QUARTERLY REPORT 7/1/2005 - 9/30/2005
CENTER FOR TRANSPORTATION STUDIES

Project Title: Toward A Multi-State Consensus on Rural Intersection Decision Support

CTS Project # 2004039 ***Contract #*** 81655 ***Work Order #*** 106 ***Authorization Date:*** 1/2/2004

Funding Source:

Mn/DOT

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Task Update

1 Project Management

Project management involves coordinating state activities (between states participating in this pooled fund study and with the national IDS program), scheduling the driver interface workshop, and disseminating research results to participating states. Travel coordination and management for the kickoff, biannual project meeting, and design workshops will be handled by Mn/DOT.

Deliverables: Coordination of research and design workshop activities, results dissemination, and periodic project reporting. Pooled fund states will be kept informed of developments and results through task summary reports

Task Budget $36,193.00
Task Due Date (calculated): 1/2/2007
Date Delivered (reported by PI):
Task Approved: No Date Approved (CTS received task approval) :

Progress: Management tasks continue. California was added to the pooled fund, requiring a change of scope and a change of budget. Those requests were made to and approved by Mn/DOT. Subsequently, an ammendement to increase the scope and the budget for the CH2MHill Crash analysis was submitted to SPA for approval.

2 State Crash Analysis

Crash analysis consists of two key components: the development of a methodology by which intersection crashes can be reviewed and the development of statistical models which relate the characteristics of a rural stop-controlled intersection to that intersection's crash experience. With respect to the former, relevant crash data was used to determine which crash configurations and intersection types lead to high frequency and severity of crashes. Intersections having crash rates higher than the critical rate were identified as potential candidates for intersection research. Further analysis led to the selection of a candidate experimental intersection. This work is complete in Minnesota; the report documenting this analysis is presently in press. The statistical models relating the characteristics of a rural stop-controlled intersection to that intersection's crash experience will be used to identify intersections which are atypically dangerous or safe. To also identify the characteristics associated with atypically high or low crash experiences, and ultimately to estimate the potential safety impacts of the proposed intersection decision support system. This work is still in progress. For member states analyses focused on identifying critical rural intersections using the critical crash rate and severity measure methodology will be performed by the Minnesota team. The Minnesota team will request specific crash information from the crash database in each state. The Minnesota team will then provide to each state a list of intersections with crash rates and severities above the critical level as well as a recommendation for the experimental intersection. In the even that some states lack particular data in their crash reporting/recording systems, modifications to the analysis developed for the national IDS project will be made to best compute similar statistics

Deliverables: Reports summarizing the rural intersection crash problem in each member state, a list of rural intersections with crash rates above the critical level, and a recommendation for an intersection to be instrumented and studied further. Techniques and methodologies developed for the national IDS project will be used to analyze state crash databases

Task Budget $150,000.00
Task Due Date (calculated): 2/2/2005
Date Delivered (reported by PI):
Task Approved: No Date Approved (CTS received task approval) :

Progress: Work continues. An ammendment to increase scope and budget to support the California analysis has been submitted.
The status of the states follow:

1. Minnesota: Coordination done, crash data review done, field review done, report done.
2. California: Coordination has begun, with contact being made with Caltrans.
3. Georgia: Coordination has been done, crash data has been reviewed.
4. Iowa: Coordination done, crash data review done, field review done, report approximately 25% done.

5. Michigan: Coordination done, crash data review done, field review done, report approximately 50% done.
6. Nevada: Coordination done.
7. New Hampshire: Coordination done.
8. North Carolina. Coordination done, crash data review done, field review done, report done.
9. Wisconsin: Coordination done, crash data review done, field review done, report done.

3 Intersection Design Workshops

A key element of the rural IDS system is the driver-infrastructure interface, which will convey relevant intersection state data to the driver attempting to enter or cross the traffic stream. The goal of the IDS program is to develop a nationally deployable system. Design input from member states will be sought.Two interactions with the representatives from each member state are planned. The first interaction will be a design brief describing the proposed driver infrastructure interface(s). This design brief will be provided to each of the participating states; a review/critique of the proposal will be requested. Feedback provided by participants will be used to determine which interface(s) will be replicated in the HumanFIRST driving simulator. Once the interface design set has been defined, a workshop will be held for representatives of the participating states. In this workshop, participants will have the opportunity to experience the interface in the University of Minnesota HumanFIRST driving simulator. Participants again will have the opportunity to critique the interface, and and provide design recommendations based on their experience. The final interface design will take into account the feedback produced by the design workshop. Once the design is "finalized," it will be tested under the national IDS contract in the HumanFIRST driving simulator to determine driver response and acceptance.

Deliverables: A prototype design drawing sn specification for a rural IDS driver-infrastructure interface that will satisfy national constraints with respect to deployment, maintenance, and public and Manual on Uniform Traffic Control Devices (MUTCD) acceptance points of view.

Task Budget $19,781.00
Task Due Date (calculated): 10/2/2004
Date Delivered (reported by PI):
Task Approved: No Date Approved (CTS received task approval) :

Progress: DII design work will continue with the CICAS program. At project meetings, the states will be kept abreast of developments of the DII.

4 Development of a Portable Intersection Surveillance System

The Minnesota team will develop a portable intersection surveillance system to be used to collect driver behavior data at remote, rural intersections. This system will be based on the rural intersection surveillance system developed for and operating at the intersection of US 52 and CSAH 9 in Goodhue County, MN.

