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Voice Response Translator (VRT)

Support for Prototype Development and Results of Initial Field Testing

Prepared for:

Office of Science & Technology
National Institute of Justice

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BACKGROUND

The Voice Response Translator (VRT) is a speaker-dependent, one-way translator designed to assist Law Enforcement Officers in communicating with non-English speaking individuals. The prototype device is being developed by Integrated Wave Technologies, Inc, (IWT) and Eagan, McAllister Associates (EMA) through funding from the National Institute of Justice (NIJ). The VRT uses voice recognition technologies developed in the former Soviet Union. The device, on initial operation, requires users to "program" or "train" the unit to their voice patterns for specific "trigger" phrases. When spoken, the VRT will respond to the trigger phrase with an audio (recorded human voice) translation in a complete command or sentence, in the selected language. For example: if the user is working in Spanish and says "registration" as the trigger phrase the device's response would be "Puedo ver la registracion del vehiculo?" (May I see the vehicle registration?). Because the device uses voice recognition, success in the field is highly dependent on the user saying the trigger phrases with the same inflection and volume as recorded at the time of programming.

This report summarizes the activities of the Naval Air Systems Command Orlando Training Systems Division (NAVAIR ORL TSD) (formerly the Naval Air Warfare Center Training Systems Division – NAWCTSD) related to the evolution of the prototype Voice Response Translator. It provides a record of NAVAIR ORL TSD's efforts in support of NIJ and documents the results of field evaluations of the VRT conducted in Central Florida from May 2001 to May 2002.

NAVAIR ORL TSD ROLE

NIJ and NAVAIR ORL TSD signed an Interagency Agreement in 1997, enabling collaborative efforts such as those involving the VRT. NAVAIR ORL TSD researchers and training experts became involved in NIJ's VRT project in the Spring of 2000 when NIJ requested assistance in the development of training materials for law enforcement officers who would be participating in the field evaluations of the VRT. The first device tested by NAVAIR ORL TSD included 50 phrases recorded in three languages (Cantonese, Vietnamese, and Spanish), and ran on small (286-class) processors (see Figure 1). The device could be programmed for a single user at that time. Over the four-year period of development and evaluation, the number of users per device has grown to eight and the number of phrases has expanded to approximately 200 covering a variety of situations/events including:

- Initial greetings
- Crowd control
- Field interviews
- Victim interviews
- Medical assistance
- Domestic issues
- Lost children
- Traffic stops
- Driving Under the Influence (DUI).

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During the course of developing the training materials, NAVAIR ORL TSD identified hardware and software challenges with the device. NAVAIR ORL TSD worked with IWT and NIJ to help resolve the design and engineering issues and assumed the lead role for training potential users and conducting field evaluations with law enforcement officers. Training requirements and training materials were developed concurrently with improvements and modifications of the device. As engineers tested the device and developed recommendations for modifications, the areas of training development and software engineering began to overlap. Details regarding software/hardware improvements and modifications are provided later in this report. During this time, the device was also introduced to several military units and to the Coast Guard.

TRAINING MATERIAL DEVELOPMENT

In the fall of 2000, NAVAIR ORL TSD was asked to develop training materials that would enhance an officer's ability to operate the VRT device without assistance. At that time, the phrases were already categorized into eight situations. IWT provided NAVAIR ORL TSD with printed materials (some of which were used by Nashville Metro Police in earlier testing) and NIJ requested that IWT provide a device to NAVAIR ORL TSD for use in the development of training materials.

NAVAIR ORL TSD reviewed the initial materials and recommended the refinement of performance support materials (in lieu of a training product) designed to help the officers quickly access the 200 trigger phrases. There were instructional reasons for this approach. As the officers would use some phrases infrequently, retention of the phrases could become a major issue. Furthermore, phrases learned and programmed in the device under classroom type conditions would have to be recalled and spoken in exactly the same manner while the officers were working on the streets. It was determined that most officers would be unable to recall all of the exact words/phrases in order to operate the VRT properly on the street. For an officer to recall the exact words for a given phrase under stressful conditions would be even more difficult (e.g., "Door Open", or "Open Door"?). Phrases used infrequently would be even more difficult or, in many cases, impossible to recall under stressful situations.

NIJ concurred with the recommendation and NAVAIR ORL TSD developed two performance support tools for officers to use. The first is the Evaluation Guide (Appendix A), which provides user directions for initial voice recordings (programming) of trigger phrases, tips for using the device, and a synopsis of situations/events where the device could be helpful. All of the directions needed to use the device were developed and tested in-house at NAVAIR ORL TSD. This was to ensure user success with following the instructions in the Evaluation Guide to record the voice commands and subsequent successful operation of the VRT in the operational environment. Color-coded Command Cards (Appendix B) were further developed to assist the officer in recalling the trigger words and phrases. The color codes arranged commands or trigger phrases into four categories:

Black for the Event (Situation) Command Titles
Blue for commands having to do with paperwork such as "Warrants," "Car Registration," "Insurance," etc.
Green for conversational applications such as "Hello," "Thank you," "Was the Suspect Bald?" etc.
Red for emergencies, such as "Hands Up" "Stop Police,"

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"Does He Have a Weapon?" etc.

The commands within each event (situation) were arranged into sequential order of use. For example, officers ordered the Traffic Stop commands to begin with, "Turn Off Engine" followed by "Step out of the Vehicle." "May I have your Driver's License please" is followed with "Take it Out of Your Wallet Please," and "Your Vehicle Registration Please" is followed with "The Registration is Not Current." Other arrangements of the 200 commands, such as alphabetical within each situation/event had been tried but proved more difficult to use than the sequential order. Once finalized, the Graphics Department at NAVAIR ORL TSD completed the production work for the User's Guide and the Command Cards (Appendices A and B).

NAVAIR ORL TSD also recommended the development of introductory training for VRT users assisting with the field tests. The training is designed for approximately two hours duration with an instructor/student ratio of 1-8. The purpose of this session is to familiarize officers with the Evaluation Guide, the VRT device, and the Command Cards. Officers also receive assistance in programming the trigger phrases and guidance for troubleshooting problems in the field. Two additional tools were developed to assist in the training and evaluation: Lecture Notes for the Training Session (Appendix C) and a field-testing feedback questionnaire for law enforcement officers (Appendix D).

HARDWARE / SOFTWARE IMPROVEMENTS AND MODIFICATIONS

Design and production challenges emerged as NAVAIR ORL TSD prepared the VRTs for the field evaluations. Improvements made by NAVAIR ORL TSD engineers and technicians in the laboratory included a new microphone, improved LED colors and wiring, and standardization of the software. Other needed improvements were identified during the field tests with law enforcement officers. Throughout this process, recommendations were provided to NIJ and IWT and the improvements needed were made prior to completion of the field evaluations. The remainder of this section provides a detailed history of this process.

Initial Observations Related To Hardware

NAVAIR ORL TSD received a VRT from NIJ May 15, of 2000. The device was slightly larger than the current pocket-sized version and was blue in color (see Figure 1). (Note: This was the second version of the VRT but the first one received at NAVAIR ORL TSD.) This unit arrived with a faulty battery circuit. After laboratory trials, it was determined that the unit was unable to hold more than two recordings on a battery charge. These problems were reported to NIJ and IWT agreed to provide a new battery charger. A charger was shipped and arrived within 2 days. However, the new charger did not correct the problem. NAVAIR ORL TSD technicians fashioned an AC/DC adapter and determined that, even when powered, the unit was still not able to record voice commands. NIJ, IWT, and NAVAIR ORL TSD all agreed the unit was dysfunctional.

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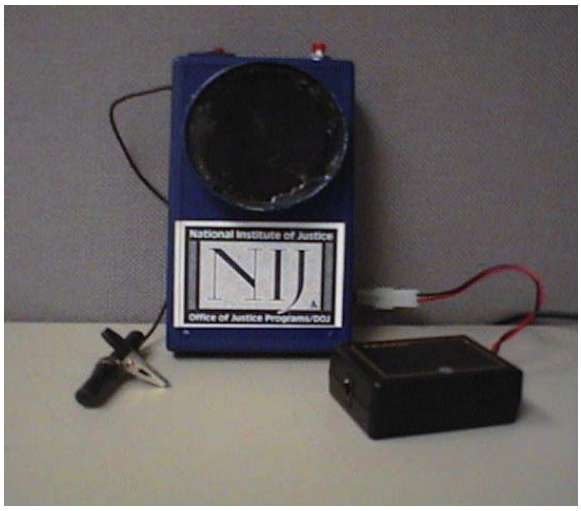

Figure 1. Second Version of the Prototype VRT Device.

An additional unit was shipped. This VRT was gray in color and had a clip on microphone (see Figure 2). The unit had only crowd control and traffic stop situations/events recorded. A flash memory card with a more complete set of the commands was sent from IWT but a check of the translated phrases revealed some translation inaccuracies. In July of 2000, NAVAIR ORL TSD was approved to begin recording revisions of the inaccurate Vietnamese, Cantonese, and Spanish translations.

Figure 2. Gray VRT with Original Microphone.

During in-house testing, the device developed a problem retaining the user's recorded situations/event commands. It was determined that flash memory was the problem, and the device was returned to IWT for repair. In August of 2000, a new Project Manager was assigned at NIJ. The new Project Manager shipped three VRT units to NAVAIR ORL TSD in September 2000. Again, it was discovered that both the software and the

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commands were different from earlier versions. IWT used the terms “Nashville version” and "IWT version" to differentiate between the two. Apparently, changes had been

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made to the original IWT version after some preliminary field tests with officers in Nashville.

Laboratory And Field Tests Of Microphones

During laboratory testing the NAVAIR ORL TSD sound engineer identified the need for improved microphone performance. Initial comparisons of some off-the-shelf microphones with the standard VRT microphone provided confirmation that improved performance was achievable. For example, an off-the-shelf, Radio Shack lapel microphone priced at $15.00 had better reception and better noise reduction than the original VRT microphone. Based on this finding, NIJ approved laboratory and field evaluations of several off-the-shelf microphones (Appendix E).

The laboratory tests were conducted in a sound studio, so the findings included a report of the maximum allowable background decibels before a microphone cuts out, microphone ranges and modifications needed for each microphone, etc. The Crown CM-311A/E microphone had the best noise immunity of those tested and also had fair ability to recognize changing voice inflection.

Field-testing of several microphones followed the laboratory tests. The field tests were conducted on a residential street with 25-30 mph traffic passing by as often as every eight seconds and up to 90-second intervals without traffic (Appendix E). Decibel ratings ranged from very quiet to up to 85 decibels when large trucks passed by. None of the microphones tested were able to operate when decibel readings exceeded 90 decibels. However, even if the microphones could have operated under these conditions, an individual would not have been able to hear the translated phrase (a 85-90 decibel output at 36 inches) over the ambient 90-decibel noise.

One field test involved a patrol car (with the Crown Microphone, CM 311A/E) to determine any problems that might result from road noise, wind noise, and general abuse. On a busy six-lane highway, commands sometimes had to be repeated several times, but no commands were processed incorrectly. Sometimes a command simply could not be recognized, i.e., “situation” and "translate.” On a six-lane divided highway with heavy traffic, the unit was found to be reliable under typical working conditions of a patrol officer. Further tests were conducted to determine if a VRT in an officer's pocket would experience interference problems from operational radios. Those test results were negative.

Modifications Resulting From The Field Tests For Microphones

Field tests of microphones resulted in the identification of several issues that led to additional modifications in the hardware, software, and training materials. For example: the microphone jack broke off one of the units during the trials. This led to a modification in the design of the joints.

A second example occurred as the result of the VRT's consistent difficulty with long phrases. Eighty percent of the failures were multi-word commands (Appendix E). It was hypothesized that shorter one-word commands might work better, since there was less chance for different speed and inflection of pronunciation. IWT later confirmed this hypothesis, explaining that a ¼-second gap between words is discerned as the start of a new command by the unit. The Lecture Notes and Evaluation Guide were modified to

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include this finding. (Note: Later in the project, additional insight was gained regarding the role of voiced and unvoiced sounds from a linguistic viewpoint. See Linguistic Review section of report and Appendix F.)

A portion of the microphone field test results is presented in Table 1. As seen in this Table, 95% of the problem commands were made up of multiple words and 66% were comprised of unvoiced components (see Linguist Analysis section). All of the problem phrases that also subsequently failed in laboratory tests were comprised of unvoiced components.

Table 1. Summary Analysis of Problem Commands from Crown Microphone Field Test

Situation/Event	Not Recognized	Repeats Required
Medical	Chest Hurt * ** You Shot **	She Drugs **
Traffic Stop	Driver's License Write Name	
Field Interview	Hands Behind* **	Door Open Hands Visible ** Arrest Warrant
Crowd Control		Tear Gas
Found Child	Lost Before Father Work **	Police Before Mother Coming * **
Domestic	Kids in Danger * ** File Complaint **	He Strike ** Hit Before * **
Greetings	*Negative*	
Interview Victim	How Tall * **	Pants Color **

* *Six Commands not recognized in subsequent laboratory tests, all six (100%) later identified as having Unvoiced Components*

** *14 of 21 (66%) Commands were later identified as having Unvoiced components*

Italics: Only single-word Problem Phrase, all others (95%) were Multi-Word Commands

An additional hardware modification resulting from the microphone field tests was the development of the option for a citation book adaptation. During the field-testing period, NAVAIR ORL TSD was also conducting interviews with Police Officers for feedback regarding the Evaluation Guide and to determine general acceptance for the guide. There was little support for a completely hands-free device as most officers preferred not to have another piece of equipment on their belts or in their pockets. As an alternative the device was mounted onto a citation or modified “ticket-book.” These devices were also equipped with adjustable gooseneck microphones. This adaptation ensured the microphone would be in place whether the device was used with a bullhorn (Figure 3) or a citation book (Figure 4) and would be suitable for the hands-free (wearable) pocket version.

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Figure 3. VRT, Goose Neck Microphone and Bullhorn.

Figure 4. VRT Mounted on Citation Book.

Another issue that emerged during the early testing period was that of standardization. This was due to the fact that improvements and advancements were being incorporated as the product evolved. In October 2000, nineteen new units arrived from NIJ. The units had three different hardware configurations and required reprogramming to provide consistency and reliability with the commands across the units. At that time, NAVAIR ORL TSD had received a total of 25 units, with four different versions of the software program and three different hardware configurations. Out of 25 units, ten units appeared to be identical, but tests revealed that the indicator lights functioned differently during use. The 25 units were modified so that they had the same hardware configuration (Appendix I), same phrases and trigger cues (Appendix F), the same eight-user option executable directory (Appendix G), the same indicator light configuration (see Figure 5), the same microphones (CM 311A/E), and the same (minimum 32mb) memory capacity.

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NAVAIR ORL TSD ordered a newer version of the 311A/E Crown microphone that had reduced the noise reduction circuitry from the size of a small wallet to less than an eighth of an inch in diameter on the microphones wire harness. After testing the engineer recommended the model with smaller circuitry be used in all subsequent field tests and evaluations. The later version incorporated the electronics into the wiring between the microphone and the receiving device, eliminating the requirement for the user to wear any additional equipment when using the Crown Microphone. The change in microphones was approved by NIJ for all devices in December 2000.

NIJ also approved the evaluation design in December 2000. This included the evaluation guide, command cards, lecture notes, and feedback questionnaire for law enforcement officers using the VRT (Appendices A-D). At that time, NIJ requested that NAVAIR ORL TSD proceed with the field evaluations.

Subsequent to NIJ's request to initiate field tests, IWT added new commands for two new events (Routine, Custody). The decision was made not to include these in the field tests since the command cards, evaluation guide, and training literature had already been printed. At about the same time IWT introduced a version of the program that could support ten languages (with purchase of new 64MB Compact Flash cards). Rather than pursue additional translations for six new languages, it was decided to proceed with an evaluation of ten units. Then as NAVAIR ORL TSD technicians replicated the units; others were to be added to the field evaluation as they became available.

FIELD EVALUATIONS BY LAW ENFORCEMENT OFFICERS

The first field evaluations were conducted with the West Palm Beach, FL Police Department (PD). Five officers received the citation book version of the VRT and three officers received a hands-free, wearable version. All eight units were programmed with commands in Cantonese, Vietnamese, and Spanish. The translations for all languages were complete and had been verified.

During the initial evaluation period, West Palm Beach PD requested the addition of Creole translations. NIJ approved this change as an opportunity to learn and document how to make such modifications. At the end of the initial three-week evaluation period, NAVAIR ORL TSD personnel returned to West Palm Beach to collect the officers' reactions and comments. At that time, NAVAIR ORL TSD technicians recorded and reprogrammed the language software (substituting Creole for Cantonese) on three units. The time required for recording, editing and loading the Creole onto three units was about 12 hours, and a local police officer who spoke Creole provided the translations. (Instructions for programming the VRT were documented at this session and are provided in Appendix G.) The three units with Creole were left with the officers at West Palm Beach PD to complete their evaluation. After the West Palm Beach addition of Creole, all units to be used in the field tests were modified to include all four languages. Additionally, based on officer feedback from the initial testing period, all units were enhanced with low battery indicator lights, "on" indicator lights and bullhorn jacks (See Figure 5).

The VRT was then evaluated at six different Central and Southern Florida law enforcement agencies (West Palm Beach Police Department again, Seminole County Sheriff's Office, Oviedo Police Department, Orange County Sheriff's Office, Pinellas

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County Sheriff's Office and the Ocala Police Department). Officers were provided with approximately two hours of training, including approximately five to ten minutes of one-on-one, on-site coaching by NAVAIR ORL TSD psychologists (see Appendix C, Lecture Notes). One-on-one proficiency checks were conducted to help reduce street-related problems experienced in earlier stages of the evaluation. Each officer also received the Evaluation Guide, Command Cards, and a VRT unit (mounted on a citation book or the hands-free, wearable version). A total of 27 VRT units were distributed. Over a period of approximately 3 weeks, 23 of the 27 officers were able to use the device. The officers generally worked four days per week, depending on their department's shift schedule. Thus, the total field evaluation time was 276 days (23 Officers x 4 days x 3 weeks) of on-the-street use of the device. (The remaining four devices were found to be dysfunctional by the officers and the NAVAIR ORL TSD technicians confirmed this finding when the units were returned.) NAVAIR ORL TSD then conducted interviews with the officers in person or via telephone to complete the evaluation questionnaire (Appendix D).

