Final Report

Wrong-Way driving technology analysis on Heisman Dr, Auburn, AL

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Description of problem

Wrong-Way driving (WWD) crashes have been a persistent issue in the United States, posing a significant challenge to transportation safety improvement. Each year, these crashes result in hundreds of fatalities and thousands of injuries. Unlike other types of crashes, WWD crashes carry a higher risk of fatality due to the involvement of vehicles moving in opposing directions, leading to greater combined speeds, particularly on freeways. Numerous studies have explored different models to predict the severity of WWD crashes using various variables. However, most of these studies have primarily focused on traditional factors such as blood alcohol concentration (BAC) levels and drug involvement. While these studies have contributed to a decrease in WWD crashes, there is still ample room for further improvement. Consequently, it becomes crucial to comprehend the level of damage caused by WWD crashes and identify its determinants to enhance transportation safety.

To mitigate the impact of Wrong-Way driving crashes, various studies have focused on employing different technologies. One commonly used approach by transportation agencies involves the implementation of signs and pavement markings to combat WWD. Additionally, Intelligent Transportation Systems (ITS) technologies have been utilized to alert impaired Wrong-Way drivers. An example of this is the radar based WWD detection system installed by the Harris County Toll Road Authority in Houston, Texas, on the Westpark Toll Road in March 2007. As a result of these countermeasures, a total of 94 Wrong-Way vehicles self-corrected between 2008 and 2013 (1). In Tampa, Florida, the Florida Department of Transportation (FDOT) installed a set of Rectangular Rapid Flashing Beacons (RFBs) at 16 interstate exit ramps (2). These countermeasures align with the suggestions provided by the Manual on Uniform Traffic Control Devices (3) and include pavement markings such as red reflective raised pavement markers, pavement arrows indicating Wrong-Way directions, and colored edge lines on exit ramps.

Our research focuses on the analysis of the expansion of Wrong-Way Driving (WWD) technology deployments on Auburn Main campus. Based on the data, there are several incidents occur infrequently, the frequency of reports raises concerns regarding the safety of drivers. The proactive approach of deploying WWD technology at ramps aims to provide drivers with additional notice, allowing them to correct their course promptly. Moreover, since this area is on campus near the Jordan Hare Stadium and this is the only exit for Tiger-transit. It is also vital to protect pedestrian and school bus. By implementing these measures, our goal is to enhance overall safety, minimize the impact of WWD incidents, and improve road conditions.

Description of solution

The study site is located at a one-way street near the Auburn University campus area - Heisman Dr, Auburn, AL. The end of this one-way road connects with a signalized intersection, and two DO-NOT- ENTER signs on both sides to prevent the WWDs. However, from daily observation, WWDs were still happened frequently. Most of the WWDs happened on the weekends, especially at nighttime, which
convince us that WWDs were caused by impaired drivers or drivers under influence. At the same time, TAPCO company, a company that focus on producing traffic devices, wished us could test their new ITS technology, which named Wrong Way Alert System. This System could automatically detect the WWD movements and alarm the drivers to mitigate the WWDs incidents. In this case, this study was applied to test the efficiency and accuracy of this new wrong-way detection ITS.

To better collect the wrong data and reduce the WWD at this intersection, the first step is setting a whole TAPCO system to better warning the Wrong driver. The Wrong Way Alert System consists of radar sensor, 2 monitors for each direction, 3 DO-NOT-ENTER signs with LED enhanced Blinker, illuminator, and an operation cabinet. **Figure 1** shows the detailed road condition and design scope of work while installing the system on the study site. When a WWD vehicle enters the detection zone (orange area in Figure 1), radar sensor will detect the object and determine whether the object is a vehicle or other stuff, like animal, pedestrian, and other non-motor vehicles. Then if the object is a vehicle, the system will trigger the flashing LEDs on the edge of the DO-NOT-ENTER signs to command WWD drivers' attention and alarm them to stop or at least slow down their operation speed. At the same time, the monitors will go on and start to record a 2-min short footage and 15 continuous images for the detection zone (orange area in Figure 1) and confirmation zone (blue area in Figure 1), respectively. These footage and images will be sent to the cloud server for officers to manually classify the incidents into different categories. Moreover, the officers will get a real-time notification when there's a WWD incident detected by the system. With the installed equipment, if a driver happens to drive in the wrong direction, they will be promptly warned by high-intensity flashing lights. Simultaneously, all three wrong-way signs will illuminate to further emphasize the error. This immediate and prominent visual feedback serves as a strong indication to the driver that they are traveling in the wrong direction. It is highly likely that this clear warning will prompt the driver to self-correct their course and rectify the situation by turning around or taking the appropriate corrective action.

