MATERIALS & RESEARCH SECTION
Research & Technology Implementation

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Wavetronix® SmartSensor Matrix™ Radar Stop Bar Detection

INTRODUCTION

According to the Federal Highway Administration (FHWA) negotiating intersections is one of the most complex and demanding tasks that a driver faces. Data shows that in 2007, approximately 2.4 million intersection-related crashes occurred, representing 40 percent of all reported crashes. Of the 37,435 total fatalities, 8,061 occurred at intersections, equaling 21.5 percent of total deaths (*1*). Many transportation agencies have developed solutions such as regulatory signs and electronic traffic control signals in an effort to reduce these alarming totals and decrease driver confusion.

In accordance with the 2009 Manual on Uniform Traffic Control Devices (MUTCD), Section 4B.03, Advantages and Disadvantages of Traffic Control Signals, "When properly used, traffic control signals (TCS) are valuable devices for the control of vehicular and pedestrian traffic. They assign the right-of-way to the various traffic movements and thereby profoundly influence traffic flow" (*2*). The MUTCD further notes that properly designed and well maintained TCS will provide the following advantages: 1) orderly traffic movement, 2) reduce crash frequency and severity, 3) provide continuous traffic flow along a route, and 4) interrupt heavy traffic volumes at specific intervals to allow other traffic including pedestrians to cross the roadway. The MUTCD notes that if TCS are not properly placed or maintained then they can result in: 1) excessive delay, 2) excessive disobedience of the signal indications, 3) increased use of less adequate routes as road users attempt to avoid TCS, and 4) significant increases in the frequency of collisions (*2*).

Although the intention of TCS is to minimize crashes at intersections, common driver errors at these locations still occur. Some of the most common is underestimating the time it takes to reach the intersection or smooth stop and whether or not they have time to clear the intersection when approaching a yellow signal indication (*1*). Different technologies have been employed to increase safety at signalized intersections. A new technology, developed by Wavetronix, named "SmartSensor Matrix™" is a radar stop bar presence detector. The system uses frequency modulated continuous (FMCW) radar to detect and report vehicle presence in as many as 10 lanes simultaneously.

In an effort to increase safety the Vermont Agency of Transportation (VTrans) installed one Wavetronix SmartSensor Matrix™ system at an existing intersection located along VT Route 116 in Hinesburg, VT. The purpose of this study is to evaluate the overall effectiveness of the proprietary Wavetronix SmartSensor Matrix™ system during varying weather and traffic stream conditions.

LOCATION

The Wavetronix SmartSensor Matrix™ was installed at an existing span wire intersection located at mile marker 5.46 along Vermont Route 116 and Town Highways 1 and 7 in the town of Hinesburg, VT as part of the Hinesburg-Richmond improvement project, STPG SGNL (38). The average annual daily traffic (AADT) at this intersection is 9,200. From 2000 to 2009 there were 55 crashes, 27 injuries, and 0 fatalities. This location was selected due to the high rate of damage and subsequent repair of the existing loop detection system.

PRODUCT

According to product literature, SmartSensor Matrix™ system is comprised of four radar detection units. Ideally they would be installed in two corners of an intersection to allow for 90º field of view so that when vehicles enter the user-defined zones the controller will detect their presence. Each detection box measures 13.2 in. x 10.6 in. x 3.3 in., weighs 4.2 lbs, and is resistant to corrosion, fungus, moisture deterioration, and ultraviolet rays. Based on manufacturing techniques, the system is considered to be extremely low maintenance. Battery replacement, recalibration, cleaning, and readjustments are not necessary. The purpose of the system is to detect vehicles and extend the green light if the system detects the speed at which a vehicle is travelling would cause a conflict if they were to stop abruptly. This overhead system is also not susceptible to damage induced by frost heaves, rutting, and other pavement structure deformations as is the case for standard loop detection systems (*3*). The device is shown in Figures 1 and 2 below.

Figure 1: Traffic Facing Side of Sensor.

Figure 2: Pole Facing Side of Sensor.

COST

All product material and installation costs were paid for through the improvement project. The estimated cost was $5,000 per approach, and $5,000 for incidental items, totaling $25,000.

CONSTRUCTION

The system was installed on June 15th and June 16th, 2011. Research personnel were onsite to document the installation.

