Reducing School Bus/Light-Vehicle Conflicts Through Connected Vehicle Communications

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Introduction

Although connected-vehicle communications (e.g., DSRC, cellular, WiFi) could be applied to all passenger bus types (e.g., transit, school, motorcoach), this work will focus on school buses (Image below) engaged in pupil transportation. School bus drivers face unique safety concerns as professional drivers. They carry what is perhaps the nation's most precious cargo: our children. Every school day, more than 25 million school-aged children are transported to and from school on nearly 480,000 school buses. This annually equates to approximately 20 billion boardings and de-boardings of school buses throughout the United States2. Many of these boardings and de-boardings result in school buses stopped in the roadway. This scenario is considered one of the most dangerous situations for a school bus and its student riders. Connected-vehicle technology could be the solution for improving bus conspicuity and increasing awareness among other roadway users of a stopped school bus.

School Bus Stop on a Blind Curve with the Potential for Oncoming Traffic

Research Objectives

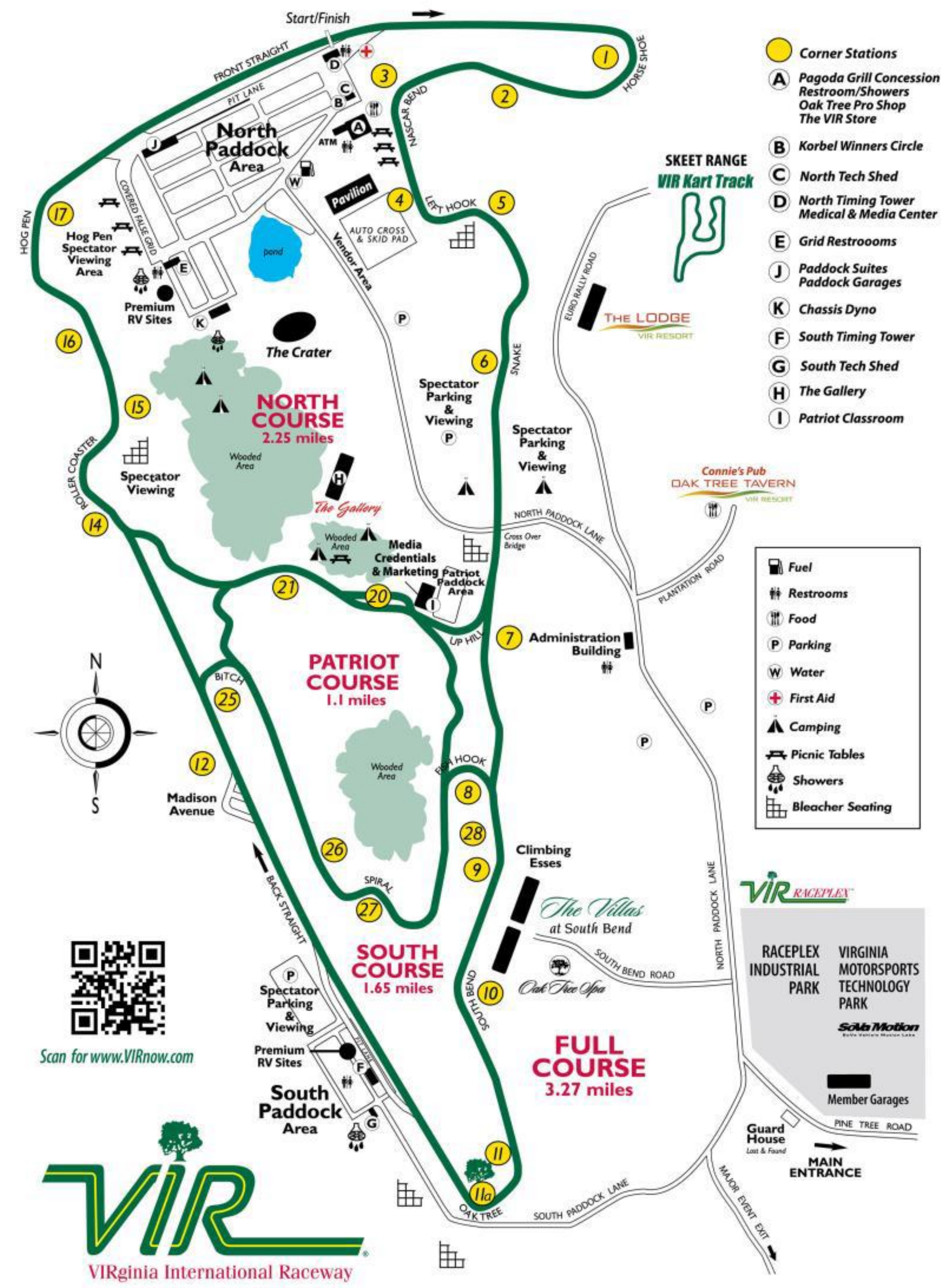
The objectives of this 12-month study are threefold. First, the research team will develop a Concept of Operations (ConOps) for the connected school bus. Second, the research team will develop a prototype, in-vehicle message display for following vehicles to alert them of a stopped school bus. Finally, the team will conduct preliminary testing of the prototype driver-vehicle interface (DVI) on the Virginia International Raceway (VIR) in southern Virginia.