To address the issue of large pedestrian flows during game days near the Jordan-Hare Stadium, which can trigger the system and generate false data, your team has implemented a solution using the TAPCO system integrated with BOSCH cameras. These cameras have the capability to categorize different types of objects within the camera's field of view.

By utilizing this advanced system, the software can differentiate between actual wrong-way drivers and the increased pedestrian activity during game days. This categorization feature helps reduce the occurrence of false data and prevents unnecessary triggering of the warning system. As a result, the warning system will operate more accurately, ensuring that genuine wrong-way drivers are appropriately alerted while minimizing false alarms caused by the presence of pedestrians during game days.

In this study, the BlinkLink cloud database was utilized to identify and categorize various incidents detected by the Wrong Way Alert System. The database contains incident reports for vehicles,pedestrians, bikes, scooters, skateboards, and emergency response, including the accurate report time, day, and date. All incidents were classified into five categories, including Authorized Maintenance Vehicles, Emergency Response, Pedestrian, Bicycle, Continued WW, and Self-Corrected WW. However, as this research primarily focuses on wrong-way incidents, these incidents were not automatically labeled and required manual categorization by human analysts using specific criteria.

As mentioned in the previous paragraph, the system used specific criteria to identify different types of vehicles. Pedestrians and bicycles were easy to detect, while the presence of an Auburn University logo identified maintenance vehicles. Emergency response vehicles, such as police cars and ambulances, were also distinguishable. Additionally, the system tracked two key actions labeled " continued WW" and "self- corrected WW." These actions were identified by short videos recorded by the system when the sensor detected them. For WW actions, the system checked whether the vehicle turned around and returned in the correct direction. **Figure 2** shows example images of a wrong-way vehicle self-correcting.

Cost and Breakdown

The entire system consists of three Tapco BlinkerSign Flashing LED Warning Signs and one Vehicle Presence Sensor, equipped with two FLEXIDOME IP starlight 8000I cameras. It functions through an entry detection system, enabling direct access through a website. The total cost encompasses both the unit product fee and installation fee, as indicated in Table 1.

Table 1 Total cost

Item	Units	Quantity	Unit Cost	Total
TAPCO 24/7 BlinkerSign® Flashing LED Wrong-Way Sign R5-1A	Each	3	1800	5400
Entry Alert detection system	Each	1	1000	1000
TC30 Ultrasonic Vehicle Presence Sensor	Each	1	525	525
Bosch FLEXIDOME IP starlight 8000I	Each	2	1500	3000
Install Fee	Each	1	15000	15000
				24925

According to Table 2, the installation of the entire system is expected to be completed within one month. However, an additional three months are required for estimating data needs, collecting data for determining the location, and obtaining quotes for installation. Furthermore, an additional three months are needed to collect traffic video data. Please refer to Table 2 for the complete timeline.

Table 2 Timeline

Tasks	Duration
Estimate of Data Need and DATA Collection	June 15-August 15,2023
Traffic Video Data Collection	July 15-November 15,2023
Development of Video Data Analysis Tool	November 16-December 31,2023

Anticipated impacts

Heisman Drive, located near Auburn University's campus in Auburn, AL, is a heavily trafficked one-way street serving as the sole exit for tiger transit and experiencing a high volume of daily pedestrians. The implementation of TAPCO technology is expected to have several positive impacts on traffic safety in this area. Firstly, based on existing data, the introduction of the Wrong Way Detection (WWD) feature will likely lead to a reduction in incidents involving wrong-way driving. This improvement will contribute to a safer traffic environment. Additionally, the presence of cameras will aid campus officers in locating suspicious activities by capturing video footage, thus enhancing campus safety measures. Importantly, the installation of the technology in elevated positions ensures minimal impact on the surrounding environment, maintaining a neat appearance. In summary, this solution offers multiple advantageous factors while outweighing any potential drawbacks.

Reference

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3. Cooner, S. A., A. S. Cothron, and S. E. Ranft. Countermeasures for Wrong-Way Movement on Freeways: Overview of Project Activities and Findings. Publication FHWA/TX-04/4128-1. Texas Transportation
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4. Kayes, M. I., Al-Deek, H., Sandt, A., Rogers Jr, J. H., & Carrick, G. (2018). Analysis of performance data collected from two wrong-way driving advanced technology countermeasures and results of countermeasures stakeholder surveys. *Transportation research record*, *2672*(14), 96-105.