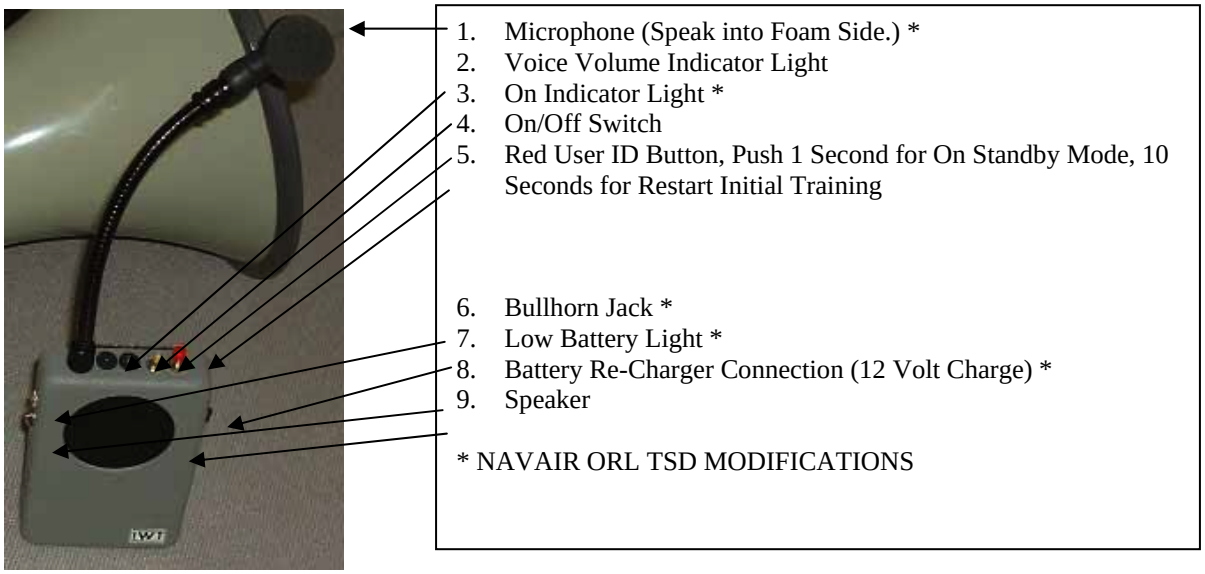

Figure 5. Detail of Added Features on Enhanced VRT.

EVALUATION FINDINGS

During the training sessions for officers participating in the field evaluations, it was noted that important tips on using the device were best delivered via modeling the behaviors, rather than having the officers read the guide alone. The officers did generally not use the written instructions regarding vocal volume levels or how to hold the device. (This finding is not unusual as many people skip or skim operating instructions and user manuals when first using new appliances, technology, or software.) Communicating how closely to hold the microphone to one's mouth was most effectively conveyed with modeled demonstrations. For this reason, consideration should be given to developing an instructional video demonstrating how to hold, use, speak into, and control the device for potential users who may not have the benefit of one-on-one instruction or who might need refresher training.

The evaluation questionnaire and interviews were conducted to obtain data related to engineering issues as well as how the VRT was used in the field. A summary of the

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questionnaire results can be found in Table 2 with detailed results provided at Appendix H.

Table 2. Summary of Field Evaluation

Question	Summary Results	Further Analysis
1. Problems with recording voice.	56 % reported problems → see breakdown at right 44 % reported no problems	• 15 % (2 units) confirmed as faulty devices • 15 % (2 users) attributed to failure to follow directions • 70 % attributed to device sensitivity to phrasing/ volume/accents
2. Time required to become comfortable with VRT.	65 % required less than one day 35 % did NOT achieve a "comfort" level	Of the 35% who did not become proficient with the VRT: • 2 confirmed faulty devices • 2 failed to follow directions
3. Clarity of Evaluation Guide	100 % reported guide clear	• Lecture materials added
4. Where used and conditions.	Most tried to use in multiple conditions -- indoors, outdoors, traffic, varying weather conditions	• 11 officers used indoors • 11 used outdoors • 9 officers used in traffic • 2 used with crowds
5. Number of days the officer had the device.	Varied from 7 to 14 days	• Total number of days in field evaluation was 276
6. Total number of times used for police work.	Range from 0 – 20	• Average three opportunities per officer
7. Languages used	Positive tests of all languages in restaurants and homes	• 14 used Spanish • 2 used Creole • 1 used Vietnamese
8. Situations/events where VRT was used.	Device used in all situations	• Traffic stops 40 % • Greetings 9 % • Other situations/events 3%
9. VRT problem areas.	Problems reported 35 times in 78 uses in the field. Only six of 23 respondents reported no problems	• Microphone failure to pick up voice most common problem • Unreliable in noise and with unvoiced commands
10. Recommendations for VRT	Wide range of ideas and recommendations	• Volume switch most requested feature • Others see Appendix H
11. Recommended Commands	Most common shortcomings identified were DUI and Lost Driver's License situations	• Driving Under Influence • Please Write Date of Birth • Miranda Rights • Permission Weapons Search • Ability to give directions

The highest use reported involved traffic stops with the VRT successfully assisting in 31 cases. The VRTs were also used more than once in each of these situations/events:

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- Found child
- Medical emergency
- Interview victims of crimes
- Field interviews
- Domestic disputes
- Crowd control

Officer feedback also indicated the need for additional phrases to assist in DUI arrest procedures and in searching for a record of a lost driver's license (DL). Search parameters require a birth date and State in which the Drivers License was issued.

Officers unable to use the device often stated it was too sensitive to voice inflection and phrasing (see Table 2, question 9). One officer who was very soft spoken demonstrated how his voice changed inflection and tone when on the street. This change in voice tone and volume rendered the device unable to recognize the commands he had recorded in his normal (off the street) soft-spoken tone of voice. Those with distinctive ethnic dialects or varied speech patterns/accents also had considerable trouble getting the device to recognize their commands, as they seemingly varied their speech patterns somewhat randomly. One officer, who spoke Hebrew as his first language, was unable to get the device to work at all using English spoken commands. This may have been the result of his tendency to mimic the pre-recorded voice during recording and verification. When he recorded the trigger phrases in his native Hebrew, he reported that the device worked "extremely well."

The tendency to mimic the pre-recorded English voice appeared to be natural during the recording and verification phases of training the device. However, when using the device, there is no such prompt, and many officers were simply unable to recall exactly how they had mimicked a given command. This may be due in part to the fact that some of the commands are prompted as a question, with an upward inflection at the end of the phrases while others are spoken as statements. When officers were asked to state the troublesome key phrase as a question, they were more successful in the operation of the device.

A final finding was that approximately half of the twenty-three officers were interested in continuing use of the device. Those that wished to continue using the device reported it was useful, user-friendly, and that the device enabled them to handle many situations that otherwise would have required a translator. The rest of the officers (again about half) had reported that they found it difficult to operate, and consequently opted not to use it. In summary: the officers were either strongly positive about the device, or extremely negative about it, depending on how user-friendly they found it to be.

SUMMARY OF IMPROVEMENTS AND MODIFICATIONS

Table 3 is a summary of the improvements and modifications made to the VRT as a result of laboratory and/or field tests. Both hardware and software changes are included and detailed in Appendix I.

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Table 3. Summary of Problems Encountered and Improvements/Modifications

PROBLEM	IMPROVEMENT / MODIFICATION
1. Users inadvertently drain battery	Power On indicator
2. Loss of power without warning	Low Battery indicator
3. Inconsistent Light Emitting Diode (LED) color and functions	Standardized LED colors and wiring
4. Insufficient volume output	Audio output jack and bull horn added
5. Need to charge unit when not near 120 volt source (i.e., in police vehicle)	12 volt recharging unit on circuit board & cigarette lighter charger
6. Poor overall performance -recognition	Laboratory and field tests of microphones
7. Microphone tests reveal range of discrimination & sensitivity	Replace original microphones with top performing noise rejecting Crown microphones
8. Varied noise levels in environment problem in first field evaluation site	Optimal gain control Setting (at low) for enhanced user recording/reliability
9. Users mimic pre-recorded voice	Analysis of numeral-based trigger commands
10. Users unwilling to wear device	Ticket/citation book holders developed
11. User manual technically difficult to read	Eighth grade level evaluation guide & lecture training materials developed
12. Commands very similar in nature require different prompts (i.e., Write All, Telephone)	Deletion/correction of redundant/ multi-word commands (e.g., Show Hurt, Where Hurt)
13. Device clips end of recorded trigger phrase during recordings	Trimmed phrases to remove dead pause at end of recorded commands
14. User can't find or recall commands	Command Cards task-sequenced, tabulated, color-coded
15. User reactions to be collected	Questionnaire developed, approved
16. Needed lead for field evaluation	NAVAIR ORL TSD directed initial field evaluation in Central and South Florida
17. Language recordings need quality check	Creole (new) Cantonese, Spanish, and Vietnamese (verified and corrected)
18. Commands that begin with "s"	Identified command strengths & weaknesses; Linguist analysis of commands and revisions
19. Need to identify best types of words for commands	Linguist review of commands to maximize voiced components of speech
20. Need for Driving Under the Influence (DUI) commands and "write your birth date"	Standard DUI phrases added and verified
21. Need for additional languages	Chip with 10 language capacity added
22. Need for lost Drivers License commands	Phrases for "write State Drivers License was issued in"

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ACTIVITIES AND ADDITIONAL RESEARCH

In addition to the field assessments, NAVAIR ORL TSD also provided support to NIJ regarding several factors that could influence the commercialization of the VRT. These included: 1) an evaluation of the trigger phrases by linguistic experts, 2) a comparison of the VRT with other similar devices, and 3) other potential markets for the VRT in Public Safety. Therefore, the next sections of the report present linguist's analyses of the trigger phrases used, a comparison analysis of the VRT with other products claiming to have similar capabilities, and finally a description of how the device was introduced to the Navy and U.S. Coast Guard and modified for testing in those environments. (Note, the VRT was also demonstrated to representatives from the Drug Enforcement Agency (DEA), the Environmental Protection Agency (EPA), and several other public safety agencies.)

Linguist Analysis Of The Non-Recognition Problem

Throughout the evaluation period, there were ongoing discussions theorizing that some of the VRT's problems with recognizing the trigger phrases might be due to linguistic issues. At NIJ's request, NAVAIR ORL TSD researchers met with two professors from the Communicative Disorders Department at the University of Central Florida to explore this theory. Discussions included why some commands worked well and others did not. The professors were not prompted with pre-identified problem phrases, other than to say that commands such as "Hello" did not work reliably on the device. The professors were given the list of 200 Law Enforcement commands used on the device for review prior to the meeting. NAVAIR ORL TSD personnel gained substantial insight into how linguistics could well be a contributing factor to some of the problems encountered. The professors explained how speech is composed of two components, voiced and voiceless (AKA sound and noise). The voiced components do employ use of the vocal cords and one can touch the throat and feel vibrations when making these sounds. A way of determining this is to touch the throat while talking and see "if the motor is humming." The device we are using is designed to discern using primarily these vibratory voiced portions of speech and to match with the pre-recorded phrases within the current situation/event. They include:

B, D, G, V, Z, & A, E, I, O, U, and other blends and consonants.

The voiceless speech components do not require use of the vocal cords; rather air and the shape of the mouth, tongue, and teeth are employed to make voiceless (or noise) sounds. These include:

Ch, F, H, K, P, S, Sh, T, Th, Wh

For example, a phrase like SIT DOWN (a command in the Medical Situation) is said without use of the vocal cords at the onset and ending of the phrase. Therefore, this phrase should be avoided on a device like the VRT. Only the "I" in the middle of the word "sit" will generate a signal that can be reliably detected by the device, as the "I"

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requires voiced components of speech. Down ends with the nasal consonant “N” that is produced with air flowing through the nasal tract and the vocal tract totally constricted by the tongue behind the front teeth. Therefore, if a command such as SIT DOWN must be used, it should be preceded by a word that is rich in voiced inflections, such as PLEASE. So now, the command becomes "Please Sit" which the device should more reliably recognize than simply "Sit Down." (The P in Please is acceptable as it is blended with an L, the "PL" blend in the sound onset.)

It was also pointed out that someone with a sore throat or someone who has been yelling has a notably different voice quality. After overuse of the vocal cords, nodules and swelling can occur on the tissue, and one's voice generates noticeably more voiceless sounds (that is, hoarseness results). It had been reported by several of the officers during the debriefing that they had to re-train the device because of chest or head colds.

It was learned that the VRT problems can be explained using research findings from the late 1970's and early 1980's. Researchers at that time were seeking a method of capturing a subject's reaction time more efficiently. Rather than have subjects manually push a button, it was thought that using voice activated microphones could simplify the gathering of reaction times. What the researchers found was that "voice onset" varied as a result of the specific spoken phrase being used by the subject to indicate their reaction time. Phrases with more noise (that is: voiceless) components were not detected reliably, while phrases with overt voiced components tended to be captured more reliably.

NAVAIR ORL TSD reported the results of the meeting with the linguistic experts to NIJ. It was agreed that a modified version of the commands, to make the users voiced speech more pronounced was needed. It was recommended and approved that improvements be made on 32% of the Law Enforcement command structure (Appendix F). The changes were subtle, yet should improve future performance of the trigger commands. Examples include "Situation" replaced with "Event,” and "Put Hands" replaced with "Place Hands.” "Situation" of course begins and ends with "noise" - as does PUT and HANDS.” The command “Put Hands” is compounded with a combined "noise" in the middle, so if one does not loudly enunciate the T-H sound in the middle, all the device may hear is UU-AAND. Another good example is replace "How Old" (which starts with a voiceless/noise based H-W) with "Your Age.” (For a complete list, see Appendix F.)

Potential Solution For Mimicking Prompts Problem

There is a need to identify an optimal way of cueing the user to state each phrase during recording verification. Due to the natural human tendency to mimic another's accent, mannerisms, and cadence when repeating words, the linguists recommended the use of a flat sounding "computer-generated" voice as the prompt for recording the user's voice. The use of a computerized voice might help to prevent the mimicking of the voice prompt and avoid any unintended inflections. For example, we could avoid the upward questioning inflection that naturally comes from an English speaker’s voice when asking a question. It was also suggested that having a woman’s voice provide the English commands might lessen the largely male law enforcement population’s tendency to mimic the pre-recorded voice. There is one additional factor for consideration. The wave file used to prompt the users recording is also used in the operational environment

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to verify the command. This is to assure the user that the device has accurately recognized the phrase triggered. The combination of a male officer saying the trigger phrase with confirmation of the phrase in a female voice could result in additional confusion for non-English speaking personnel.

Comparisons With Other Hand Held Translator Devices (Phraselator, Ut-30, Pda's)

At NIJ's request, NAVAIR ORL TSD conducted an analysis to compare the VRT to three other products with similar characteristics or claimed capability. The hand-held translators were all about the size of a large pocket calculator. Some of the devices included a microphone and speaker, or jacks for attachment to a bullhorn. Others had an option for manual or voice-activated operation. The devices all use compact flash memory modules that contain pre-recorded phrases in foreign languages. Some of the voice-activated devices are speaker independent while others are speaker dependent. The user triggers the translated phrases either manually from a menu or by spoken words or phrases into the device. The device then "translates" these command/words/phrases into corresponding phrases in a pre-recorded foreign language. Note that like the VRT, these devices are not true translators: any keystroke, word, numeral, or phrase can trigger the output of an existing, pre-recorded foreign language phrase. A comparison with several other devices that are currently in development or commercially available in the marketplace follows.

Phraselator

Marine Acoustics is developing a handheld translator, called the Phraselator, with speaker independent speech recognition. This means that an individual can use the device without having to record their voice for specific recognition. Unlike the VRT, the Phraselator is not a hands-free device to operate. Marine Acoustics completed the design in 2001 and expects to be building and delivering the Phraselator prototypes in 2002. The demonstration model of the Phraselator had the software loaded on a COMPAQ IPAQ (Pocket PC). The final product should be a "box" containing a SA1110 Strong ARM 206MHZ processor running Windows CE and the translator software. The software uses SRI's DynaSpeak as its speaker independent speech recognizer. The "box" will have a microphone-speaker developed by Marine Acoustics and will be slightly larger than an IPAQ. It will have a noise canceling microphone and a 1-watt speaker. There will be an option to use lithium ion batteries or off-the-shelf (three AA sized) batteries to power the device. The Phraselator will have an audio output jack for connection to a bullhorn as well as audio input jacks to supplement the microphone on the "Phraselator." The user will be able to load new phrases and/or languages or edit existing phrases and languages using proprietary software and training provided by the developer.

As of January 2002, Defense Advanced Research Projects Agency (DARPA) was scheduled to deliver 500 units in the next few months (using DARPA plus-up funds). The device was to be equipped with the following languages: Eastern Farsi; Pushti; Erdu (Hindu); and Gulf Arabic. A copy of the software was sent to NAVAIR ORL TSD in January 2002 for review. Based on specifications provided, there are some engineering concerns regarding the low performance type microphone, and the fact that it does not offer hands-free operation. Reported plans are to produce 1000 units with priority going

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to the Special Operations/Operation Freedom units. Price is estimated at about $1200/unit, with all income being invested in the production of additional units.

UT-103

The Universal Translator 103 is an off-the-shelf commercial unit that retails for $250.00. The unit has over 3,000 phrases and can be voice activated (i.e., in a hands-free mode) or hand-held and manually controlled. While the device is speaker independent, the device's ability to discriminate what is being said was found to be poor when tested in the NAVAIR ORL TSD laboratory. Additionally, the phrases were very difficult to recall or locate by manually navigating the list. The unit operates on AA batteries and reportedly has a 20-hour battery life. The speaker on the unit was considered very small and underpowered. Although the UT-103 has a volume control, the unit produced unintelligible sounds at high volume levels. It does have audio output jacks, intended for headphone listening. The unit is housed in a plastic case that appears fragile. The unit has a screen with a two-line readout, which is relatively difficult to read. Navigation is also considered difficult. Tests repeatedly found the UT-130 to be difficult to learn to operate, unreliable in performance, and the user manuals were considered equally low in quality. The user cannot modify the device. Additionally, the software is not government-owned.

