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# Intelligent Railroad Crossing Maintenance Jumper

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**During track maintenance, jumper cables are used to disable crossing signals. In rare occasions, the jumper cables may be forgotten due to human error, and the disabled crossing signals pose a risk to human life. The goal of this project is to Design a device with jumper cables or signal crossing devices to lessen the impact of human error during and after maintenance.**

## Introduction

Maintenance crews use jumper cables to disable crossing signals while working as maintenance vehicles will activate crossing signals if not disabled. However, maintenance crews on rare occasions forget the jumper cables. This allows trains to pass through the disabled crossing without activating the signals. The team has designed a device that monitors a voltage on a GCP-3000, HXP-3 or PMD-3, which measures changing impedance on the tracks. As a train approaches the crossing, the train shunts the RL circuit used by a crossing predictor. The track resistance decreases as the train approaches the crossing. Since voltage is proportional to resistance, the voltage corresponds to position. Position data can then be used to find the velocity of the approaching vehicle. This design solution uses voltage to distinguish between trains and maintenance vehicles. The tool reactivates the crossing signals if a train is detected but keeps the crossing disabled while maintenance vehicles are detected. After a predetermined time period, an optimal timer in the device will turn the jumper off, regardless of the presence or absence of a train.

## Prototype

A prototype of the Intelligent Jumper cable was created and tested. This prototype combines software to detect trains with switching hardware that opens the jumper cable circuit if a train is detected. The software filters voltage and takes the derivative of position to find velocity. Special algorithms use velocity to distinguish between trains and maintenance vehicles. A signal is sent to the switching hardware to open the jumper cable circuit when a train is detected. Then the switching hardware opens the circuit, using a solid state relay connected to the jumper cable circuit. The entire prototype could fit in a hand-sized box with cables for power supply and inputting voltage.

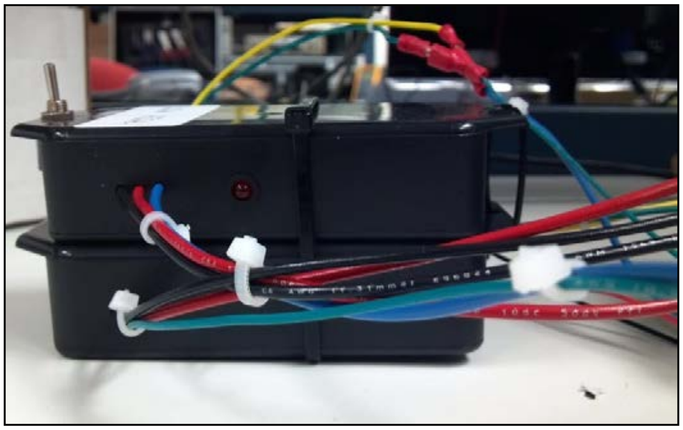

Figure 1. Switching Hardware with LED Indicator and Activation Switch

## Results

In simulations, using prerecorded data taken from a crossing, warning times of approximately 20 seconds and greater were achieved. This is not only sufficient for a car to stop, but is also above the required minimum of warning times set by Federal Railroad administration. A live test was conducted in which the prototype successfully deactivated itself with less warning than expected based on simulations. Further testing and calibration could improve the results.This device can be


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a low cost, effective and robust component in a track maintainers toolkit. Its functionality can be easily integrated into modern crossing predictors in the future, eliminating the need for a separate device.

## Cost

A complete Intelligent Jumper Cable unit could be created for under 30 USD. If this device prevented even one railroad accident it would save a railroad company millions of USD in legal fees and damages.