ITS Field Operational Test Summary

Idaho Storm Warning System

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Introduction

The Idaho Storm Warning System ITS Field Operational Test is an Advanced Rural Transportation System test that is evaluating a system to warn motorists about adverse weather conditions. The system consists of a group of sensor systems that provide visibility and weather data coupled to a set of variable message signs (VMS) located along the highway. The system operates along a stretch of Interstate 84 in Idaho and northern Utah. The primary goal of the system is to reduce the number and severity of visibility-related multiple-vehicle accidents along this section of I-84.

Testing of the system components began in 1994. Due to a lack of visibility events in the early winters of the test and because of equipment operation problems, the data collection period has been extended until March 1998.

Project Description

The project consists of two phases. The first phase tested three visibility sensors incorporating two weather information systems The purpose of the first phase was to determine the suitability of the sensors and weather systems for use in Phase II. The first phase also established the baseline information regarding driver behavior on the test section of Interstate 84 in southern Idaho. The second phase is integrating the sensing technologies and a set of variable message signs (VMS) into an alarm and warning system to advise motorists of adverse visibility conditions.

The project need and purpose arose because of the history of accidents on a 100-mile long section of I-84 (see Figure 1). Certain areas in the test location are subject to low visibility conditions caused by blowing snow during winter and dust during spring. This section of I-84 also functions as a passenger and commercial vehicle travel route between Boise, Idaho, and Salt Lake City, Utah. From 1988 to 1991, this area experienced 18 major visibility related accidents, according to Idaho Transportation Department statistics. The percentage of trucks involved in these accidents (44 percent) exceeds their proportional representation (33 percent) in the traffic stream.

The project intended to reduce the number and severity of accidents on the subject section of I-84. The purposes of Phase I include evaluating the capability of three sensor systems to provide weather and visibility information and establishing baseline information about vehicle speeds before the installation of VMSs. In Phase II of the project, test partners are installing and integrating the VMSs. They are also evaluating the capability and suitability of the entire system in providing weather and visibility information to motorists.

Phase I of the test installed and evaluated three sensing systems: SCAN, Handar, and LIDAR. The SCAN system incorporates two separate visibility sensors, one using visible light and the other using infrared light. This system also includes four weather measurement sensors for wind speed and direction, air temperature, relative humidity, and type and amount of precipitation. The Handar system includes weather sensors similar to the SCAN system and a point detection visibility sensor similar to the visible light sensor of the SCAN system. The Light Detection And Ranging (LIDAR) system is a single visibility sensor using advanced laser technology. The LIDAR system operates similar to radar systems and can provide visibility measurements over a larger area than the other two technologies. During this phase, test personnel also used a video camera system to provide real-time verification of the conditions at the test site. Information from all these systems was transmitted to a master data collection computer at the Cotterell Port of Entry (POE) facility. The computer collected and analyzed sensor data every five minutes and alerted POE personnel if visibility fell below a predetermined threshold. If a visibility event occurred, system operators at the Cotterell POE confirmed the event using the video system. In Phase II when the operators confirm a low visibility event, they will manually activate the VMSs to advise motorists.

