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May 12, 2009

STATE PROJECT NO. 742-17-0008
FEDERAL AID PROJECT NO. 9713(006)
INTERSECTION IMPROVEMENTS FLANNERY ROAD AT FLORIDA BOULEVARD
EAST BATON ROUGE PARISH

SUBJECT: ADDENDUM NO. 2 (CONSTRUCTION PROPOSAL REVISION)

Gentlemen:

The following proposal revision dated 05/12/09 on the captioned project for which bids will be received on Wednesday, May 20, 2009 has been posted on http://www.dotd.la.gov/cgi-bin/construction.asp.

1. Revised the special provision entitled **Item S-001, Video Detector.** (8 pages)

Please note this revision in the proposal and bid accordingly. Mandatory electronic bidding is required for this project, and electronic bids and electronic bid bonds must be submitted via www.bidx.com for this letting date.

Sincerely,

RANDAL D. SANDERS, P. E.
CONTRACTS & SPECIFICATIONS ENGINEER

Attachments
ec: Mr. Brian Buckel
Mr. Roy Schmidt
Mr. Mike Vosburg
Ms. Laura Riggs
Mr. Eric Burges
Mr. Masood Rasoulian
City of Baton Rouge

ITEM S-001, VIDEO DETECTOR:

1. **General**

This specification sets forth the minimum requirements for a system that monitors vehicles on a roadway via processing of video images. The detection of vehicles passing through the field-of-view of an image sensor shall be made available to a large variety of end user applications as simple contact closure outputs that reflect the current real-time detector or alarm states (on/off) or as summary traffic statistics that are reported locally or remotely. The contact closure outputs shall be provided to a traffic signal controller and comply with both the National Electrical Manufacturers Association (NEMA) type C and D detector rack.

The system architecture shall fully support Ethernet networking of system components through a variety of industry standard and commercially available infrastructures that are used in the traffic industry. The data communications shall support direct connect, [modem,] and multi-drop interconnects. Simple, standard Ethernet wiring shall be supported to minimize overall system cost and improve reliability, utilizing existing infrastructure and ease of system installation and maintenance. Both streaming video and data communications shall optionally be interconnected over long distances through fiber optic, microwave, or other commonly used digital communications transport configurations.

On the software application side of the network, the system shall be integrated through a client-server relationship. A communications server application shall provide the data communications interface to a minimum of one thousand (1,000) traffic signal video vehicle detection system (TSVVS) sensors and a number of client applications. The client applications shall either be hosted on the same PC as the communications server or may be distributed over a local area network of PC's using the industry standard TCP/IP network protocol. Multiple client applications shall execute simultaneously on the same host or multiple hosts, depending on the network configuration. Additionally, a web-browser interface shall allow use of industry standard Internet web browsers to connect to TSVVS sensors for setup, maintenance, and playing digital streaming video.

2. **System Hardware**

The field devices for the machine vision system hardware shall consist of three (3) components:

- **a.** One (1) color, minimal twenty-two by (22x) zoom, TSVVS sensor
- **b.** One (1) modular cabinet interface unit
- **c.** One (1) communication interface panel.

In the office, an optional personal computer (PC) shall host the server and client applications that are used to program and monitor the system components. The real-time performance shall be observed by viewing the video output from the sensor with overlaid flashing detectors to indicate the current detection state (on/off). The TSVVS sensor shall optionally store cumulative traffic statistics internally in non-volatile memory for later retrieval and analysis.

The TSVVS shall communicate to the modular cabinet interface unit via the communications interface panel and the software applications using the industry standard TCP/IP network protocol. The TSVVS shall have a built-in, Ethernet-ready, Internet Protocol (IP) address and shall be addressable with no plug

in devices or converters required. The TSVVS shall provide standard MPEG-4 streaming digital video. Achievable frame rates shall vary be variable to account for video quality and available bandwidth from five (5) to thirty (30) frames per second.

The modular cabinet interface unit shall communicate directly with up to eight (8) TSVVS sensors and shall comply with the form factor and electrical characteristics to plug directly into a NEMA type C and D detector rack providing up to thirty-two (32) inputs and sixty-four (64) outputs to a traffic signal controller respectively.

The communication interface panel shall provide four (4) sets of three (3) electrical terminations for three-wire power cables for up to eight (8) TSVVS sensors that may be mounted on a pole or mast arm with a traffic signal cabinet or junction box. The communication interface panel shall provide high-energy transient protection to electrically protect the modular cabinet interface unit and connected TSVVS sensors. The communications interface panel shall provide single-point Ethernet connectivity via RJ45 connector for communication to and between the modular cabinet interface module and the TSVVS sensors.