PDA/IPAQ

As part of the overall technical evaluation, NAVAIR ORL TSD engineers tested the feasibility of using a commercial, off-the-shelf PDA to perform some of the desired functions. The IPAQ PDA was selected as a test unit and government owned software and sound files were loaded as a modifiable form of translated phrases. The commercial PDA's base cost was less than $500. With upgraded memory cards (costing about $1,000) the unit has capacity for delivery of 200+ commands in 12 languages. The units have volume controls, but the sound quality is considered low. The units can run on rechargeable or AA batteries, and can be operated for up to eight hours. Inputs are limited to manual operation (i.e., no voiced inputs) but the large touch-screen makes it easier to navigate and select phrases than the two-line screen on the UT-103. One additional drawback is the fact that these are not hands-free devices; one must hold the device in one hand and select commands with the other. The unit, however, is considered user-friendly, easy to operate and requires virtually no training time for the user to learn to operate.

Summary Of Comparisons

The handheld translators all have unique strengths and weaknesses for consideration in determining suitability for law enforcement. First, the voice command interfaces provide hands-free operation, but were largely unreliable, or speaker dependent, and/or untested. While the VRT device requires a "voice training/imprinting" session, it does now have the capacity for storing up to eight different users' voice commands. At the time of this evaluation, the other voice-activated devices were either untested by the agency (Phraselator) or erratic at best (UT-130) in performance. Second, the voice recognition systems tested here were somewhat intolerant of variations in voice inflection and volume. Third, three of the devices were configured to take speech inputs; three could be manually triggered; and two (the Phraselator-untested and UT-130-

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unreliable) made claims to do both in the field. The lack of manual input on the VRT could possibly be overcome by specifying the addition of a miniature keypad or touch-screen for manual input, before commercialization. Finally, it was the opinion of the NAVAIR ORL TSD research team that there are multiple types of users in Public Safety, with each type requiring unique configurations of a hand-held translator device. For this reason, no one device would meet all these requirements. This is substantiated by the fact that even the Patrol Officers interviewed had contradictory opinions about which input method made the most sense for on-the-street use.

A comparison of the suitability of these four units for Law Enforcement can be found in Table 4. Comparisons of the four units find remarkable similarity, with the largest differences being 1) ruggedness, 2) quality of speakers and microphones, and 3) voice-activation for hands-free operation. In the comparison, the VRT scored as the top choice for law enforcement. The second choice is the IPAQ, although it's lack of hands-free operation and speaker output quality were serious shortcomings for street law-enforcement applications. The shortcomings of the VRT (lack of a volume control, lack of an auto-off feature, and lack of a PC link) could be easily overcome with a specification for these features included in the production/manufacturing requirements.

Table 4. A Top Rank Comparison of Hand Held Translators

Criteria Rating	**Phraselator**	**VRT**	**UT-103**	**IPAQ**
1. # Phrases	1500	200+	3,000 *	200+
2. # Languages	5	10 *	4	10/card *
3. LE Situations	No	Yes *	No	Yes
4. Volume Control	Yes *	No	Yes *	Yes *
5. Time to Market	Not Tested**	< 6 months	On the shelf *	< 6 months
6. Batteries	Rechargeable *	Rechargeable *	AA	Rechargeable *
7. PC Link Jack	USB Jack *	None	No	Yes *
8. Auto Off	Not Tested	No	Yes *	Yes *
9. Screen Image	Yes *	None	Poor	Yes *
10. Govt. Owned	No	No	No	Yes *
11. Speaker Indep.	Yes *	No (8 Users)	Yes, Poor	N/A
12. User Friendly	Not Tested	½ Time *	No	Yes
13. Hands-Free	No *	Yes *	No	No 2-Handed
14. Easy Changes	No	No	No	No
15. Field Tested	No	Yes *	No	No
16. Price	$1,200	$ 3,000	$ 250 *	$ 1400***
17. Battery Life	Not Tested	9 hours	20 hours *	8 hours
18. Voice Activated	Not Tested	Excellent *	Poor	No
19. Speaker	Fair	Excellent *	Poor	Poor
20. Rugged	Not Tested	Yes *	No	No
TOTAL Top Ranks Law Enforcement Criteria	**6**	**9**	**6**	**7**

Rating: ***** = Best Performer
Note: When units were equivalent, both received the same rating.
***Not Tested in this Study.*

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****Price includes upgraded memory card. Cost for memory cards has decreased since time of this study.*

FLEET/COAST GUARD INTEREST

As a direct result of this collaborative effort between NIJ and NAVAIR ORL TSD, a variety of Naval Officers and Department of Defense civilians were exposed to the VRT. Specifically, the Navy Criminal Investigative Service (NCIS), Coast Guard, and several commanding officers of U.S. Navy ships expressed interest in a hand-held translator like that developed by IWT, Inc. and EMA, Inc.
NAVAIR ORL TSD provided funding for device modifications and the development of nautical versions of the instruction booklet and command cards. The NIJ sponsor approved the temporary conversion of four law enforcement translators for experimental use by the Fleet. With that approval, NAVAIR ORL TSD modified the devices and/or software to enhance performance at sea. Coast Guard and Navy personnel collaborated and agreed on a collection of 200+ nautical commands, which were organized into nine situations/events. NAVAIR ORL TSD then arranged for the pilot tests onboard the USS Klakring, FFG 42; the USS Samuel B Roberts, FFG 58; and the USS The Sullivans, DDG 68.

FUTURE WORK/RECOMMENDATIONS

The need for multiple modifications to hardware and software was identified throughout this evaluation. Some of those requirements were identified early in the testing period. In those cases, the modification was accomplished and incorporated in the remaining evaluations. For example, the need for a battery indicator light was identified during the first weeks of evaluation at West Palm Beach Police Department. All devices used with other participating agencies had the benefit of having this feature already installed at the time of their evaluation. The following summary points and lessons learned may be useful should a decision be made to proceed with commercialization.

- Users will need detailed procedures for adding or editing commands, languages, and situations/events. These procedures should be published as well-defined, user-friendly instructions for non-technical personnel to follow.

- While users need the capability to add or edit the existing database, it is recommended that the agencies maintain central control over phrases and languages that are used on the devices. The patrol officer (or device user) could submit a request for a change. If approved by the agency's central authority, the request would then be processed and the change made to the agency's central database of translated commands. For example, the new command sound files might be routed to legal, community relations, and other departments for screening purposes. Once approved, the command, and its translation, would be loaded onto all of the devices under the agency's jurisdiction. It is <u>not</u> recommended that individual officers have the ability to modify commands. The potential for liability to the agency is too great. The proposed procedure would ensure central control. New translated phrases would have full approval of the department or agency prior to being systematically implemented.

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- Users should have a choice as to configuration, e.g., mounted on bullhorn, mounted on citation book, or hands-free/wearable.

- Any new phrases should undergo linguistic analysis before approval.

- Consider computerized voice for prompting users when they are initially recording and verifying their voice commands.

- Consider developing an instructional video, which demonstrates how to hold, use, speak into, and control the device. This video would accommodate potential users who may not have the benefit of one-on-one instruction or who might need refresher training.

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APPENDIX A - VOICE RESPONSE TRANSLATOR EVALUATION GUIDE

Introduction

User's Guide for

VRT

Voice Response Translator

The National Institute of Justice (NIJ) is sponsoring the development a communications tool to help better serve non-English speaking people and cultural groups. The Naval Air Warfare Center Training Systems Division (NAWCTSD), Orlando, Florida is assisting NIJ with the evaluation of this tool. The pocket-sized, voice activated, Voice Response Translator (VRT) developed by Integrated Wave Technologies (IWT) will communicate with persons who have difficulty comprehending English. Potential users should be aware that this communications tool is not designed to completely resolve all language problems. For example, the VRT will only translate phrases to predetermined languages (for example, Spanish or Creole) and the person being addressed will be told to nod yes or no, or to write down answers. The VRT will not translate what the individual is saying back into English. Also, the VRT is a user-dependent system, and can only recognize (up to eight different user's) pre-recorded voice commands. Should an ninth person wish to use a VRT device, that person must record their voice over another users pre-recorded voice commands (recordings take about 20 minutes).

Since the inception of this development effort, five generations of the VRT prototype have evolved. NAWCTSD is assisting NIJ in a field assessment of these 5th generation prototype devices in several locations. Based on what is learned from the various individuals participating in this evaluation, NIJ will evaluate the need for improvements to the VRT, prior to pursuing the commercialization and subsequent commercial distribution processes.

The manual will assist personnel with initial set-up and training needed to become proficient with the VRT. The device can fit easily within a shirt pocket. The VRT can also be attached to a clipboard if preferred. Users must consistently place the microphone in the same location (that is, very close to the users mouth) when recording and using the VRT. Failure to consistently place the microphone the same location will result in the VRT not responding to the user's commands. The manual explains how to set-up the VRT, and offers other ***TIPS!*** on use of the device. Your participation in this evaluation is greatly appreciated, as your comments and suggestions will help to ensure the commercial device is optimally designed for the 21st Century.

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Set-up of your VRT

The VRT is designed to recognize your voice, but in order to do this you must first record all of your voice commands on it in a loud, clear and consistently commanding voice. After turning on the device, press the red button on the top to select your user number (up to eight users can record their voices onto the device). To record commands, simply listen to the VRT command, and then repeat each command into the VRT microphone. After a number of commands are recorded, the VRT will ask you to repeat those commands a second time to ensure that the VRT can recognize your commands. For this to work, you must speak the commands in exactly the same pitch, inflection, volume, speed, and keep the microphone the same distance from your mouth each time you speak them. This ensures that the commands are recorded and verified quickly and easily, before you record another set of commands. Please read the ***TIP!*** Sections carefully, and review the instructions before you begin recording (it will save you some headaches and confusion later). It will take you about 20 minutes to record the individual phrase commands for all of the situations supported by the VRT device. These situations and phrases are indicated on the easy-reference cards. The recordings of your commands will not be lost or degraded when you turn off the device. In fact, you may turn it off at any time without worry.

TIP! **Always watch the light on your VRT**

The lights on the top of the VRT serve a dual purpose. When you first turn on the VRT, they will briefly illuminate, indicating the unit has power. After it is turned on, the same lights act as sound level indicators, flickering from green to orange during recordings. While recording, project your voice volume and keep the same distance between the microphone and your mouth, so that the light goes into a yellow-orange color. **If the light does not come on while you are speaking, or if it flickers in green only, the VRT has not heard you. Simply repeat the command with more volume, clarity, or correct the distance between your mouth and the microphone.**

TIP! **When you hear the recording prompt, wait until the red light goes off before reciting the command. This allows the VRT to switch from play to record. Though this takes only a fraction of a second, do not begin speaking too quickly or your command may not be completely recorded.**

Recordings should be done when you are alone, in a quiet room so that there is no background noise. Make sure there will not be any interruptions from telephones, radios, or other people. Speak loudly, as if you were on a street in heavy traffic. **Maintain a consistent distance between the microphone and your mouth, and speak in a fairly loud, commanding voice. Watch the light during recording. If you vary the pitch, tone, or speed of your voice the VRT may not recognize your command. You must speak in a consistent and commanding tone of voice. Up to eight users can record their voices on the VRT, when you turn the unit on, just press the red button twice if you are user number two, three times if you are user number three, etc.**

READ THIS PAGE FIRST!

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The parts of the VRT

Figure 1.

1. Microphone (sound cancelling)
2. Battery Re-Charger Connection
3. Voice Volume Indicator Light
4. Battery Status Indicator Light
5. On/Off Switch
6. Red Interrupt Button, 1 sec. On Standby Mode, 10 sec. Initial Training
7. Speaker
8. Easy Reference Cards
9. Bullhorn Jack
10. Low Battery Indicator

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VRT Recording Instructions

Step 1:
(Takes 3 Minutes)

Record:
- Initial Commands
- Language Commands
- Event Commands

Purpose of the VRT Recording

The purpose of recording is to ensure the VRT can recognize your voice. You must first record ALL of your voice commands on the VRT prior to using it.

Phrases emitted from the VRT are in ALL CAPS, while your voice commands are always in "Quotation Marks."

TIP! **Say it again when the VRT is silent for more than 4 seconds**

1. Turn the VRT On using the Top Switch

2. Press the Red Button up to eight times to select your user identification number.

It will say: *INITIAL TRAINING, TO TRAIN PLEASE SAY THE FOLLOWING WORDS:*

MY LOCATION	you say "My Location"
CHANGE LANGUAGE	you say "Change Language"
EVENT	you say "Event" etc.

(See Command Cards for a complete list of all 24 commands to be recorded)

TIP! **GOOD BYE is one of 12 Initial Commands to be recorded**

4. Next the VRT will say:
TO VERIFY PLEASE SAY THE FOLLOWING WORDS

You simply repeat each word, until VRT says:
TRAINING COMPLETE

TIP! **Don't rush, wait until the red light has gone out before repeating each command.**

TIP! **If the VRT does not respond, repeat the command. If there is no response for 20 or 30 seconds, turn the unit off and begin again.**

TIP! **The first recordings require the most repeats and volume. Stand up and use your diaphragm!**

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Step 2:
(Takes 20 Minutes)

Record Event Commands

1. Record ALL of the Initial Commands, then briefly press the Red Button to put the VRT into ON STANDBY mode. If you don't say anything, it will automatically go to STANDBY mode.

2. Say "Begin Training"
   VRT says: *WHICH EVENT?*

3. Say "Medical"
   VRT says: *MEDICAL, TO TRAIN PLEASE SAY THE FOLLOWING WORDS*:

IN PAIN? you say: "In Pain?"

WHERE HURT? you say: "Where Hurt"

(See complete list of Medical commands on the Medical command list)

4. Continue until all Medical Commands are recorded

5. VRT says: *TO VERIFY PLEASE SAY THE FOLLOWING WORDS...*

IN PAIN? you say: "In Pain?"
(Again, repeat each command)

6. Repeat steps 2-5 for each event on the Command Card.

TIP! **Watch the LIGHT: When you hear the recording prompt, wait until the red light goes off before reciting the command. This allows the VRT to switch from play to record. Though this takes only a fraction of a second, do not begin speaking too quickly or your command may not be completely recorded.**

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Step 3:

Using Your VRT

- SELECT LANGUAGE "Different Language"
- TELL CITIZEN HOW VRT WORKS with "Begin Directions"
- SELECT "EVENT" Eight to choose from!
- USE COMMANDS Listed on Card "DIFFERENT LANGUAGE" or "EVENT" whenever necessary

Turn on VRT.

1. Try a few of the Initial Commands, these work at all times! (See Initial Commands Card)

2. Say "Different Language", VRT will say *DIFFERENT LANGUAGE?*

3. Say "Creole", VRT will say *CREOLE*

4. Say "Begin Directions" (You'll use the command "Begin Directions" every time you use the device. "Begin Directions" tells the person being addressed how the VRT will help you communicate with him/her.), VRT will say in the selected language:

   I AM SPEAKING THROUGH A DEVICE THAT TRANSLATES SELECTED PHRASES INTO (Spanish/Cantonese/Creole/Vietnamese). PLEASE RESPOND WITH HAND SIGNALS OR BY WRITING ANSWERS FOR ME. PLEASE NOD YOUR HEAD FOR YES AND SHAKE YOUR HEAD FOR NO.

5. Say "Event", VRT will say *WHICH EVENT?*

6. Say selected situation, for example "Medical," VRT will say *MEDICAL*.

7. Proceed to give Medical Commands listed on the Command Card.

8. At any time, you may "Different Language" or change "Event" ...

Try it!

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Command Reference List

- "Begin Directions" Plays the following:
- *I AM SPEAKING THROUGH A DEVICE THAT TRANSLATES SELECTED PHRASES INTO (Spanish/Creole/Cantonese/Vietnamese). PLEASE RESPOND WITH HAND SIGNALS OR BY WRITING ANSWERS FOR ME. PLEASE NOD YOUR HEAD FOR YES AND SHAKE YOUR HEAD FOR NO.*
- "Go to Standby": Resets the VRT to the ON STANDBY position. Accessible at all times.
- "Use VRT": Starts the translation sequence and the *WHICH LANGUAGE?* prompt. Only accessible in the ON STANDBY position.
- "Begin Training": Starts the training sequence and the *WHICH EVENT?* prompt. Only accessible in the ON STANDBY position.
- "My Location": This command orders the VRT to tell where it is in the program, such as, *WHICH EVENT* or *WHICH LANGUAGE.* This command is accessible within all events.
- "Different Language": Orders the VRT to change language and leads to the *WHICH LANGUAGE?* prompt. The VRT remains in the current event. Accessible in all events and after the *WHICH LANGUAGE?* prompt.
- "Event": Orders the VRT to change events and leads to the *WHICH EVENT?* prompt. The VRT remains in the language in which it was located in the previous event. This command is accessible in all events.
- "Hello": Plays the word *HELLO* in the selected language. Accessible in all events.
- "My Name": Plays the phrase, *MY NAME IS …* in the selected language. Accessible within all events.
- "Speak English": Plays the phrase, *DO YOU SPEAK ENGLISH?* in the selected language. Accessible within all events.
- "Don't Move": Plays the phrase, *DON'T MOVE*. Accessible in all events.
- "Calm Down": Plays the phrase*, CALM DOWN*. Accessible within all events.

