic system performance over time. Some of the patterns being investigated include reliability of roadways and intersections at different times of the day and where cars remain stopped most frequently along the route.

Future generations of smartphones will likely provide even more powerful platforms and even better sensors than currently available. Meanwhile, UNLV's NUTC will continue to maximize use of the current generation of smartphones.

About This Project

Sergio Contreras is pursuing a Masters of Science degree under the guidance of Pushkin Kachroo, Ph.D., P.E., in Electrical & Computer Engineering at UNLV, while also taking classes needed for a M.S. in Mathematical Sciences. His current research includes investigating the use of smartphones for transportation applications as well as pattern recognition and statistical analysis in nuclear forensics.

Pushkin Kachroo, Ph.D., P.E., (pushkin@unlv.edu) is the director of the Nevada University Transportation Center (NUTC) and also a professor in the Department of Electrical and Computer Engineering at the University of Nevada, Las Vegas. He has a Ph.D. from the University of California Berkeley in Mechanical Engineering focusing on vehicle control, and another Ph.D. in Mathematics from Virginia Tech focusing on traffic control.