3. System Software

The TSVVS sensor embedded software shall incorporate multiple applications that perform a variety of diagnostic, installation, fault tolerant operations, data communications, digital video streaming, and vehicle detection processing. The detection shall be reliable, consistent, and perform under all weather, lighting, and traffic congestion levels. An embedded web server shall permit standard internet browsers to connect and perform basic configuration, maintenance, and video streaming services.

There shall be a suite of client applications that reside on the host client / server PC. The applications shall execute under Microsoft Windows XP or Vista. Available client applications shall include but not be limited to:

a. Master network browser: Learn a network of connected modular cabinet interface units and TSVVS sensors, display basic information, and launch applications software to perform operations within that system of sensors.

b. Configuration setup: Create and modify detector configurations to be executed on the TSVVS sensor and the modular cabinet interface unit.

c. Operation log: Retrieve, display, and save field hardware run-time operation logs of special events that have occurred.

d. Software install: Reconfigure one or more TSVVS sensors with a newer release of embedded system software.

e. Streaming video player: Play and record streaming video with flashing detector overlay.

f. Data retrieval: Fetch once or poll for traffic data and alarms and store on PC storage media.

g. Communications server: Provide fault-tolerant, real-time TCP/IP communications to / from all devices and client applications with full logging capability for systems integration.

4. TSVVS Sensor

The TSVVS sensor shall be an integrated imaging color CCD array with zoom lens optics, high-speed, dual-core image processing hardware bundled into a sealed enclosure. The CCD array shall be directly controlled by the dual-core processor, thus providing high-quality video for detection that has virtually no noise to degrade detection performance. It shall be possible to zoom the lens as required for setup and operation. It shall provide JPEG video compression as well as standard MPEG-4 digital streaming video with flashing detector overlay. The TSVVS shall provide direct real-time iris and shutter speed control. The TSVVS image sensor shall be equipped with an integrated twenty-two by (22x) zoom lens that can be changed using either configuration computer software. The digital streaming video output and all data communications shall be transmitted over the three-wire power cable.

5. Power

The TSVVS sensor shall operate on 110 VAC, 60Hz at a maximum of twenty-five (25) watts. The camera and processor electronics shall consume a maximum of ten (10) watts and the remaining fifteen (15) watts shall support an enclosure heater.

6. Detection Zone Programming

Placement of detection zones shall be by means of a PC with a Windows XP or Vista operating system, a keyboard, and a mouse. The PC monitor shall be able to show the detection zones superimposed on images of traffic scenes.

The detection zones shall be created by using a mouse to draw detection zones on the PC monitor. Using the mouse and keyboard it shall be possible to place, size, and orient detection zones to provide optimal road coverage for vehicle detection. It shall be possible to download detector configurations from the PC to the TSVVS sensor and cabinet interface module, to retrieve the detector configuration that is currently running in the TSVVS sensor, and to back up detector configurations by saving them to the PC fixed disks or other removable storage media.

The supervisor computer's mouse and keyboard shall be used to edit previously defined detector configurations to permit adjustment of the detection zone size and placement, to add detectors for additional traffic applications, or to reprogram the TSVVS sensor for different traffic applications or changes in installation site geometry or traffic rerouting.

7. Detection Types

The TSVVS shall be able to be programmed with a variety of detector types that perform specific functions.

a. Detector types shall include at a minimum the following without additional equipment being required:

1. Count Detector--outputs traffic volume statistics;
2. Presence Detector--indicates presence of a vehicle, stopped vehicle, or vehicles traveling the wrong direction;
3. Speed Detector--provides vehicle speed, length, classification, volume, density and traffic flow statistics;
4. Detector Function--combines outputs of multiple detector types via Boolean logic functions and allows timing extensions and delays. Similar to the Contrast Detector below, it monitors video signal quality globally in the scene.
5. Station--accumulates traffic data over user specified time intervals, including cycle splits for intersection applications;
6. Input Label Detector--provides states of a user-provided input signal;
7. Speed Alarm--generates an alarm output based on user-defined speed and volume thresholds;
8. Contrast Detector--monitors video signal quality and provides an optical fail safe alarm feature. Unlike the global measure of video quality in the Detector Function above, this Contrast Detector can monitor specific areas of the scene.
9. Incident Detector--operates an incident detection algorithm which monitors speed and occupancy data from individual traffic lanes to detect the shock wave effects which propagate upstream from a capacity-reducing incident that occurs outside the camera field of view. It is adjustable for regularly recurring congestion.
10. Scheduler--controls detector operation based upon a user-defined time schedule;
11. Label--displays system or user-defined static or dynamic information on the output video of the TSVVS, including titles and bitmap graphics.
12. Lane Detector-- generates an alarm for stopped vehicle (default setting), a slow vehicle, or a wrong-way vehicle along an entire outdoor traffic lane within the field of view.
13. Tunnel Detector--generates an alarm for stopped vehicle (default setting), a slow vehicle, or a wrong-way vehicle along an entire tunnel lane within the field of view.