Notification Conditions

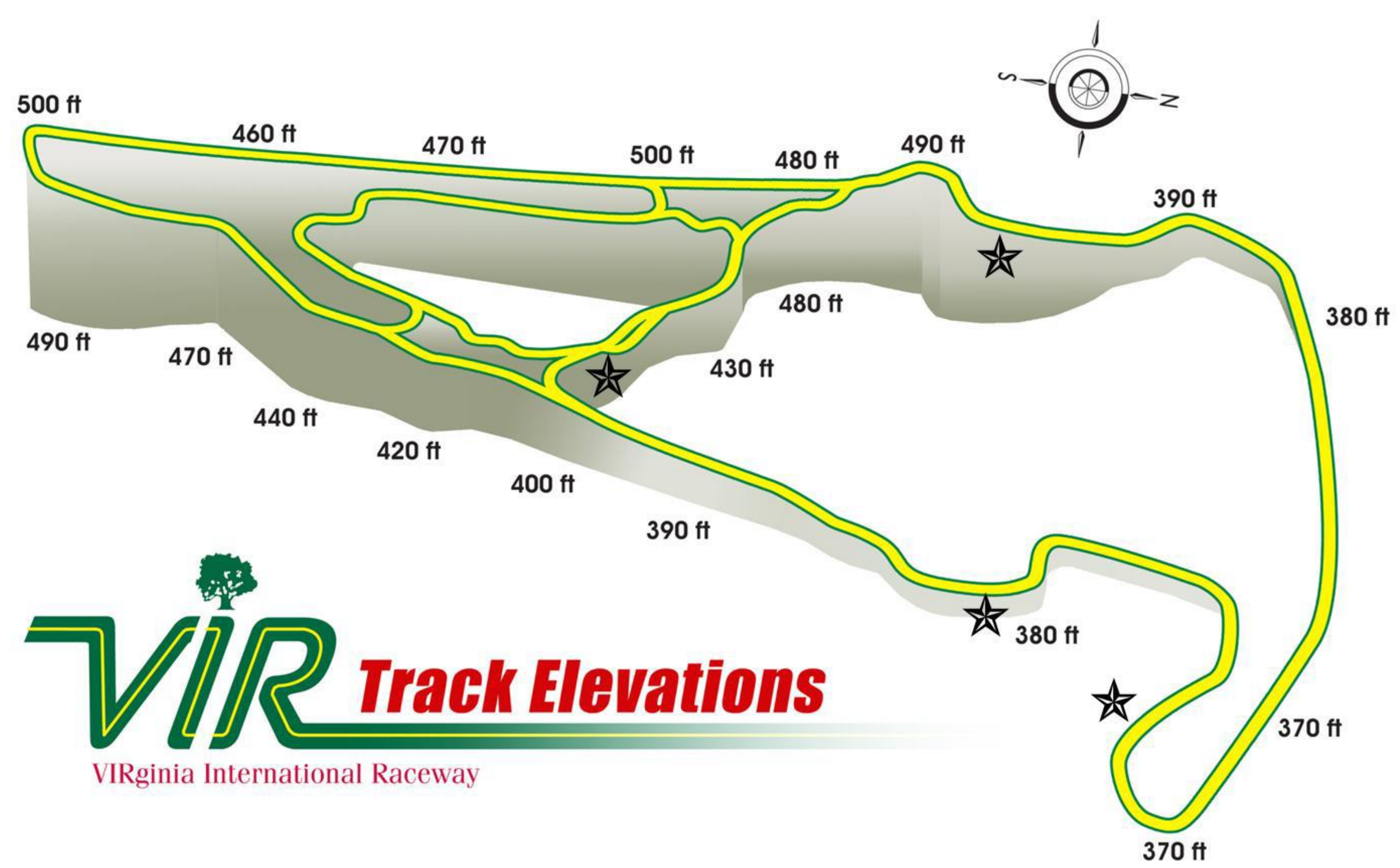
- ***In-vehicle notification*** – This condition will include visual and auditory notifications/alerts generated from the prototype DVI in addition to normal lighting/signals generated from the stopped school bus (Image below on the left).
- ***Roadway sign*** – In addition to normal lighting/signals generated from the stopped school bus, this condition will include a single roadway sign that displays a graphic representing, "School Bus Stop Ahead," from the 2009 edition of the Manual on Uniform Traffic Control Devices (Image below on the right).
- ***None*** – an absence of either alternate notification system.

