Development of a Low Power, Low Cost Rural Railway Intersection Smart Detection and Warning System

Development and implementation of a novel low cost, low power rural railway intersections detection and warning system

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19SAUTSA03

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$50,000

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Tran-SET
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$66,010

In the U.S. there are 830 railroads comprised of more than 130,000 miles of track with more than 200,000 railroad crossings. Approximately 46% of these crossing points are passive, meaning they don't have any active warning/control system or gates. Every year within the last decade, more than 400 rail-related fatalities occur, in which grade crossing accidents make up the majority. The lack of unsignalized intersections, active signage, and sustainable power at rural railway intersections (to warn vehicles to slow down before a train approaches) is the major cause of these crashes. The goal of this project is to develop and implement a novel low cost, low power rural railway intersection detection and warning system for monitoring railway traffic and increase motorist safety by activating warning signs to alert of danger ahead (i.e., when the train is approaching the intersection). The type of sensor that is proposed in the detection module is a multiple pixel passive infrared sensor due to the low cost, low power consumption, large field of view and ability to collect a wide range of data. The warning module will be responsible for alerting motorist that a train is approaching the intersection when a signal is received from the detection module. The warning module will be attached on the railroad crossing sign infrastructure. Both the detection and warning module will be powered by solar energy since the system will not have access to the power grid. The detection module will be designed to be an off-railway detection system that could be quickly and easily installed on pre-existing infrastructure with little to no specialized training.

Problem Statement

In the U.S. there are 830 railroads comprised of more than 130,000 miles of track with more than 200,000 railroad crossings. Approximately 46% of these crossing points are passive, meaning they don't have any active warning/control system neither gates. Every year within the last decade, more than 400 rail-related fatalities occurs and grade crossing accidents are the majority of those. The lack of unsignalized intersections, active signage and sustainable power at rural railways intersections to warn vehicles to slow down before a train approaches is the major cause of these crashes. The goal of this project is to develop and implement a novel low cost, low power rural railway intersections detection and warning system for monitoring railway traffic and increase motorist safety by activating warning signs to alert of danger ahead (train is approaching the intersection). The proposed technique can be implemented to provide costeffective methodologies for real-time monitoring of traffic anywhere with no access to the power grid through power generation using renewable energy (solar panels) and wireless communication (RF). This innovative problem will be addressed with cross-disciplinary experts at UTSA in electrical and computer engineering (communication, sensing and power conversion) and civil engineering (transportation experts). The proposed outcome of this study is a technical solution of a novel robust low cost, low power detection and warning system.

Objectives

The main objective of this project is to develop a novel self-powered low cost, detection and warning system that detects trains and then alerts motorists with an approaching train (Figure 1). The detection module incorporates passive infrared sensor that will monitor the railway to detect the trains and gather information on the passing trains. The type of sensor that is proposed to be used in the detection module is a multiple pixel passive infrared sensor due to the low cost, low power consumption, large field of view, and ability to collect a wide range of data. However, other types of sensors will also be evaluated during the course of the project. The warning module will be responsible for alerting motorist that a train is approaching the intersection when a signal is received from the detection module. The warning module will be attached on the railroad crossing sign infrastructure. Both the detection and warning module will be powered by solar energy since the system will not have access to the power grid. The detection module will be designed to be an off-railway detection system

that could be quickly and easily installed on pre-existing infrastructure with little to no specialized training. The benefits of both modules being part of an off-railway/pavement system is that the modules can be installed on the railway and roadway without impeding traffic, lower the installation cost of the modules, and will not be damaged by rail/road maintenance. In the scenario shown in Figure 1, four modules will be used to create a warning network that detects Figure 1. Rural Railway Intersection Smart Detection and Warning System trains and alerts the motorist of an approaching train at the intersections. The detection modules on the railway are responsible for the detection of passing trains, gathering information regarding these trains, and then alerting the receiving modules via RF or other communications on the railway crossing sign that a train has been detected and to activate the flashing beacon for a certain time duration. This will be a dynamic amount of time that is calculated based on the measured velocity of the train.

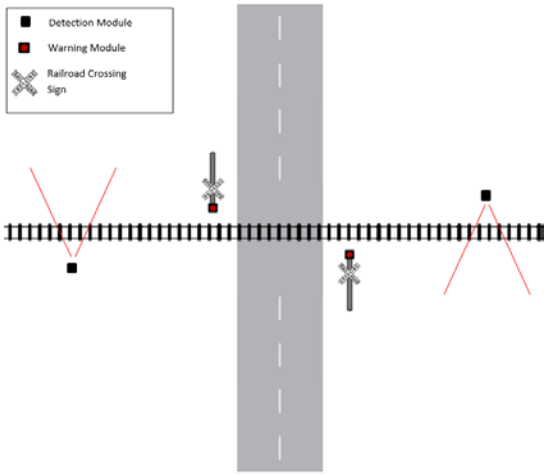

Figure 1. Rural Railway Intersection Smart Detection and Warning System.

Intended Implementation of Research

Education and Workforce Development: 1) Graduate Student Support The proposed research project will provide funding to one PhD student at UTSA. The research activities will provide the participating researchers with hands-on experience in laboratory and in the field in designing and testing of sensors, energy converters, and storage systems. 2) Workforce Development Graduate students will have the opportunity to learn about this research project by incorporating our findings in a graduate level courses.

Outreach Activities: 1) Recruit and engage students from underrepresented groups including Hispanic, Native American and women (50% of the undergraduate population in UTSA are Hispanic and other minority students). 2) Seminars and webinars explaining the concept and project results will be offered to DOTs, cities, utilities and industry.

Anticipated Impacts/Benefits of Implementation

It will be potentially a valuable water level detecting unit for Region 6, allowing flood stage information to reach critical corridors using a cellular module in the UWLD system to communicate with Region 6 traffic command centers. Information can also be directly sent to Texas emergency operation centers or other local/regional centers. The accurate and rapid flood information will transfer to a district operation center to potentially reduce damage and accidents as well help in the preservation of the transportation network from damage caused by flash floods alerting them more quickly about flooding situations. This project will address a direct need to improve the ability to assess and reduce the impacts of severe weather events on the transportation infrastructure and travelers' safety.

Web links

- TranSET's website (https://transet.lsu.edu/research-in-progress/)
- TRB's Research in Progress (RIP) database (https://rip.trb.org/View/1644428)

Tran-SET

Tran-SET is Region 6's University Transportation Center. It is a collaborative partnership between 11 institutions (see below) across 5 states (AR, LA, NM, OK, and TX). Tran-SET is led by Louisiana State University. It was established in late November 2016 "to address the accelerated deterioration of transportation infrastructure through the development, evaluation, and implementation of cutting-edge technologies, novel materials, and innovative construction management processes".

Learn More

For more information about Tran-SET, please visit our website, LinkedIn, Twitter, Facebook, and YouTube pages. Also, please feel free to contact Mr. Christopher Melson (Tran-SET Program Manager) directly at transet@lsu.edu.