b. The speed detector shall report vehicle speed and vehicle classification based on five user-defined length categories, satisfying the four generalized category requirement recommended by FHWA.

c. Multiple detector outputs can be combined together via logic operators such as OR, AND, NAND, and N of M logical functions. In addition, the TSVVS shall be able to condition the detector outputs based on the state of associated input signals. The following detector output types shall be available:

1. Type 0 -- send a call for every vehicle presence detected;
2. Type 1 -- extends a call on GREEN, delays a call on NOT GREEN;
3. Type 2 -- both Extends and Delays a call on Green, no change to call on NOT GREEN;
4. Type 3 -- provides Stop Bar detection;
5. Type 4 -- provides Stop Bar detection with a timer;
6. Type 5 -- provides Stop Bar detection with a reset timer;
7. Type 6 -- enables a call when the input phase is RED;
8. Type 7 – not required or used;
9. Type 8 -- provides Dilemma Zone detection, based on the speed of the vehicle;
10. Type 9 -- provides moving vehicle detection and time validation during RED;

11. Type 10 -- arbitrates between individual Contrast Loss detectors to determine video quality loss.

d. Each TSVVS shall be able to detect the absence of a valid video signal on each image sensor input. Upon detecting the absence of a valid video signal, the TSVVS shall place all the detector outputs associated with the failed image sensor input into a fail-safe ON state known as recall.

e. Each TSVVS shall be able to detect when the quality of the video input from the image sensor is not sufficient to enable vehicle detection (e.g., when environmental conditions obscure the sensor view). Use of this video loss detection capability shall be selectable by the user. If a video loss failure is detected, the TSVVS shall place the detector outputs associated with the failed sensor on minimum recall, maximum recall, or fixed time recall as selected by the user.

8. Interval Traffic Data

a. Each TSVVS shall count vehicles in real-time and compute the average of traffic parameters over user-defined time intervals (or time slices), as follows:

1. Volume -- number of vehicles detected during the time interval;
2. Occupancy -- detector occupancy measured in percent of time;
3. Vehicle Classification -- number of vehicles in each of five classes, as defined by vehicle length in feet or meters (per FHWA recommendations);
4. Flow Rate -- vehicles per hour per lane;
5. Headway -- average time interval between vehicles;
6. Speed -- time mean and space mean vehicle speed in mi/hr;
7. Level of Service -- determined by user-defined thresholds for average speed or capacity flow rates;
8. Space Occupancy -- sum of the vehicle lengths divided by average distance traveled during the time interval measured as percent;
9. Density -- flow rate divided by space mean speed expressed in vehicles/mi.

b. The duration of the time intervals (or time slices) shall be user-customizable as per signal control cycle or 10, 20, or 30 seconds, or 1, 5, 10, 15, 30, or 60 minutes, or any other engineered required time interval.

c. It shall be possible to poll the TSVVS for traffic flow, vehicle presence, or event alarm data during normal operation when connected to a computer with serial communications.

Furthermore, an option to minimize data loss, called persistent polling, shall be provided to collect time interval data when the TSVVS is not connected to a computer. It shall operate as follows: When the communication link to the traffic management computer is cutoff temporarily, for whatever reason, the TSVVS shall write the persistent poll data to non-volatile EEPROM flash memory. At such time as the link is restored, the persistent poll data shall be transferred to the traffic management computer. Thus though delayed, there is no loss of data due to communications link failures. This shall also allow the use of dial-up modem applications

to be scheduled, for example daily or weekly calls, to collect all data since last connection was made.

Finally, the option for persistent polling shall begin accumulating and storing defined poll data to flash memory, if needed after system reboot, as may be caused by local mains power failures.

d. Using the persistent polling technique above, it shall be possible to save the time-interval data in non-volatile EEPROM flash memory within the TSVVS for later transfer to the supervisor computer for analysis.

e. Retrieval of real-time poll data or persistent poll data stored in the memory of the TSVVS shall be via a serial communications port or integrated Ethernet port using manufacturer provided software tools. Provision shall be made for transfer of data via a modem and dial-up telephone lines, via private cable, fiber optic network, wireless system, Ethernet or via direct connection to another computer by serial cable.

f. Each TSVVS shall provide an optional power line monitor to ensure the accuracy of its internal clock.