The portable surveillance system will be composed of four primary subsystems:
·Radar Stations (for mainline traffic surveillance, including wireless data transmitters)
·Lidar stations (for both vehicle classification and median vehicle trajectory tracking, including wireless data transmitters)
·Main Computer Station (central control computer, Data Acquisition System, housed in a lockable trailer, and a single video camera to capture unusual events at the intersection crossroads)
·Power distribution system (including generators, transformer, auxiliary fuel tanks, cables, and automatic starting system (for battery charging), contract electrician , and an ATV to assist with system set up at each state site).

Two primary differences exist between the fixed and portable surveillance systems: power distribution and data transmission. To minimize the number of refueling trips needed by the state DOTs to keep the system running, a battery/generator system is proposed. With this system, each sensor station will be powered locally by a 12 Volt, deep cycle battery, which in turn is connected to battery charger. This battery charger is connected to a portable generator. The generator is connected to a Programmable Logic Controller (PLC) which has an internal clock. Two or three times per day, the PLC will instruct the generator to start. The generator will energize the battery chargers, which will in turn charge the batteries. After the generator runs a sufficient amount of time to charge the batteries, the PLC will shut down the generator. The process will be repeated as needed to keep the batteries sufficiently charged. A diagram of one leg of the power distribution system is shown in Figure 1 below.

Data transmission at the Minnesota test intersection is performed with a local DSL network using hardwired CAT V conductors. For the portable intersection surveillance system, wireless communication is proposed to control both the cost and the complexity of the portable system. A number of variations of 802.11a, b, and g as well as Mesh Networks will be tested at the Minnesota test intersection to identify an optimal technology for this portable surveillance system application.

Once power distribution and data transmission systems are validated, the portable surveillance system will be tested alongside the Minnesota test intersection instrumentation to validate the system performance (accuracy, reliability, data transmission robustness, etc.), fuel economy, and battery charge and discharge rates. Once the system performance and operating conditions are known, the system will likely be deployed initially in Wisconsin. The intersections identified in the Wisconsin crash analysis are on US 53, and are reasonably close to the University of Minnesota. Because of this proximity, periodic checks of this initial deployment are relatively convenient for the Minnesota team.

Deliverables: The deliverable for this task will be a portable rural intersection surveillance system which will be transported to partner states for the purpose of recording driver behavior at intersections jointly selected by each partner state and the Minnesota team.

Task Budget $195,000.00
Task Due Date (calculated): 7/2/2005
Date Delivered (reported by PI):
Task Approved: No Date Approved (CTS received task approval) :

Progress: The development of the portable system is nearly complete. The system trailer has been delivered, wired for power, and all computers and wireless communication equipment has been installed and tested.

Generators for powering remote sensors have been purchased, and development of the PLC-based power cycle system (generator runs 1 hour, turns off, and power is supplied by on-board batteries) is complete, and undergoing testing. 15 gallon fuel cells and necessary plumbing has been procurred, and will be installed at the conclusion of the ITS world congress. (See more below).

The in-trailer data acquisition system is installed and operational. The wireless system has been tested and is operational.

The next step is to deploy the system at the intersection of US 53 and Wisconsin 77 in Minong in December after the conclusion of the ITS world congress demo. After the system is has been validated and data is collected, the system will be deployed in a warm weather state, likely North Carolina.

5 Data Collection

Data will be collected with the portable surveillance system for approximately one month at one intersection per partner state. The Minnesota team will work with each state to identify the intersection at which data will be collected. Once the intersection is known, the Minnesota team will arrange for the portable system to be shipped to a state DOT facility close to the intersection. Once the equipment arrives, Minnesota personnel will travel to the DOT facility, pick up the equipment, and bring the portable system on line. State DOT personnel will assist with this process by providing and installing sensor posts at locations determined by the Minnesota team. State DOT's will also provide a means to secure portable equipment at the intersection to discourage theft or vandalism.

The expected time to bring the system on-line and test its performance is one week. At the conclusion of the first week, the Minnesota Team will turn the portable system over to the state DOT, who will refuel generators when needed, periodically check for component theft or vandalism, and in the unlikely event, reboot either the intersection controller or data acquisition computer. (The need to reboot has not been an issue with the permanent system.)

At the conclusion of the data collection process, the Minnesota team will return to the test site, take the system off-line, and prepare to ship it to its next destination. Data collected at the intersection will be archived at the University of Minnesota for subsequent analysis.

Deliverables: At least one month of driver behavior data collected in each partner state. The data will be archived and analyzed on a per state basis. Analysis includes gap acceptance statistics as functions of time of day, vehicle class, maneuver type, and speed variation along mainline roads. The results of the analysis will be summarized for each state in a letter report.

Task Budget $58,571.00
Task Due Date (calculated): 1/2/2007
Date Delivered (reported by PI):
Task Approved: No Date Approved (CTS received task approval) :

Progress: The portable data acquisition system is nearly complete. Once data has been collected, it will be analyzed using techniques developed for the IDS program. Once the data from all states is collected, the data will be analyzed to determine whether differences exist between states.

With the emergence of the CICAS program, resources will be leveraged to collect more data. The plan at this point is to increase the duration of data collection in each state to two months to provide a more statistically valid data set.

6 Data Analysis

Deliverables:

Task Budget $38,955.00
Task Due Date (calculated):
Date Delivered (reported by PI):
Task Approved: Yes Date Approved (CTS received task approval) :

Progress: This will commence once remote intersection data is available.

Future Plans: Data collection at remote intesections will commence in December. The likely scenario will be data collection in Wisconsin, followed by data collection in North Carolina (because North Carolina crash analysis is complete, and North Carolina will be relatively warm in February and March).

Problems Encountered/Actions Taken: The plan was to collect data in Wisconsin in October. However, demonstration of the IDS/CICAS system at the world congress has delayed the deployment of the portable in Wisconsin by approximately two months. The intent is to deploy in Wisconsin in December.