

UTC Spotlight

University Transportation Centers Program

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North Carolina A&T State University, with consortium members Embry-Riddle Aeronautical University, University of the District of Columbia - Community College, and Virginia Polytechnic Institute and State University



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Vulnerable Road User Mobility Assistance Platform

Application Concept

Researchers at the Virginia Tech Transportation Institute (VTTI) and North Carolina A&T State University (NC A&T) are collaborating on an innovative project sponsored by NC A&T's Center for Advanced Transportation Mobility (CATM) Tier 1 UTC. The goal of the Vulnerable Road User Mobility Assistance Platform (VRU-MAP) project is to improve the safety and efficiency of mobility for people with disabilities who walk and use transit in urban and suburban environments. This will be accomplished by developing an application platform that will provide highly personalized guidance.

As with existing navigation software, the app will allow travelers to use their smartphones to map out routes to destinations and provide turn-by-turn directions. However, this app will provide routes that are custom-tailored to an individual's unique needs and capabilities. For example, a wheelchair user needs to avoid stairs, while a person who is frail may require a place to sit and rest at regular intervals.

The VRU-MAP app will enable users to save personal information about themselves that is relevant to their transportation needs, such as stamina and ability to traverse uneven terrain. It will then combine that personal information with publicly-available information about route nodes, elevation changes, weather, traffic, multimodal transit, etc., along with crowd-sourced information about route impediments (such as construction), facilities, rest opportunities, etc. to provide personalized route guidance for users. A potential use case is presented in figure 1.

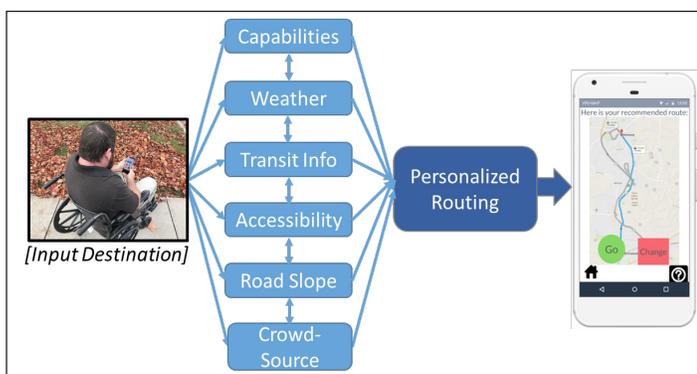


Figure 1. Example app use case.

Implementation

Currently, the app is being developed for the Android smartphone platform using Android Studio, Java, and database management software including local SQL databases and Firebase's Cloud Firestore for crowd-sourcing capabilities (figure 2). Map data are sourced from the open-source platform Mapbox, with routing being implemented using custom code. Routes are developed using a series of location nodes, with weights for segments between nodes being associated with positive or negative valences depending on information present in the public and crowd-sourced datasets combined with individual needs and capabilities. For example, a segment with a steep elevation change or stairs would have a strong negative weighting for a person who uses a wheelchair, while crowd-reported accessible restroom facilities may have a positive weighting if the user requires more frequent restroom access. Future modules will incorporate additional information about the state of the world, including weather and multimodal transit, to enable further route customization; for all of these, weights generated by the interaction between external information and the recorded capabilities of the user will be used to create truly customized routes.

In addition to routing capabilities, the app is being developed to incorporate augmented reality (AR) components. Current AR capabilities under development include the ability to read,

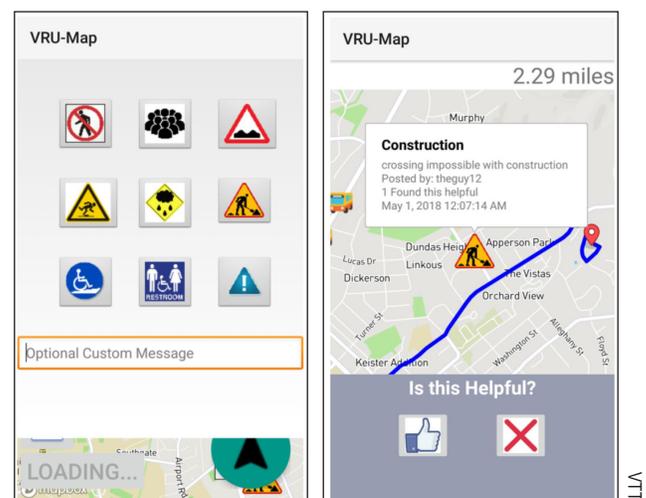


Figure 2. Prototype crowd-source interface.

interpret, and highlight signs and other transportation-relevant information (figure 3). In the future, the team intends to develop modules to allow the overlay of relevant information on top of a live view of the surrounding environment, enabling for example a directly perceivable route line and the highlighting of important location information such as restrooms.