9. Traffic Data Collection & Web Posting

The TSVVS sensor shall store cumulative traffic statistics, internally in non-volatile memory, for later retrieval and analysis. TSVVS sensor shall have at a minimum five (5) megabytes (Mb)of memory for data storage. Data collection shall not require additional modules or extra software.

The above data types shall also be compatible to and available to be viewed real-time through a standard web browser via the existing Louisiana Department of Transportation and Development (LaDOTD) Data Collection and Management Service (DCMS). This DCMS shall have the capability of polling any and all video detector sensors via a number of communication interfaces, including but not limited to PSTN, CDPD, CDMA, dedicated twisted-pair, fiber, and wireless and displaying the data real-time on a custom website provided by the manufacturer. In addition to displaying real-time data and color snapshots of the image sensor, the manufacturer shall archive all data for the agency to create custom data reports in Excel or HTML by simply accessing the website and filtering the dates and reporting parameters. All hardware necessary to archive the data shall be owned and maintained by the manufacturer with the agency only needing a web browser to view and operate the DCMS.

10. Optimal Detection

The video detection system shall optimally detect vehicle passage and presence when the TSVVS sensor is mounted at either: the manufacturers recommended height of 30 feet or higher above the roadway, or when the image sensor is adjacent to the desired coverage area, or when the distance to the farthest detection zone locations are not greater than ten (10) times the mounting height of the TSVVS. The recommended deployment geometry for optimal detection also requires that there be an unobstructed view of each traveled lane where detection is required. Although optimal detection may be obtained when the TSVVS is mounted directly above the traveled lanes, the TSVVS shall not be required to be directly over the roadway. The TSVVS shall be able to view either approaching or receding traffic or both in the same field of view. The preferred TSVVS sensor orientation shall be to view approaching traffic since there are more high contrast features on vehicles as viewed from the front rather than the

rear. The TSVVS sensor placed at a mounting height that minimizes vehicle image occlusion shall be able to simultaneously monitor a maximum of six (6) traffic lanes when mounted at the road-side or up to eight (8) traffic lanes when mounted in the center with four (4) lanes on each side.

11. Modular Cabinet Interface Unit

The modular cabinet interface unit shall provide the hardware and software means for up to eight (8) TSVVS sensors to communicate real-time detection states and alarms to a local traffic signal controller. It shall comply with the electrical and protocol specifications of the detector rack standards. The card shall have a minimum of 1500 Vrms isolation between rack logic ground and street wiring.

The modular cabinet interface unit shall be a simple interface card that plugs directly into a NEMA type C or D detector rack. The modular cabinet interface unit shall occupy a maximum of two (2) slots within the detector rack. The modular cabinet interface unit shall accept up to a maximum of sixteen (16) phase inputs and shall provide up a minimum of twenty-four (24) detector outputs.

12. Communications Interface Panel

The communications interface panel shall support up to eight (8) TSVVSs. The communications interface panel shall accept 110 VAC, 60 Hz power and provide predefined wire termination blocks for TSVVS power connections, a Broadband-over-Power-Line (BPL) transceiver to support up to ten (10) MB/s inter-device communications, electrical surge protectors to isolate the modular cabinet interface unit and TSVVS sensors, and an interface connector to cable directly to the modular cabinet interface unit.

The interface panel shall provide power for up to eight (8) TSVVS sensors, taking local line voltage 110 VAC, 60 Hz and producing 110 VAC, 60 Hz, at about thirty (30) watts to each TSVVS sensor. These circuits shall be protected by fuses to protect the communications interface panel.

13. System Installation & Training

The supplier of the video detection system may supervise the installation and testing of the video detection system and computer equipment as required by the contracting agency.

Training is available to personnel of the contracting agency in the operation, set up, and maintenance of the video detection system. The TSVVS sensor and its support hardware / software is a sophisticated leading-edge technology system. Proper instruction from certified instructors is recommended to ensure that the end user has complete competency in system operation. The User's Guide is not an adequate substitute for practical classroom training and formal certification by an approved agency.

14. Warranty, Service, & Support

a. The Supplier shall warrant the video detection system for two (2) years.
b. Ongoing software support by the supplier shall include free software updates of the TSVVS sensor, modular cabinet interface unit, and supervisor computer applications.

c. The Suppler shall provide free of charge technical support for the life of the unit though a technical support phone number
d. In the event of extraordinary problems, the Supplier shall provide free of charge on-site personnel within twenty-four (24) hours, as needed, should difficulties occur in order to safe guard the public transportation system.

15. Measurement

Measurement will be made per each video detector installation. Measurement will include furnishing and installing all equipment and apparatus (including equipment in the controller cabinet), and performing work required for a complete video detector installation.

16. Payment

Payment will be made under:

Item S-001, Video Detector, per each.