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APPENDIX B –LAW ENFORCEMENT COMMAND CARD

INITIAL

You're Under Arrest ..... YOU'RE UNDER ARREST
"Put Hands ..... PUT HANDS UP
"Calm Down" ..... CALM DOWN
"Start Directions" ..... Start Directions Paragraph
"Hello" ..... HELLO
"Good bye" ..... GOOD BYE
"My Name" ..... MY NAME
"Change Language" ..... WHICH LANGUAGE?
"Situation" ..... WHICH SITUATION?
"Translate" ..... TRANSLATE
"My Location" ..... CURRENT LOCATION
"Go To Standby" ..... ON STANDBY
"Start Training" ..... START TRAINING

START LANGUAGE COMMANDS

"Start Viet" ..... START VIETNAMESE
"Start Spanish" ..... START SPANISH
"Start Cantonese" ..... START CANTONESE

EIGHT SITUATION COMMANDS

"Greetings" ..... GREETINGS
"Medical" ..... MEDICAL
"Interview Victim" ..... INTEVIEW VICTIM
"Found Child" ..... FOUND CHILD
"Field Interview" ..... FIELD INTERVIEW
"Traffic Stop" ..... TRAFFIC STOP
"Crowd Control" ..... CROWD CONTROL
"Domestic" ..... DOMESTIC

GREETINGS

"Did You See?" ..... DID YOU SEE THIS HAPPEN?
"Show Me" ..... SHOW ME WHERE IT HAPPENED
"Write When" ..... WRITE DOWN WHEN IT HAPPENED
"Good Morning" ..... GOOD MORNING
"Good Day" ..... GOOD DAY
"Good Afternoon" ..... GOOD AFTERNOON
"Good Evening" ..... GOOD EVENING
"How Are You?" ..... HOW ARE YOU?
"Goodbye" ..... GOOD-BYE
"Speak English?" ..... DO YOU SPEAK ENGLISH?
"Understand?" ..... DO YOU UNDERSTAND?
"Don't Understand" ..... I DON'T UNDERSTAND
"Slower" ..... PLEASE SPEAK SLOWER
"Repeat" ..... PLEASE REPEAT WHAT YOU SAID
"Thank You" ..... THANK YOU
"You're Welcome" ..... YOU'RE WELCOME
"Yes" ..... YES
"Negative" ..... NEGATIVE
"Sign Name" ..... PLEASE SIGN YOUR NAME
"Name Called ..... WRITE DOWN THE NAME
..... THAT PEOPLE CALL YOU
"Family" ..... WHICH NAME IS YOUR FAMILY NAME?
"Address" ..... PLEASE WRITE YOUR ADDRESS
"Telephone" ..... WHAT IS YOUR TELEPHONE NUMBER?
"How Old?" ..... HOW OLD ARE YOU?
"You Married?" ..... ARE YOU MARRIED?

TRAFFIC STOP

"Turn Off Engine" ..... TURN OFF THE ENGINE
"Step Out" ..... STEP OUT OF THE VEHICLE
"You're Arrested" ..... YOU'RE UNDER ARREST
"Vehicle Search?" ..... PERMISSION TO DO A VEHICLE SEARCH?
"Car Taken" ..... YOUR CAR IS BEING TAKEN BY THE POLICE
"How Fast?" ..... HOW FAST WERE YOU GOING?
"Too Fast" ..... YOU WERE EXCEEDING THE SPEED LIMIT
"Red Light" ..... YOU DROVE THROUGH THE RED LIGHT
"Stop Sign" ..... YOU DROVE THROUGH THE STOP SIGN
"Illegal Turn" ..... YOU MADE AN ILLEGAL TURN
"Car Headlights" ..... THE CAR HEADLIGHTS ARE NOT WORKING
"Tail lights" ..... THE CAR TAIL LIGHTS ARE NOT WORKING
"Driver's License" ..... MAY I SEE YOUR DRIVER'S LICENSE?
"Take It Out" ..... TAKE IT OUT
"Current Address?" ..... IS THIS YOUR CURRENT ADDRESS?
"Registration" ..... MAY I SEE THE VEHICLE REGISTRATION?
"Not Current" ..... THE REGISTRATION IS NOT CURRENT
"Insurance" ..... DO YOU HAVE INSURANCE?
"Citation" ..... I AM ISSUING YOU A CITATION
"Write Name" ..... WRITE YOUR NAME
"Other Name?" ..... DO YOU USE ANY OTHER NAME?
"Write Address" ..... WRITE YOUR ADDRESS
"Name Address" ..... WRITE YOUR NAME AND ADDRESS
"Car Owner" ..... ARE YOU THE VEHICLE OWNER?
"No Guilt" ..... WHEN YOU SIGN YOU ARE NOT ADMITTING GUILT
"Pay Fine" ..... YOU PAY THE FINE (BY MAIL) AT THIS ADDRESS

FIELD INTERVIEW

"Police" ..... POLICE
"Stop" ..... STOP, POLICE
"Door Open" ..... POLICE, OPEN THE DOOR NOW
"Weapons?" ..... DO YOU HAVE ANY WEAPONS ON YOU?
"Show Hands" ..... SHOW ME YOUR HANDS
"Hands Visible" KEEP YOUR HANDS WHERE I CAN SEE THEM
"Hands in Front" ..... KEEP YOU HANDS IN FRONT
"Hands Behind" ..... PUT YOUR HANDS BEHIND YOUR BACK
"Arrest Mrs." ..... I'M GOING TO ARREST HER
"Arrest Lady" ..... I'M GOING TO ARREST THIS LADY
"Drugs on You?" ..... DO YOU HAVE ANY DRUGS ON YOU?
"Probation?" ..... ARE YOU ON PROBATION OR PAROLE?
"Identification?"... DO YOU HAVE ANY IDENTIFICATION ON YOU?
"Search Warrant"..... POLICE, WE HAVE A SEARCH WARRANT
"Arrest Warrant" ... POLICE, WE HAVE AN ARREST WARRANT

CROWD CONTROL

"Keep Moving" ..... KEEP MOVING
"Break Up Now" ..... FAILURE TO BREAK UP NOW WILL
..... RESULT IN YOUR ARREST
"Tear Gas" ..... FAILURE TO LEAVE IMMEDIATELY WILL RESULT
..... IN OUR USE OF TEAR GAS
"Barricades" ..... STAY BEHIND THE BARRICADES
"Against the law" ..... WHAT ARE DOING IS AGAINST THE LAW
"Group Leader" ..... WHO IS THE GROUP LEADER

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APPENDIX B (CONT'D)
LAW ENFORCEMENT COMMAND CARD

FOUND CHILD

"Your Name"....WHAT IS YOUR NAME
How Long?"....HOW LONG HAVE YOU BEEN HERE?
"Someone Come?"....WHEN WILL SOMEONE COME FOR YOU?
"Someone Coming?"....IS SOMEONE COMING?
"Mother Coming?"....IS YOUR MOTHER COMING?
"Father Coming?"....IS YOUR FATHER COMING?
"How Here?"....HOW DID YOU GET HERE?
"Stranger"....DID A STRANGER BRING YOU HERE?
"Lost Before?"....HAVE YOU EVER BEEN LOST BEFORE?
"Police Before?"....POLICE EVER HAD TO LOOK FOR YOU BEFORE?
"Show Hurt"....ARE YOU HURT? IF YOU ARE, SHOW ME WHERE
"Live with Who?"....WHO DO YOU LIVE WITH?
"Where Parents?"....WHERE ARE YOUR PARENTS?
"Brother/Sister?"....DO YOU HAVE BROTHERS OR SISTERS?
"Brother's School?"....WHERE DO THEY GO TO SCHOOL?
"Parents' Work"....WHERE DO YOUR PARENTS WORK?
"Father Work?"....WHERE DOES YOUR FATHER WORK?
"Mother Work?"....WHERE DOES YOUR MOTHER WORK?
"Dad's Name"....WHAT IS YOUR DAD'S NAME?
"Mom's Name"....WHAT IS YOUR MOM'S NAME?
"Telephone"....PLEASE WRITE YOUR TELEPHONE NUMBER
"Address"....DO YOU KNOW YOUR HOME ADDRESS?
"How Old"....HOW OLD ARE YOU?
"Work Telephone"....DO YOU KNOW THEIR WORK PHONE NO'S

INTRV. VICTIUM

"The Victim?"....WHO IS THE VICTIM?
"What Time?"....WHEN DID IT HAPPEN?
"Know Suspect"....DO YOU KNOW THE SUSPECT OR WHERE HE LIVES?
"Flee Where?"....WHICH WAY DID THE SUSPECT FLEE?
"More Than One?"....WAS THERE MORE THAN ONE SUSPECT?
"Weapons"....DID THE SUSPECT HAVE A WEAPON?
"Go On Foot"....DID THE SUSPECT LEAVE ON FOOT?
"In Car?"....DID THE SUSPECT LEAVE IN A CAR?
"In Truck?"....DID THE SUSPECT LEAVE IN A TRUCK?
"Van?"....IS THE VEHICLE A VAN?
"Color?"....WHAT COLOR IS THE VEHICLE?
"Old Vehicle?"....IS THE VEHICLE OLD?
"Car?"....IS THE VEHICLE A CAR?
"Truck?"....IS THE VEHICLE A TRUCK?
"Man?"....IS THE SUSPECT A MAN OR A WOMAN?
"How Old?"....HOW OLD?
"Show How Tall"....SHOW ME HOW TALL THE SUSPECT IS
"How Tall?"....IF SO, SHOW ME HOW BIG
"Heavier?"....IS THE SUSPECT HEAVIER THAN ME?
"Caucasian"....IS THE SUSPECT WHITE?
"Latino"....IS THE SUSPECT LATINO?
"Black"....IS THE SUSPECT BLACK?
"Asian"....IS THE SUSPECT ASIAN?
"Mustache?"....DOES THE SUSPECT HAVE A MUSTACHE
"Beard?"....DOES THE SUSPECT HAVE A BEARD?
"Bald?"....IS THE SUSPECT BALD
"Shirt Color"....WHAT COLOR WAS SHIRT?
"Pants Color?"....WHAT COLOR WERE PANTS?
"Jacket Color"....WHAT COLOR WAS JACKET?
"Plate Number"....DO YOU KNOW THE LICENSE NUMBER? IF SO, WRITE IT HERE
"Write All" WRITE YOUR NAME, ADDRESS & PHONE No.

DOMESTIC

"You Injured?"....ARE YOU INJURED?
"He Strike?"....DID HE STRIKE YOU? DID HE STRIKE YOU?
"She Strike?"....DID SHE STRIKE YOU?
"No Hit"....IT IS AGAINST THE LAW IN CALIFORNIA FOR A PERSON TO HIT ANOTHER PERSON
"Hit Before?"....HAS THIS PERSON HIT YOU BEFORE ?
"He Weapon?"....DOES HE HAVE A WEAPON?
"She Weapon?"....DOES SHE HAVE A WEAPON?
"Gun"....A GUN?
"Knife?"....A KNIFE?
"Go To Jail"....I AM TAKING THIS PERSON TO JAIL
"Who Called?"....WHO CALLED THE POLICE?
"Your Name"....WHAT IS YOUR NAME?
"Live Here"....DO YOU LIVE HERE?
"Another Room"....LET'S TALK IN ANOTHER ROOM
"Together"....DO YOU LIVE TOGETHER?
"Your Husband"....IS THIS PERSON YOUR HUSBAND?
"Your Wife?"....IS THIS PERSON YOUR WIFE
"Children?"....DO YOU HAVE CHILDREN?
Children There?....ARE THE CHILDREN IN THERE?
"Kids In Danger"....ARE THE CHILDREN IN DANGER?
"Your Children?"....DO YOU HAVE CHILDREN IN COMMON?
"Who Custody?"....WHO HAS CUSTODY OF THE CHILDREN?
"File Complaint?"....DO YOU WISH TO FILE A COMPLAINT ?
"Temporary Shelter"....YOU WISH TO STAY TEMPORARILY IN A SHELTER FOR WOMEN?
"Restraining Order"....IS THERE A RESTRAINING ORDER ON THAT PERSON?
"Copy Order"....CAN I SEE A COPY OF THE RESTRAINING ORDER OR THE CUSTODY ORDER

MEDICAL

"Pain?"....DO YOU HAVE PAIN?
"Where Hurt"....WHERE DOES IT HURT?
"Chest Hurt?"....ARE YOU HAVING CHEST PAIN?
"Breathing"....ARE YOU HAVING DIFFICULTY BREATHING?
"Ambulance"....THE AMBULANCE IS COMING
"OK"....YOU WILL BE OK
"Caused Injury"....SHOW ME WHAT CAUSED THE INJURY
"You Shot?"....HAVE YOU BEEN SHOT?
"Stabbed?"....HAVE YOU BEEN STABBED?
"Assaulted?"....HAVE YOU BEEN ASSAULTED?
"You Ill?"....ARE YOU ILL?
"Diabetic?"....ARE YOU DIABETIC?
"Nauseated?"....ARE YOU NAUSEATED?
"Pregnant?"....ARE YOU PREGNANT?
"Swallowed?"....YOU SWALLOWED ANYTHING THAT MIGHT HURT YOU?
"Injected?"....YOU INJECTED ANYTHING THAT MIGHT HURT YOU?
"Taken Pills?"....YOU TAKE ANY PILLS OR MEDICINE?
"He Drugs?"....HAS HE TAKEN ANY DRUGS?
"She Drugs?"....HAS SHE TAKEN ANY DRUGS?
"Relax"....RELAX
"Sit Down"....PLEASE SIT DOWN
"You Lay Down"....I NEED FOR YOU TO LAY DOWN NOW
"Don't Move"....PLEASE DO NOT MOVE
"Stand Back"....EVERYBODY PLEASE STAND BACK NOW
"OK"....YOU WILL BE OK
"Medications"....WRITE THE NAMES OF ANY MEDICATIONS YOU ARE ALLERGIC TO
"Doctors"....WRITE DOWN THE NAMES AND PHONE NUMBERS OF YOUR DOCTORS
"Medical Card?"....DO YOU HAVE A MEDICAL CARD?
"Conditions"....WRITE DOWN ANY MEDICAL CONDITIONS YOU MAY HAVE

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APPENDIX C

LECTURE NOTES HOW TO USE THE VRT

There are two switches on the VRT unit, a toggle switch and a red pushbutton. The toggle switch is for power on/off. The red pushbutton switch is used to place the VRT in standby mode or to start initial training. To begin initial training, hold the red button down for 10 seconds, and then release. The VRT will guide you through the initial training. There are also two LED displays. The first illuminated LED will indicate when the power is on. The second illuminated LED indicates the level of your voice (green/amber/red).

Speaking in a clear, commanding voice, you should light up the voice level indicator LED. Speak loud enough to turn the LED amber, but not red. Ideally, the LED should flicker green/amber when giving a command. The same voice level should be used during training and use of the device. Please remember that you will sub-consciously project your voice more in an open area or out of doors than you will when in an enclosed room. You should train the unit by speaking a little louder than normal, as if you were out on the street. Better yet, train outside, but be sure you are not standing within 30 feet of a loud source of noise.

Position the microphone close to the mouth, touching or almost touching the upper lip. The microphone is designed to work best when you speaking directly into it. Recognition is reduced when turning your head or while walking around. Stand up and stand still during training. The VRT must be trained in a relatively quiet area, away from actual noise sources. Background noise outside is OK, as long as it is at least 20 feet away. If possible, train the VRT in the environment in which it is to be used, i.e. indoors or outdoors).

Do not pause your voice between words in a single command, either during training or operation – as the unit has an automatic ¼ second timeout. Speak normally, in a natural, flowing voice. It is mandatory to let your words flow together when giving commands of two or more words. For example, say “GOTOSTANDBY” as if it is one word, not “GO---TO---STANDBY”. Also, note that speed and inflection of pronunciation must be the same every time you use the VRT. Although the VRT will work at different levels of volume for your voice, it is best to train the unit the same way it will be used. If it will be used indoors, you will naturally (and subconsciously) speak more softly, so position the microphone closer. Outdoors, your voice naturally compensates for the lack of acoustic reflection, and you subconsciously speak louder, so hold the microphone a little farther away (i.e, 1 inch from mouth). In all cases, watch the light on the device and strive to turn the LED to an amber color; remember, no light or green is too soft, red is too loud.

Occasionally, a command may need to be repeated, this does not usually indicate a problem, other than you may be speaking either too loud or too soft - watch the lights. It also may be that the background noise level was simply too loud. Move away from the noise source or wait for the noise level to drop. This unit has been tested to work at the side of a road with cars moving by at 45-50 mph (approx 90db). However, you must

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remain calm and repeat commands in the same tone of voice and same cadence in which you recorded them for it to recognize your commands.

Sometimes a command will simply not be recognized after repeated attempts. In this case, the unit must be re-trained for that situation. Re-training will not overwrite any existing training in other situations/events. When used with the ticket book, the user must be careful to hold the microphone the same way each time as it was recorded (remember to keep the microphone close to the mouth).

Commands that start with S or F, H, M, or N (soft sounds) can be a problem - you must enunciate these clearly. When you say the word “male” for example, the sound is actually coming out of your nose (try plugging your nose and saying the letters N or M). While the trigger command can actually be anything the user wants, as long as it can be remembered and repeated, some sounds do not work well and are not recommended for this device (for more detail see linguist analysis section of the VRT Evaluation Report). Remember that in Standby, the only commands that work are "Start-Training" and "Translate".

To use the device, turn it on and set the desired language (“Different Language”). When you encounter someone who does not speak English, determine what language they speak, then, use the "Begin Directions" command in that language. This command will explain to the person what you are doing. The Begin Directions command translates to the following:

> " I am using this device to translate my voice into <language>.
> Please respond by using hand gestures, or writing your
> answers. Use head movements for yes and no."

At this point the officers should record their commands into the devices. This can be done in the same room in which the lecture was delivered without undue concern or problems of too much noise being made. Next the instructor should individually test each officer’s proficiency at operating the device in and out of doors. Two hours is ample time to train up to eight officers in this fashion. Officers should then be told to practice with the device at home, in public, etc., until they are comfortable with it, before taking it into the field for on-the-job use.

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APPENDIX D - FIELD EVALUATION QUESTIONNAIRE

Device # _____ Duty _____

1. While recording your voice onto the unit, did you encounter any problems? No; Yes
   (If yes, describe)

2. How long did it take you to become comfortable with the device?

3. Were the directions in the booklet confusing or unclear? No; Yes
   (If Yes, explain)

4. Where did you use the VRT (street, indoors, crowds, rain?):

5. How long did you have the device? (# days) _____

6. Total number of times used for Police work_____

7. Check Languages Used on Duty: Spanish _____ Vietnamese _____ Cantonese _____

8. Check Situations/events Used on Duty:

_____ Greetings	**_____ Crowd Control**
_____ Traffic Stop	**_____ Domestic**
_____ Found Child	**_____ Field Interview**
_____ Medical	**_____ Interview Victim**

9. Problems Encountered: (Check all that apply)

____ Microphone didn't pick up my voice	____ Device gave wrong commands
____ Couldn't find commands on Cards	____ Power Switch / Battery Life
____ Did not work in Noisy Environments	____ Citizens put off/offended by it
____ Commands beginning with letter "S"	____ Microphone Awkward
____ Other _____	

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APPENDIX D (Cont.)- FIELD EVALUATION QUESTIONNAIRE

10. What recommendations or features would you suggest for the device?

11. What additional Commands should be added?

Thank You for your participation in this effort. Please return the completed form to:

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APPENDIX E

MICROPHONE TEST RESULTS

NAWCTSD Testing and Modifications

The four VRT units supplied to NAWCTSD were modified to allow connecting different microphones (mics), and two of the units were modified for connection to more professional type mics.

