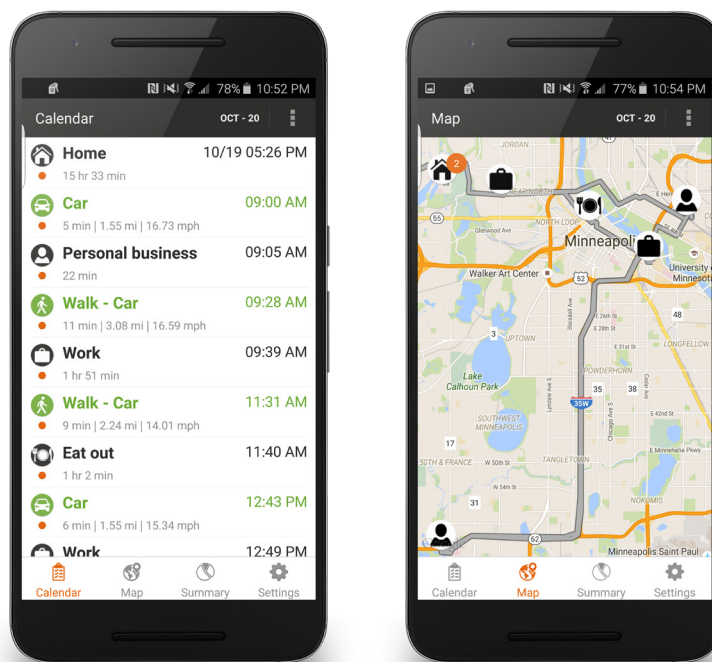# Daynamica

A Smartphone Solution for Collecting and Processing Travel Behavior Data

Key Features

- Daynamica is an open-source smartphone app that captures detailed travel behavior data in a convenient and low-cost way.

- Daynamica seamlessly collects data about multiple travel modes.

- Daynamica makes it easy for users to recall and annotate their travel activities, resulting in richer, more accurate data.

- Daynamica hosts data captured from sensors and data added by users in a single device, enabling real-time interaction between the two data sources. This in turn allows for data calibration and processing refinements over time.

- Daynamica reduces the need for data post-processing, saving time and expense for transportation agencies.

A team at the University of Minnesota has created Daynamica, an innovative smartphone application for collecting and processing detailed, multimodal, and multidimensional travel data.

Why Daynamica?

Transportation agencies need travel behavior data to plan changes to their networks, systems, and policies. The Daynamica open-source app makes it easier and less costly to collect this important information and delivers richer, more accurate data compared with traditional collection methods.

Daynamica captures detailed data regardless of travel mode—driving or walking, biking or transit. It automatically detects, identifies, and summarizes travel activity and then allows users to view and annotate that information at their convenience.

In contrast, traditional travel survey methods—commonly, paper diaries—are often burdensome to study subjects and increasingly impractical for use in a diverse, mobile, and increasingly time-stressed population. GPS sensing tools can collect travel mode, position, and route, but they are unable to obtain key dimensions such as trip purpose, travel experience, and travel companionship.

"All of these factors are critical for understanding people's travel choices," says Yingling Fan, associate professor in the Humphrey School of Public Affairs. "Daynamica gives us the best of both worlds: It captures many more dimensions of travel behavior data than either travel surveys or GPS sensing can alone."

Ultimately, Daynamica will help transportation planners and agencies make more-informed decisions—and the best use of transportation dollars.

Daynamica.umn.edu
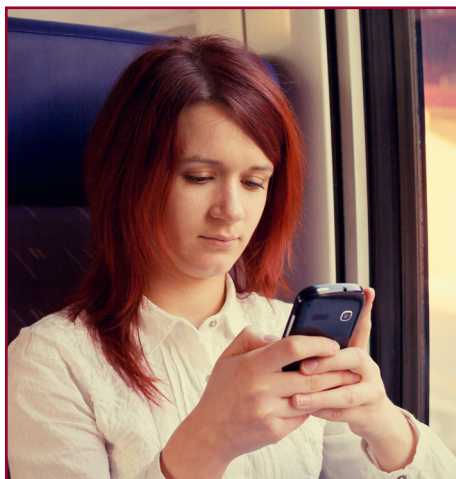
How Daynamica works

Daynamica combines GPS sensing with advanced statistical and machine learning techniques to automatically detect, identify, and summarize attributes of daily activity and travel episodes. It then allows users to view, correct, and provide additional information on the activity and travel episodes at their convenience—every day, at home or on the go.

Data from the two sources—the sensors and the users—interact to inform, calibrate, and augment each other:

- Sensor data are analyzed and processed locally on the smartphone in real time to extract meaningful activity and travel information. The extracted information serves as a basis to prompt the user for more detailed and more accurate information.
- The user-entered data in turn optimize how the sensor data are analyzed and processed. This increases the accuracy of the information extracted from sensor data over time—the algorithm "learns" about a user's routine travel locations and behaviors—so that the user needs to make fewer updates or corrections.

Performance Test Results

A series of laboratory tests and two rounds of seven-day field tests found that the app has:

- **Reasonable battery consumption rate.** With Daynamica running continuously, 74% of the phones had a battery life longer than six hours, and about half the phones had a battery life longer than eight hours.
- **Moderate data storage and transmission requirements.** Daynamica produces 50 megabytes (uncompressed) of data per day; the associated weekly data transfer needs are roughly 150 megabytes after data compression.
- **Good accuracy.** Daynamica had high accuracy in identifying activity versus trip episodes (90%) and in classifying the travel modes of each trip episode (86%), and medium-high accuracy in classifying the types of activity episodes (user-specified activity type is among the top two most probable predicted activity types 70-80% of the time).

About the Project

Daynamica was developed by Associate Professor Yingling Fan, Assistant Professor Julian Wolfson, Professor Gediminas Adomavicius, and computer science students Jie Kang and Yash Khandelwal. Daynamica expands on the previous SmarTrAC app developed by the team under contract with the Volpe Center at the U.S. Department of Transportation in support of the Intelligent Transportation Systems Joint Program Office. Daynamica development was also supported with funding from CTS.

Summary of Benefits

Daynamica benefits include:

- **Comprehensive data.** Daynamica captures many more dimensions of travel behavior data than either travel surveys or GPS sensing alone.
- **Lower respondent burden.** Because it automatically collects data on several trip attributes, Daynamica puts a much lower time burden on respondents compared to traditional travel survey methods. In addition, respondents do not need to carry or use any additional devices if they already own a smartphone.
- **More accurate data.** Because users are able to see trip information derived from the sensor data before entering additional trip information, Daynamica minimizes user recall bias or reporting errors.
- **Richer data.** Lower user burden could allow agencies to lengthen the time studied from a typical day to a week or more, thus allowing analysis of the differences between weekdays and weekends or other variations.
- **Simplified distribution and management.** Daynamica is easier to distribute and manage than other systems. Users only need to download and install the app; updates can be sent to users quickly and easily.
- **Reduced post-processing and costs.** Daynamica collects and processes data in real time and locally on the smartphone, which reduces the need for post-processing by agencies.

Future Directions and Commercialization

Possible future improvements include battery-saving techniques, reduced data storage requirements, predictive accuracy improvements, integration with additional geographic data and knowledge bases, enhanced data privacy and security features, enhanced visualization and analytical tools, and development of a web interface.

Although currently targeted for agency use only, plans are to form a start-up company to commercialize the app for the general public.

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