Federal Motor Carrier Safety Administration
Research & Technolgoy Development Initiative

Enhancing Regulatory Enforcement
Use of Voice Recognition (VR) Technology in Driver/Vehicle Safety Inspection Software

Synopsis: FMCSA, through the Field Systems Group (FSG) and interested States, has conducted several low cost experiments with voice recognition (VR) systems. The goal has been to expedite the roadside vehicle inspection process. These tests have been successful enough to prove the concept, but have not provided an Aoff the shelf@ solution which can be applied to our task of completing 2.2 million safety inspections per year.

As we have been pursuing this research, information technology has also been steadily advancing to bring voice recognition (VR) technology into the mainstream. Dictation systems are seeing growing importance and VR chips are introduced steadily.

We believe it is time to leverage our experience in VR and carefully integrate this technology into our inspection systems as a mainstream technique for inspectors to interact with the computer. Evidence suggests very positive cost/benefits by reducing the time for inspections and increasing the usefulness of various screening software.

REGULATORY ENFORCEMENT BENEFITS THROUGH USE OF VR

1. **Faster inspections** B Current driver/vehicle inspections are slow and much time is spent in data entry. VR proof-of-concept tests have shown great potential for speeding inspections. This R&T project would introduce VR in several key areas of the inspection and greatly expedite the inspection process.

2. **Better Vehicle/Carrier Screening** B Despite development of screening software and algorithms (ISS and SAFESTAT), actual roadside screening to focus on true high risk carriers has been limited. This is primarily because, once a vehicle is stopped for initial data collection, it is often inspected regardless of the returned ISS scores. VR enhanced screening will allow faster, and hands-free prioritization of more vehicles. It reduces inspections of carriers with few problems. One example is a Washington State proposal to use VR ISS to enter DOT numbers as trucks roll down the road. Troopers would pull over vehicles if the system calls for an inspection. Another proposal calls for using VR ISS at the International border to screen vehicles while expediting traffic at these high congestion points. Several States are highly interested in using VR-ISS but need an updated version.

3. **Faster APast Inspection Queries@ to reduce Out of Service (OOS) running** B A significant problem facing regulatory enforcement is drivers & companies who ignore out of service orders and continue to operate OOS vehicles. FMCSA spends considerable money on special grants to conduct Acovert operations@ which is little more than Ahiding in the bushes@ to see if a vehicle moves without first being repaired. The Past Inspection Query (PIQ) system is a remedy to this since it readily identifies recent OOS problems

and allows quick verification that the problems were fixed. But PIQ queries take time and are only done on stopped vehicles. A VR enabled PIQ would speed the process and ensure more vehicles are screened even before being stopped.

R&T Initiative: This R&T contract would allow further development, testing, and implementation of VR concepts previously tested. The strategy is to devise an overall VR system strategy which fits the inspection environment and then expand it into a series of increasingly complex applications.

TASK #1 -- Establishing the VR environment. This task would focus on integrating a VR engine to the target computers and existing inspection applications software. One primary goal is not to reinvent the software just to operate under VR, but to use existing (perhaps slightly modified software) with VR input. The approach calls for strict adherence to:

1. **modularity** -- VR will be enabled on a modular basis with each target application. Users can pick and choose from several stand alone applications as their needs change. The VR component would likely be in the form of a DLL (Dynamic Link Library) or similar construct, which could be called by the Delphi application software. We will work with the contractor to modify the applications software as needed, but do not want to support multiple versions of the applications code.

2. **practicality** -- The system must have 98+% recognition rate and not require excessively rigid word pronunciation. We prefer speaker independent systems, but will consider speaker dependent systems if benefits support that approach. Final costs to State users must be practical for procurement. The system must be flexible enough to work in the following environments:

    1. Inside a vehicle inspection building
    2. Inside a police cruiser while traveling down the road
    3. Outside while attached to an inspector

3. **Software open architecture --** The VR development platform must be commercially available and accessible for future modification by different development teams. Software developed through this contract would become the property of the U.S. Government and deployment would not require run-time fees. The VR engine would operate under various popular operating systems (MS Windows is the mostly likely target).