- **NIJ # 001, 002 -** have 5v power for electret microphone
- **NIJ # 003, 004 -** have been modified for use for dynamicrophone or phantom powered mics. 5v power is no longer on the microphone signal line.

Ambient background noise was measured using a Radio Shack Sound Pressure Level (SPL) Meter. All noise measurements were made with 'C' weighting. 'C' weighting measures sound using a flat response curve (all frequencies are given equal weight), while 'A' weighting mimics the response of the human ear. Note that while a person may think the background noise level is low, the actual noise level can be 15-20dB higher (# 4, inside car). This is due to the characteristic of the human ear being less sensitive to rumble and other low frequency sound.

Above 95dB, the VRT becomes useless, due to background noise masking the output of the box.

Ambient background noise measurements were taken of the following:

1)	quiet room (studio)	42dB avg
2)	office	60-65dB avg
3)	side of highway 50	85-95dB avg, 105dB peaks
4)	inside a police car, at 55 mph	85dB avg, 70dB (avg, A wt)

Microphones were evaluated in a quiet studio and in a noisy environment. Loud music was used as the noise source, as it is random and wide-spectrum. Pink noise is a broadband audio test signal, similar to radio static. The ambient noise limit is defined as the point at which the VRT microphone no longer responds or recognizes commands (over 50%).

Micophone Evaluation Results:

VRT Original Equipment electret microphone

- Pattern - Omni?
- Output Sensitivity = 5.0mv @ 76dB pink noise
- 80dB ambient noise limit (music)
- This microphone required a lot of re-training.

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- approximately 70% recognition accuracy - in a quiet room

Radio Shack 33-3028 lavalier electret mic

- Pattern - Omni
- Output = 2.0mv @ 76dB pink noise
- 75dB ambient noise limit (music)
- No re-training was needed
- 100% recognition accuracy
- Note: this microphone was excellent at recognizing different voice inflections.

Noise-cancelling electret microphone (homemade by Tim McQuen)

- Pattern - Unknown
- Output = 2.0mv @ 76dB pink noise (microphone fixed)
- Output = 10mv @ 76dB pink noise (microphone moving)
- 85dB ambient noise limit (music)
- Some re-training was needed
- 85-90% recognition accuracy
- Note: the orientation of this microphone is critical - it must not be moved while in use.

Crown CM-311A head/collar worn condenser microphone (noise rejecting)

- Pattern - Differoid
- Output = 0.4mv @ 76dB pink noise
- 95dB ambient noise limit (music)
- Very little or no re-training needed
- 98% recognition accuracy, up to the noise limit.
- Note: this microphone was also tested in stairwell and at the side of highway 50.

Microphone Field Tests

Microphone field tests were conducted on a residential street with 25-30 mph traffic passing by as often as every eight seconds, and up to 90 second intervals without traffic. Decibel ratings ranged from very quiet, up to 85 decibels when large trucks passed by. None of the microphones were able to operate when noise readings exceeded 80-90 decibels, although if they had one could not have heard the translated phrase anyway. The command NEGATIVE was not recognized, although trained successfully, by any of the units. On two of the tests, (see D-7, D-8) two thirds of the commands not recognized were composed of unvoiced components. (For example, “Chest Hurt,” “How Tall”, “He Strike”). On the other two tests, over a third of the problem commands were unvoiced in nature. Finally, unit # 4 had the microphone jack break off during the trials. The design of these joints was improved prior to the field evaluations.

Crown Microphone (standard): Test had 21 errors occur, 9 were not recognized, 12 were repeats-required. Laboratory tests confirmed that the device could not recognize 6* of commands. Unvoiced commands comprised 66% of the commands that the device was unable to discern (see table of results for this microphone).

Crown Microphone on Ticket Book: Handled very well, comfortable to use. Field test had 3 of 29 commands not recognized in an extremely noisy (10% in a 90+ dB.

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environment) Highway tests had 20 errors occur, 9 were not recognized, 11 were repeats-required. In Laboratory tests with this microphone configuration, 13 errors occurred, 6 were repeats-required, 7 commands were not recognized by the device. Unvoiced commands comprised 37% of the commands that the device was unable to discern.

Original Microphone: Tested on the Ticket Book. Handled very well, comfortable to use. Test had 28 errors occur, 13 were not recognized, 15 were repeats-required. In Laboratory tests with this microphone afterwords, 13 of the commands were still not recognized by the device. Unvoiced commands comprised 64% of the commands that the device was unable to discern.

TGX-5: Tested on the Ticket Book. Responded poorly, although also comfortable to use on the ticket book. Test had 33 errors occur, 14 were not recognized, 19 were repeats-required. In Laboratory tests with this microphone afterwords, 15 of the commands were still not recognized by the device. Unvoiced commands comprised 38% of the commands that the device was unable to discern.

Crown Microphone Field Test Results

Situation/Event	**Not Recognized**	**Repeats Required**
Medical	Chest Hurt * ** You Shot **	She Drugs **
Traffic Stop	Driver's License Write Name	
Field Interview	Hands Behind* **	Door Open Hands Visible ** Arrest Warrant
Crowd Control		Tear Gas **
Found Child	Lost Before Father Work **	Police Before Mother Coming * **
Domestic	Kids in Danger * ** File Complaint **	He Strike ** Hit Before * **
Greetings	*Negative*	
Interview Victim	How Tall * **	Pants Color **

* Six Commands not recognized in subsequent laboratory tests, all Six (100%)later identified as having Unvoiced Components

** Fourteen of 21 (66%) Commands were later identified as having Unvoiced components

Italics: Only single-word Problem Phrase; all others (95%) were Multi-Word Commands

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Original Microphone Field Test Results

Situation/Event	**Not Recognized**	**Repeats Required**
Medical	Taken Pills * ** Breathing * = My Name	*Injected* Chest Hurt * **
Traffic Stop	Vehicle Search,* Driver's License * Tail Lights ** Current Address ** = Write Address Write Address * = Car Headlights	How Fast ** Too Fast ** Not Current
Field Interview	*Police** **	
Crowd Control		
Found Child	*Address** Someone Coming **	Mother Coming * ** Show Hurt **
Domestic	*Knife* ** Kids in Danger ** Copy Order **	
Greetings	How are You * ** Sign Name * ** = My Name	
Interview Victim	*Mustache* Shirt Color ** *Man* ** *Truck,** *Car* ** *Van**	

* Twelve Commands not recognized in subsequent laboratory tests, (50%) had unvoiced components

** Eighteen of 28 (64%) commands were later identified as having unvoiced components

Italics: Single-word problem phrases; others (64%) were multi-word commands

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TGX-5 Beyerdynamicrophone Test Results

Situation/Event	Not Recognized	Repeats Required
Medical	*Ambulance* *Assaulted* You Ill *Nauseated* She Drugs ** Medical Card *	
Traffic Stop *	Vehicle Search *Name* Address * **	
Field Interview	Hands Behind * **	
Crowd Control		
Found Child	Father Coming * ** = Mother Coming How Here ** *Address* *	Lost Before * Brother Sister Show Hurt **
Domestic	Hit Before * ** Who Custody * **	He Strike ** *Children* ** Children There * **
Greetings	Speak English *Negative* *	Good day Good Afternoon Name Called
Interview Victim *	Go on Foot * In Car In Truck *Van = Man* Know Suspect Plate Number *Color = Car* ** How Tall * **	

* Twelve commands not recognized in subsequent laboratory tests, of these seven (58%) were Identified as having unvoiced components

** Twelve of 32 (38%) Commands were later identified as having unvoiced components

Italics: Single-word problem phrases, others (78%) were multi-word commands

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Crown Microphone Test (Mounted On Ticket Book)

Situation/Event	**Not Recognized**	**Repeats Required**
Medical	Chest Hurt * ** OK	*Relax* Medical Card
Traffic Stop	Write Name *	
Field Interview	Hands Behind * ** Arrest Warrant	Door Open
Crowd Control		
Found Child	Father Coming * ** = Mother Coming	*Address**
Domestic	Your Husband	He Strike **
Greetings	Write When Good Afternoon	Name Called How Old **
Interview Victim	How Tall * **	Shirt Color ** More Than One Write All *

* Seven Commands not recognized in subsequent laboratory tests, of these four (57%) were identified as having unvoiced components

** Seven of 19 (37%) Commands were later identified as having unvoiced components

Italics: Single-word Problem Phrases, others (90%) were Multi-Word Commands

Audio-Technica Microphone (Head Mount)

Microphone was too uncomfortable to wear in field tests.

Microphone Evaluation Conclusions

The original equipment microphone supplied with the VRT had the worst performance, while the Crown CM-311 microphone had the best overall performance.

The Crown CM-311 microphone has the best noise immunity of any microphone, and has fair ability to recognize changing voice inflection. Performed well in echoic stairwell. On a busy six-lane highway, commands sometimes had to be repeated several times, but no commands were processed incorrectly. Sometimes a command simply could not be recognized ("translate"). On a six-lane divided highway with heavy traffic the unit was reliable at the workable limit of performance. Cost $220 each.

The Radio Shack lavalier microphone had the least re-training needed, and is able to recognize changing voice inflections, after training. However, this microphone only works in a quiet environment. Cost $29.

The VRT unit had more difficulty with long phrases, and commands starting with the letter 'S'. Shorter one-word commands seemed to work better, since there was less chance for different speed and inflection of pronunciation. While a command can be

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anything the user wants, as long as it can be remembered. The VRT often confused the commands "Sign Name" and "My Name." Later it was learned that “Name” and “My Name” are composed primarily of nasal consonants, which are emitted through the nasal passages, hence not reliably discerned with microphones located in front of the mouth. The word “sign” begins with an unvoiced speech component and ends with a nasal consonant, making it equally difficult for the computer to discern reliably (see linguist analysis section).

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APPENDIX F – LINGUIST CORRECTED LAW ENFORCEMENTCOMMANDS
(Corrections Underlined in Right column)

INITIAL	INITIAL
"Start Directions" ..... Start Directions Paragraph	"Begin Directions" ..... Directions Paragraph Begins
"You're Under Arrest" ..... YOU'RE UNDER ARREST	"You're Under Arrest" ..... YOU'RE UNDER ARREST
"Put Hands ..... PUT HANDS ON YOUR HEAD	"Place Hands" ..... PUT HANDS ON YOUR HEAD
"Calm Down" ..... CALM DOWN	"Calm Down" ..... CALM DOWN
"Hello" ..... HELLO	"Greetings" ..... HELLO
"My Name" ..... I AM A POLICE OFFICER	"My Name" ..... I AM POLICE OFFICER
"Change Language" ..... WHICH LANGUAGE?	"Different Language" ..... WHICH LANGUAGE
"Situation" ..... WHICH SITUATION?	"Event" ..... WHICH EVENT
"My Location" ..... CURRENT LOCATION	"My Location" ..... CURRENT LOCATION
"Go To Standby" ..... ON STANDBY	"Go to Standby" ..... ON STANDBY
CHANGE LANGUAGE COMMANDS	**CHANGE LANGUAGE COMMANDS**
"Viet" ..... VIETNAMESE	"Viet" ..... VIETNAMESE
"Spanish" ..... SPANISH	"Begin Spanish" ..... SPANISH
"Cantonese" ..... CANTONESE	"Cantonese" ..... CANTONESE
"Creole" ..... CREOLE	"Creole" ..... CREOLE
SITUATION COMMANDS	**EVENT COMMANDS**
"Greetings" ..... GREETINGS	"Meetings" ..... MEETINGS
"Medical" ..... MEDICAL	"Medical" ..... MEDICAL
"Interview Victim" ..... INTEVIEW VICTIM	"Interview Victim" ..... INTERVIEW VICTUM
"Found Child" ..... FOUND CHILD	"Lost Child" ..... LOST CHILD
"Field Interview" ..... FIELD INTERVIEW	"Entry" ..... ENTRY
"Traffic Stop" ..... TRAFFIC STOP	"Traffic Stop" ..... TRAFFIC STOP
"Crowd Control" ..... CROWD CONTROL	"Crowd Control" ..... CROWD CONTROL
"Domestic" ..... DOMESTIC	"Domestic" ..... DOMESTIC
COMMANDS IN STANDBY	**COMMANDS IN STANDBY**
"Translate" ..... TRANSLATE	"Translate" ..... TRANSLATE
"Start Training" ..... START TRAINING	"Begin Training" ..... BEGIN TRAINING

GREETINGS	MEETINGS
"Did You See?" ..... DID YOU SEE THIS HAPPEN?	"Did You See?" ..... "DID YOU SE THIS HAPPEN?"
"Show Me" ..... SHOW ME WHERE IT HAPPENED	"Show Me" ..... "SHOW ME WHERE IT HAPPENED"
"Write When" ..... WRITE DOWN WHEN IT HAPPENED	"Write When ..... "WRITE DOWN WHEN IT HAPPENED"
"Good Morning" ..... GOOD MORNING	"Good Morning" ..... "GOOD MORNING"
"Good Day" ..... HAVE A NICE DAY	"Good Day" ..... "HAVE A NICE DAY"
"Good Afternoon" ..... GOOD AFTERNOON	"Good Afternoon" ..... "GOOD AFTERNOON"
"Good Evening" ..... GOOD EVENING	"Good Evening" ..... "GOOD EVENING"
"How Are You?" ..... HOW ARE YOU?	"You OK" ..... "YOU OK"
"Goodbye" ..... GOOD-BYE	"Goodbye" ..... "GOODBYE"
"Speak English?" ..... DO YOU SPEAK ENGLISH?	"English" ..... "DO YOU SPEAK ENGLISH"
"Understand?" ..... DO YOU UNDERSTAND?	"Understand?" ..... "DO YOU UNDERSTAND"
"Don't Understand" ..... I DON'T UNDERSTAND	"Don't Understand" ..... "I DON'T UNDERSTAND"
"Slower" ..... PLEASE SPEAK SLOWER	"Slower" ..... "PLEASE SPEAK SLOWER"
"Repeat" ..... PLEASE REPEAT WHAT YOU SAID	"Repeat" ..... "PLEASE REPEAT WHAT YOU SAID"
"Thank You" ..... THANK YOU	"Gracias" ..... "THANK YOU"
"You're Welcome" ..... YOU'RE WELCOME	"You're Welcome" ..... "YOU'RE WELCOME"
"Yes" ..... YES	"Yes" ..... "YES"
"Negative" ..... NEGATIVE	"Negative" ..... "NO"
"Sign Name" ..... PLEASE SIGN YOUR NAME	"Write Name" ..... "PLEASE SIGN YOUR NAME"
"Name Called ..... WRITE THE NAME THAT PEOPLE CALL YOU	"Name Called" .... "WRITE THE NAME THAT PEOPLE CALL YOU"
"Family" ..... WHICH IS YOUR FAMILY NAME?	"Last Name" ..... "WHICH IS YOUR FAMILY NAME?"
"Address" ..... PLEASE WRITE YOUR ADDRESS	"Address" ..... "PLEASE WRITE YOUR ADDRESS"
"Telephone" ..... WHAT IS YOUR TELEPHONE NUMBER?	"Phone" ..... "WRITE YOUR TELEPHONE NUMBER?"
"How Old?" ..... HOW OLD ARE YOU?	"Your Age" ..... "HOW OLD ARE YOU?"
"You Married?" ..... ARE YOU MARRIED?	"You Married?" ..... "ARE YOU MARRIED"

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TRAFFIC STOP

"Turn Off Engine" .....TURN OFF THE ENGINE
"Step Out"..... STEP OUT OF THE VEHICLE
"Vehicle Search?".....PERMISSION TO DO A VEHICLE SEARCH?
"Car Taken" .....YOUR CAR IS BEING TAKEN BY THE POLICE
"How Fast?"..... HOW FAST WERE YOU GOING?
"Too Fast"..... YOU WERE EXCEEDING THE SPEED LIMIT
"Red Light" ..... YOU DROVE THROUGH THE RED LIGHT
"Stop Sign" ..... YOU DROVE THROUGH THE STOP SIGN
"Illegal Turn" ..... YOU MADE AN ILLEGAL TURN
"Car Headlights" ..... THE CAR HEADLIGHTS ARE NOT WORKING
"Tail lights".....THE CAR TAILLIGHTS ARE NOT WORKING
"Driver's License" ..... MAY I SEE YOUR DRIVER'S LICENSE?
"Take It Out" ..... TAKE IT OUT
"Current Address?".....IS THIS YOUR CURRENT ADDRESS?
"Registration".....MAY I SEE THE VEHICLE REGISTRATION?
"Not Current" .....THE REGISTRATION IS NOT CURRENT
"Insurance" .....DO YOU HAVE INSURANCE?
"Citation".....I AM ISSUING YOU A CITATION
"Write Name".....WRITE YOUR NAME
"Other Name?" .....DO YOU USE ANY OTHER NAME?
"Write Address" .....WRITE YOUR ADDRESS
"Name Address" ..... WRITE YOUR NAME AND ADDRESS
"Car Owner" ..... ARE YOU THE VEHICLE OWNER?
"No Guilt"....WHEN YOU SIGN YOU ARE NOT ADMITTING GUILT
"Pay Fine"..... YOU PAY THE FINE (BY MAIL) AT THIS ADDRESS

TRAFFIC STOP

"Turn Off Engine" .....TURN OFF THE ENGINE
"Get Out" ..... STEP OUT OF THE VEHICLE
"Vehicle Search?".....PERMISSION TO DO A VEHICLE SEARCH?
"Car Taken" .....YOUR CAR IS BEING TAKEN BY THE POLICE.
"How Fast?"..... HOW FAST WERE YOU GOING?
"Too Fast"..... YOU WERE EXCEEDING THE SPEED LIMIT.
"Red Light" .....YO DROVE THROUGH THE RED LIGHT.
"Stop Sign" ..... YOU DROVE THROUGH THE STOP SIGN.
"Illegal Turn" ..... YOU MADE AN ILLEGAL TURN.
"Car Headlights" ..... THE HEADLIGHTS ARE NOT WORKING.
"Rear Lights" .....THE CAR TAILLIGHTS ARE NOT WORKING.
"Driver's License" ..... MAY I SEE YOUR DRIVER'S LICENSE?
"Remove It" ..... TAKE IT OUT.
"Current Address?".....IS THIS YOUR CURRENT ADDRESS?
"Registration".....MAY I SEE THE VEHICLE REGISTRATION?
"Not Current" .....THE REGISTRATION IS NOT CURRENT.
"Insurance" .....DO YOU HAVE INSURANCE.
"Ticket" .....I AM ISSUING YOU A TICKET.
"Write Name" .....WRITE YOUR NAME.
"Other Name" .....DO YOU USE ANY OTHER NAME?
"Write Address" .....WRITE YOUR ADDRESS.
"Name Address" ..... WRITE YOUR NAME AND ADDRESS.
"Car Owner" ..... ARE YOU THE VEHICLE OWNER?
"No Guilt"....WHEN YOU SIGN YOU ARE NOT ADMITTING GUILT.
"Payment" .... YOU PAY THE FINE (BY MAIL) AT THIS ADDRESS.