Simulated Integrated Factory-Installed Display

Example of a "School Bus Stop Ahead MUTCD Roadway Sign



Virginia International Roadway Facility Map



Virginia International Roadway Track Elevation Map

Major Tasks Accomplished Under Project

Task 1 – Develop a Con Ops for connected school bus applications

Task 2 – Develop a light-vehicle DVI for the stopped school bus notification system using an integrated, mutli-use touchscreen device (e.g. electronic tablet) designed to emulate a "factory-installed" stacked display.

Task 3 – Conduct a study to evaluate the prototype DVI on the Virginia International Roadway closed test track.

Task 4 – Disseminate the findings of this project

Methodology

Twelve to 15 naïve light-vehicle drivers will navigate through several stopped school bus scenarios. A mid-sized sedan will be instrumented with the Virginia Tech Transportation Institute data acquisition system (DAS) that will accurately record all relevant performance data for subsequent analysis. It is anticipated that up to three additional confederate vehicles will be used during testing scenarios to provide a more realistic roadway environment (e.g., school bus, light truck, light vehicle).

This study will use a within-subject design. Three obscured stopped school bus scenarios (events of interest) will be presented, each with a different stopped school bus notification condition (order counterbalanced). Based on the VIR track geometry/environment, it is likely that the school bus will be positioned around a curve or over a hill during each scenario to obscure the bus from the following vehicle driver's immediate vision. In addition to these three scenarios, other basic driving tasks will be performed on the VIR track to provide a more robust driving experience and to avoid leading participants to expect the obscured stopped school bus scenarios.

The anticipated Independent Variable (IV) will be *notification type* (i.e., in-vehicle notification, roadway sign, none). *Age* will act as a covariate (younger, older). Anticipated Dependent Variables (DVs) of interest will be *time-to-respond* (e.g., eye-drawing, brake reaction time), *final stopping gap* (distance from school bus to light vehicle after light vehicle comes to rest), and *unintended consequences* (e.g., swerves, hard braking). Participants will also fill out subjective rating scales of acceptability (e.g., usefulness, trust) and will complete a sample of open-ended questions.

Once the evaluation is complete, the research team will execute several activities to disseminate the findings of the project. First, the project will culminate in a draft final report to be submitted to Connected Vehicle/Infrastructure University Transportation Center (CVI-UTC) staff for review. The research team will submit the draft report one month prior to the end of the contract. The final report will include background information, descriptions of specific methods employed by the research team, results, a discussion of the results, implications, and future research needs. The suggested revisions from the CVI-UTC review will be incorporated into a Final Report. The final revised report will be due on the last day of the contract period. Lastly, the research team will be prepared to disseminate the project findings via journal articles (e.g., *AASHTO Journal*, *Thinking Highways*, *ITS International*) and presentations made at conferences and meetings (e.g., ITS America, Transportation Research Board [TRB] annual meeting, American Association of State Highway and Transportation Officials [AASHTO] annual meeting) in support of the CVI-UTC program.

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