4. **Hardware open architecture** B The VR system would operate with a variety of mainstream Digitial Signal Processor (DSP) cards (also called sound cards). The DSP card must be available in both PCMCIA and ISA or PCI form factor. USB interfaces would also be considered.

    The target computer systems would include:

    1. Desktop computers (in scale houses)
    2. Laptop computers (in police cruisers)

3. Wearable computers (attached to users)
4. PDA devices linked to other computers (future)

Microphone requirements include:

1. Noise cancellation technology capable of operating in diesel truck inspection environment such as found at an inspection site.
2. Not limited to headset mounting. Scale house applications would work much better with stick mounted microphones.

System Architecture:

Past development has focused on separating the system into two units: a portable recognition engine and RF transceiver worn by the the inspector with a transceiver and applications software mounted elsewhere to process the incoming data and complete the report.

While we don=t discount this approach, we want to now focus on systems where the two components are combined onto (a) a wearable computer, (b) into a laptop system, and (c) into a desktop system.

We also wish to look at use of a Portable Digital Assistant (PDA) device, radio linked to a laptop system. We have some in-house work underway in this area using technology from Symbol Technologies (Palm & CE). Although conventional thinking is that existing PDAs are inadequate to support the VR process, be believe this is the likely direction of future technology and will support further developments in this area.

NOTE: All tasks below are based on the system developed under Task #1

TASK #2 Adding VR to ISS-2 for carrier/vehicle screening.

A VR version of ISS was successfully built, but proved impractical because it only ran on a desktop computer with a proprietary ISA sound card and required very careful pronunciation. This task would build another ISS application using the new ISS-2 software. The voice recognition input requirements are limited to input of DOT#, ICC#, and flipping between output screens. The system would also supply audio feedback of the carrier name and inspection value. An extension of this software might be to add carrier name recognition.

TASK #3 Adding VR to the Past Inspection Query

The Past Inspection Query (PIQ) allows access and display of past vehicle inspections based on queries with the vehicle plate# and State. This task would be to add VR input to that query. Audio output would be limited to several phrases, but full display of past inspections would be part of the system.

TASK #4 Adding VR to CDLIS

Commercial Driver License Information System (CDLIS) queries are a standard part of the the inspection process. This task would add VR capability to that process. The CDL number is a alpha-numeric string and State name. Output would be an audio status phrase and a computer screen of past conviction history if present. The CDLIS check also populates certain fields in ASPEN.

TASK #5 VR and Query Central

Over the next few months, FSG will be working to combine these three queries (ISS, PIQ, CDLIS) and others into a highly synergistic application called Query Central. If timing permits, we would include this task to add VR capability to Query Central as it is developed.

TASK #6 ASPEN violation entry collection using VR.

A vehicle inspection involves checking a number of subsystems for correct operation and noting any problems in the form of violations of the applicable safety regulations. The VR approach to doing an inspection is to develop a word phrase hierarchy related to certain violations. The user works through the hierarchy to identify specific violations which are recorded by the system as violations.

This approach has already been successfully tested. The next step is to improve the VR system in Task #1 and implement the same phrase identification system. This approach potentially offers significant time savings but may have to be coupled with a visual indicator to see these benefits. User acceptance based on ease of use needs to be addressed with better systems design.

TASK #7 Identification other inspection areas for VR input

The above tasks only identify the most obvious applications for voice recognition where a time savings is easy to identify. This task would be to further examine the inspection process to look for and develop other VR applications with good cost/benefit potential.

TASK #8 Marketing and system deployment

This entire development effort is designed to go beyond simple Aproof of concept@. We propose taking the completed VR system and doing multiple demonstrations at both the end user and management level. From there we would encourage States to become involved in pilot deployment programs using MCSAP special grant money. The contractor would be involved in the various demonstrations and negotiations for pilot programs. Although States would control pilot program contracts, the likely scenario is for the developer to become the integration contractor for those States. Completion of Task #8 would depend on success in earlier tasks. Obviously we would not market a marginally successful system.

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SOURCE: Federal Motor Carrier Safety Administration
Field Systems Group
Contact: Michael W. Blevins,
Lakewood, CO, 303-969-5140 ext 430
Michael.Blevins@FHWA.DOT.GOV
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