FIELD INTERVIEW

"Police" ..... POLICE
"Stop"..... STOP, POLICE
"Door Open" .....POLICE, OPEN THE DOOR NOW
"Weapons?".....DO YOU HAVE ANY WEAPONS ON YOU?
"Show Hands" ..... SHOW ME YOUR HANDS
"Hands Visible"....KEEP YOUR HANDS WHERE I CAN SEE THEM
"Hands in Front" .....KEEP YOU HANDS IN FRONT
"Hands Behind" .....PUT YOUR HANDS BEHIND YOUR BACK
"Arrest Lady" .....I'M GOING TO ARREST THIS LADY
"Drugs on You?"..... DO YOU HAVE ANY DRUGS ON YOU?
"Probation?" .....ARE YOU ON PROBATION OR PAROLE?
"Identification?".. DO YOU HAVE ANY IDENTIFICATION ON YOU?
"Search Warrant"..... POLICE, WE HAVE A SEARCH WARRANT
"Arrest Warrant" ..... POLICE, WE HAVE AN ARREST WARRANT

ENTRY

"Police" ..... POLICE.
"Halt" ..... STOP, POLICE.
"Door Open" .....POLICE, OPEN THE DOOR NOW.
"Weapons?".....DO YOU HAVE ANY WEAPONS ON YOU?
"Your Hands" ..... SHOW ME YOUR HANDS.
"Hands Visible"....KEEP YOUR HANDS WHERE I CAN SEE THEM.
"Hands in Front" ..... KEEP YOUR HANDS IN FRONT.
"Hands behind".....PUT YOUR HANDS BEHIND YOUR BACK.
"Arrest Lady" .....I'M GOING TO ARREST THIS LADY.
"Any Drugs?" ..... DO YOU HAVE ANY DRUGS ON YOU?
"Probation?" .....ARE YOU ON PROBATION OR PAROLE?
"Identification?"... DO YOU HAVE ANY IDENTIFICATION ON YOU?
"Search Warrant"..... POLICE, WE HAVE A SEARCH WARRANT.
"Arrest Warrant" ..... POLICE, WE HAVE AN ARREST WARRANT.

CROWD CONTROL

"Keep Moving"..... KEEP MOVING
"Break Up Now"..... FAILURE TO BREAK UP NOW WILL RESULT IN YOUR ARREST
"Tear Gas".....LEAVE IMMEDIATELY OR WE WILL USE TEAR GASON YOU
"Barricades"..... STAY BEHIND THE BARRICADES
"Against the law" ... WHAT YOU'RE DOING IS AGAINST THE LAW
"Group Leader".....WHO IS THE GROUP LEADER?

CROWD CONTROL

"Move" ..... KEEP MOVING.
"Break Up Now"..... FAILURE TO BREAK UP NOW WILL ..... RESULT IN YOUR ARREST.
"Tear Gas".....LEAVE IMMEDIATELY OR WE WILL USE ..... TEAR GAS ON YOU.
"Barricades"..... STAY BEHIND THE BARRICADES.
"Against the law" ... WHAT YOU'RE DOING IS AGAINST THE LAW.
"Group Leader".....WHO IS THE GROUP LEADER?

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FOUND CHILD

"Your Name".....WHAT IS YOUR NAME?
"How Old".....HOW OLD ARE YOU?
"Someone Coming?"..... IS SOMEONE COMING FOR YOU?
"Show Hurt"..... ARE YOU HURT? IF YES, SHOW ME WHERE
"How Here?"..... HOW DID YOU GET HERE?
"Stranger"..... DID A STRANGER BRING YOU HERE?
"Lost Before?" .....HAVE YOU EVER BEEN LOST BEFORE?
"Police Before?" .....POLICE EVER LOOK FOR YOU BEFORE?
"How Long?".....HOW LONG HAVE YOU BEEN HERE?
"Live with Who?" ..... WHO DO YOU LIVE WITH?
"Where Parents?"..... WHERE ARE YOUR PARENTS?
"Brother/Sister?"..... DO YOU HAVE BROTHERS OR SISTERS?
"School?"..... WHERE DO THEY GO TO SCHOOL?
"Telephone".....PLEASE WRITE YOUR TELEPHONE NUMBER
"Address"..... DO YOU KNOW YOUR HOME ADDRESS?
"Dad's Name".....WHAT IS YOUR DAD'S NAME?
"Mom's Name".....WHAT IS YOUR MOM'S NAME?
"Parents Work?".....WHERE DO YOUR PARENTS WORK?
"Work Telephone" ..... DO YOU KNOW THE WORK PHONE #'s?

LOST CHILD

"Your Name"..... WHAT IS YOUR NAME?
"Age".....HOW OLD ARE YOU?
"Adult Coming" .....IS SOMEONE COMING FOR YOU?
"Where Hurt?".....ARE YOU HURT? IF YES, SHOW ME WHERE.
"Get Here?" .....HOW DID YOU GET HERE?
"Stranger".....DID A STRANGER BRING YOU HERE?
"Lost Before?" ..... HAVE YOU EVER BEEN LOST BEFORE?
"Police Before?" ..... POLICE EVER LOOK FOR YOU BEFORE?
"How Long?"..... HOW LONG HAVE YOU BEEN HERE?
"Live with who?".....WHO DO YOU LIVE WITH?
"Where Parents?".....WHERE ARE YOUR PARENTS?
"Brother/Sister?.....DO YOU HAVE BROTHERS OR SISTERS?
"Name School?" .....WHERE DO THEY GO TO SCHOOL?
"Phone" ..... PLEASE WRITE DOWN YOU TELEPHONE NUMBER.
"Address".....DO YOU KNOW YOUR HOME ADDRESS?
"Dad's Name"..... WHAT IS YOUR DAD'S NAME?
"Mom's Name"..... WHAT IS YOUR MOM'S NAME?
"Parent's Work"..... WHERE DO YOUR PARENTS WORK?
"Work phone".....DO YOU KNOW THE WORK PHONE NUMBERS?

INTERVIEW VICTIM

" Victim?".....WHO IS THE VICTIM?
"What Time?" ..... WHEN DID IT HAPPEN?
"Know Suspect?"..... DO YOU KNOW THE SUSPECT OR WHERE HE LIVES?
"Flee Where" ..... WHICH WAY DID THE SUSPECT FLEE?
"More Than One?" .. WAS THERE MORE THAN ONE SUSPECT?
"Weapons?".....DID THE SUSPECT HAVE A WEAPON?
"Go on Foot?".....DID THE SUSPECT LEAVE ON FOOT?
"In Car?".....DID THE SUSPECT LEAVE IN A CAR?
"In Truck?".....DID THE SUSPECT LEAVE IN A TRUCK?
"In Van?" .....DID THE SUSPECT LEAVE IN A VAN?
"Color" .....WHAT COLOR IS THE VEHICLE?
"Old Vehicle?" ..... IS THE VEHICLE OLD?
"Car?" ..... IS THE VEHICLE A CAR?
"Truck?".....IS THE VEHICLE A TRUCK?
"Man"..... IS THE SUSPECT A MAN OR A WOMAN?
"How Old" .....HOW OLD?
"Show How Tall".....SHOW ME HOW TALL THE SUSPECT IS
"Heavier?" .....IS THE SUSPECT HEAVIER THAN ME?
"Caucasian"..... IS THE SUSPECT WHITE?
"Latino".....IS THE SUSPECT LATINO?
"Black"..... IS THE SUSPECT BLACK?
"Asian"..... IS THE SUSPECT ASIAN?
"Mustache?" ..... DOES THE SUSPECT HAVE A MUSTACHE
"Beard?" ..... DOES THE SUSPECT HAVE A BEARD?
"Bald?".....IS THE SUSPECT BALD
"Shirt Color"..... WHAT COLOR WAS SHIRT?
"Pants Color"..... WHAT COLOR WERE PANTS?
"Jacket Color".....WHAT COLOR WAS JACKET?
"Plate Number".....DO YOU KNOW THE LICENSE NUMBER? IF SO, WRITE IT HERE
"Write All" ..... WRITE YOUR NAME, ADDRESS & PHONE #

INTERVIEW VICTUM

" Victim?".....WHO IS THE VICTIM?
"What Time?" ..... WHEN DID IT HAPPEN?
"Know Suspect?"..... DO YOU KNOW THE SUSPECT OR .....WHERE HE LIVES?
"Go Where"..... WHICH WAY DID THE SUSPECT FLEE?
"More Than One?" .. WAS THERE MORE THAN ONE SUSPECT?
"Weapons?".....DID THE SUSPECT HAVE A WEAPON?
"Go on Foot?".....DID THE SUSPECT LEAVE ON FOOT?
"In Car?".....DID THE SUSPECT LEAVE IN A CAR?
"In Truck?".....DID THE SUSPECT LEAVE IN A TRUCK?
"In Van?" .....DID THE SUSPECT LEAVE IN A VAN?
"Vehicle Color".....WHAT COLOR IS THE VEHICLE?
"Old Vehicle?" ..... IS THE VEHICLE OLD?
"Auto?" ..... IS THE VEHICLE A CAR?
"Truck?".....IS THE VEHICLE A TRUCK?
"Male" ..... IS THE SUSPECT A MAN OR A WOMAN?
"Age".....HOW OLD?
"Show How Tall".....SHOW ME HOW TALL THE SUSPECT IS
"Bigger?".....IS THE SUSPECT HEAVIER THAN ME?
"White" ..... IS THE SUSPECT WHITE?
"Latino" .....IS THE SUSPECT LATINO?
"Black" ..... IS THE SUSPECT BLACK?
"Asian"..... IS THE SUSPECT ASIAN?
"Mustache?" ..... DOES THE SUSPECT HAVE A MUSTACHE
"Beard?" ..... DOES THE SUSPECT HAVE A BEARD?
"Bald?".....IS THE SUSPECT BALD
"Color Shirt" ..... WHAT COLOR WAS SHIRT?
"Color Pants " ..... WHAT COLOR WERE PANTS?
"Color Jacket " .....WHAT COLOR WAS JACKET?
"Plate Number".....DO YOU KNOW THE LICENSE NUMBER? ..... IF SO, WRITE IT HERE
"Write All" ..... WRITE YOUR NAME, ADDRESS & ..... PHONE #

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DOMESTIC

"You Injured?" ..... ARE YOU INJURED?
"He Strike?" ..... DID HE STRIKE YOU?
"She Strike?" ..... DID SHE STRIKE YOU?
"No Hit" ..... IN THIS STATE IT IS AGAINST THE LAW FOR SOMEONE TO HIT ANOTHER PERSON
"Hit Before?" ..... HAS THIS PERSON HIT YOU BEFORE?
"He Weapon?" ..... DOES HE HAVE A WEAPON?
"She Weapon?" ..... DOES SHE HAVE A WEAPON?
"Gun" ..... A GUN?
"Knife?" ..... A KNIFE?
"Go To Jail" ..... I AM TAKING THIS PERSON TO JAIL
"Who Called?" ..... WHO CALLED THE POLICE?
"Your Name" ..... WHAT IS YOUR NAME?
"Live Here" ..... DO YOU LIVE HERE?
"Another Room" ..... LET'S TALK IN ANOTHER ROOM
"Together" ..... DO YOU LIVE TOGETHER?
"Your Husband" ..... IS THIS PERSON YOUR HUSBAND?
"Your Wife?" ..... IS THIS PERSON YOUR WIFE
"Children?" ..... DO YOU HAVE CHILDREN?
"Children There?" ..... ARE THE CHILDREN IN THERE?
"Kids In Danger" ..... ARE THE CHILDREN IN DANGER?
"Your Children?" ..... DO YOU HAVE CHILDREN IN COMMON?
"Who Custody?" ..... WHO HAS CUSTODY OF THE CHILDREN?
"File Complaint?" ..... DO YOU WISH TO FILE A COMPLAINT?
"Temporary Shelter" ..... DO YOU WISH TO STAY TEMPORARILY IN A SHELTER FOR WOMEN?
"Restraining Order" ..... IS THERE A RESTRAINING ORDER ON THAT PERSON?
"Copy Order" ..... CAN I SEE A COPY OF THE RESTRAINING ORDER OR THE CUSTODY ORDER?

MEDICAL

"Pain?" ..... DO YOU HAVE PAIN?
"Where Hurt?" ..... WHERE DOES IT HURT?
"Chest Hurt?" ..... ARE YOU HAVING CHEST PAIN?
"Breathing?" ..... ARE YOU HAVING DIFFICULTY BREATHING?
"Ambulance" ..... THE AMBULANCE IS COMING
"OK" ..... YOU WILL BE OK
"Caused Injury" ..... SHOW ME WHAT CAUSED THE INJURY
"You Shot?" ..... HAVE YOU BEEN SHOT?
"Stabbed?" ..... HAVE YOU BEEN STABBED?
"Assaulted?" ..... HAVE YOU BEEN ASSAULTED?
"You Ill?" ..... ARE YOU ILL?
"Diabetic?" ..... ARE YOU DIABETIC?
"Nauseated?" ..... ARE YOU NAUSEATED?
"Pregnant?" ..... ARE YOU PREGNANT?
"Swallowed?" ..... HAVE YOU SWALLOWED ANYTHING THAT MIGHT HURT YOU?
"Injected?" ..... HAVE YOU INJECTED ANYTHING THAT MIGHT HURT YOU?
"Taken Pills?" ..... YOU TAKEN ANY PILLS OR MEDICINE?
"He Drugs?" ..... HAS HE TAKEN ANY DRUGS?
"She Drugs?" ..... HAS SHE TAKEN ANY DRUGS?
"Relax" ..... RELAX
"Sit Down" ..... PLEASE SIT DOWN
"You Lay Down" ..... I NEED FOR YOU TO LAY DOWN NOW
"Don't Move" ..... PLEASE DO NOT MOVE
"Stand Back" ..... EVERYBODY PLEASE STAND BACK NOW
"Medications" ..... WRITE THE NAMES OF ANY MEDICATIONS YOU ARE ALLERGIC TO
"Doctors" ..... WRITE THE NAMES AND PHONE NUMBERS OF YOUR DOCTORS
"Medical Card?" ..... DO YOU HAVE A MEDICAL CARD?
"Conditions" ..... WRITE DOWN ANY MEDICAL CONDITIONS YOU HAVE

DOMESTIC

"You Injured?" ..... ARE YOU INJURED?
"Man Strike?" ..... DID HE STRIKE YOU?
"Woman Strike?" ..... DID SHE STRIKE YOU?
"Don't Hit" ..... IN THIS STATE IT IS AGAINST THE LAW FOR SOMEONE TO HIT ANTOHER PERSON
"Beat Before?" ..... HAS THIS PERSON HIT YOU BEFORE?
"Man Weapon?" ..... DOES HE HAVE A WEAPON?
"Woman Weapon?" ..... DOES SHE HAVE A WEAPON?
"Gun" ..... A GUN?
"Knife?" ..... A KNIFE?
"Go To Jail" ..... I AM TAKING THIS PERSON TO JAIL
"Who Called?" ..... WHO CALLED THE POLICE?
"Your Name" ..... WHAT IS YOUR NAME?
"Live Here" ..... DO YOU LIVE HERE?
"Another Room" ..... LET'S TALK IN ANOTHER ROOM
"Together" ..... DO YOU LIVE TOGETHER?
"Your Husband" ..... IS THIS PERSON YOUR HUSBAND?
"Your Wife?" ..... IS THIS PERSON YOUR WIFE
"Youngsters?" ..... DO YOU HAVE CHILDREN?
"Children There?" ..... ARE THE CHILDREN IN THERE?
"Any Danger?" ..... ARE THE CHILDREN IN DANGER?
"Your Children?" ..... DO YOU HAVE CHILDREN IN COMMON?
"Who Custody?" ..... WHO HAS CUSTODY OF THE CHILDREN?
"File Complaint?" ..... DO YOU WISH TO FILE A COMPLAINT?
"Temporary Shelter" ..... DO YOU WISH TO STAY TEMPORARILY IN A SHELTER FOR WOMEN?
"Restraining Order" ..... IS THERE A RESTRAINING ORDER ON THAT PERSON?
"View Order" ..... CAN I SEE A COPY OF THE RESTRAINING ORDER OR THE CUSTODY ORDER?