Cabinet

Because the existing components within the controller cabinet are typically positioned close to each other, the existing equipment was arranged and modified so the new components could fit into the controller cabinet. This included drilling out new and old hardware and remounting them to keep things organized within the controller cabinet. The control box is shown in Figure 3 below.

Figure 3: Control Box.

Sensor Anchoring

The brackets to attach the sensors were mounted on the utility poles. Each bracket was mounted at least 17 feet up the pole to avoid the power lines in place. Two brackets were mounted to each pole and are secured by two metal bands, one tightened on the bottom and one on the top. Two electrical boxes were mounted next, one over each bracket. These were also secured with metal bands. The brackets and electrical boxes are shown in Figures 4 and 5 below.

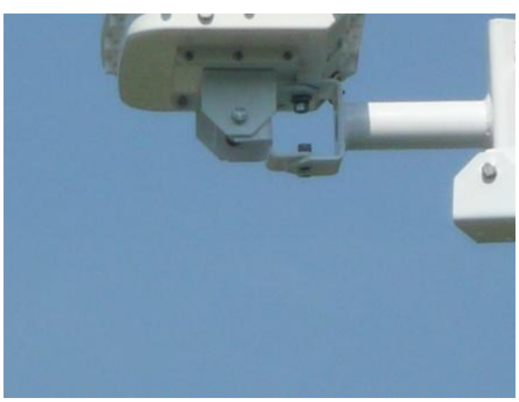

Figure 4: Mounting Brackets.

Figure 5: Mounting Brackets and

Electrical Boxes.

The sensors were then anchored on each mount. Each sensor is responsible for regulating a lane so they must be properly positioned to the correct lane. This is shown in Figures 6-8 below.

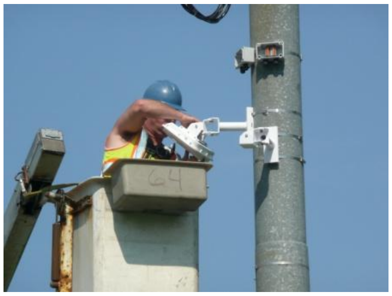

Figure 6: Anchoring Sensor.

Figure 7: Positioning Sensor.

Figure 8: Sensors After Positioning.

Wire Installation

All wiring for the system was fed through the main traffic pole, and connected to the controller cabinet. The length of the wire stretching across the intersection was determined. Once measured, the wire was stretched across the intersection on the ground from a spool and was then raised and fixed to the correct positions. Once everything was wired, a programmer prepared the controller cabinet. The wire installation is shown in Figures 9-11 below.

Figure 9: Measuring Wire.

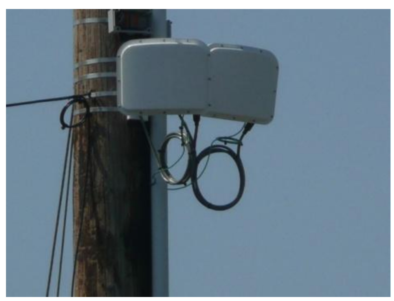

Figure 10: Connecting Wire to Sensor.

Figure 11: Running the Wire Across Intersection.

MONITORING

The site has been visited in both dry and wet conditions. The system and control box was checked and the system appeared to be operating properly. VTrans Traffic Design Unit was contacted and no complaints have been made regarding the installation.

FOLLOW UP

The experimental SmartSensor Matrix™ system will be monitored through the summer of 2014. A site visit will be made in the winter season of 2013-2014. Crash data will be analyzed with particular attention to the type and cause of crash and time of day. Analysis of this data will aid in successful determination of whether or not the radar stop bar detection system is a beneficial safety addition to our roadways.

REFERENCES

1. USDOT - FHWA. "The National Intersection Safety Problem." FHWA-SA-10-005. http://safety.fhwa.dot.gov/intersection/resources/fhwasa10005/docs/brief_2.pdf. Accessed: 12-20-10.

2. Federal Highway Administration. "Advantages and Disadvantages of Traffic Control Signals." Manual on Uniform Traffic Control Devices. Section 4B.03. Page 434. 2009.

3. Wavetronix. "SmartSensor Matrix." www.wavetronix.com. Accessed: 12-20-10.