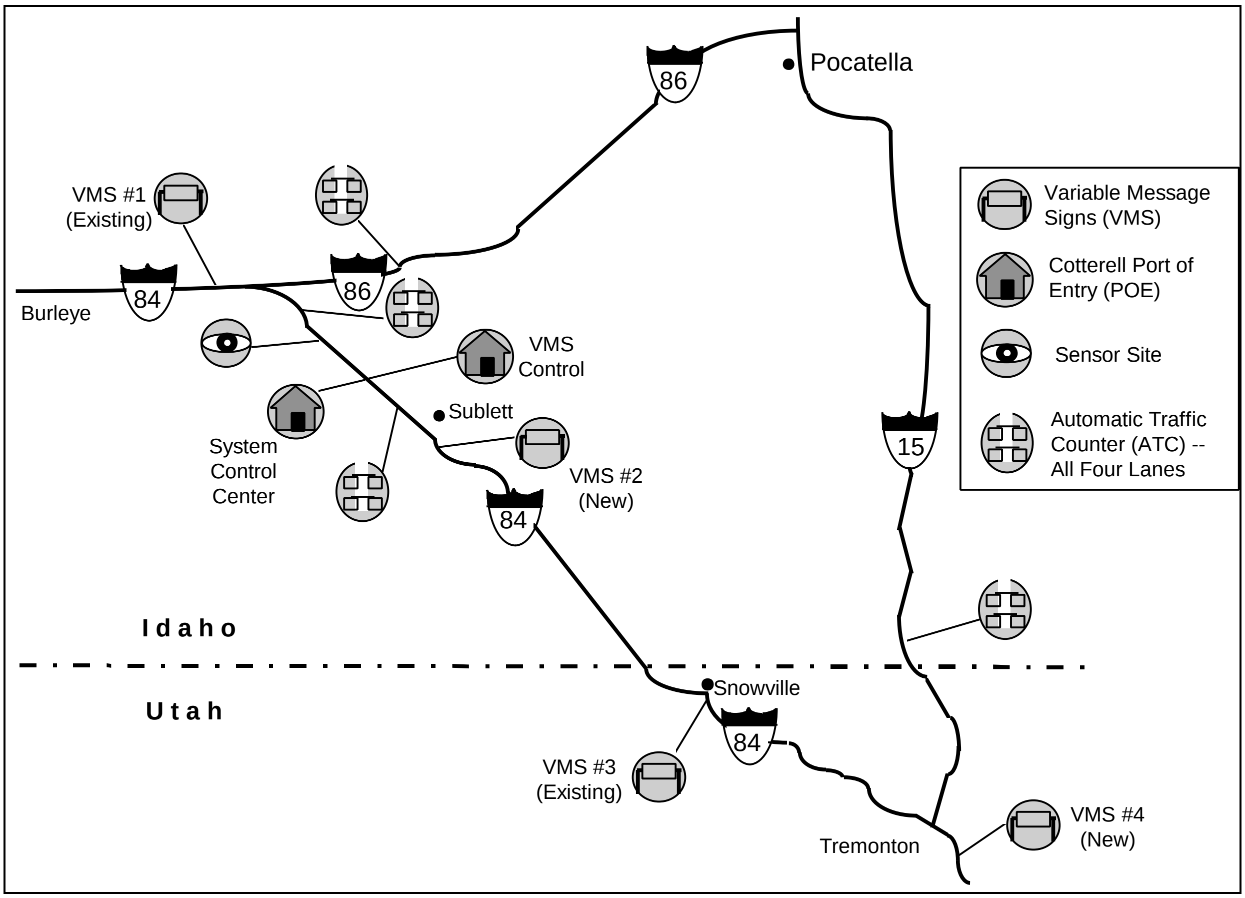

Figure 1: Map of Project Location

Test Status

Phase I of the test is continuing in parallel with Phase II, which began in November of 1996. Due to equipment operation problems and the lack of visibility events in winter 1996/1997, data collection has been extended until March 1998. The results presented in this summary come from an interim report on Phase I dated January 1997 and a progress report for the winter of 1996/1997. The LIDAR system visibility sensor was not operational during the winter of 1995/1996 as reported in the Interim Report. The test defines a visibility event as one in which sight distance drops below 1,200 feet. According to available sensor information, there were no visibility events during the winter of 1996/1997. The LIDAR system did operate during this later period but the accuracy of the LIDAR data is subject to question because the system was still being calibrated. The Final Report is expected in August 1998.

The primary purpose of Phase I of the test was to determine whether the three sensor systems were capable of measuring visibility accurately. Test evaluators analyzed the visibility sensor effectiveness through three methods: POE personnel confirmation, video playback visibility comparison, and correspondence between the operating sensors.

The POE personnel confirmation and the video playback comparison were both subject to many problems that reduced their effectiveness as an accurate confirmation method. POE personnel confirmation problems included technical problems that caused the POE personnel to lose confidence in the system and the complicated and time-consuming nature of the method. Video playback problems included an ineffectiveness at determining precise visibility distances and several technical problems that resulted in limited availability of information. Considering the limited information available using POE personnel confirmation and video playback, this confirmation method shows general agreement between the observations of the personnel and the sensors' visibility during several event periods. Precise correlations, however, proved to be impractical due to differences in individual judgment and the POE personnel's busy schedule of other duties.

Despite the problems that reduced the effectiveness of the video playback confirmation method, the available Handar and SCAN data show a general agreement between the observed distances in the videos and the sensor distances.

The comparison of visibility readings from the Handar and SCAN sensing systems (involving three different sensors) showed that this comparison is unable to determine if the sensors provide accurate visibility distances. The sensors do, however, show a high correlation between themselves. Although they provide significantly different visibility readings, it was common to have correlation values of over 0.900 between different sensors. In particular, the infrared sensor tended to give lower visibility readings during snowy conditions but higher readings during foggy conditions compared to the two visible light sensors. In spite of these differences, the three sensors showed a strong, positive linear relationship. This means that when one sensor shows a decline in visibility, the other two also exhibit a decline. Conversely, when visibility improves according to one sensor, the others also show improvement.

The LIDAR information from the winter of 1996/1997 indicated more frequent low visibility readings than the other sensors. As noted earlier, however, the LIDAR system was still being calibrated. The LIDAR system shows the complexity of visibility measurements because it produces visibility estimates at one-quarter mile intervals for up to several miles away from the site. These discrete quarter-mile estimates show significant variations in visibility (as much as several thousand feet) from one interval to another. This implies that information from point sensors like Handar or SCAN is highly dependent on sensor location.

The information from Phase I indicates that the sensors have the potential to provide useful information regarding low visibility. The mixed results, however, mean that in Phase II it is important to have information from all three sensors to determine the nature of the message to be displayed on the VMSs.

Test Partners

Federal Highway Administration

Handar Incorporated

Idaho Transportation Department

National Weather Service

Santa Fe Technologies

Surface Systems Incorporated

References

Shannon, Dr. P., Kyte, Dr. M, and Liang, W. L.; Idaho Storm Warning System ITS Operational Test, Phase 1 Interim Report, January 1997

Liang, W. L., Kyte, Dr. M., Shannon, Dr. P.; Idaho Storm Warning System ITS Operational Test, Progress Report for Winter 1996/1997, Evaluation of Weather and Traffic Conditions, December 1997