MEDICAL

"In Pain?" ..... DO YOU HAVE PAIN?
"Where Hurt?" ..... WHERE DOES IT HURT?
"Pain in Chest?" ..... ARE YOU HAVING CHEST PAIN?
"Breathing?" ..... ARE YOU HAVING DIFFICULTY BREATHING?
"Ambulance" ..... THE AMBULANCE IS COMING
"OK" ..... YOU WILL BE OK
"Injury Caused" ..... SHOW ME WHAT CAUSED THE INJURY
"You Shot?" ..... HAVE YOU BEEN SHOT?
"Knifed?" ..... HAVE YOU BEEN STABBED?
"Assaulted?" ..... HAVE YOU BEEN ASSAULTED?
"You Ill?" ..... ARE YOU ILL?
"Diabetic?" ..... ARE YOU DIABETIC?
"Nauseated?" ..... ARE YOU NAUSEATED?
"You Pregnant?" ..... ARE YOU PREGNANT?
"Swallowed?" ..... HAVE YOU SWALLOWED ANYTHING THAT MIGHT HURT YOU?
"Injected?" ..... HAVE YOU INJECTED ANYTHING THAT MIGHT HURT YOU?
"Any Pills?" ..... YOU TAKEN ANY PILLS OR MEDICINE?
"Man Drugs?" ..... HAS HE TAKEN ANY DRUGS?
"Woman Drugs?" ..... HAS SHE TAKEN ANY DRUGS?
"Relax" ..... RELAX
"Please Sit" ..... PLEASE SIT DOWN
"You Lay Down" ..... I NEED FOR YOU TO LAY DOWN NOW
"Don't Move" ..... PLEASE DO NOT MOVE
"Back" ..... EVERYBODY PLEASE STAND BACK NOW
"Medications" ..... WRITE THE NAMES OF ANY MEDICATIONS YOU ARE ALLERGIC TO
"Doctors" ..... WRITE THE NAMES AND PHONE NUMBERS OF YOUR DOCTORS
"Medical Card?" ..... DO YOU HAVE A MEDICAL CARD?
"Conditions" ..... WRITE DOWN ANY MEDICAL CONDITIONS YOU HAVE

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Appendix G

Programming the VRT

The IWT Voice Response Translator (VRT) uses a set of image files and an executable VRT program that reside in the VRT's compact flash card. The loadable image sound files are created by running a DOS utility (MWN.exe). The executable VRT program to use with the Crown CM311 microphone is 99_200_8. The loadable image files have two-digit names, without extension, (01, 02, 33, 40, 56, etc.)

Overview

The situations/events/commands/languages to be used must be chosen first. Sound files are recorded, edited, organized, and compiled into a VRT software loadable image as follows:

NOTE: NAWCTSD used the audio editing program Cool Edit 2000 for steps 1 - 6. For steps 3, 4, and 5, the script/batch processing capability provided by Cool Edit was used (.wav files were processed in batches).

1) Record phrases in 16 bit, 44.1 Khz format. Name each file appropriately, in English.
2) Edit each phrase for noise, pops, etc. Trim excess silence from the beginning and end of each recorded phrase. If the phrase contains very soft & loud parts, apply some audio compression (tweak levels).
3) Normalize to 100%.
4) Compress each phrase to the 8-bit 11.025KHz VRT format.
5) Normalize to 90%.
6) Keep the set of original phrase files (named in English) separate from those below.

7) Organize and re-name phrases, with the correct file naming convention, in an appropriate folder on the hard drive. (File naming convention is discussed in paragraph II, FILE STRUCTURE - NAMING CONVENTIONS.)

8) Execute a software build (run MWN.exe in same subdirectory where all phrases of step 5 are stored).
9) Re-load the Flash Card with the new image files created by MWN, and install the Flash Card in a VRT.
10) Test it for each phrase, every language.

A directory must be created for the individual phrase files, related files, and the MWN utility. The naming scheme is straightforward, but must be followed precisely. Note that all audio files must be 8-bit, 11025 Hz, mono and have a ".wav" extension. If strange noises are heard when using the VRT, or if the VRT program is in a runaway state or locks up, it is likely a wav file was loaded in the wrong format. Best sound quality is obtained by recording at 16-bit, 44.1KHz, and re-sampling the file down to the 8-bit, 11025 Hz format. Trim all recorded wav files such that there is no excess silence header or trailer - save only the part with speech. This will minimize the time the Red LED stays on during training, which will improve training and recognition performance.

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File Structure – Naming Conventions

Besides the translated language files, the VRT uses the following four file groups, each with a 2 character alpha part followed by a 2 digit numeric part:

Co phrases - (6) control commands - the function cannot be changed.
Cv phrases - (6) global commands. Always active.
La language prompts - correlated to phrases, La01 = _a, La02 = _b, etc.
Si situation prompts - Si01, etc.

There are 6 or 7 other files that also should not be changed, such as "_w_la.wav" which is the file that asks, "Which language?".

Global and Control Commands

The VRT includes global (always active) user commands that can be accessed regardless of the active Situation. In Standby mode, only two of the commands are active - "Begin Training" and "Use VRT". Global commands are of two types – "Co" for control commands such as "Begin training" or "Different language" and "Cv" for translated user commands such as "Hello" or "Calm down". Co phrases are fixed into the VRT design and cannot be changed (although the phrase can be). Cv phrases can be anything. The first English voice prompt is Cv01.wav, for example. The corresponding foreign language phrases are named Cv01_a.wav, Cv01_b.wav and so on ("_a", "_b" indicate a different language). Note that with the 99_200 version of the program, only six Cv0X commands can be used, however newer versions may be different.

The following are the fixed control commands:

Co01 "My Location"
Co02 "Different Language"
Co03 "Event"
Co04 "Go to Standby"
Co05 "Begin Training"
Co06 "Use VRT"

The following shows the file naming scheme for user-definable global commands, for the languages used in the NIJ VRT:

English	Creole	Viet	Spanish	Cantonese
Cv01 "under arrest"	Cv01_a	Cv01_b	Cv01_c	Cv01_d
Cv02 "place hands"	Cv02_a	Cv02_b	Cv02_c	Cv02_d
Cv03 "calm down"	Cv03_a	Cv03_b	Cv03_c	Cv03_d
Cv04 "begin dir"	Cv04_a	Cv04_b	Cv04_c	Cv04_d
Cv05 "greetings"	Cv05_a	Cv05_b	Cv05_c	Cv05_d
Cv06 "my name"	Cv06_a	Cv06_b	Cv06_c	Cv06_d

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Language Prompts

Language prompts are named “La” followed by a number which corresponds to the _a, _b, and so on, in the language files (01 = _a). The first language is “La01.wav”. If the user says “different language,” the VRT says “which language”, and the user could respond, “Spanish”, which would be an “La" file. Each new language must have an "La" file.

The following illustrates the file naming of language prompts found in the NIJ VRT (these can be changed).

La01 "Creole"
La02 "Viet"
La03 "Begin Spanish"
La04 "Cantonese"

Situation/Event Prompts

Situation/Event prompts are named "Si", followed by a number. The first situations/event is “Si01.wav”. These are the English voice prompts for changing the Situation/Event; there may be as many of these as desired, and they can be anything the user wants. (Amount of Compact Flash memory defines limits to the number of phrases/situations/events/languages.)

The following shows the situation/event prompts found in the NIJ VRT:

Si01 "Meetings"
Si02 "Medical"
Si03 "Interview Victim"
Si04 "Found Child"
Si05 "Field Interview"
Si06 "Traffic Stop"
Si07 "Crowd Control"
Si08 "Domestic Dispute"

Phrase Prompts/Translations

For the English phrase prompts, the name is a two-digit code for the situation/event (i.e., 07) followed by a two-digit code for phrase (i.e., 03). For example, phrase 1, in situation/event 1, is named “0101.wav”. Phrase 3, in situation/event 2, is named “0203.wav”. (Note: The software allows a maximum of 32 phrases per situation/event.)

	Situation	**Situation**	**Situation**	
Phrase	**1**	**2**	**3**	**etc.**
1	0101	0201	0301	
2	0102	0202	0302	
3	0103	0203	0303	
etc.				

For each foreign language phrase, the numbering scheme corresponds to the English set of phrases, but with an underscore and a letter added. Thus, the first language for the above examples would be “0101_a.wav” and “0203_a.wav”. The second language would be “0101_b.wav” and “0203_b.wav” (shown on next page).

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Situations/event 1

English	Creole	Viet	Spanish	Cantonese
0101	0101_a	0101_b	0101_c	0101_d
0102	0102_a	0102_b	0102_c	0102_d
0103	0103_a	0103_b	0103_c	0103_d

Software Build and Program Load

Once all files are assembled into one directory, run the MWN utility from a DOS window and indicate the number of languages being used. For example, if seven languages are used, then at the DOS prompt, in the directory containing the hundreds of individual wav files and the MWN utility, one should type: "MWN 7". The final number of files created by MWN varies, based on the number of translated languages and phrases used. Each loadable image file has a two-digit name without an extension - e.g., 01, 02, 03, 33, 40, 56. The executable program and loadable image files created by the MWN utility must then be copied onto a newly formatted Compact Flash card.

1. Remove Compact Flash card from a VRT.
2. Install Flash card in a programming device, and FORMAT the device (in Explorer, right-click on the device, select Format).
3. Copy the executable program 99_200_8 first.
4. Then copy the other two-digit image files that were created by MWN.
5. Re-install into the VRT.

NOTE: If the Flash Card has been previously used, always reformat it.

Executable Programs

There are several versions of the executable program. The digits after the last underscore in the name indicate the Gain of the program. A higher number means less inherent gain; 99_200_2 has ½ the maximum gain possible. The program is chosen to match the microphone being used. (99_220 is auto-gain, 99_200_8 is the single-user program used with the Crown microphone).

99_200_2	(1/2 of max gain)
99_200_4	(1/4 gain)
99_200_8	(1/8 gain)
99_200_16	(1/16 gain)

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Multi-user Capability

Multi-user capability provides for up to 8 users. When the unit is turned on, it will promt with "Input user ID." To input the user ID, press the red button one to eight times.
The VRT is now functioning the same as the single-user model. Note that anytime a new Flash card is installed in a VRT, it will put you directly into training mode. When you turn it on again after training, it will ask for the user ID. If you input an ID that has been trained, it's ready to go. No hardware changes are needed for multi-user operation.

To create the multi-user version, put the following sound files in the same directory as the regular (numbered) files:

_d1	_d2	_d3	_d4
_d5	_d6	_d7	_in_id

Run the MWN8.exe utility to build the software, the same way as with MWN;
i.e. type "mwn8 3" for three languages (MWN8 is used instead of MWN).

99_822 is the new executable program.
Load this onto Flashcard first (instead of 99_200_8).

98_8 is a file to set a fixed gain = 1/8.
Load this onto the Flashcard second. Without this file, the executable program uses AGC (not recommended).

Load the remaining two-digit image files, as mentioned before.

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QUICK REFERENCE

Control commands (6)

Co01 "My Location"
Co02 "Different Language"
Co03 "Event"
Co04 "Go to Standby"
Co05 "Begin Training"
Co06 "Use VRT"

Global user commands (6)

English	Creole	Viet	Spanish	Cantonese
Cv01 "under arrest"	Cv01_a	Cv01_b	Cv01_c	Cv01_d
Cv02 "place hands"	Cv02_a	Cv02_b	Cv02_c	Cv02_d
Cv03 "calm down"	Cv03_a	Cv03_b	Cv03_c	Cv03_d
Cv04 "begin dir"	Cv04_a	Cv04_b	Cv04_c	Cv04_d
Cv05 "greetings"	Cv05_a	Cv05_b	Cv05_c	Cv05_d
Cv06 "my name"	Cv06_a	Cv06_b	Cv06_c	Cv06_d

Change Language prompts

La01 "Creole"
La02 "Viet"
La03 "Begin Spanish"
La04 "Cantonese"

Situation/event prompts

Si01 "Meetings"
Si02 "Medical"
Si03 "Interview Victim"
Si04 "Found Child"
Si05 "Field Interview"
Si06 "Traffic Stop"
Si07 "Crowd Control"
Si08 "Domestic Dispute"

Phrase Prompts/Translations

Phrase	Situation 1	Situation 2	Situation 3	etc.
1	0101	0201	0301	
2	0102	0202	0302	
3	0103	0203	0303	
etc.				

Situations/event 1

English	Creole	Viet	Spanish	Cantonese
0101	0101_a	0101_b	0101_c	0101_d
0102	0102_a	0102_b	0102_c	0102_d
0103	0103_a	0103_b	0103_c	0103_d
0104	etc.			

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Appendix H

Voice Response Translator Field Assessments Results

Question # 1: While recording your voice onto the unit, did you encounter any problems?

Forty-six percent responding said no, fifty-four percent responding said yes.

No: 10

Yes: 13 Explanation of the 13 Yes answers, with associated comments, below:

Two were confirmed as faulty devices.

Yes, didn't respond to recording commands. *Note, device 008 was behaving unreliably and would not take commands: medical, domestic, when tested by the researcher during the follow-on visit.*

Yes, this device started in on standby and was not user friendly at all. Had to redo several commands more than once. *Note: Complaint was valid, device only started in "On-Standby"*

Two were attributed to low user skill level:

Yes, I had to repeat some commands several times. *Note: While on site the psychologist had the officer train device while being observed, officer could not get device to record "Start Cantonese" or "Child" (which sounded like "chil-"). Note the officer had a black ethnic dialect/accent to the English, and it had a high rate of variability, almost musical in nature, making it nearly impossible to recall and repeat exactly how words had been said during training. This same officer had the microphone pointed at the ceiling, did not know how to turn on the device, and had to be coached on how the device would help with communications. This was learned more two weeks after the 2 hour training period, but the officer never took the initiative to report any problems with the device during training (and appeared to be using the device at that time without problem) or in the interim.*

Some problems going from one situations/Event to another *Note: I asked officer to demonstrate and officer used the command "Change Situtation" not just "Situation"*

Nine were attributed to device sensitivity to phrasing/volume/accents:

Yes. Variations in ability to work indoors and outdoors, once recorded.

Yes. Had to redo registration a couple of times, that's all.

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Yes.

Yes. Recorded in rain and occasionally after that. Used “Green One” for “Start Directions.“ That worked beautifully

Yes. Still have to re-record a few. “Arrest Lady” still not working

Yes. Does not like a southern accent, had to repeat situations/event commands and translate. I found if I changed language then went back to original language it would translate fine.

Yes. Iinitially I did because I recorded in a seated position. I then re-recorded it standing and it worked fine.

Yes. While recording my voice, certain words I had to repeat five and 6 times while other words I only had to record once.

Yes. There would always be one or more commands that would not work properly. To remedy you had to go through the whole recording process again.

Question # 2. How long did it take to become comfortable with the device?

Of the 23 Respondents, 65% (13 of 20 with valid data) required less than one day to become comfortable/familiar with device. About 30% (6 of 20 with valid data) reported they did NOT get used to operating the device.

How Long	# of Respondents
Not	6
24+ Hours	1
8 Hours	2
Few Hours	3
Right Away	8
Missing	3

Comments from six “not” answers:

I did not become comfortable with it, it did not work in noisy rooms (conversation). Only worked about half the time.

Only used device successfully once while off duty. *Note: When asked to demonstrate how it worked, the officer did not know how to operate, push buttons, etc.*

Still getting comfortable with it, only used three times on duty, maybe six more times on duty and I’d be comfortable with it. Tried it out with landscaping crews, worked great.

Didn’t, was too frustrating, this thing does not need to be hands free, if I could just push a button to make it talk that would be great.

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Still Not.

Still not comfortable, but a little more than I was at start of program.

Question #3: Were the directions in the booklet confusing or unclear?

No: 20 100% (20 of 20 with valid data.)
Missing 3

Question #4: Where did you use the VRT for police business?

Indoors	11
Outdoors	11
Traffic	9
Rain/Wind/Hail	5
Crowds	2
Over 100 Degrees	1
N/A	3
Missing	4

Note: Most users tried the VRT in multiple conditions/locations, therefore the total is larger than the number of officers who were provided the device, i.e., 23.

Question #5: How long did you have the device? (# days).

# Officers	Reported Calendar Days With VRT	Estimated Days in Field With VRT	Number Officers x Est. Days = Total
9	28	14.0	9 x 14 = 126
6	25	12.5	6 x 12. = 75
5	21	10.5	5 x 10.5 = 52
3	14	7.0	3 x 7 = 21
		Total Days VRT in Field Evaluation →	276

Reported number of days with the device ranged from 28 days to 14. Most officers worked a 10 hour schedule, 4 days on, 4 days off, so each actually had their VRT in the field about half the number of days reported. Total Estimated Days VRT was in Field Evaluation Status was 276.

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Question #6: Total number of times VRT was used for police work.

Number of Times Device was Used	Number of Officers Reporting Use
N/A	**5**
Zero	**8**
Once	**2**
Twice	**1**
Three	**1**
Five	**1**
Seven	**1**
Twelve	**2**
Fifteen	**1**
Twenty	**1**

The range of use was from none/zero to twenty, with an average of about three opportunities to use the VRT per each officer. The total (estimated) number of times the VRT was used for Police work in Central and Southern
Florida during the Field Evaluation was 78. Combining the data of questions 5 and 6: 276 days in use / 78 times used = 3.5 times per day the VRT was used to assist non-English speaking persons during the field evaluation period. Recommend that be reported as seven translation assists every two days that were provided to the officers using the VRTs during the field evaluation.

Question 7: What languages were used while on duty?

Language	Times Used
Spanish	14
Vietnamese	1
Cantonese	0
Creole	1

Of the officers who had an opportunity and ability to use the device, most required Spanish to assist them in their work. While Spanish was the predominant language used, the officers also provided assists in Creole and Vietnamese successfully with the VRT. It was reported by scholars of Spanish and by individuals from Puerto Rico that the Spanish translations were very clear.

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Question #8: Check Situations/Events Used on Duty:

Situation	Checks on Form	% of Total Checks	Number of Uses
Traffic Stop	13	40%	31
Greetings	9	28%	23
Found Child	2	6%	5
Field Interview	2	6%	5
Medical	2	6%	5
Interview Victim	2	6%	5
Crowd Control	1	3.5%	2
Domestic	1	3.5%	2
Total	32	100.0%	78

The VRT provided assistance in every "Situations/Event" it was designed for. Most officers reported using it in "Traffic Stops," followed by "Greetings" as most often used. It should be noted that the VRT assisted in an estimated 31 traffic stops, five situations/events of a found child, five medical situations/events, five crime victim interviews, five times to conduct a field interview, and twice for domestic dispute and crowd control situations/events. It is recommended that the Traffic Stop commands be further developed prior to additional field testing, as this was the most common Situations/Event that the officers used the VRT for. The lack of questions pertaining to (1) date of birth, and (2) sobriety checks, proved difficult for the officers.

