

New app helps combat climate change

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A few years ago, Dr. Arghavan Louhghalam, Assistant Professor of Civil and Environmental Engineering at UMass Dartmouth, started studying the relationship between road designs and conditions and excess fuel consumption and environmental impact. Using mechanistic models, the team established that there is a relationship between carbon dioxide

(CO₂) emissions and climate change.

"When you drive over a rough [road](#), your [suspension system](#) dissipates energy to increase the ride comfort. This energy has to be compensated with extra engine power that leads to more fuel consumption and [environmental impact](#), Louhghalam explains. "But to estimate the network level CO₂ emissions, we also needed data on road surface conditions." Because it is really hard to get the data for the entire network of roads and in a continuous way, Louhghalam and her team decided to develop an algorithm (and an app) that can be used to estimate the road surface condition from data that is readily available say through crowdsourcing.

Her team includes Dr. Mazdak Tootkaboni of UMass Dartmouth and Dr. Franz-Josef Ulm of MIT, and students from UMassD, MIT and around the world including two of her former students—Meshkat Botshekan, who is now pursuing his Ph.D. at MIT and Taylor Johansen, who is now pursuing her master's degree at Stanford University. "The results of our research reveals that rough roads will result in an increase in fuel consumption and CO₂ emission. They also impact the extent of the wear and tear for vehicles," she says.

Finding Carbin

The team developed an app called Carbin, which is uniquely spelled for several reasons. "The app provides the amount of Carbon footprint in driving on rough roads. The app provides the amount of energy (Carb) in the suspension system that is dissipated into heat and leads to emission of CO₂ in the environment, and the app is able to bin the Cars into different categories, say, sedan, SUV, truck, etcetera," Louhghalam explains.

How Carbin works

The app uses data from drivers' cellphones in a crowdsourced fashion to infer road surface roughness (much broader than potholes), vehicle fuel consumption, and the related greenhouse emissions. It is similar to any navigation app but you have the option of using it without navigation in the background. "When you open the app you need to push "record without navigation" and when you are done with driving you simply push the "finish" button to allow the transfer of the data to our server on Amazon Web Services (AWS)," Louhghalam explained. The data is completely anonymous. "In other words, Carbin will never know who went where."

Leveraging GPS data

To properly collect the data, the position of the phone must be fixed, that is on a cell-phone mount, in the cup holder, or on the floor. "It cannot be in your hand or in your pocket. We will discard the data as we recognize those instances," Louhghalam says. "We use the GPS data to be able to locate where accelerations are being recorded so we are able to show the road conditions on the map later (see <http://fixmyroad.us>)."

The result, i.e. roughness measurements in the form of international roughness index (IRI), is publicly available to everyone. "Pavement management systems in Federal and state agencies, as well as municipalities, can use the data provided by Carbin to decide which roads to repair (to save resources) and to bring down the environmental impact," said Louhghalam. "Fleet companies and drivers can use it to find routes that are less rough to decrease their fuel consumption and damage to their vehicles and the goods they transport."

Carbin's multifaceted benefits

Louhghalam says better roads are at the core of Carbin goals." While individual drivers can make informed decisions, saving fuel for a single driver is not enormous. On the other hand, the accumulated impact is huge. This means that highway agencies and authorities that manage roads are the ones who benefit most from Carbin by including the results in their maintenance decision-making processes to not only save their resources but also minimize the environmental impact of driving," she says. "The other entity would be Fleet owners and freight companies. "The results will help them in route selection to minimize their fuel usage and damage to their vehicles and goods."

In cities, the quality of pavements can contribute to around 15% of a vehicle's fuel consumption, which consequently translates to more greenhouse gas emission, Botshekan says. "Furthermore, users can take an extra index into account to choose their route— roughness of the road— which helps them reduce [fuel](#) consumption as well as contribution to a more sustainable environment." The Carbin app is free and available for download to iOS and Android devices. "Also our team is working on developing Carbin Ghost apps and SDKs to be included in other devices as well," Louhghalam says.

Provided by University of Massachusetts Dartmouth

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