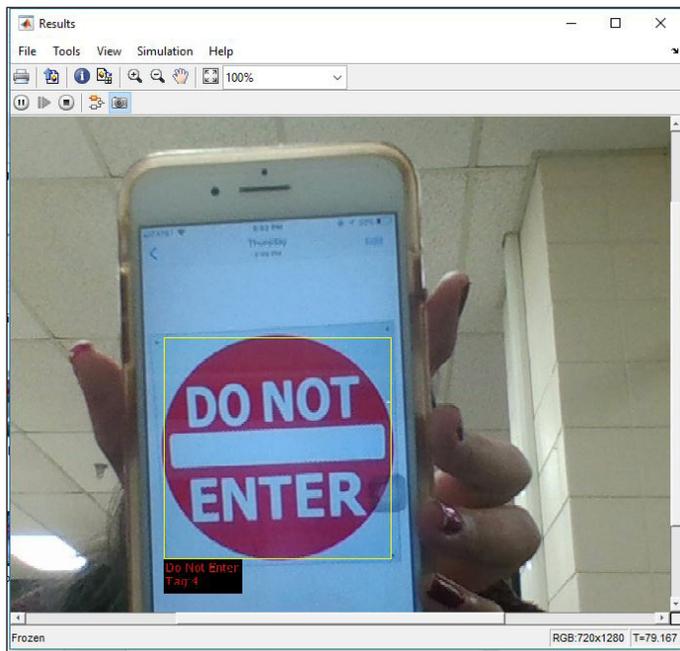


Figure 3. Prototype sign-recognition function.

The prototype app is currently deployed on a Samsung Galaxy S8 smartphone. While the current focus is on Android smartphones, the team intends to extend implementation to iOS devices including iPhones and iPads. We anticipate that users may eventually prefer either phones for their small size and portability or tablets for their larger screens and ease of physical interaction, depending on each user's capabilities.

Project Team

The project team unites researchers from VTTI, Dr. Justin Owens (Center for Vulnerable Road User Safety) and Mr. Andrew Miller (Center for Truck and Bus Safety), with researchers from NC A&T, Dr. Younho Seong (Department of Industrial and Systems Engineering) and Dr. Sun Yi (Department of Mechanical Engineering). While the overall group is working to a common app development vision, the two university teams are concentrating on areas that are most highly relevant to their expertise. Researchers and students at

VTTI are focusing on core routing and interface development, while researchers and students at NCA&T are developing the machine vision modules.

Each university team includes several graduate and/or undergraduate students in the conceptual, research & development processes. As an overarching goal of this project is to not only develop a quality application platform but to enrich the education of students, student members of the team from both universities have had the opportunity to present their research at multiple conferences and symposia. These include the 1st Annual CATM Symposium (Greensboro, NC, 2017), the 5th Annual UTC Conference for the Southeastern Region (Gainesville, FL, 2017), and the 2018 IEEE SoutheastCon (St. Petersburg, FL).



Figure 4. Faculty (Andrew Miller, left, and Justin Owens, center) and student (L-R: Daniel Kavanaugh, Logan Merkle, Miriam Alabi and Devi Chilukuri) members of the research team presenting at the 2017 CATM symposium.

Partnerships & Future Research

Project functionality and features are currently directed toward people with physical disabilities; however, the research team envisions that the scope and design will eventually be expanded to benefit all people with disabilities including those with intellectual and developmental disabilities (IDDs). To this end, the VRU-MAP team is coordinating with researchers in the Virginia Tech Department of Human Development to conduct a parallel project funded by CATM that investigates the mobility needs and barriers facing the nationwide population of people with a broad range of disabilities. In addition to providing standalone value, the outcome of that project will inform the future directions of the VRU-MAP project. In addition, the project team is working with partners in several states and is open to collaboration with other interested parties.

About This Project

The Project PI, Dr. Justin M. Owens, is a Research Scientist in the Center for Vulnerable Road User Safety at the Virginia Tech Transportation Institute. This project is ongoing and is anticipated to continue through 2019. Inquiries may be directed to jowens@vtti.vt.edu. More information on this and other CATM research projects can be found on the CATM Tier 1 UTC webpage at <http://www.ncat.edu/cobe/transportation-institute/catm.html>



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