Question #9: Reported VRT Problem Areas

Problem	Occurrences	Comments
Microphone failed to pick up voice	10	
Wrong Commands given by device:	7	
Unable to use device in noisy environments	5	
Letter "S" commands did not work	5	
Citizens did not like device	3	All Haitians, one frightened, other two laughed
Command cards difficult to use	1	
Power switch/battery on a problem	1	Before battery light modification was made
Microphone awkward to use	3	One had head worn unit, two had ticket book units
Other:		
• Reliability affected by environment in which recorded		
• Required more commands		
• Commands did not apply to specific situation		

Assuming the VRT's were used a total of approximately 78 times in the field, the total of 35 encountered problems is rather high. Of the 23 respondents, only six reported having no problems with the devices. Some problems were the result of three faulty devices

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from the developer, and two officers later identified as the source of the reported problems. Even when correcting for the three faulty devices, missing data, and the two officers deemed incapable of operating the devices, 9 of 15 users (60%) reported problems with the VRTs. Thus over half the users identified specific problems with the device during the field evaluation.

Question #10: Recommendations for the VRT

Times Requested	Request/Recommendation
4	Volume Switch
3	A touch pad so if voice trigger does not work I can still get it to start.
3	Smaller, Clip on microphone would be better *(Note: Officers had both ticket book and head worn units)*
2	Cigarette Charger Option *(Note: Unit now has a car cigarette lighter charger.)*
2	Clip on belt *(Note: Clips have since been added.)*
1	Light on unit to read commands with
1	Battery Low indicator *(Note: This modification has since been made)*
1	Way to redo a specific commands recording without having to do entire situation.
1	Power charger that acts as a cradle for device and is always plugged in. Like a cell phone or Palm Pilot charging cradle.

NAWCTSD Device Improvements

The following changes have all been made to the devices: a clip-on belt, cigarette lighter charger, low battery indicator, on light, and smaller microphone.

Required Changes for Commercialization

- Multi-user capability
- Crown Microphone standard
- Bias set low (users must speak up)
- Audio signal output jack
- Clip on back for belt
- Cigarette lighter charger
- Low battery indicator
- On light

These recommendations all pertain to the design of the VRT unit and its operation. Recommendations for new commands are detailed in the next section. The most requested modification was a volume switch, followed by an optional touch pad that would enable operation of the device when the voice inputs fail. Other recommendations such as a clip on for belt, cigarette lighter charger, low battery indicator, on light, and smaller microphone have all been made to the devices.

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Question #11: Commands recommended to be added:

DUI Situation: Sobriety Test directions:

- Implied Consent
- # Drinks you've had, show on hand
- Close your eyes and stand on one foot, like this
- Close your eyes and touch your nose, like this
- Walk on this line, heal to toe, till I say stop
- Exhale into this device three times
- Handheld Breath Test
- Walk-and-turn 9 steps heel to toe
- Follow-the-Pen-With-Your-Eyes, Understand?
- What state was your Drivers License Issued?

Three requests for: "Ask for DOB (written) in Traffic Stop, so check can be run on missing Driver's License."

Three requests for: "Miranda Rights"

Two requests for: "I'm going to search you for weapons"

One request for: "Turn Left, Turn Right, some way to give directions." Officer had individual headed to the local arena (had tickets), was only a few blocks away but was unable to give directions on how to get there.

Other requests:

- Always have available: "Drop Weapon" and "Stop Police"
- Add "Are you sure?" on Field Interview.
- "Leave Now" (command given to empty a house or building of occupants)
- Was the traffic light Green?
- Was car small/large/round/square
- Where is the damage?
- Empty pockets
- Is this your friend?
- Drivers License Not Valid/Suspended (Could have used "not current").

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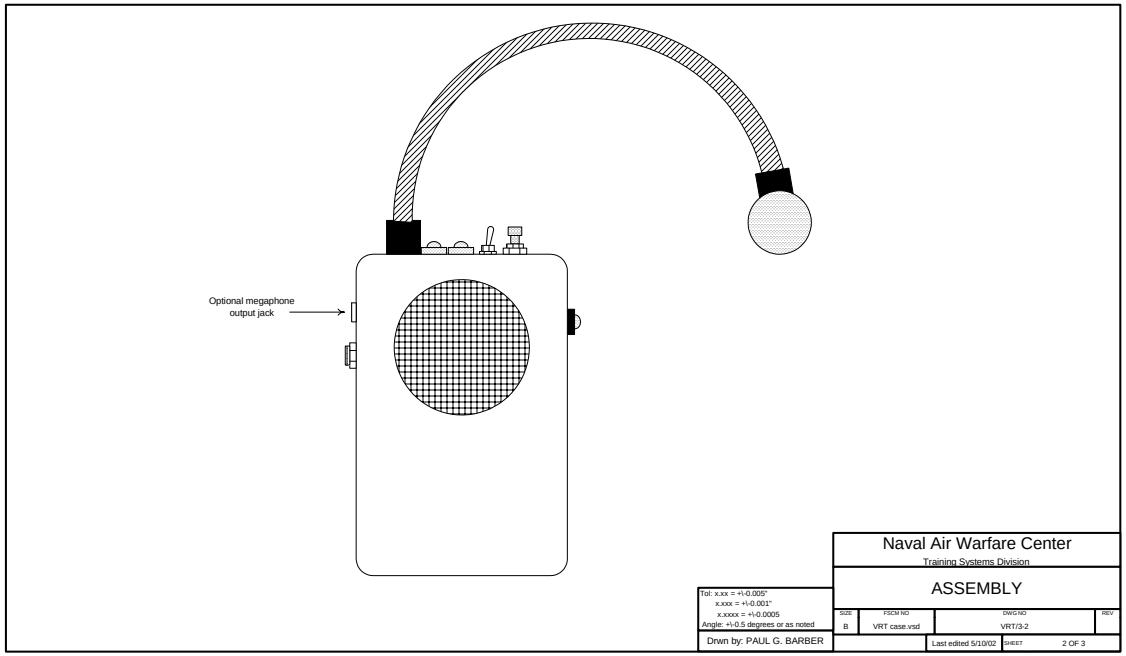

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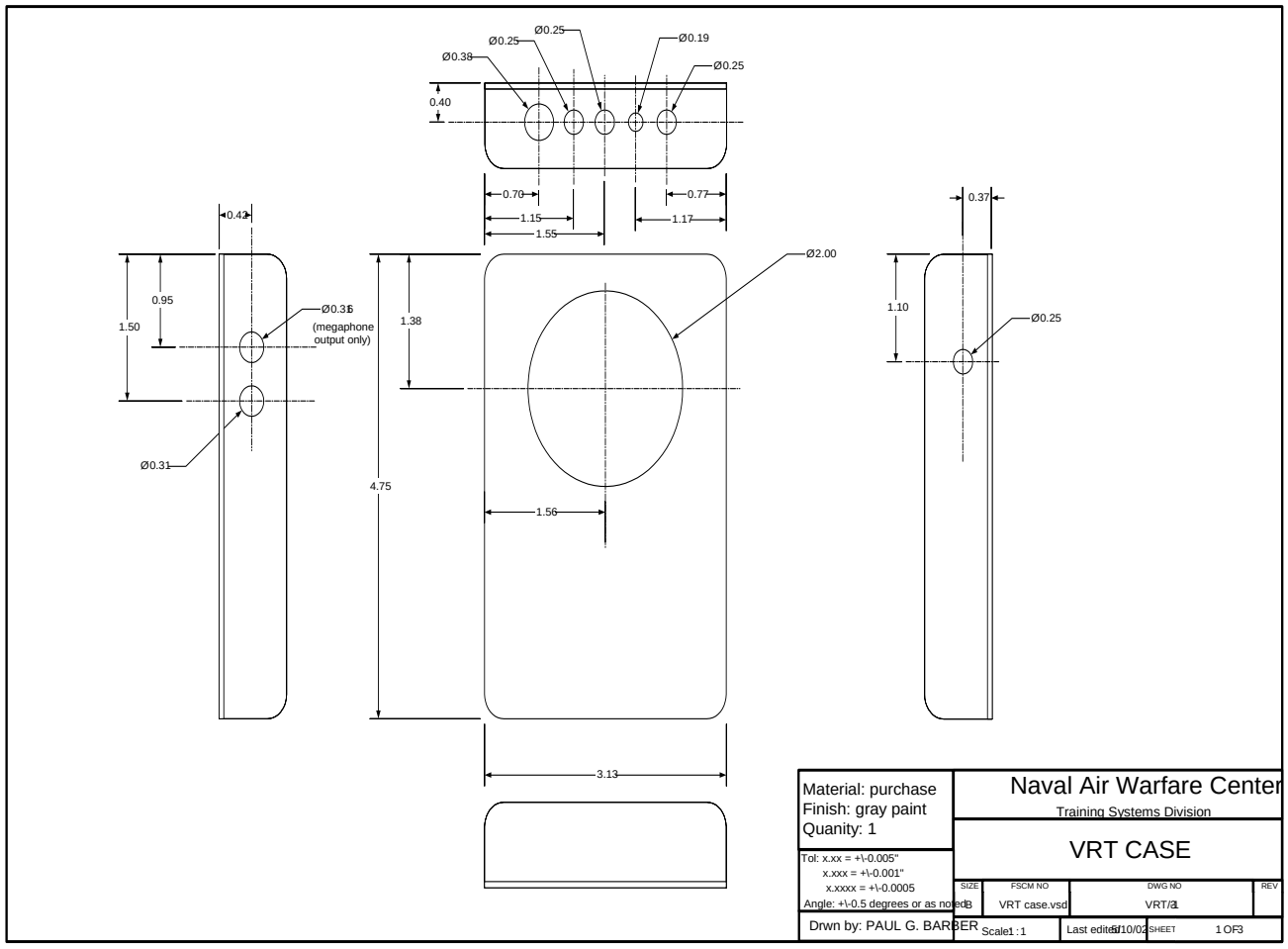

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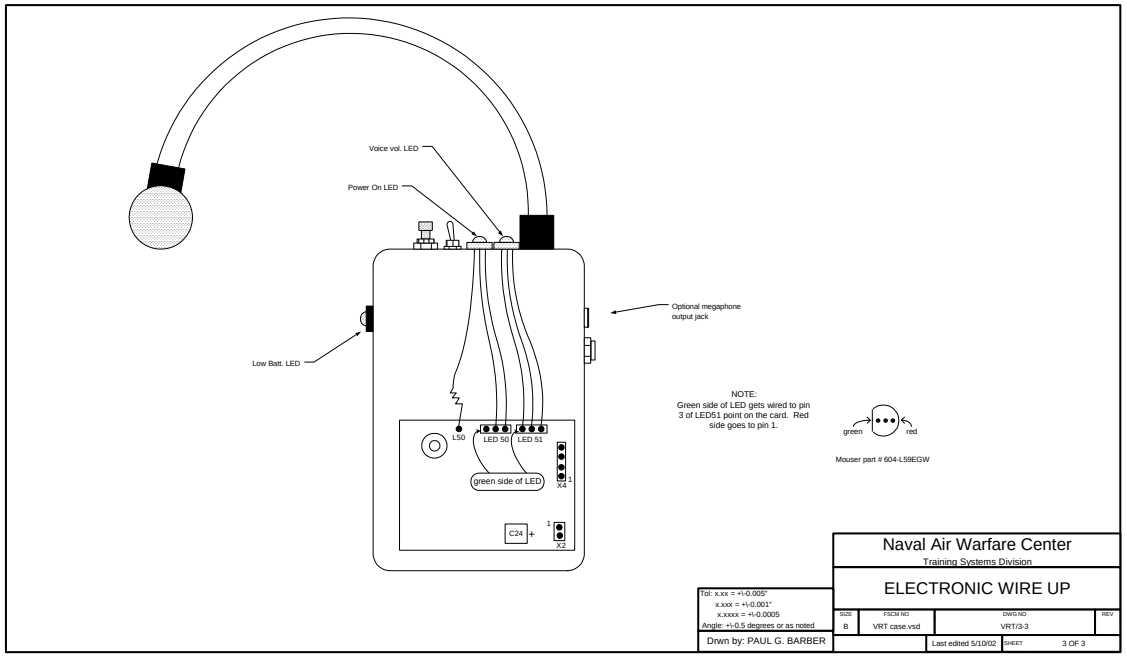

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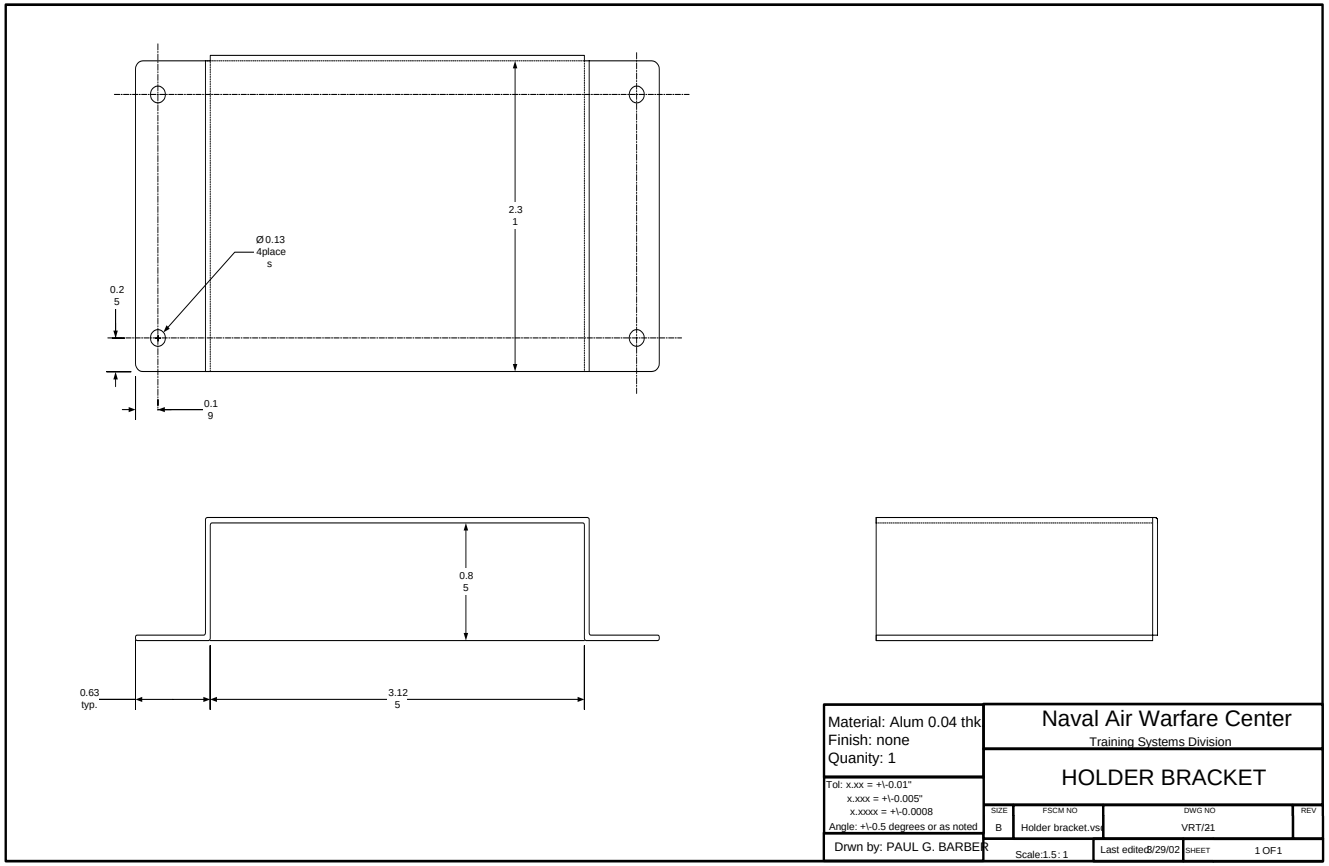

Material: Alum 0.04 thk Finish: none Quanity: 1	Naval Air Warfare Center Training Systems Division
	HOLDER BRACKET
Tol: x.xx = +\-0.01" x.xxx = +\-0.005" x.xxxx = +\-0.0008 Angle: +\-0.5 degrees or as noted	SIZE: B; FSCM NO: Holder bracket.vsd; DWG NO: VRT/21; REV:
Drwn by: PAUL G. BARBER	Scale:1.5 : 1; Last edited: 3/29/02; SHEET: 1 OF 1

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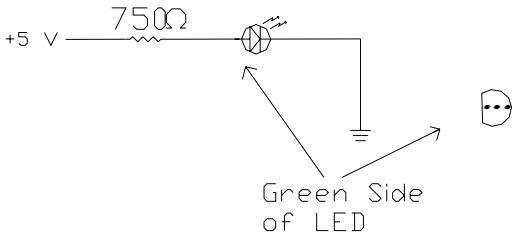
MIC Preamp

WHT (+) -> Pin 1 of X2

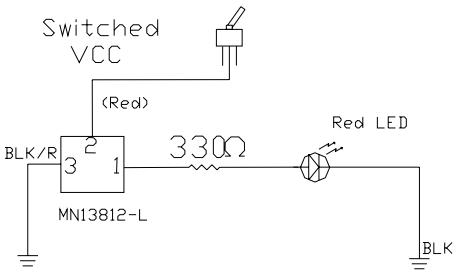
SHLD (-) -> Pin 2 of X2

RED (PWR) -> (+) side of C24

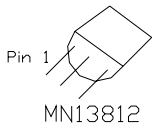
Power ON LED



Low Battery



Pin 1 output is 3.0 V trigger voltage (Hi-to-Low transition)



NOTE: Output will not reset until Vcc > 3.4 V

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Filename: 4
Directory: C:\Melanie_Folder\kreg_purcell\060704
Template: C:\Documents and Settings\mzwack\Application Data\Microsoft\Templates\NORMAL.DOT
Title: Voice Response Translator
Subject:
Author: Thomas M. Franz
Keywords:
Comments:
Creation Date: 12/18/2003 1:24 PM
Change Number: 3
Last Saved On: 12/19/2003 9:27 AM
Last Saved By: Valued Gateway Client
Total Editing Time: 5 Minutes
Last Printed On: 06/07/2004 1:33 PM
As of Last Complete Printing
Number of Pages: 43
Number of Words: 13,217 (approx.)
Number of Characters: 65,430 (approx.)

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